Sunbelt XXVI
International Sunbelt Social Network Conference
Vancouver, British Columbia - April 24-30, 2006

How to reveal the Informal Structure of Organizations.

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Organizational Network Analysis

- Organizational research has increasingly been influenced by the network paradigm during the last years.
- Research focuses on topics like
  - social capital (on the individual or structural level)
  - the embeddedness of actors (individuals or organizations) in the economic system
  - relations between organizations (e.g. firm alliances)
  - knowledge management in organizations

Network analytical methods are increasingly applied in the consulting business.

Organizational Design & Informal Structure

There are many organizational design factors, e.g.

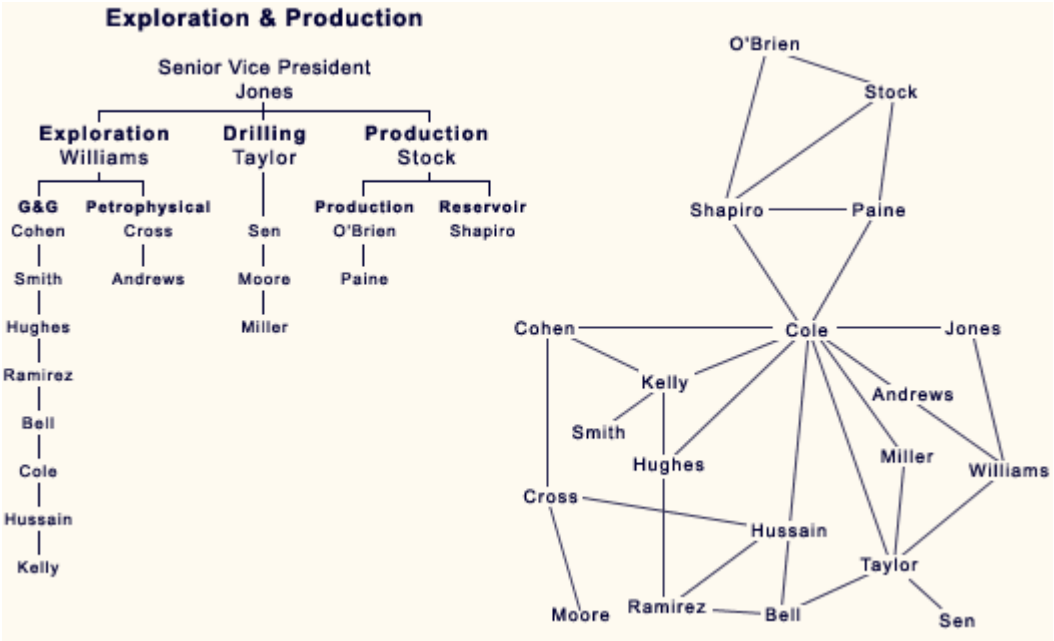
formal structure	**arrangements**
• org chart (functional structure) • affiliation to teams • workflow	• spatial arrangements • temporal arrangements • "span of control"

- On the other hand, the informal structure reflects the social relations between the members of an organization. These may be influenced by organizational design factors and/or by exogenous factors.
- A number of classical studies deal with the deviation of the informal structure of an organization from its formal structure.

Where do we start from?

