The 'What' and 'How' of Network Analytics

Network Theory and Network Data

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Outline

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There Are Several Families of Networks

Family	**Example**
Biological networks	A living organism's neural system
Cultural networks	A model of the 'returns of education'
Financial networks	A cryptocurrency
Information networks	Information sharing among BA students
Inter-organizational networks	Technological alliances among pharma industry players
Organizational networks	Knowledge sharing among financial analysists
Social networks	Friendship among BA students
Transportation networks	The Tube

Networks Have a 'Hard' and a 'Soft' Component

The hard component

A network is a collection of nodes and edges, what is formally called a 'graph':

$$G = \{V, E\} \tag{1}$$

where V is the array of nodes

$$\{v_1, v_2, ..., v_i, ..., v_N\}$$

and E is the set of edges reflecting connections among pairs of nodes

$$\{..., \{v_i, v_j\}, \{v_i, v_k\}, ...\}$$

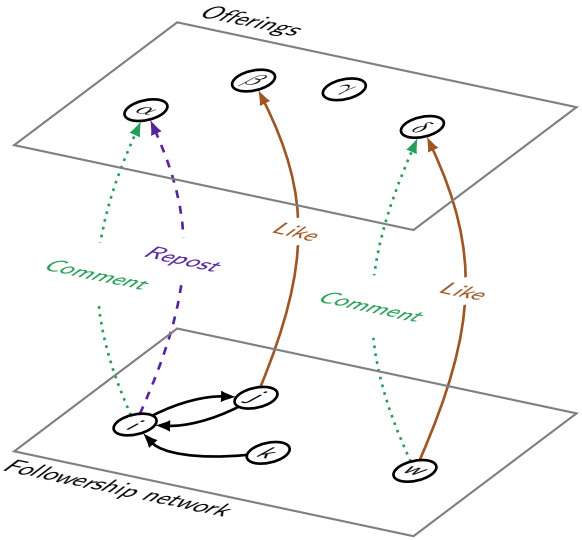
The soft component

The soft component is the relationship that maps the connections onto the pairs of nodes. Examples of relationships are affilition to a club, music collab (i.e., a 'feat'), friendship, marriage, mentoring, tube route.

!! Pay attention !!

A network is more than a graph. Two nodes may be connected for many reasons — we must be specific about the concrete relationship under investigation!

A Real-World Example: The Soundcloud Networks

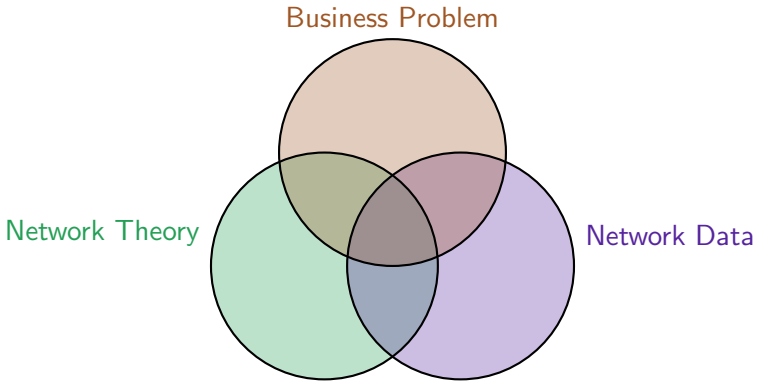


Some key general points emerging from the analysis of the Soundcloud example:

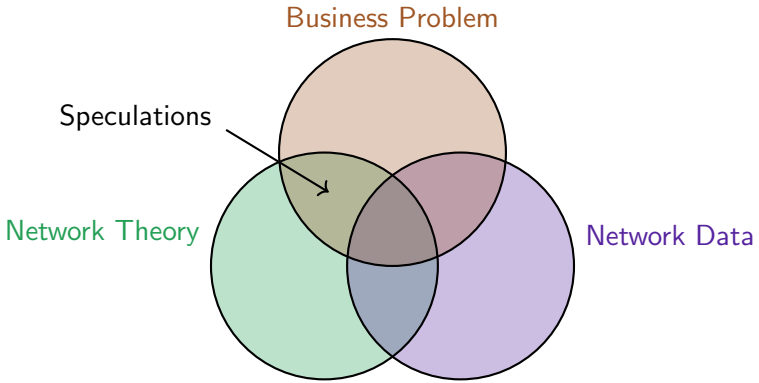
- The same pair of nodes can be connected because of multiple relatonships (i.e., 'like,' 'repost,' 'comment')
- The nodes of a network may have the same type (e.g., 'following') or different types (e.g., 'like')
- Analytically seprated networks may be correlated (e.g., one tends to like her/his followings' likes)

Outline

What Are the Components of a Network Analytics Project?



Where Does a Network Analytics Project Stand?



