



Time on teams: A social network view of team structure and performance

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Overview

- + **Social**: putting work in a social context
 - + Introduction to Social Network Analysis (SNA)
 - + Productive and unproductive patterns

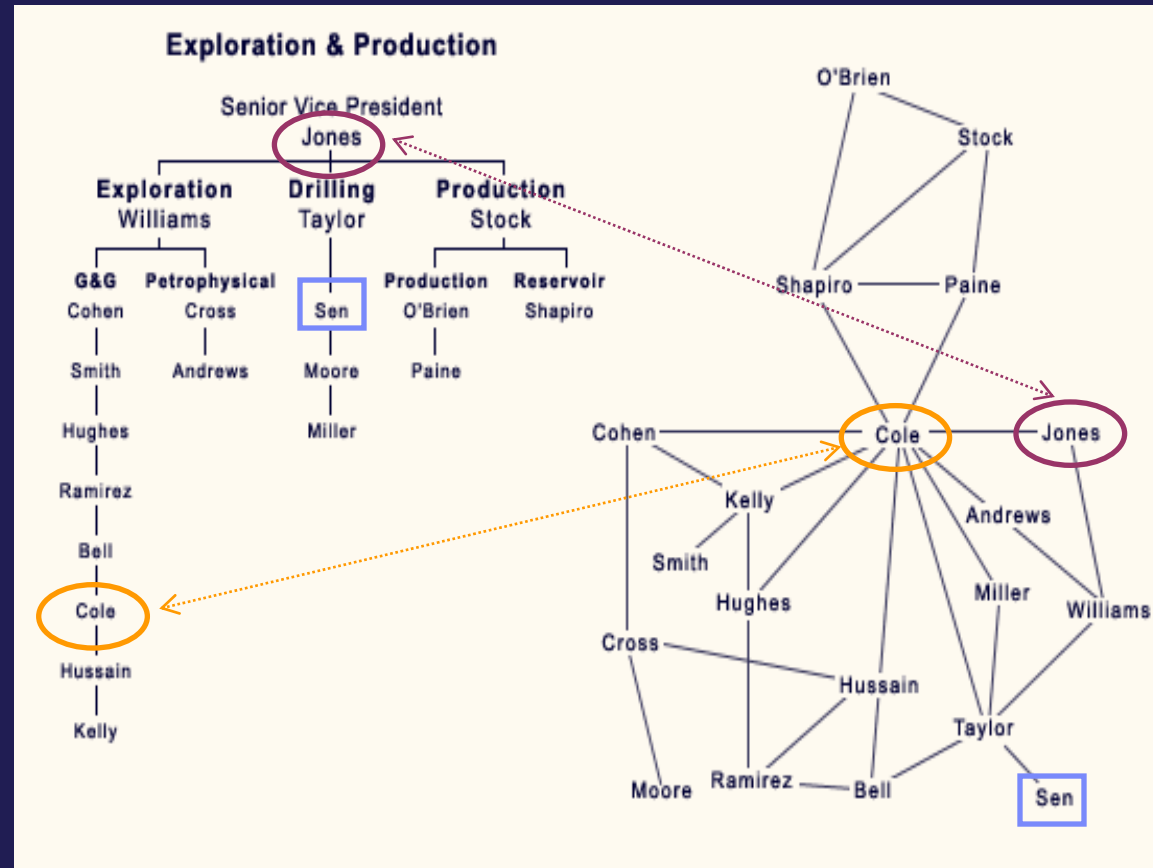
- + **Socio-technical**: coordination in teams
 - + Communication structure for distributed teams
 - + Building tools for awareness in software teams

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Informal networks govern how work is done

- + Organization charts are not the best indicator of how work gets done
- + Senior people are not always central; peripheral people can represent untapped knowledge or people at risk of leaving
- + Making the network visible makes it actionable and becomes the basis for a collaboration action plan



Source: Cross, R., Parker, A., Prusak, L. & Borgatti, S.P. 2001. Knowing What We Know: Supporting Knowledge Creation and Sharing in Social Networks. *Organizational Dynamics* 30(2): 100-120.

Identifying the roles individuals play in information flow helps in understanding the effectiveness of a network

Central people: Sam

- + Hold the network together
- + Can become bottlenecks

Knowledge Brokers: Earl

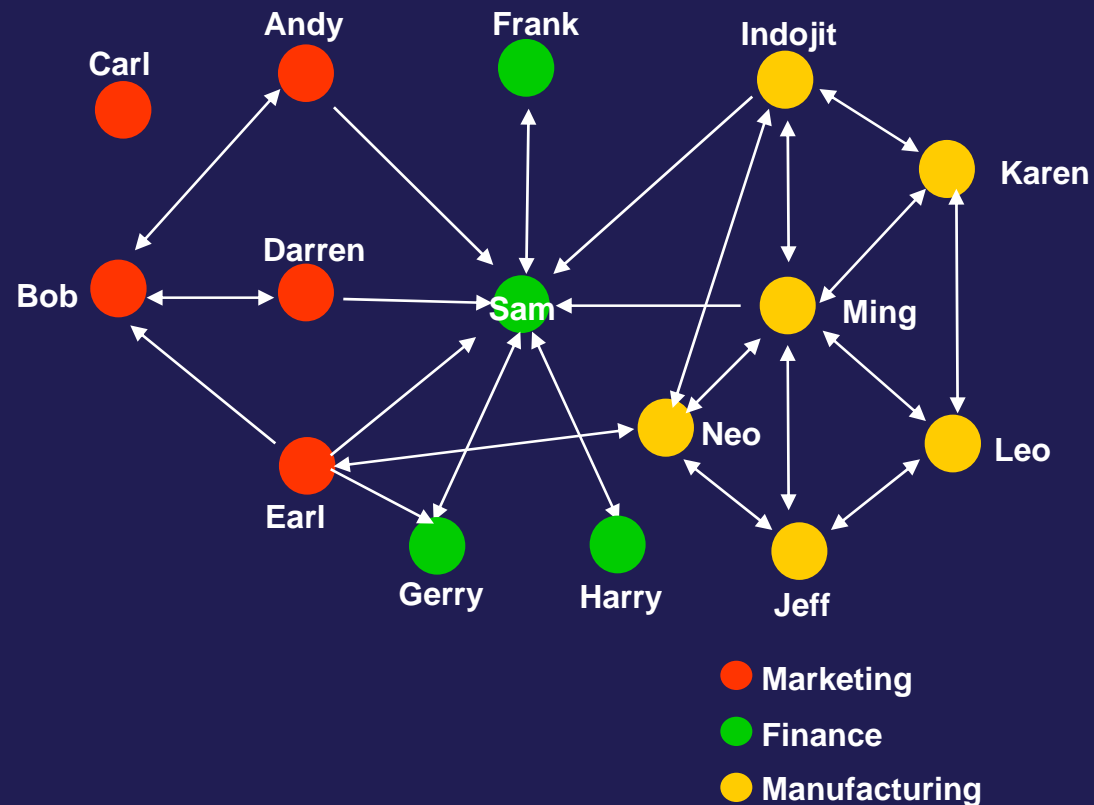
- + Critical connection to external knowledge
- + Need to be connected internally to be effective

Peripheral people: Carl

- + Out of the loop. At risk for leaving the company.

