

Army-relevant Network Science at USMA: Interdisciplinary Research, Outreach, Teaching, and Learning



Network Science Center
at West Point 

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Social Structural Perspectives



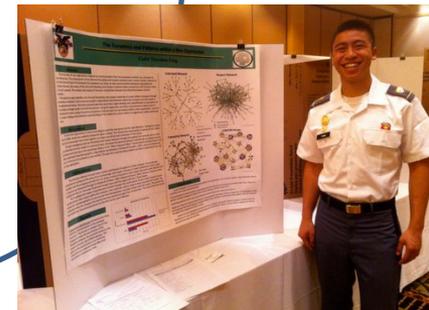
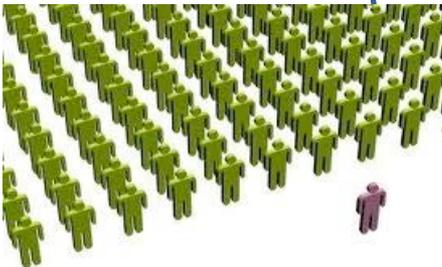
**Military Unit
Cohesion &
Policy**

**Community
& Cultural
Networks**



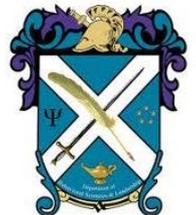
**Organizational
Leadership &
Performance**

**Officer
Education**



I. Military Unit Cohesion & Policy

- Policy and behavioral change requires shifts in cultural norms
 - How do you reconcile the warrior ethos spirit with acceptance of homosexuality and post-traumatic stress syndrome?
- Understanding how organizational networks institute policies and how the network structure can help or hinder changes to the organization.
 - DADT Repeal: Attitudes towards homosexuality in the military
 - PTSD: Network effects of leadership attitudes
 - Phishing: What is the role of social networks in cyber security



“A Network Evaluation of Attitudes toward Gays Among US Military Cadets”

- Participants are one military cadet company (n=138)
- Research Question: *Are attitudes towards homosexuality among future Army officers associated with social structure and/or network homophily.*
- Three dimensions:
 - Cultural: “I believe homosexuality is morally wrong” (*immoral*)
 - Personal: “I am comfortable sharing a personal space, such as a shower with a gay service member” (*discomfort*)
 - Organizational: “Don’t Ask Don’t Tell should be repealed this year” (*pro-DADT*)
- Social Networks defined by self-assessed (1) friendship & (2) leadership, and (2) the formal command structure.

Logistic Regression Models of Negative Attitudes towards Homosexuality

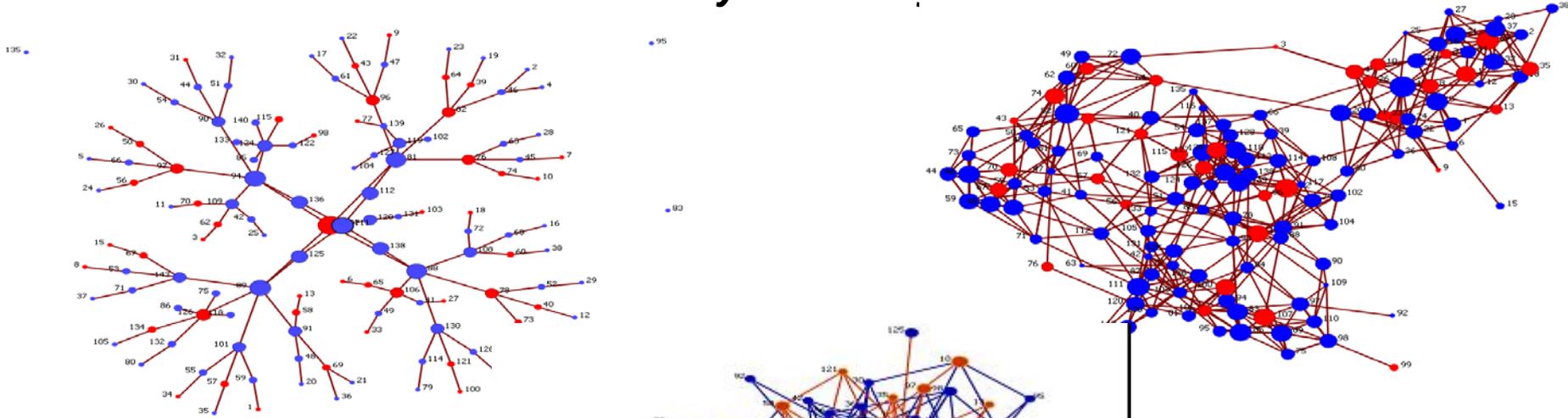
	<i>Immorality</i>	<i>Discomfort</i>	<i>Pro-DADT</i>
n	139	139	139
LR Chi2	41.93	41.75	45.83
Probability	0	0	0
Pseudo R2	0.23	0.22	0.24
Log Likelihood	-69.24	-74.43	-72.82
DEMOGRAPHIC ATTRIBUTES			
Gender	*0.33 (0.20)	**0.24 (0.16)	** 0.24 (0.14)
Religious Preference	***10.04 (6.48)	**4.78 (3.02)	** 3.66 (2.18)
Political Affiliation	***4.18 (1.91)	***7.33 (3.20)	***3.37 (1.32)
NETWORK CENTRALITY			
Friendship Centrality	0.76 (0.14)	**0.70 (0.13)	*0.78 (.12)
Leadership Centrality	*1.28 (0.17)	0.88 (0.12)	1.05 (.13)
Command Centrality	3.49 (3.61)	1.99 (1.70)	0.25 (.25)