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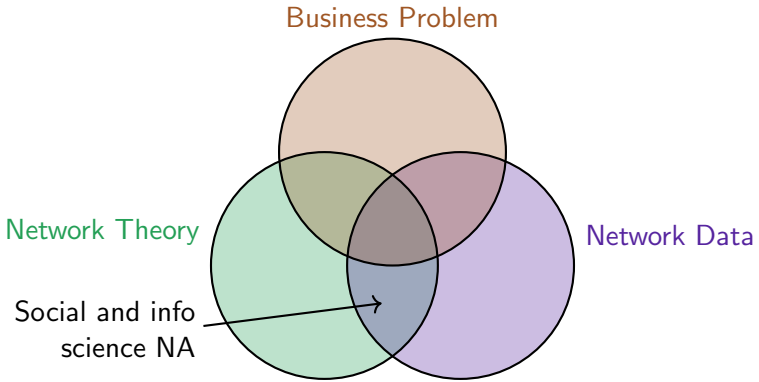

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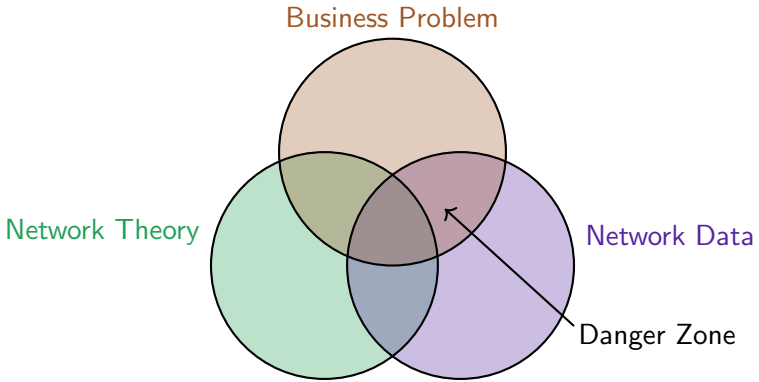

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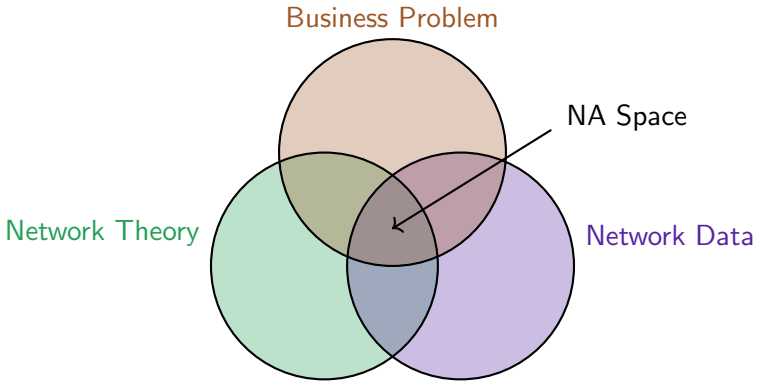


Outline

What is a business problem?

Companies Are Not Very Good at Problem Diagnosing

FEATURE ARE YOU SOLVING THE RIGHT PROBLEMS?

HOW GOOD IS YOUR COMPANY AT PROBLEM SOLVING?

Probably quite good, if your managers are like those at the companies I've studied. What they struggle with, it turns out, is not solving problems but figuring out what the problems are. In surveys of 106 C-suite executives who represented 91 private and public-sector companies in 17 countries, I found that a full 85% strongly agreed or agreed that their organizations were bad at problem diagnosis, and 87% strongly agreed or agreed that this flaw carried significant costs. Fewer than one in 10 said they were unaffected by the issue. The pattern is clear: Spurred by a penchant for action, managers tend to switch quickly into solution mode without checking whether they really understand the problem.

It has been 40 years since Mihaly Csikszentmihalyi and Jacob Getzels empirically demonstrated the central role of problem framing in creativity. Thinkers from Albert Einstein to Peter Drucker have emphasized the importance of properly diagnosing your problems. So why do organizations still struggle to get it right?

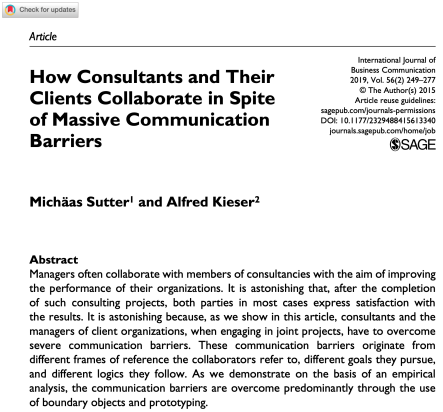
Part of the reason is that we tend to overengineer the diagnostic process. Many existing frameworks—TRIZ, Six Sigma, Scrum, and others—are quite comprehensive. When properly applied, they can be tremendously powerful. But their very thoroughness also makes them too complex and time-consuming to fit into a regular workday. The setting in which people most need to be better at problem diagnosis is not the annual strategy seminar but the daily meeting—so we need tools that don't require the entire organization to undergo weeks-long training programs.

