



Characterizing naval team readiness through social network analysis

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TNO



Overview

- › Team performance measurement
- › Social network analysis
- › Case study in naval teamwork
- › Conclusions, lessons learned and recommendations



Team performance measurement

- › Huge progress made over the past decades (e.g., Brannick, Salas, & Prince, 1997; Flin, O'Connor, & Crichton, 2008)
- › Current team performance measurement characterized by:
 - › Need for experienced raters
 - › Need for multiple raters
 - › Need for well-calibrated raters
 - › Use of abstract rating categories, not always well-understood by subject-matter experts
 - › Constructs derived from individual approach to team cognition
 - › Lack of specificity in terms of diagnosing deficiencies in teamwork



Team model 1

- › Static team entities ('leadership'; 'situation awareness'; 'decision making')
- › Aggregation of individual knowledge
- › Context-independent
- › Better teamwork leads to team effectiveness (causal I-P-O model)

Team model 2

- › Dynamic team processes
- › Analysis at the team level
- › Context-dependent
- › Better teamwork is an adaptive response whenever team goals are jeopardized (emergent model)



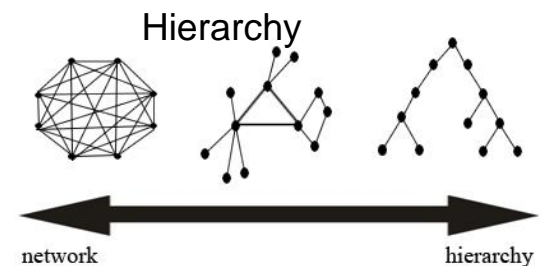
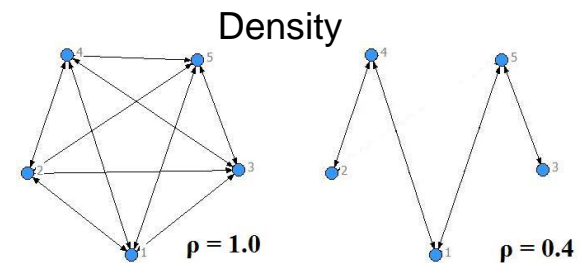
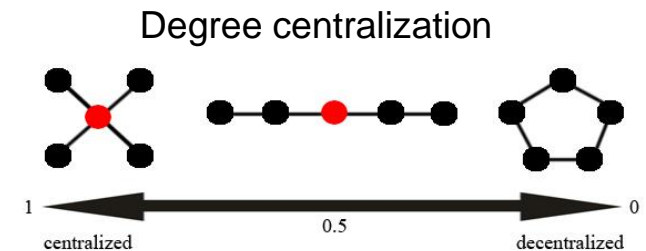
Social Network Analysis

- › Starts with sociomatrix defining which units have a 'communicates with' relationship (e.g., Pfautz & Pfautz, 2009; Wasserman & Faust, 1994)
- › Study real-time team interaction at the team level (Walker et al., 2006)
- › Advantages:
 - › Not dependent on availability of trained raters
 - › Enables precise diagnostics at specific moments in time
- › Highly suitable for assessing teamwork within Team model 2 framework (Cooke et al., 2013)



Social Network Analysis

- › Base unit: communication from <actor> to <actor>
- › SNA metrics used:
 - › Degree centralization
 - › Eigenvector centralization
 - › Closeness centralization
 - › Density
 - › Betweenness centralization
 - › Hierarchy (Krackhardt)





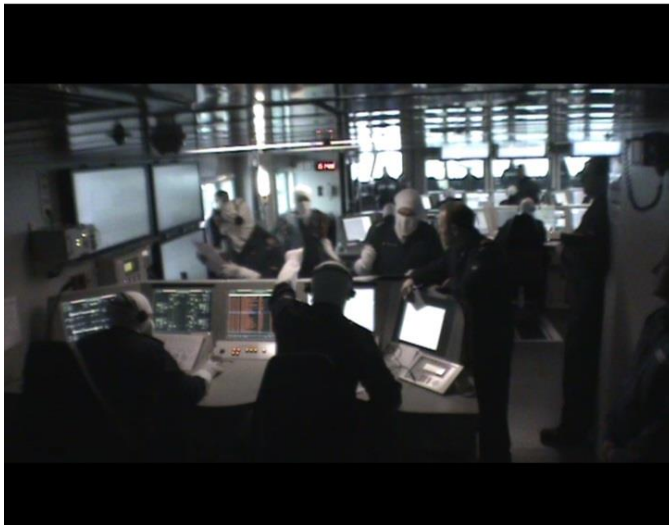
Current study: naval team readiness

- › Used Social Network Analysis techniques to study communication and coordination at the team level (ORA: Carley & Reminga, 2004)
- › Distinguished between different levels of naval team readiness
 1. 'unpracticed team'
 2. 'team in training'
- › Research question: can we characterize naval team readiness efficiently by looking at real-time team interaction?