West Point Cadet Attitudes

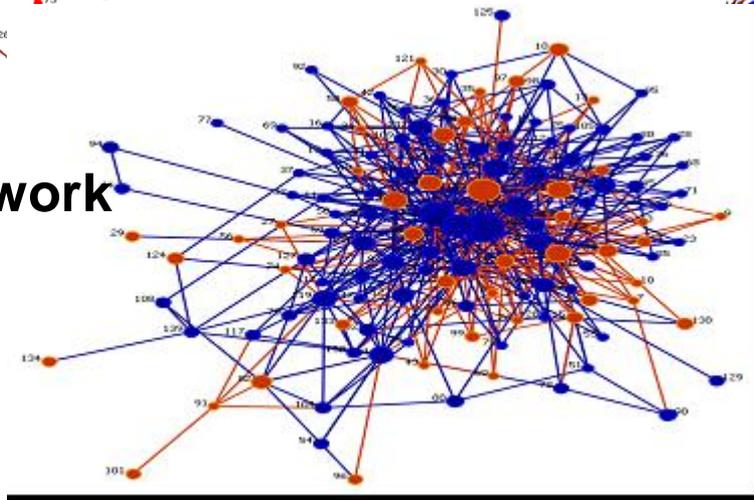
- Chain of command & informal leadership networks exhibit homophily around morality of homosexuality

“Homosexuality is Morally Wrong”



Chain of Command Network

Friend Network



Leadership Network

Recommendations for DADT repeal

- *Nondiscrimination as socialized norm*: institutionalize non-discriminatory language and values as part of the socialization process at the Military Academy.
- *Leadership training*: target command leaders to empower them to enforce and internalize non-discriminatory rules and behaviors.
- *Focus on military readiness, not morality*: focus on professional versus moral justifications for supporting openly gay service members.

Network Effects of Leadership Attitudes on PTSD



- 757 soldiers completed surveys, (4 Army companies) before deployment to Afghanistan
- 15 Platoon Sergeants and 15 Platoon Leaders data were given PTSD training in one of three conditions
- 546 respondents surveyed during deployment

PTSD

- PTSD symptoms (17-item scale; 17-75; >50 PTSD, tri-categorized)
- Perceived stigma towards PTSD treatment (8-item scale, tri-categorized)

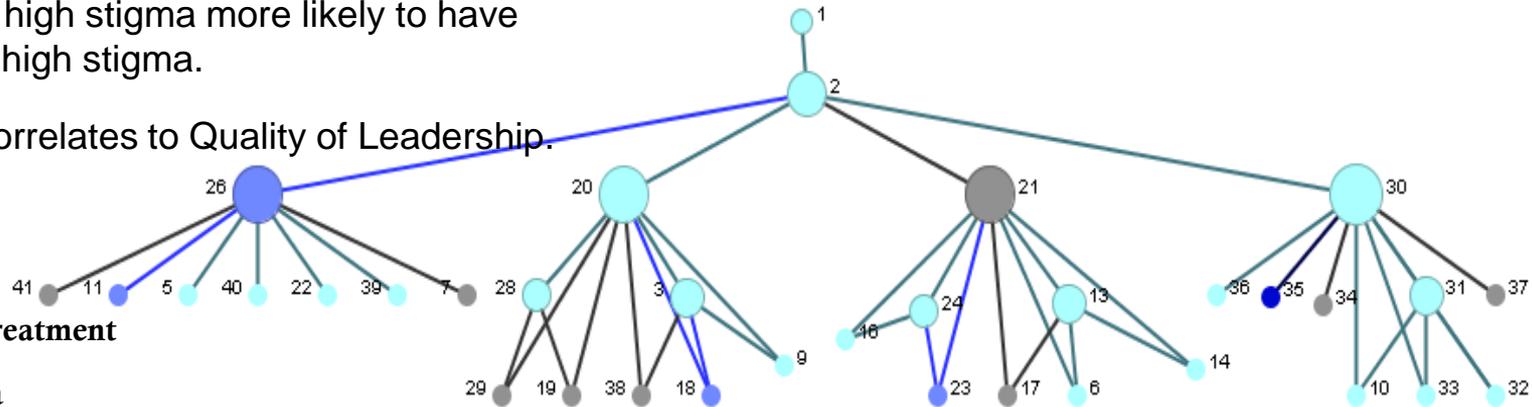
Quality Leadership (25-item scale, average of 1-5 likert scales)

“tells Soldiers when they have done a good job, does not embarrass Soldiers in front of others, treat members of the unit fairly, are concerned about the safety of Soldiers”



Chain of Command Network

- Commanders with high stigma more likely to have subordinates with high stigma.
- Reduced stigma correlates to Quality of Leadership.