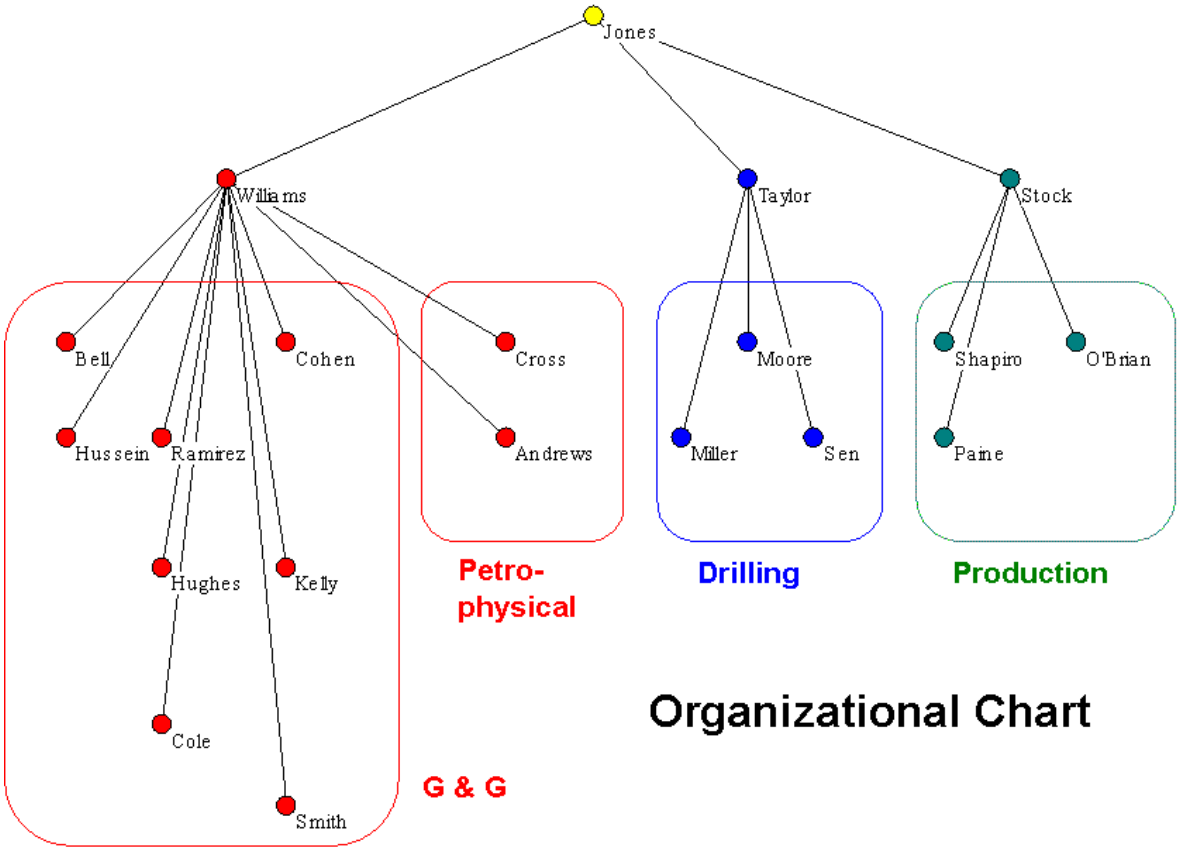
- Our objectives are
  - to contrast the design of an organization with its informal structure
  - to visualize and to measure the deviation of the informal structure from the organizational design
- Starting point is a **network-model of the organization** (e.g. the organizational chart).
  - the formal structure defines relations between the actors
  - the arrangements and restrictions may define relations between actors and/or properties of the actors
  - the resulting network may be multiple with different types of ties
- Then **data about the informal relations** between the actors have to be collected.
  - reactive data: surveys (friendship, flow of information, trust, assistance)
  - non-reactive data: email-contacts (like in the Enron case)