Sub-groups

- + Group split by function. Very little information shared across groups

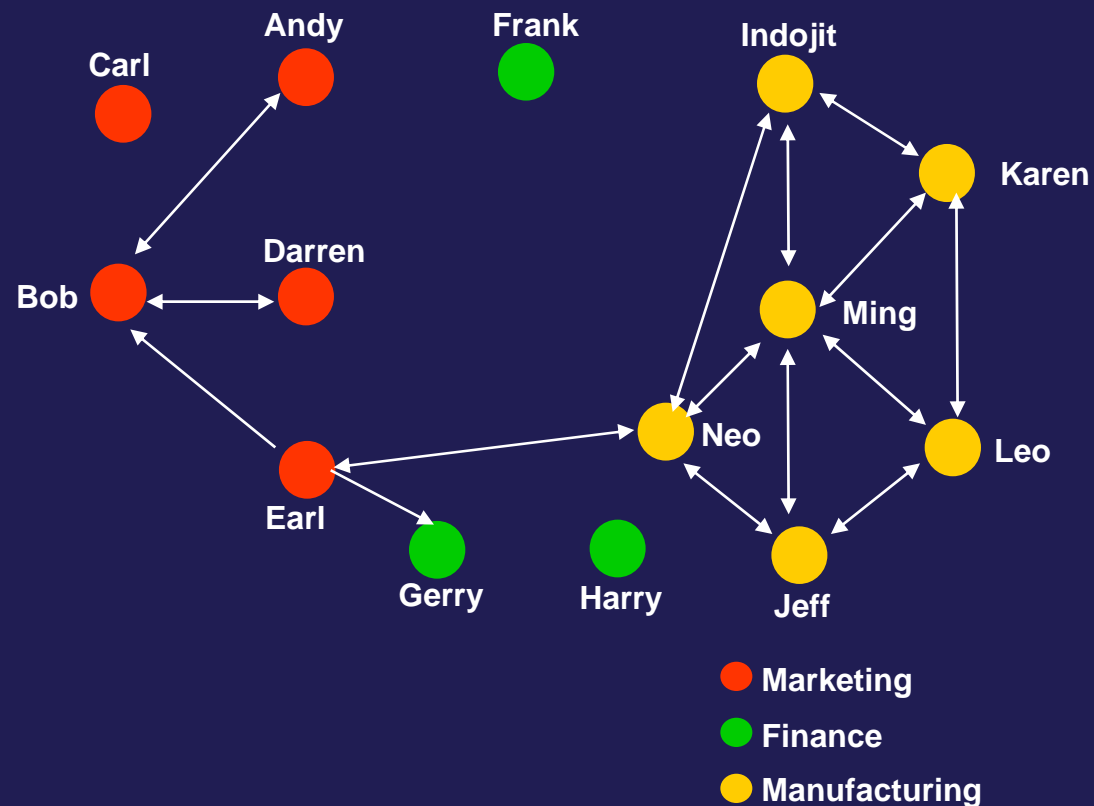


Organization at risk: What happens if Sam leaves

+ Marketing, finance and manufacturing are disconnected

+ Frank and Harry are isolated

+ Ming is overloaded





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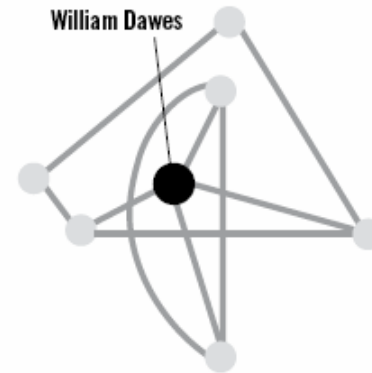
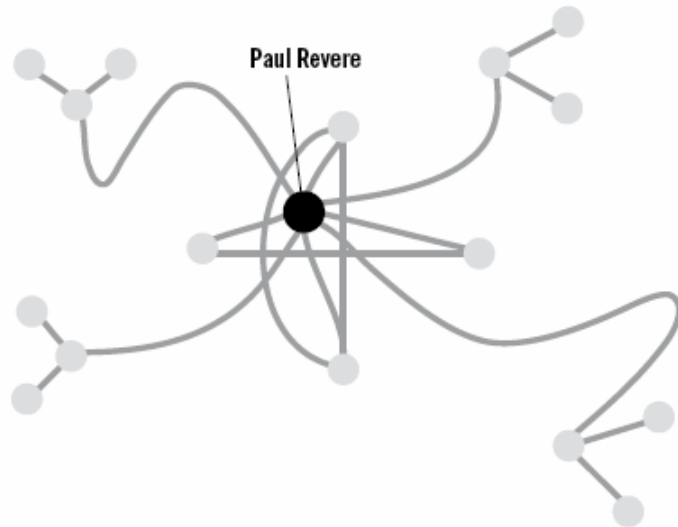


Spreading the word

High performers occupy network positions that bridge otherwise disconnected clusters of people

The Networks of Paul Revere and William Dawes

Paul Revere's social network connects multiple clusters of people who are linked through Revere himself, while William Dawes's network is just one big cluster. It's easy to see why news carried by Revere would reach a wider audience than news carried by Dawes.



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Breakdowns across boundaries

- + Breakdowns in information flow and collaboration occur most often at one of these common boundaries:

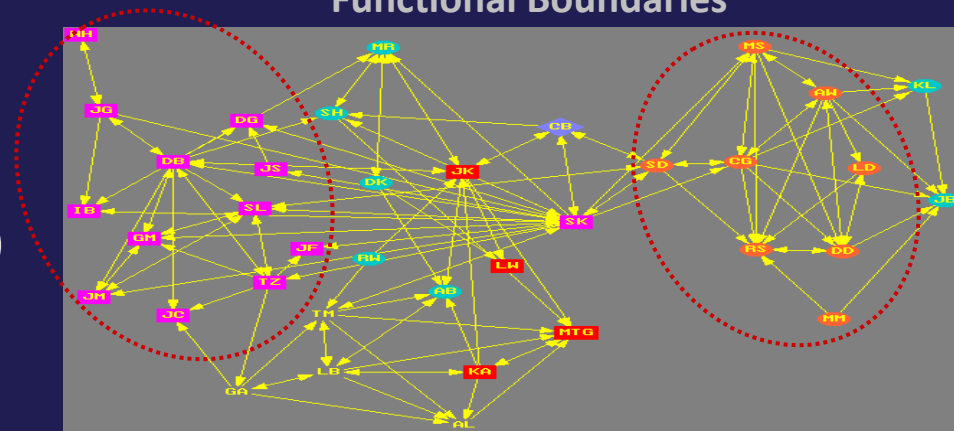
Functional: Breakdowns between divisions (e.g., marketing and finance)

Geographic: Breakdowns between geographically separated locations (e.g., US and European offices, East Coast and West Coast offices)

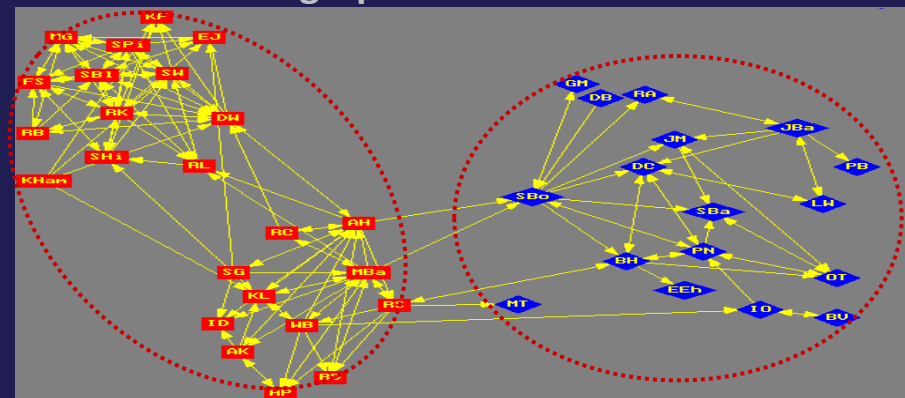
Tenure: Breakdowns between long time employees and new employees

Organizational: Breakdowns because of M&A scenarios, or among leadership networks