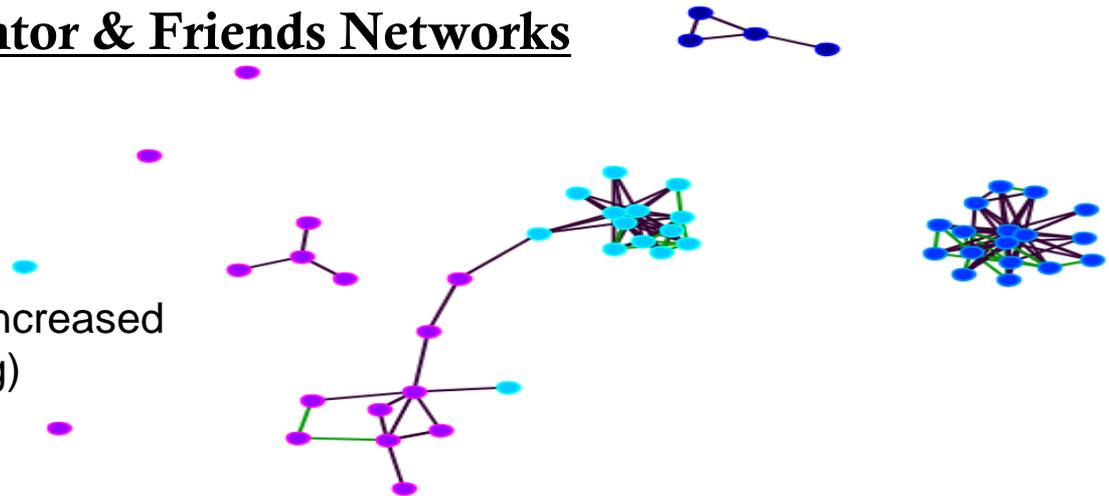


Stigma towards PTSD treatment

- = High Stigma
- = Med Stigma
- = Low Stigma

Mentor & Friends Networks

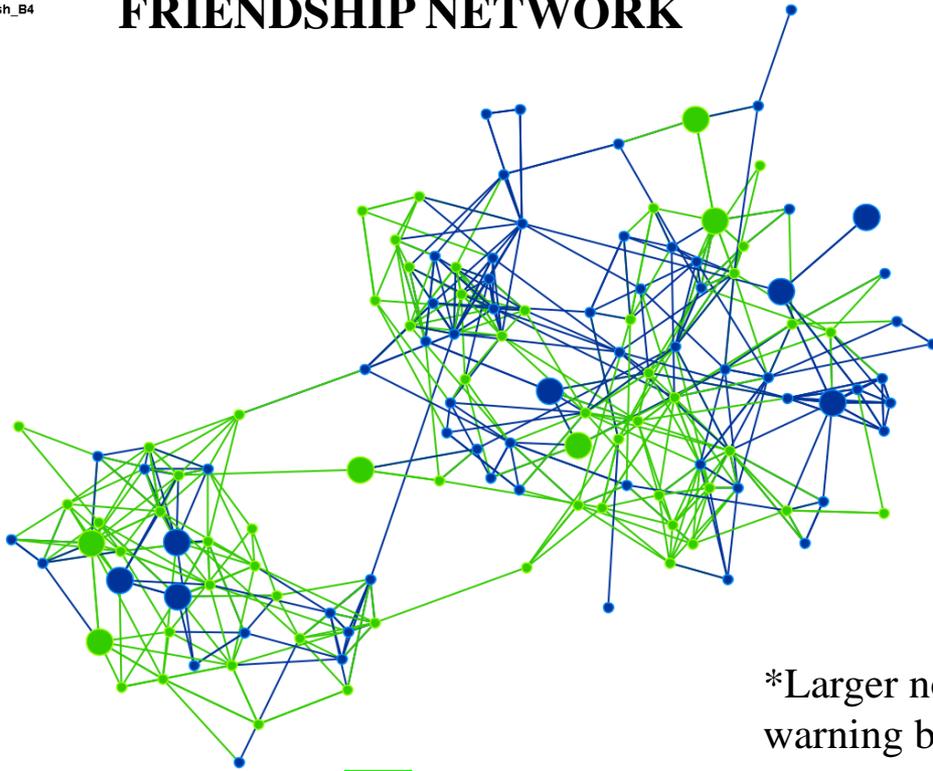
- Friend & Mentor Stigma leads to increased stigma & decreased PTSD (reporting)