A simple example

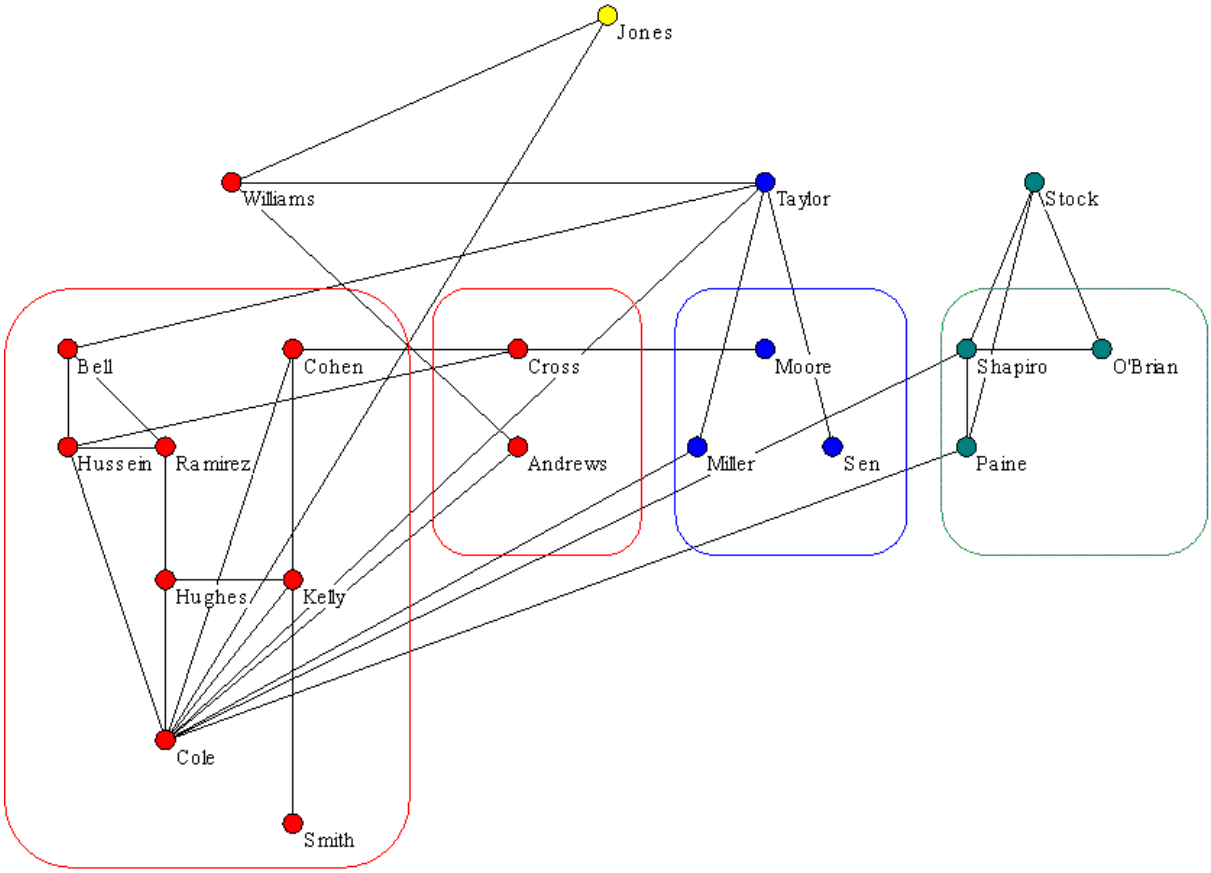


(http://www.robcross.org/sna.htm, Graphic: http://www.robcross.org/images/sna_chart_01.gif)

Organizational model



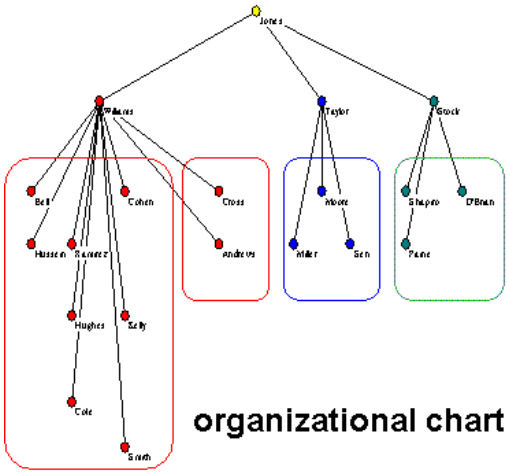
Social relations



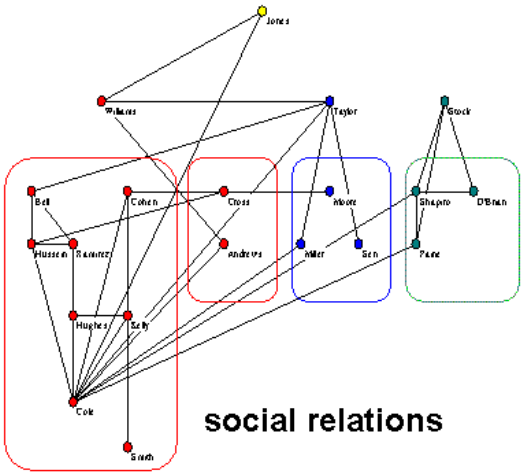
Original question:

"Please indicate the frequency with which you typically turn to each person below for information on work-related topics" : 0 - I don't know this person; 1 - never; 2 - seldom; 3 - sometimes; 4 - often; 5 - very often.