Functional Boundaries

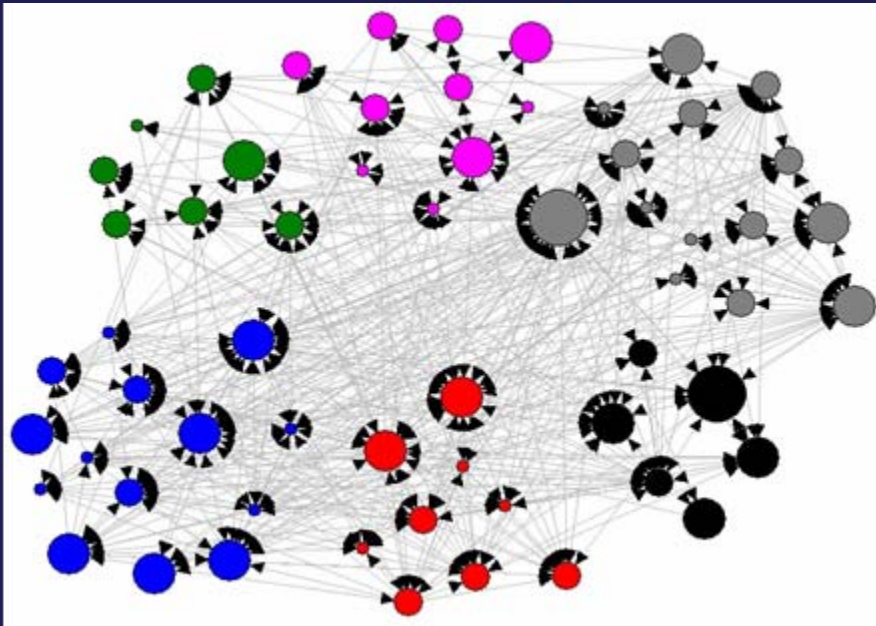


Geographic Boundaries

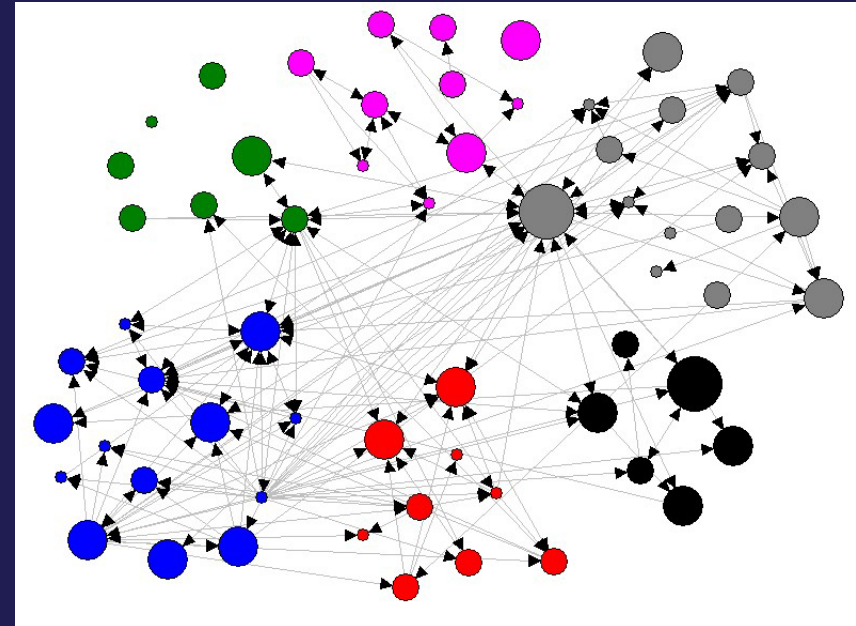


Relationships generate different networks

Awareness: I understand this person's knowledge and skills



Information Sharing: Please indicate how often the people listed below provide you with information you use to do your job

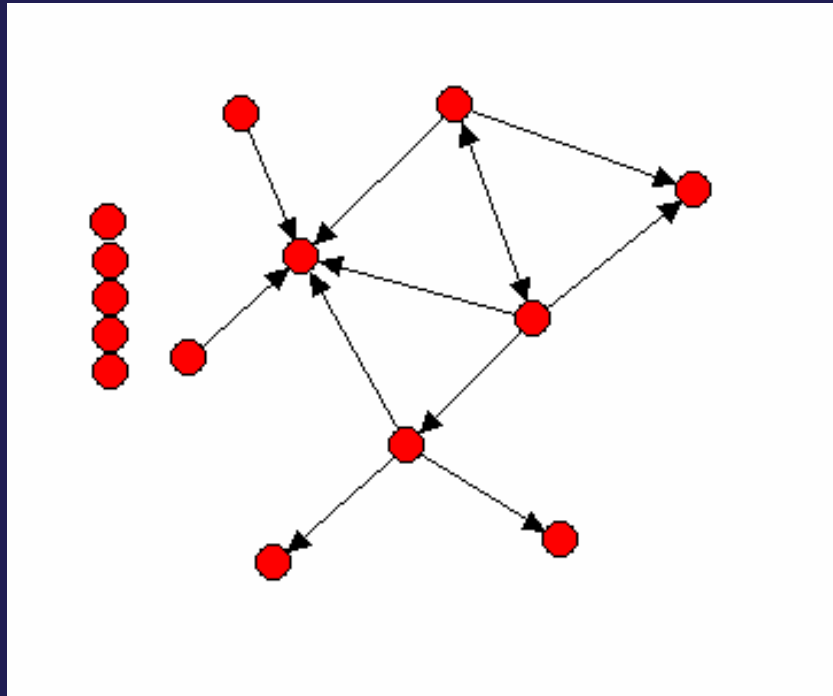


The colors represent different groups and the size the level of seniority

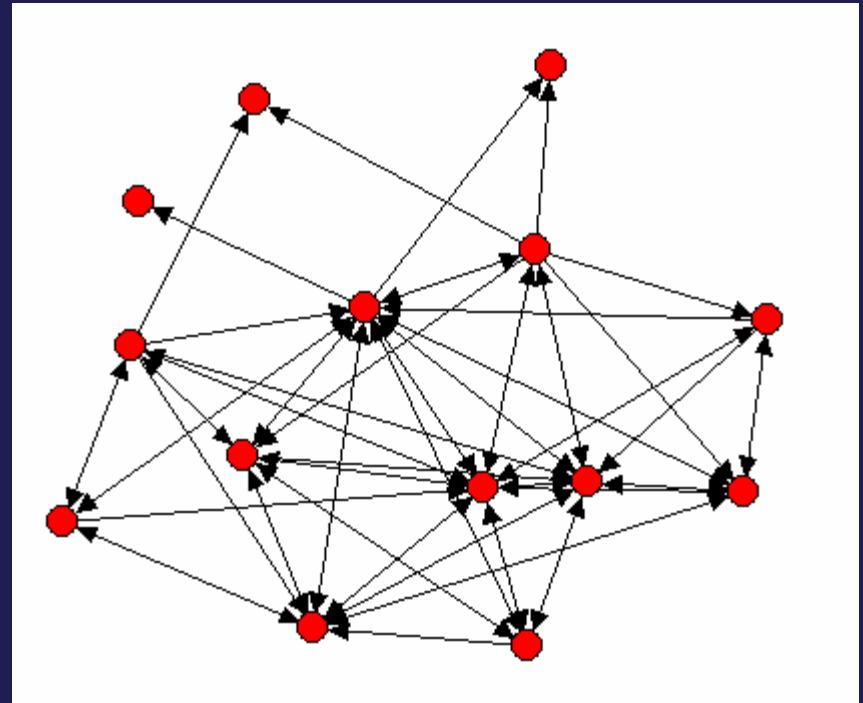


High performing teams have a richer set of connections and less centralization

Low Performing Team



High Performing Team

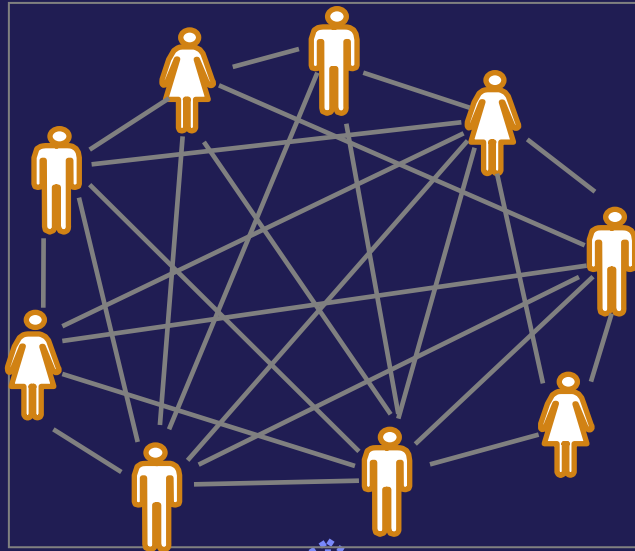


“How often do you communicate with this person about opportunities”

Social network analysis can address business problems

Business Problem	Drill down questions
Improve effectiveness of business units	<ul style="list-style-type: none"> ➤ Are there systematic gaps in communication? ➤ Is communication too centralized, not centralized enough? ➤ Are some people getting overloaded? ➤ Is decision-making aligned with the goals of the group?
Improve revenue growth	<ul style="list-style-type: none"> ➤ Is there sufficient connectivity in the group to coordinate and share client information and leads ➤ Are there systematic gaps in communication? ➤ Is communication flowing in two directions? ➤ Is there a high level of trust?
Promote innovation	<ul style="list-style-type: none"> ➤ Are there individuals in the group who are connected to unique (non-redundant) people outside the group ➤ Are these people also connected to leaders in the group ➤ Is the group appropriately structured?
Facilitate large-scale change	<ul style="list-style-type: none"> ➤ Who are the people in key network roles (e.g. brokers)? ➤ Where are the main mis-alignments between formal and informal roles and processes

Social network analysis makes connections visible so that improvements can be made in social capital



Think of social capital as “bandwidth” for knowledge. The higher the social capital “bandwidth,” the faster and richer the knowledge transfer.