Influence of Social Networks on Cyber Security

- Examine cadet social networks at the US Military Academy to identify network metrics and processes associated with security vulnerabilities.
- Identify social mechanisms to improve security among college aged cadets at the US Military Academy at West Point.
- Compare processes between formal versus informal networks.
- Participants:
 - US Military Academy cadets, aged 18-25
 - One complete military unit (n=128)
 - 89% males
 - 30% freshman, 28% sophomore, 22% junior, 20% senior
- Security
 - 48% clicked the embedded link
 - 30% entered credentials
 - 5% warned others

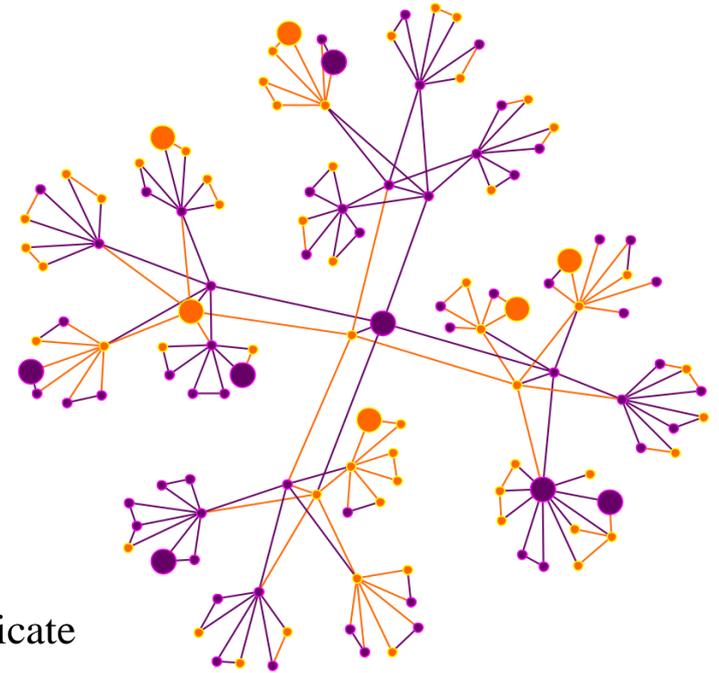
FRIENDSHIP NETWORK



■ Failed Phish

*Larger nodes indicate warning behavior

COMMAND NETWORK



■ Failed Phish

	Failure		Warning	
CENTRALITY	<i>Command</i>	<i>Friendship</i>	<i>Command</i>	<i>Friendship</i>
closeness	-0.05	0.08	0.23	-0.19
betweenness	-0.12	0.05	0.01	-0.02
eigenvector	-0.05	0.03	0.11	-0.17
indegree	0.08	0.05	0.04	0.06
outdegree	-0.12	0.16	0.02	-0.02

Local Network Homophily

Logistic Regression of Failure

	Odds Ratio	se	p-value
warn	1.21	0.75	0.754
male	1.17	0.70	0.795
class year	0.81	-0.15	0.235
CoC failure exposure	0.70	-0.12	0.033
CoC warning exposure	2.28	0.83	0.025
constant	1.62	1.16	0.496

Logistic Regression of Warning

	Odds Ratio	se	p-value
fail	0.80	0.50	0.728
male	0.38	0.29	0.199
class year	1.00	0.28	0.996
friend warning exposure	2.32	0.89	0.028
constant	0.16	0.17	0.092

- *Command* relations are involved with *phishing vulnerabilities*
- *Friend* relations are involved with *warning behaviors*

Structural Capabilities

- Friendship networks
 - Characterized as being highly centralized and clustered - few individuals have key roles in spreading information.
- Command networks
 - Have the potential to be very efficient - all individuals in the network can be reached with fewer number of steps (2 versus 5 steps, on average).

	Friendship	Command Chain
Link Count	600	198
Density	0.036	0.012
Average Distance	5.020	2.009
Betweenness	0.259	0.002
Closeness	0.042	0.708
Total Degree	0.058	0.036

Summary of Results:

Social determinants of Cyber Security

Informal Social Structure

1. Friendship leadership is vulnerable – more failure, less warning
2. Cyber risk resiliency among friends - while there is less **warning** among friends, there is homophily around this behavior

Formal Command Structure

1. Command leadership is strong – less failure, more warning.
2. Cyber risk vigilance among commanders/subordinates -- reduced security failures ego corresponds to higher **failures** and lower warnings in one's network.