How to compare these two graphs?



organizational chart

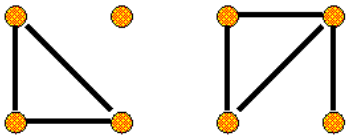


social relations

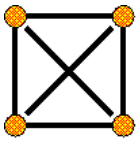
- Visually by coloring the conformities and the discrepancies.
- A set-theoretic notation proves to be helpful.

Set-theoretic notation for graphs

We've got two undirected, unvalued graphs with the same node-set N and edge-sets E_1 and E_2 .

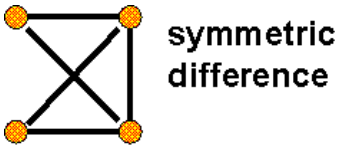


The **union** of these graphs is defined as graph with node-set N and edge-set $E_{Union} = E_1 \cup E_2$.

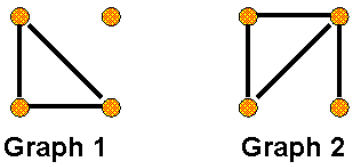


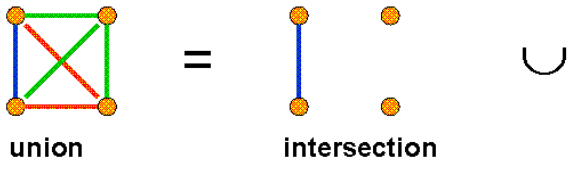
The **intersection** of these graphs is defined as graph with the node-set N and the edge-set $E_{Intersection} = E_1 \cap E_2$.

The **symmetric difference** of these graphs is defined analogously: $E_{sym.diff.} = E_1 \Delta E_2$.