Social capital enables

- **Better knowledge sharing:** better trust relationships, common frames of reference, and shared goals
- **Cost-effective knowledge transfer:** lower “transaction costs” of knowledge transfer
- **Retention:** low turnover rates and higher employee satisfaction
- **Stability:** collegial bonds that survive reorganization
- **Focus:** greater coherence of action due to shared understanding

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“The primary work unit in the enterprise will be the virtual matrixed team, which is composed of diverse competencies, knowledge, and capabilities, and assembled to meet specific project goals or ongoing process deliveries”

(Gartner Research Report 2004)

“Work once defined by superiors in the formal organization is now negotiated between colleagues who have no authority over one another. People are more than ever the authors of their jobs, not told what to do, so much as expected to figure it out.”

(Burt, 2005)



Teams are changing

- + Boundedness
- + Membership
- + Commonality
- + Task interdependence
- + Self-governance
- + Location
- + Fluid boundaries
- + Changing members
- + Multiple teams
- + Task interdependence
- + Individual responsibility
- + Distributed members

Hinds and Kiesler (2002); O'Leary and Cummings (2007)

Impact of disruption on teams

+Teams are becoming more fluid and distributed

- + Distributed sites disrupts informal communication (Martins et al, 2004)
- + More permeable team boundaries makes it harder to identify the right communication partners (Hinds & Kiesler, 2002)
- + Mobile teams have unreliable access to resources (Lamming et al, 2000)

+These factors pose challenges for communication and coordination

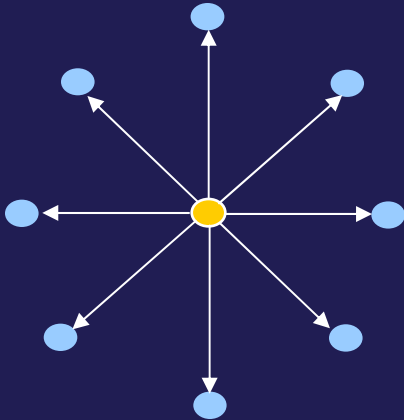
- + Disruption to shared knowledge for speedy decision-making (Cramton, 2001)
- + Reduced opportunity for awareness of others' (Borgatti and Cross, 2003)
- + Longer to develop trusted relationships (Jarvenpaa and Leidner, 1999)

+There is a cost associated with communication which rises for virtual teams

- + Communicate with too few people and risk coordination loss, communicate with too many people and get no benefit (Reagans & Zuckerman, 2001; Sparrowe et al, 2001).

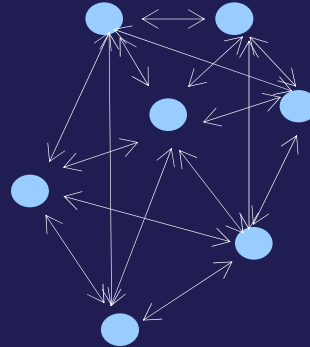


Patterns of communication



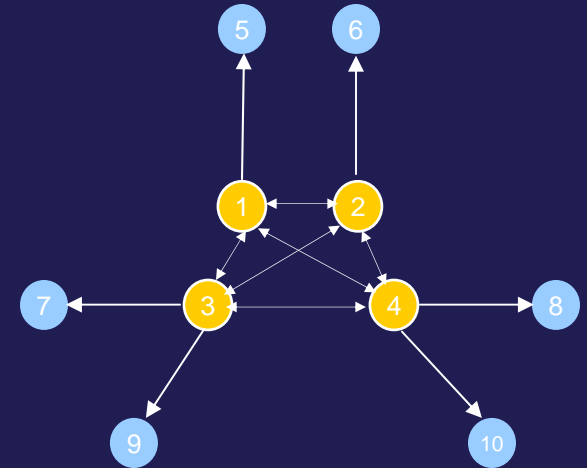
Centralized

- Information flows outward from a central source
- Good for centralized control
- Poor for coordination, consensus



Decentralized

- Everyone talks to everyone
- Good for coordination, consensus
- Poor for innovation, efficiency



Core-periphery

- Core group highly connected with peripheral disconnected
- Good for coordination, applying innovation
- Poor for collocated teams



Study Participants

+ Mobile sales teams

- + Account team structure blending many different functions and expertise
- + Distributed across multiple offices; highly mobile

+ Sample

- + 50 sales teams (639 members; 77% response rate; all teams >50% response rate)
 - + Size: 4-47 (mean = 16.98, sd = 11.20)
- + External executives rated teams as “well positioned” (23 teams) or “struggling” (27 teams)

Social structure and team performance

+Communication structure

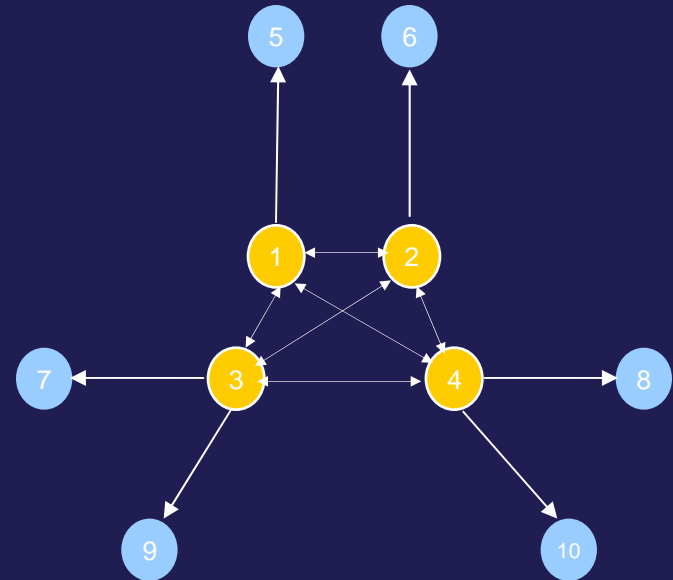
- + High performing teams (cf struggling teams) have
 - + A stronger core-periphery structure after accounting for density

+Composition of the core

- + High performing teams (cf struggling teams) have
 - + More high performers concentrated in the core
 - + Same average individual performance for high and low teams
 - + More long tenured people concentrated in the core
- + People with higher percentage of time with team in the core

Implications

- + When there is disrupted access to others, it helps to have a locus of coordination
- + Not necessary for everyone to communicate with everyone
- + Distributed responsibility reduces bottlenecks



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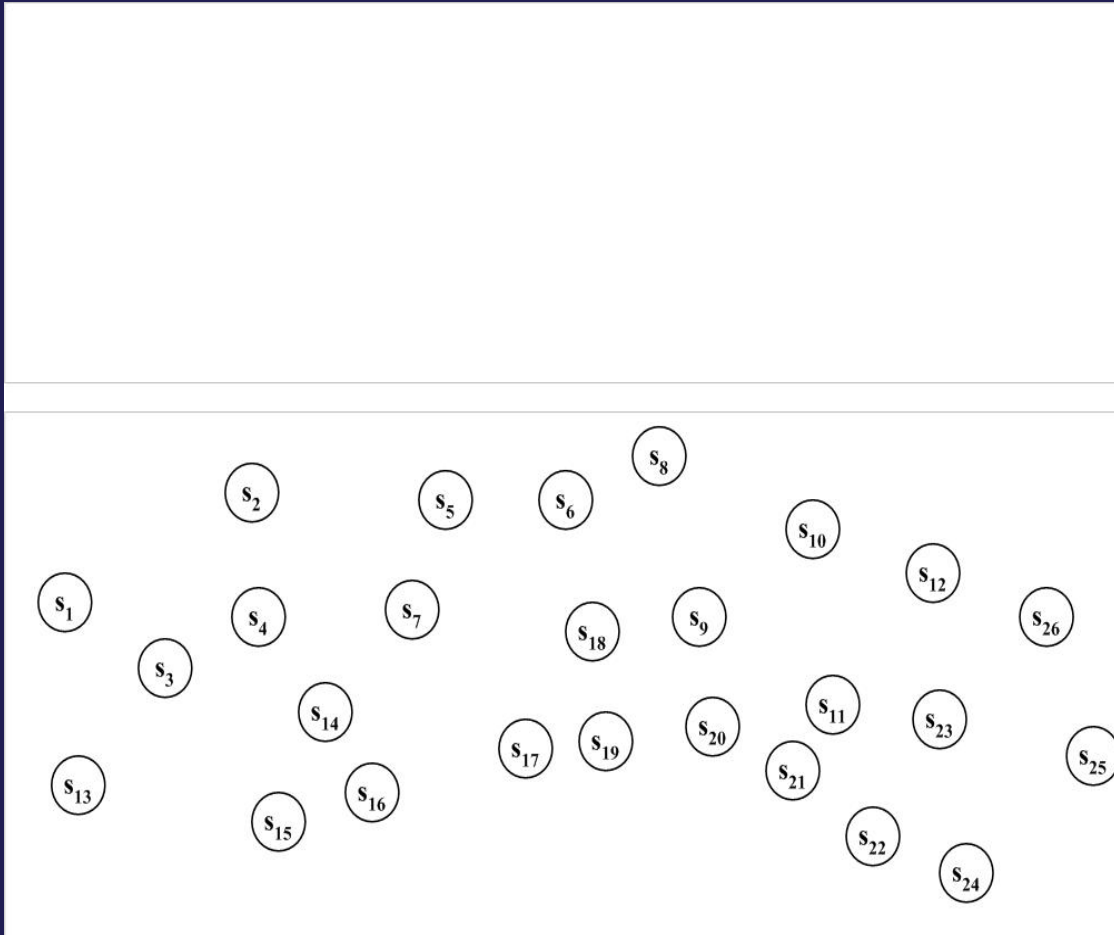
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Coordination problems in distributed software teams