Multiplex Relations

1. Trust improves security coordination -- Warning was likely given and headed among those who share friendship and command links

Security Training Recommendations

- Security training and research should:
 - Emphasize the importance of security vigilance (failure) among formal leadership structures
 - Harness positive behaviors among informal relations (warning)
 - Further explore the role of multiplex relations in these settings
 - Utilize high betweenness in friendship network, and high closeness in command network
- Currently, conducting phishing study – 3 waves. Collecting network, org identity, and trust survey data.

II. Organizational Leadership & Performance

- Leadership effectiveness and group performance are driven by communication networks
- To make teams more effective we need to understand the social dynamics underlying leadership and performance
 - Cadet leadership Network Structures (C-LeNS)
 - IkeNet: social networks in the military

“Cadet leadership Network Structures” (C-LeNS)

- Objective is to refine definitions of leadership from a social structural perspective.
- “Social leadership”:
 - the ability to navigate, cooperate and coordinate the specific array of social dynamics exhibited by the entire team.
- Identify indices of social leadership and to compare these to traditional measures of leadership.

Leadership questions

- How does social position influence individuals psychology?
- How does cognitions contribute to the success of the leader
- Is formal leadership driven by same factors as informal?
- Do cognitions of the team contribute to the success of the leader?
- Is leadership ability an individual trait, or better measured by how well leader and team match?
- Are leaders able to influence cognitions of their subordinates?
Do subordinates influence leaders?

Study Procedures

- Participants: 8 Cadet companies, 3 waves of data collection
- Measurements:
 - Leadership Psychology
 - Motivation to Lead, Shared Leadership, Authentic Leadership, Self-monitoring, Five Factor Model, Group Cohesion
 - Organizational attitudes & identity
 - Cynicism Scale (7-items)
 - Organizational Identity – Self (7-items)
 - Organizational Identity – Integration (7-items)
 - Army Values Scale (10-items)
 - Social Networks
 - Sociometric items: friendship, leadership, trust
 - Email networks
 - Formal chain of command network



IkeNET:

Study of Military Social Networks

- Unique mid-career soldier population at West Point
- Closely monitor social network evolution and attitudinal changes over time
- Explores types of “leadership” and how group structure guides spread of ideology

Procedures

- Students receive Blackberry phones which can connect to USMA server
- All email communication (from/to) is pulled off the server
- Paper-and-pencil surveys administered monthly June 2010- April 2011

Participants (n=21)

- 100% Christian
- All but 2 are white; 1 Asian, 1 Black
- 2 females
- 76% Captains, 24% Majors

Measurements



- **Networks:**

- Email: communication data pulled off server

Survey data asks for names of up to 5 ELDP students who you consider to be:

- Military Leader: “a strong military leader”
- Team Leader: “a strong team leader”
- Friendship: “a friend”

- **Psychometric Scales**

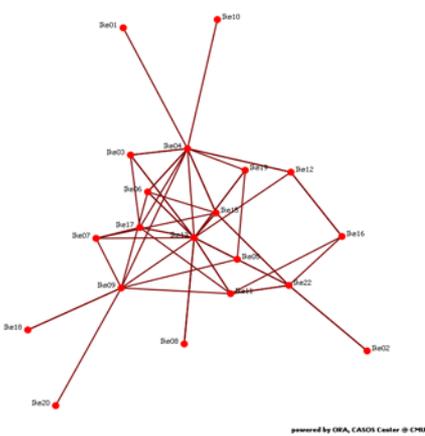
- Leadership Ability: 3-items about how they view themselves as leaders
- Opinion Leadership: 7-item scale that asks about one’s ability to influence others and susceptibility to social influence (King and Summers. 1970, 2010)
- Innovativeness: 10-item scale assesses degree of innovativeness (Valente, 1999)
- Explicit Cognitions: 4-items ask about internalization of Army values
- Implicit Cognitions: 10-cues for free word association task, e.g., democracy, war (Stacy, 1997; Szalay, 1999)

- **Social Capital**

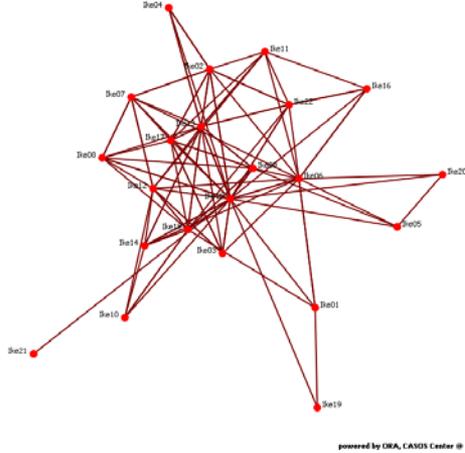
Survey asks about 10 types of emotional, instrumental and technical supports (Snijders, 2001)