Comparing two graphs visually



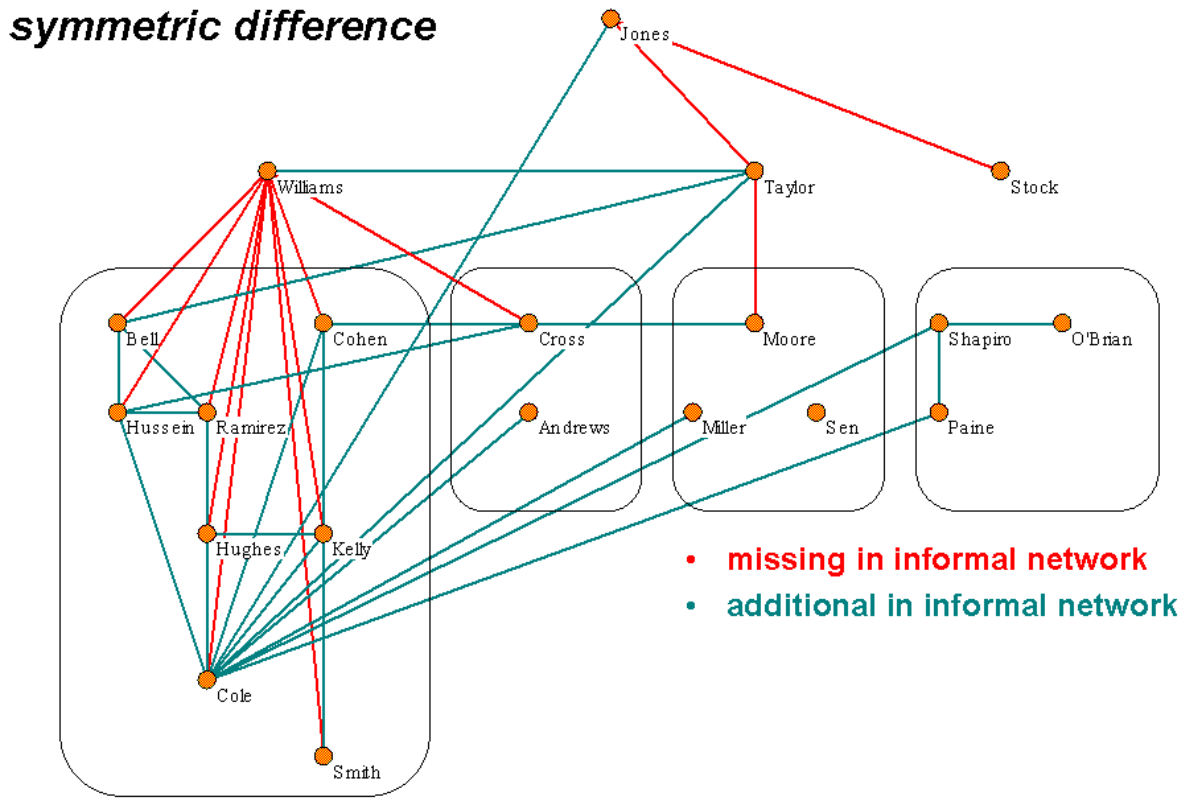


blue edges: belonging to both graphs
red edges: belonging to Graph1 but not to Graph2
green edges: belonging to Graph2 but not to Graph1

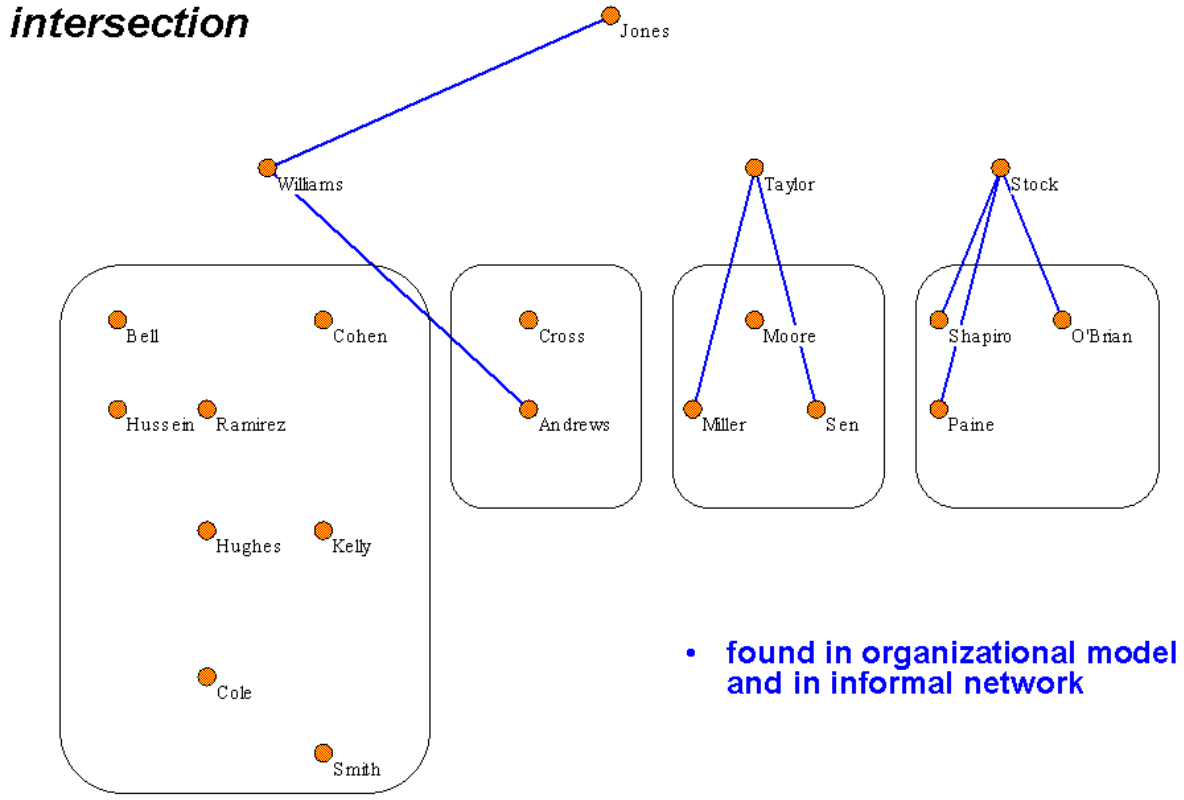
Application of set-theoretic notation

- We take the Informal Network as starting point.
- The *symmetric difference* with the organizational model
  - on one hand defines those ties, which are "expected" by the organizational model but are in fact missing in the informal network **(deficit)**
  - on the other hand defines those ties, which are "not explained" by the organizational model but in fact present in the informal network **(surplus)**
- The intersection with the organizational model defines those ties in the Informal Network, which are **"explained"** by the organizational mode