- + Distributed software teams face coordination challenges
 - + Lack of awareness of evolving code dependencies – incoming and outgoing (de Souza et al, 2007)
 - + Difficulty in maintaining coordination (Cheng et al, 2003)
- + Conway's Law – software takes on the structure of the team that created it
 - + Software gets developed faster when people working on related code communicate with each other (Cataldo et al, 2006)

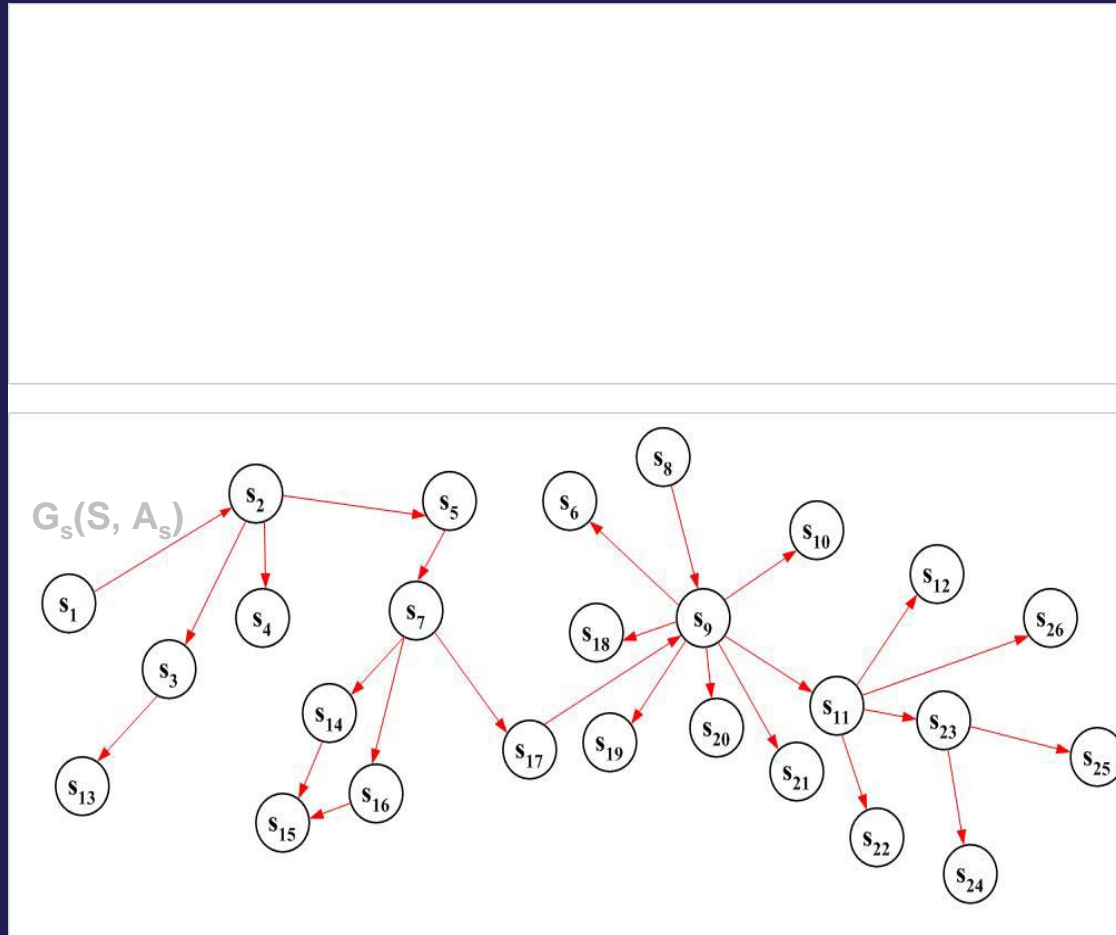


Software Artifacts



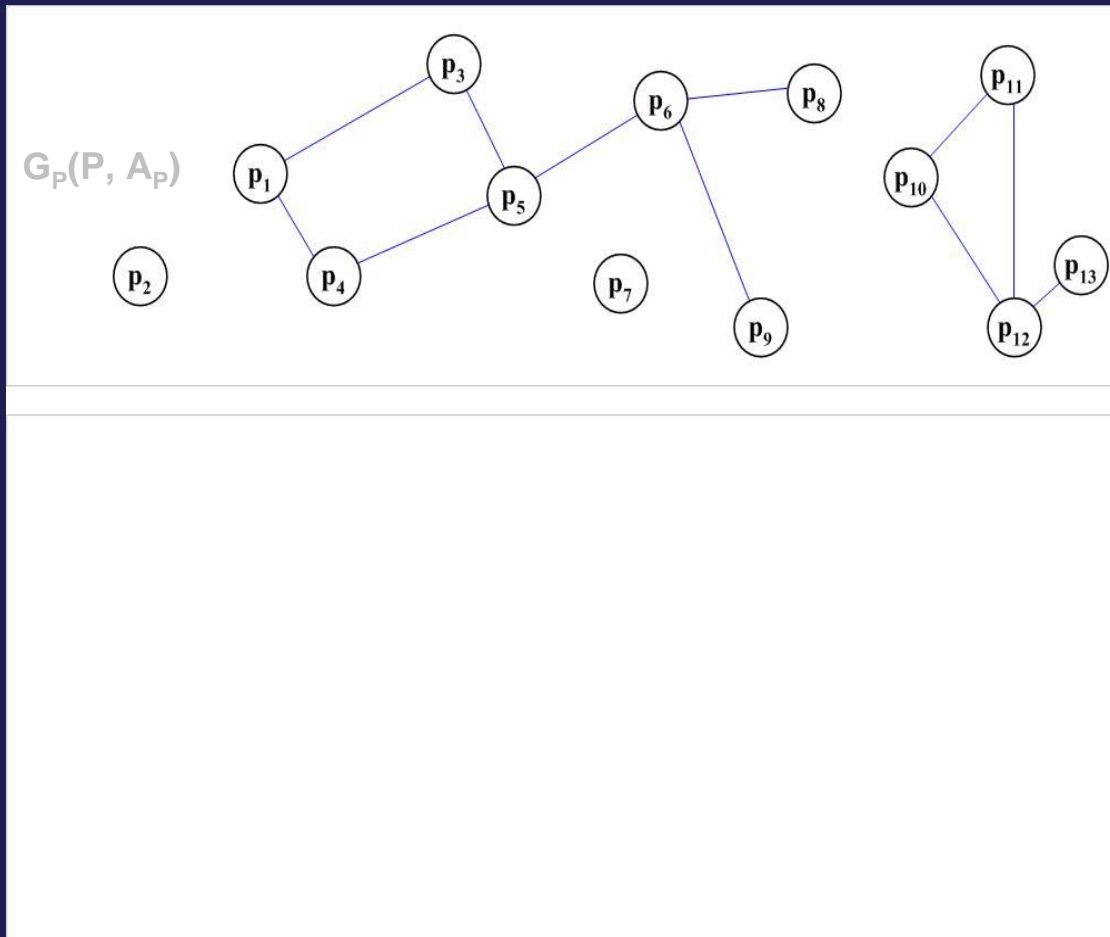
- Classes
- Modules
- Design models
- ...