- Assess their own ability and others’ abilities to provide that resource

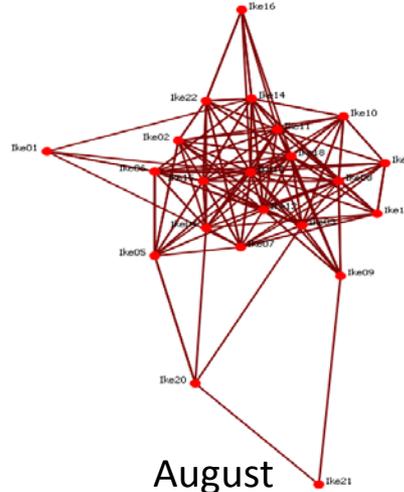
Email Communication



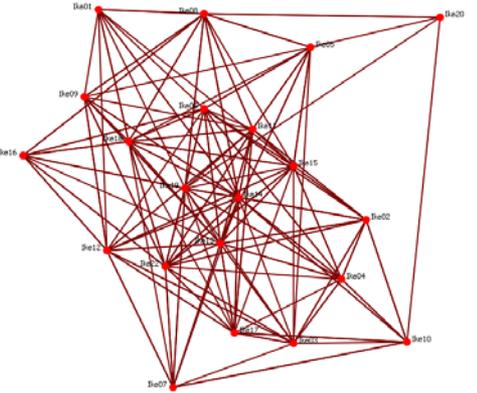
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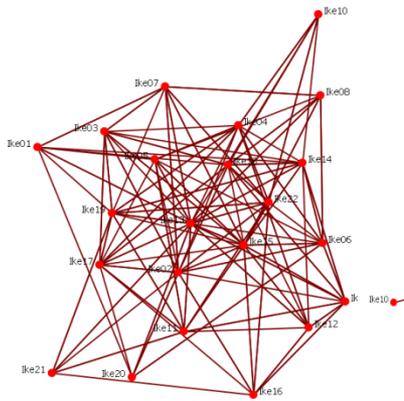
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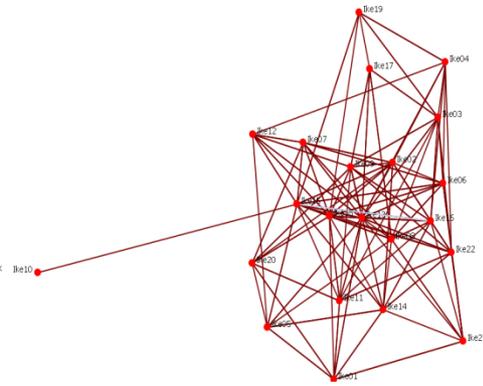
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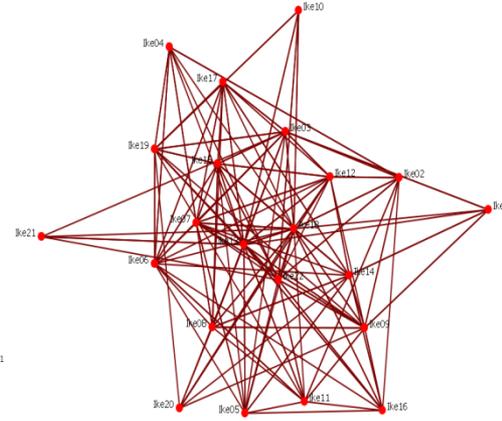
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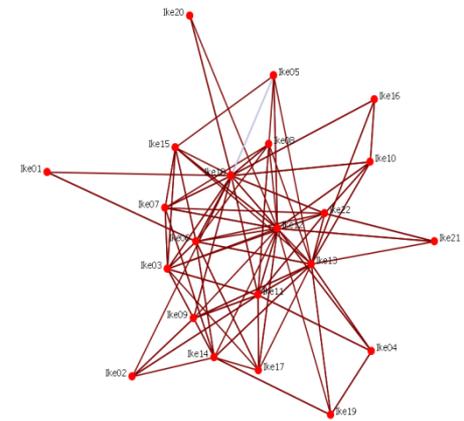
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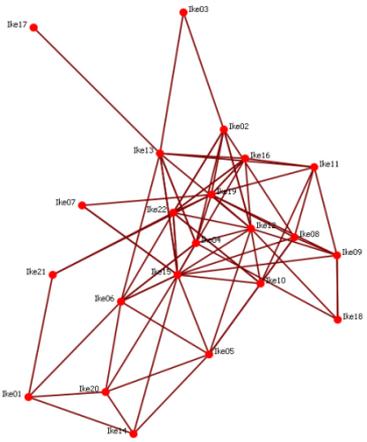


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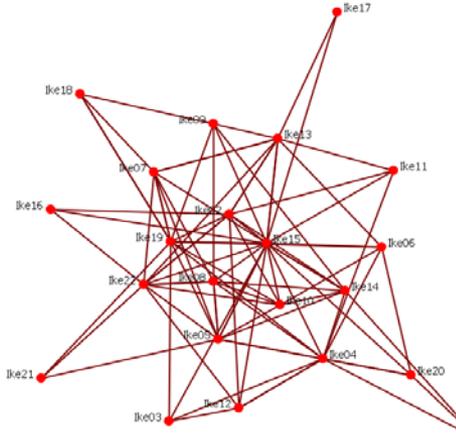