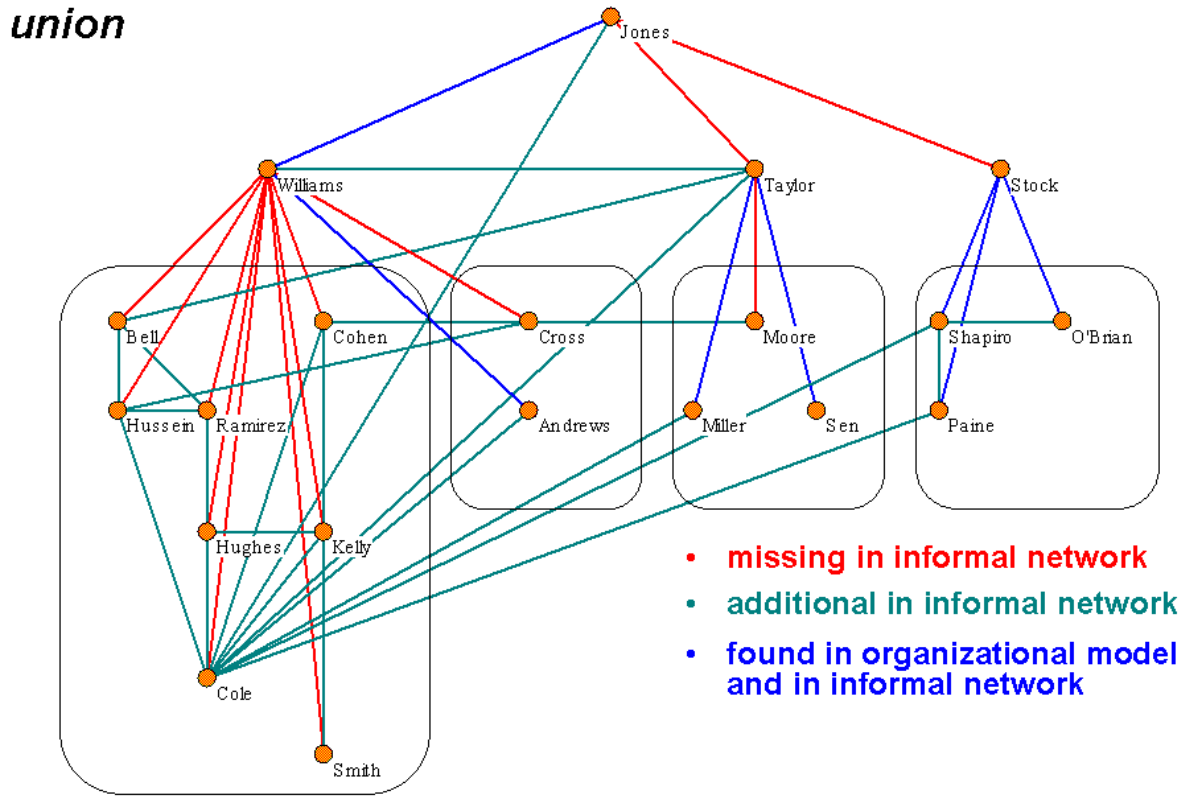
Visualization 1: Discrepancies



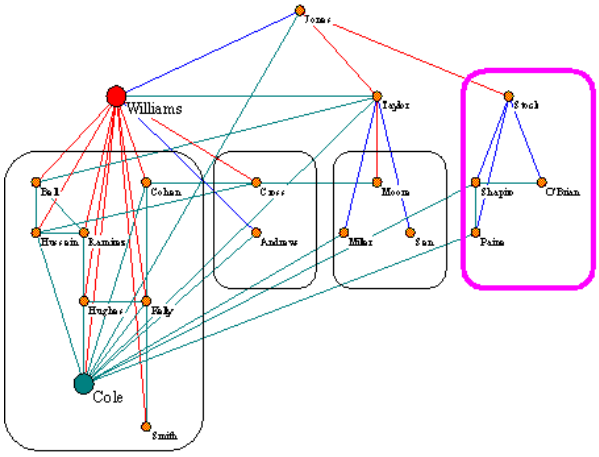
Visualization 2: Conformities



Visualization 3: Synopsis



Discussion 1

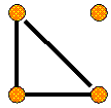


- The informal flow of information is not in accordance with the design of the organization.
- The head of the first department **(Williams)** is not well integrated in his department.
- One employee **(Cole)** can be identified as crucial for the flow of information.
- The **fourth department** is not well integrated as a whole. Further inspection showed that this is because it had moved physically to a different floor in the building.

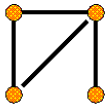
A measure for the dissimilarity of graphs

- We apply the concept of ***Levenshtein-distance*** (or edit-distance) to sets of graphs over a given node-set.
- Given a pair of undirected, unvalued graphs with the same node-set one graph can be transformed into the other by the means of the following two types of ***edit-operations*** :
  - delete one edge
  - insert one edge
- The **minimal number of edit-operations necessary** to transform one graph of a pair of graphs into the other is called the **Levenshtein-distance** L between these graphs.

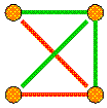
Levenshtein-distance between graphs



Graph 1



Graph 2

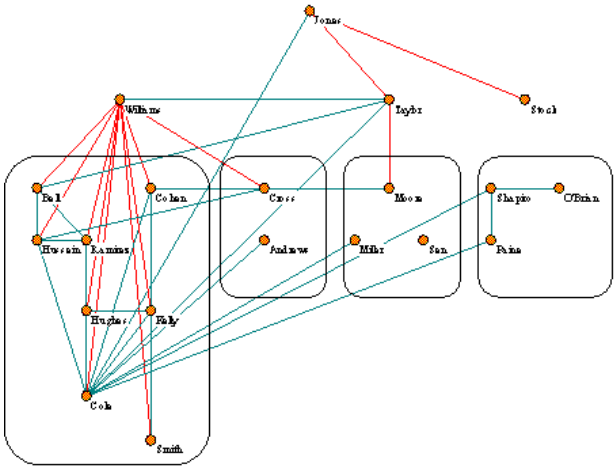


symmetric difference

- L(Graph1 , Graph2) = 5 ,
  because there are five discrepancies between Graph1 and Graph2 that have to be removed by the defined edit-operations to transform Graph1 into Graph2 or vice versa.
- This concept can be easily expanded to directed and to valued graphs over the same node-set.