Artifacts have dependencies

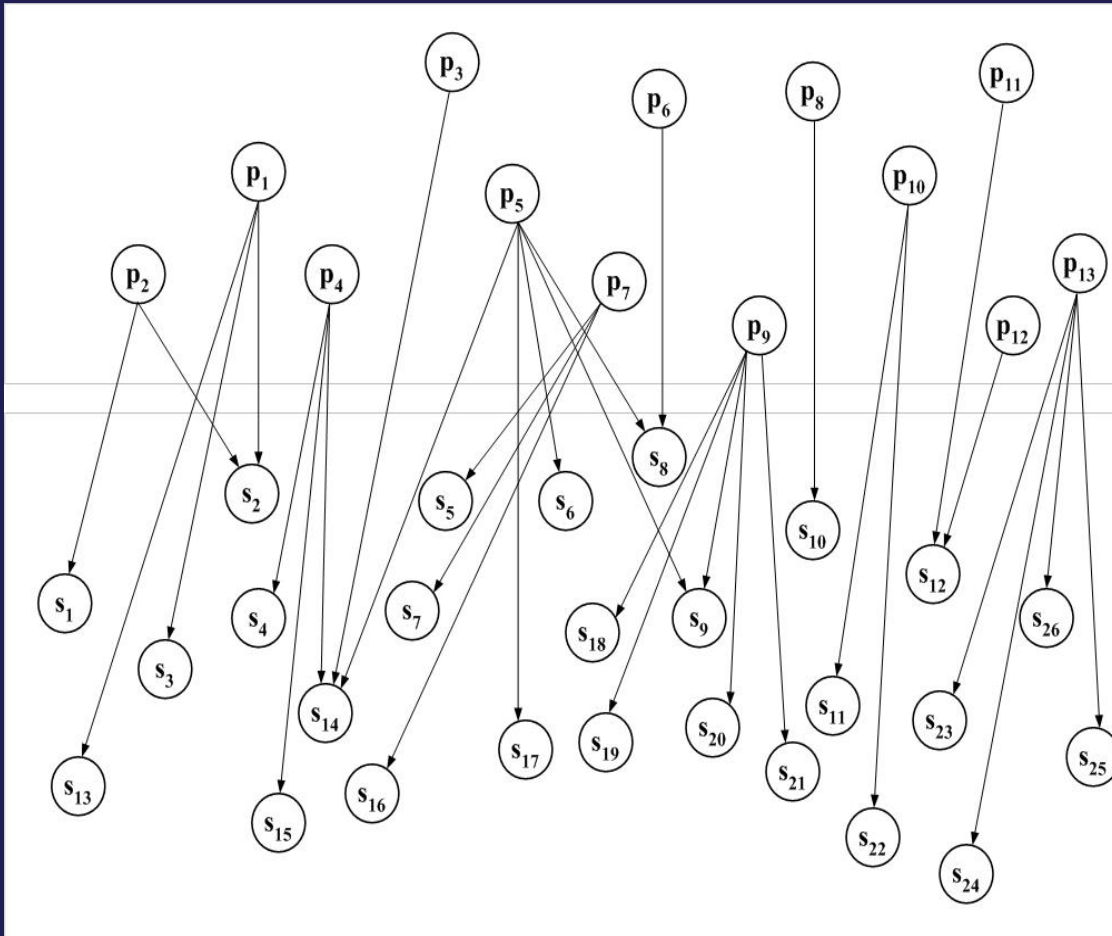


e.g. static analysis dependencies

People communicate to share information

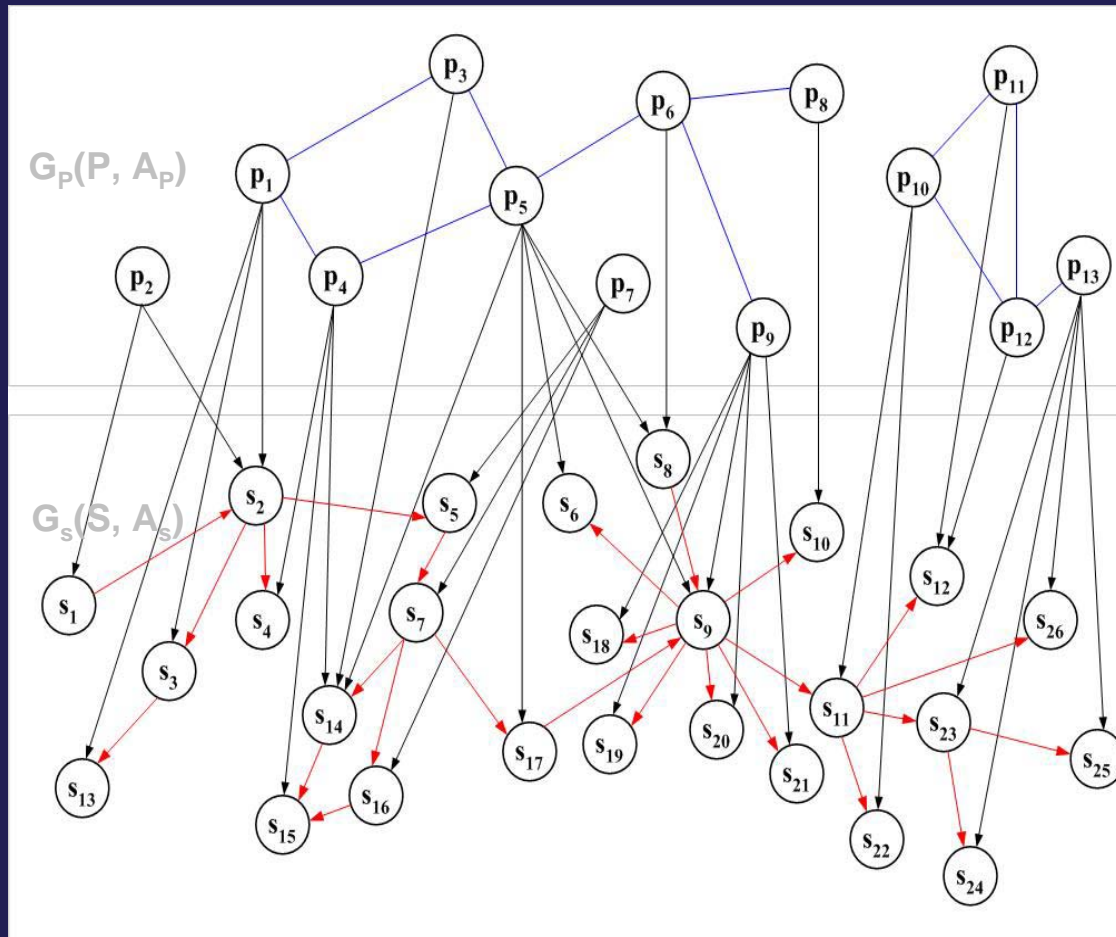


People Work with Artifacts

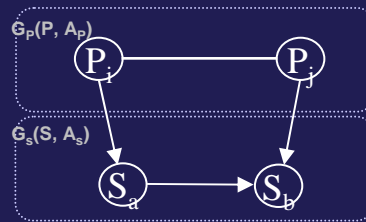
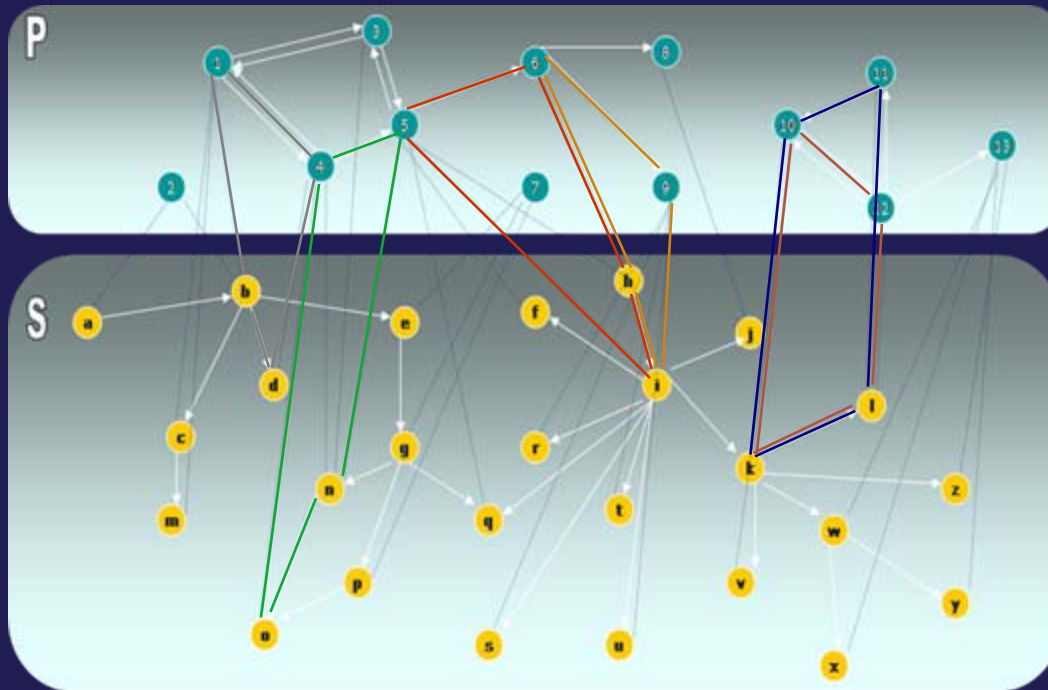


- Work assignments
- Commits
- Design models
- ...

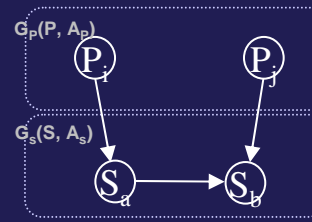
The Socio-Technical Network Model



Our algorithms identify high priority gaps



Congruence



Gap

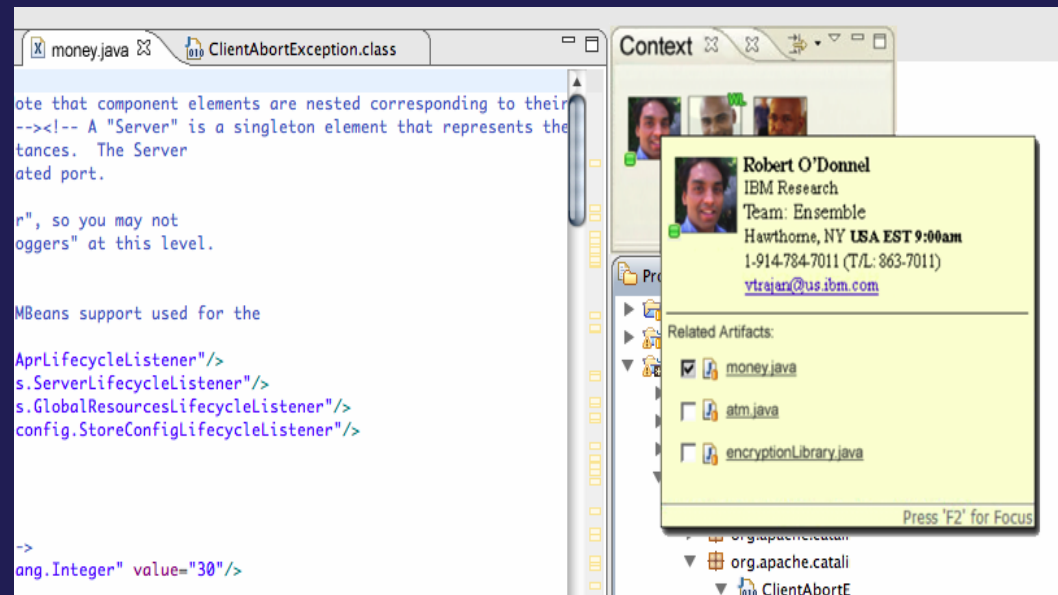
Ensemble: tools to close gaps

- + People who work on related parts of a software system must collaborate with one another to reduce the possibility of costly inconsistencies, incompatibilities, errors, and delays.
 - + But on large, distributed or long-running teams **it is not always clear who you should collaborate with**, or when.