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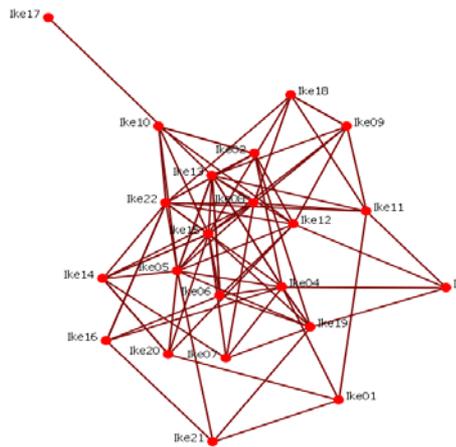
Military Leader Network



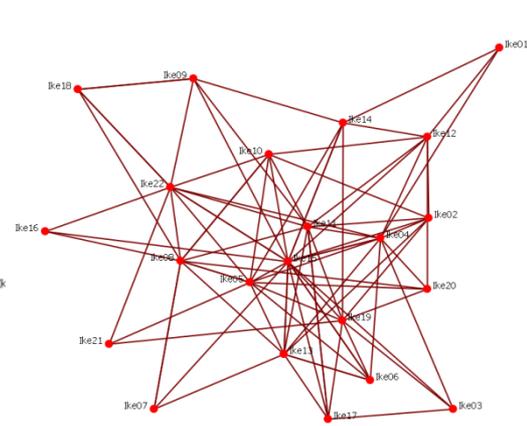
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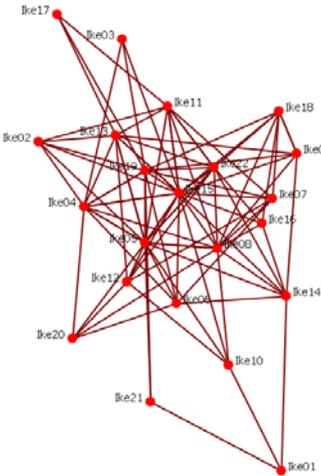
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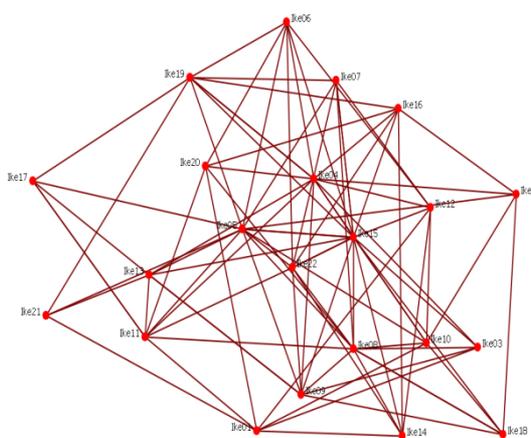
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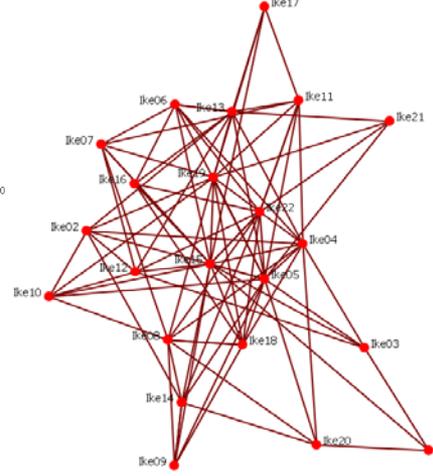
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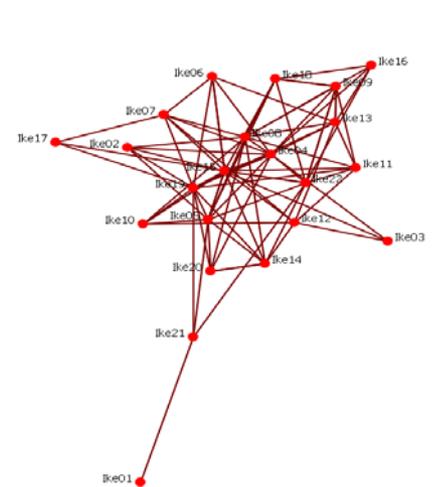
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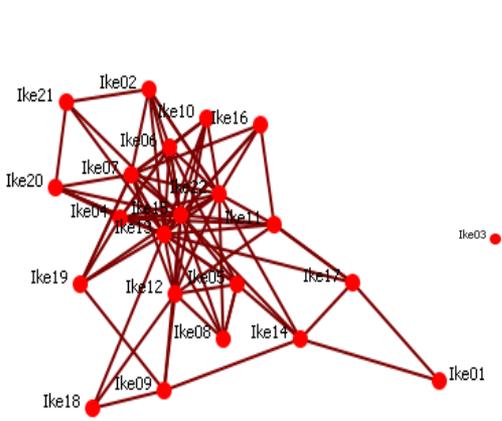