But even when people apply simpler problem-diagnosis frameworks, such as root cause analysis and the related 5 Whys questioning technique, they often find themselves digging deeper into the

There are several concurrent causes:

- The overall tendency to over-engineer the problem diagnosis process constraints the peripheral view of organizations — thus, unconventional problems could not receive attention!
- The adoption of time-consuming tools, such as 'Six Sigma,' limit the attention and energy organizations can devote to spot problems
- Organizations tend tend to dig deeper in problems they have already defined

Client-Consultancy Interaction is Troublesome



Check for updates

Article

How Consultants and Their Clients Collaborate in Spite of Massive Communication Barriers

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Abstract
Managers often collaborate with members of consultancies with the aim of improving the performance of their organizations. It is astonishing that, after the completion of such consulting projects, both parties in most cases express satisfaction with the results. It is astonishing because, as we show in this article, consultants and the managers of client organizations, when engaging in joint projects, have to overcome severe communication barriers. These communication barriers originate from different frames of reference the collaborators refer to, different goals they pursue, and different logics they follow. As we demonstrate on the basis of an empirical analysis, the communication barriers are overcome predominantly through the use of boundary objects and prototyping.

The barriers to an effective interaction originate from differences in:

- Frames of reference — individual organizations develop idyiosyncratic ways of processing information
- Goals — consultancies not necessarily tackle their clients' problems in ways that correspond with their clients' interests
- Logics — consultancies and clients live in different 'thought worlds.' For example clients value specialization and industry knowledge much more than consultancies do

Real World Problem Statements I Worked With

"Our data say employees have not come up with fresh ideas for quite a while. We need to find out."

— The innovation platform manager of a global public utility.

"The people in the [R&D] department do not part-take in the decision making process regarding the selection of the future projects. Shall they?"

— The Head of Reserch of a big pharma company.

"Engineers want more autonomy in forming a new product development team. What are the pros and cons?"

— The CTO of a global semiconductor company.

Mapping Business Problems on Objective Functions and Domains

	Domain			
Objective function	**Employee**	**Project**	**Organization**	**Inter-orgs**
Creativity	•	•		
Knowledge sharing	•	•		
Task performance	•	•		
Coordination	•	•	•	•
Innovation	•	•	•	•
Econ performance			•	

Notes. — The table shows common associations between business problems' objective functions (what clients want to achieve in essence) and domains (the level at which the problem should be addressed). Dots denote the existence of common associations.

Outline

The Goals of Network Theory

Mainly, network theory aims to explain

1. Why some nodes or groups achieve more (the social capital tradition)
2. Why some nodes or networks are more similar to each other (the social homogeneity tradition)

Network Theory's Network Views

Network theories mirror two different views of networks

- The first view — known as the 'network flow model' — emphasizes the information, resources, or artefacts that flow through the network and possibly accrue to the individual nodes
  - *Sample proposition*: central nodes have an iformation advantage over peripheral ones
- The second view — known as the 'network architecture model' — highlights the connection between network structure and individual or organizational outcomes
  - *Sample proposition*: decentralized organizational structures are more suited in high-tech industries than low-tech companies

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]

Network Theories across the Various Weeks of SMM638

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

Outline

Representing Network Data: Some Caveats

- All across the various weeks of the module, we will spend substantial time to represent various relations in network terms
- Such a representation exercise is all but trivial — oftentimes, we have to carefully consider the characteristics of the relation at the center of a network
- In order to facilitate the 'network representation exercise,' it is particularly useful to reason with some stylized networks
- Particularly, there are some differentiating dimensions, say features, that we may want to consider in order to understand 'what form of network we are dealing with'

Forms of Networks

It is socially accepted to distinguish networks between

- Directed Vs undirected
- Weighted Vs unweighted
- One Vs two-mode

!! Pay attention !!

These categories are not mutually exclusive. E.g., a network can be both directed and weighted.

Directed Vs Undirected Networks

Key features

- A network is directed when there is a sender and a receiver node, undirected otherwise
- Soundcloud's following network is an example of a directed network
- 'Friendship' is tipically represented as an undirected network

Weighted Vs Unweighted Networks

Key features

- A network is weighted when edges have a numerical value (i.e., not all edges are born equal)
- Information sharing is an example of a weighted network
- 'Friendship' is tipically represented as an unweighted network

One- Vs Two-Mode Networks

Key features

- A network is one-mode when it contains the nodes of the same type, two-mode otherwise
- Soundcloud's following network is an example of a one-mode network
- Soundcloud's like network is an example of a two-mode network

Algebric Representations for Network Data

The adjacency matrix for a one-mode, undirected, unweighted network

$$A_{i,j} = \begin{pmatrix} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \end{pmatrix} \tag{2}$$

Outline

What have we learned today?

References

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