 - + Failures to communicate adequately have been shown to result in bottlenecks, integration problems, reproduction of effort, and delays in finishing tasks.
 - + After people have agreed to collaborate, it can be **difficult to stay coordinated**
-
- + Ensemble helps developers **select the right people and right time to collaborate and remain coordinated**

Ensemble recommends people working on related code

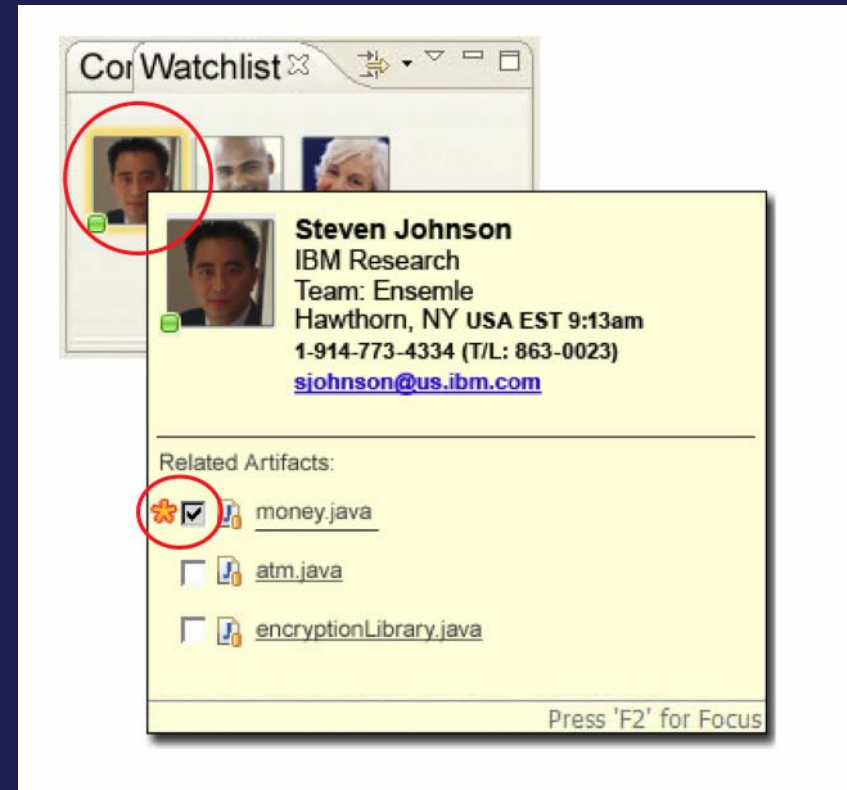
+ Local Recommendations

- + Ensemble analyzes a user's current work to recommend people who are working on related code artifacts
- + User can get more information about person's current artifacts, and, contact information for rapid communication



Ensemble provides on-going awareness of selected people

- + Dynamic awareness
 - + User can add people to a watch list to be informed when one of those people modifies an artifact



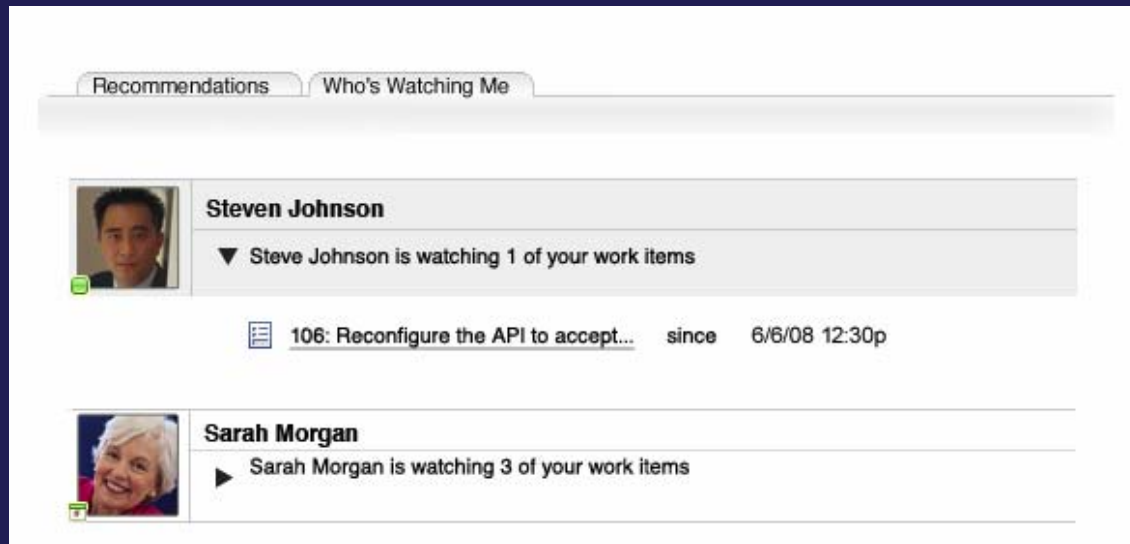
Ensemble recommends people who have work dependencies