Method

Observations of two Internal Battle coordination teams (5 officers each)



Each team: Resource Manager assisted by Damage, Sewaco, Mobility, and Personnel officers

Two highly demanding scenarios requiring all personnel on station and all systems available

Task of IB team: build adequate damage assessment within 8 minutes



Results

Network level measure	Unpracticed	In training
Density	0.80	1.00
Betweenness centralization	0.15	0.50
Degree centralization	0.34	0.62
Eigenvector centralization	0.26	0.74
Closeness centralization	0.25	0.96
Hierarchy	0.40	0.00



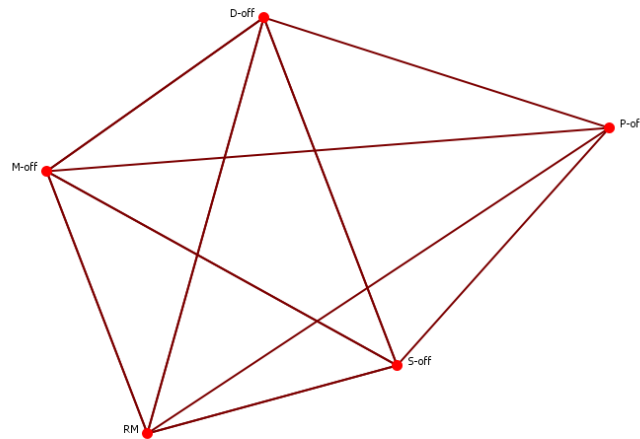
Sensitivity analysis, extending to actors beyond Internal Battle team

Network level measure	Unpracticed	In training
Density	0.17	0.22
Betweenness centralization	0.16	0.07
Degree centralization	0.16	0.17
Eigenvector centralization	0.60	0.73
Closeness centralization	0.01	0.01
Hierarchy	0.61	0.60



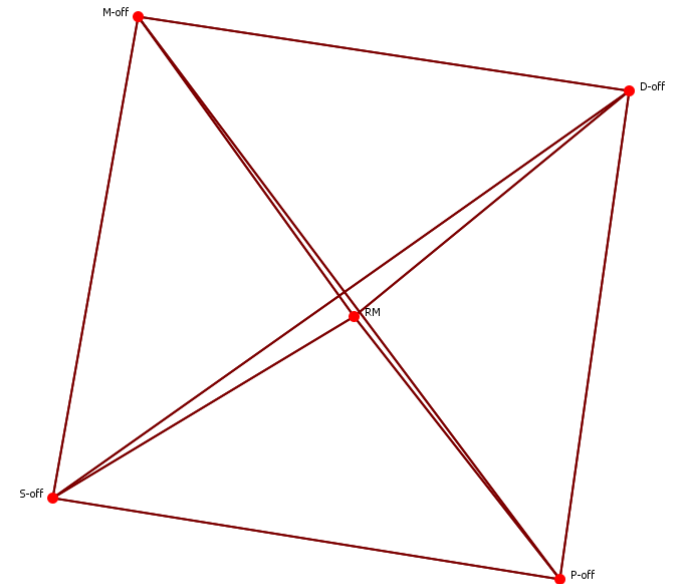
Network structures of unpracticed team (left) versus 'team in training' (right)

NEWSNA-G-beginnersCOBRASOLO



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NEWSNA-H-intermediateCOBRASOLO



powered by ORA-NetScenes



Difference scores on node level measures for RM versus average of S-, M-, D-, and P-officers on 'unpracticed' and 'in training' vessels.

Node level measure	Unpracticed	In training
Degree centrality	0.25	0.46
In-degree centrality	0.20	0.46
Out-degree centrality	0.19	0.46
Eigenvector centrality	0.19	0.56



Conclusions

- › Network level: More experienced team showed higher levels of information sharing and team member participation
- › Node level: Resource Manager played more central role in more experienced team
 - › Resource Manager 'in the know', needs to advice Commanding Officer
- › 'Team in training' was more 'ready' than 'unpracticed' team



Lessons learned (data analysis)

- › Include core team only
- › Restrict communication to actor-initiated communication (rather than proceduralized communication)
- › Exclude broadcasted communication directed at groups



Recommendations and future steps

- › SNA highly suitable for point-to-point communication
- › May be carried out in real time, using keyword recognition
- › Useful for debriefing teams, providing objective and to the point feedback

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