Application

The Levenshtein-distance between the organizational model and the informal network is given by the number of edges of the symmetric difference of these two networks.



symmetric difference:

- **edges missing in informal network**
- **edges additional in informal network**

For our example (20 nodes) we find: L = 36

(L_{max} = ½ * 20 * 19 = 190 , L_r = 36/190 = 19%)

Discussion 2

- The analysis of an informal network in organization usual-ly is a stepwise or iterative process, during which different organizational models may be considered.
- Taken for itself the Levenshtein-distance is not very in-formative. But it allows us to compare the good-ness of fit of the observed informal network to different organizational models.
- If the organizational model and the informal network are given as undirected, unvalued graphs with n nodes, the maximal Levenshtein-distance between two graphs is given as L_{max} = ½ * n * (n-1) . This allows us to compare organizations of different size using the relative measure L_r = L / L_{max} for each of it.

Conclusion

- We outlined some ideas how to reveal the informal structure of organizations.
  - We showed how to visualize the discrepancies and conformities between organizational model and observed informal network
  - We gave a measure for the goodness of the fit of the observed informal network to an organizational model.
- Both concepts are easily extendable to directed (and valued) informal relations.
- There is a wide field of applications of the pro-posed concepts outside organizational research, e.g. the analysis of Cognitive Social Structure.

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