- + General recommendations
 - + Ensemble computes recommendations based on the number of dependent work items

Recommendations Who's Watching Me

Rank	Information																
1	Robert O'Donnel ▼ Robert O'Donnel and you have 5 interdependent work items Your Dependency on Robert Your Artifact: <table border="1"> <thead> <tr> <th>Artifact</th> <th>Dependencies</th> </tr> </thead> <tbody> <tr> <td>106: Reconfigure the...</td> <td>144: Implement...</td> </tr> <tr> <td>128: Forgo the method...</td> <td>139: Bug Fix on the...</td> </tr> <tr> <td>133: Replace instance of...</td> <td>129: Create a method...</td> </tr> </tbody> </table> Robert's Dependency on You: Robert's Artifact: <table border="1"> <thead> <tr> <th>Artifact</th> <th>Dependencies</th> </tr> </thead> <tbody> <tr> <td>107: Reconfigure acc...</td> <td>106: Reconfigure the...</td> </tr> <tr> <td>108: Implement acc...</td> <td>109: Provide accoun...</td> </tr> <tr> <td></td> <td>119: Clarify the use of...</td> </tr> </tbody> </table>	Artifact	Dependencies	106: Reconfigure the...	144: Implement...	128: Forgo the method...	139: Bug Fix on the...	133: Replace instance of...	129: Create a method...	Artifact	Dependencies	107: Reconfigure acc...	106: Reconfigure the...	108: Implement acc...	109: Provide accoun...		119: Clarify the use of...
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107: Reconfigure acc...	106: Reconfigure the...																
108: Implement acc...	109: Provide accoun...																
	119: Clarify the use of...																
2	Steven Johnson ✓ watching ▶ Steven Johnson and you have 4 interdependent work items																
3	John Smith ✓ watching ▶ John Smith and you have 3 interdependent work items																
4	Arthur Edwards ▶ Arthur Edwards and you have 2 interdependent work items																
5	Sarah Morgan ✓ watching																

Users have transparency to who is watching them



- + Mutual awareness
 - + Developers can see who is dependent on their work as well as who they depend on

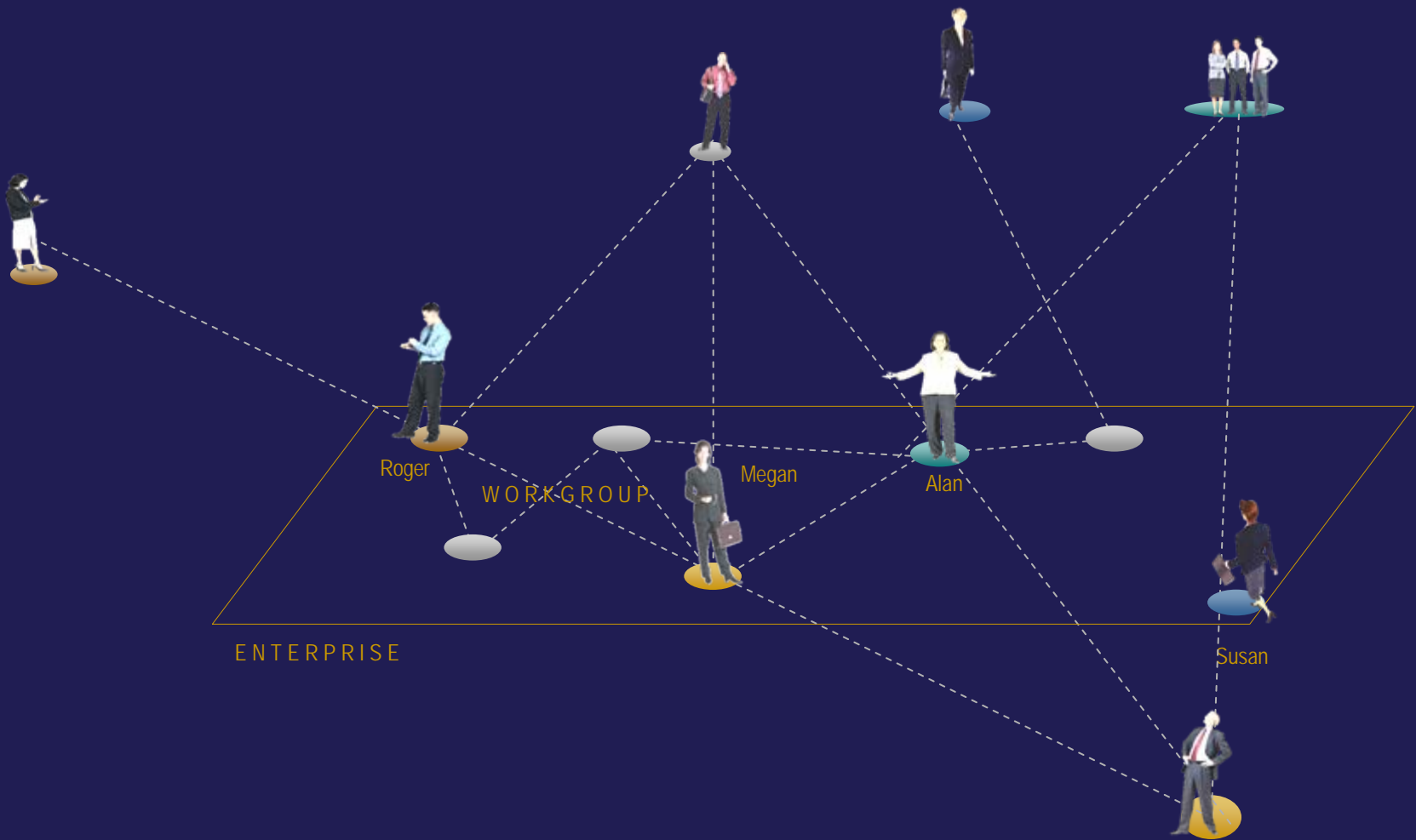
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Networks are critical to successful enterprises



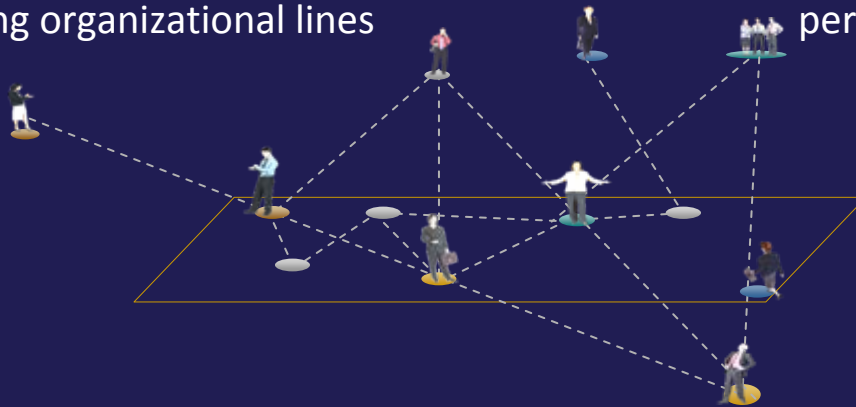
Understanding networks helps enterprises perform better

Where Innovation and Information Lives...

- Rely on people FAR more than databases for information
- Innovation lives in re-combining expertise and ties bridging organizational lines

Where Work Happens...

- After decades of restructurings, work and coordination of work occurs in networks
- Appropriate connectivity drives performance



Invisible Source of Inefficiency...

- Costs of collaboration increasing but not systematically managed
- Invisible decision-making delays consume time and resources

But These Networks Are...

- Invisible and highly misunderstood
- At odds with formal structure, process views of work and standard culture inventories

Slide courtesy Rob Cross



THANK YOU

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