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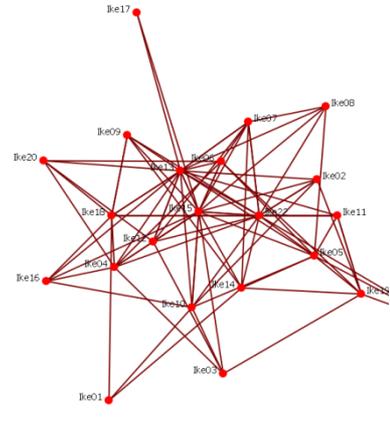


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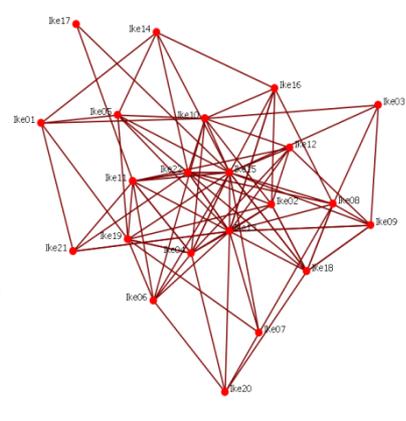
Team Leader Network



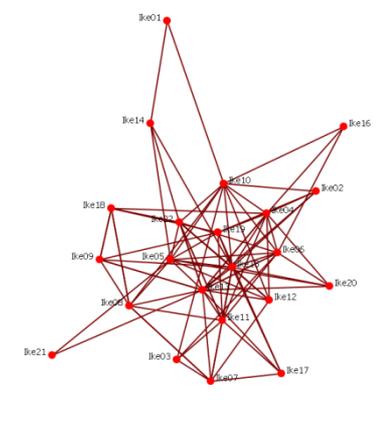
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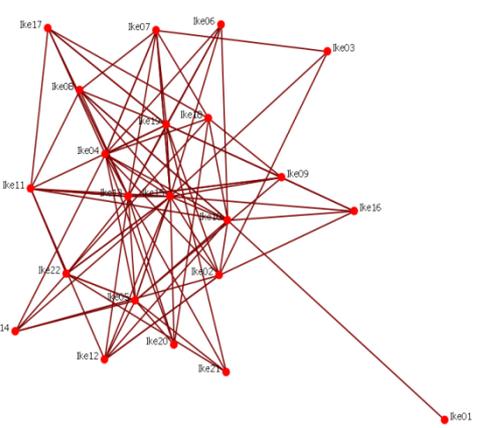
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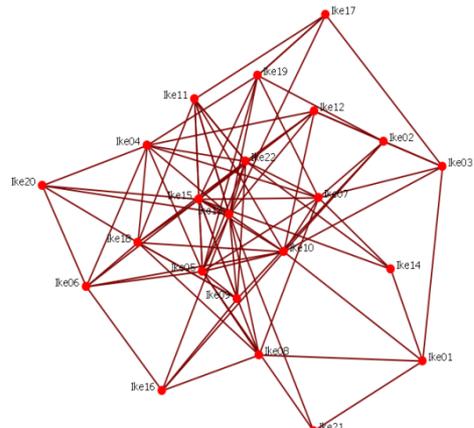
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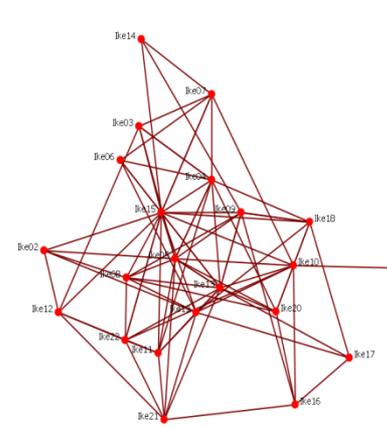
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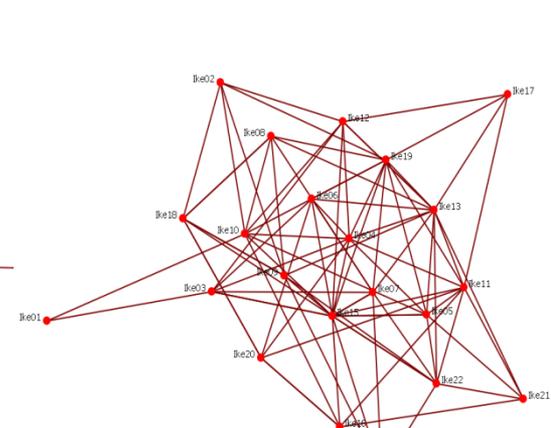
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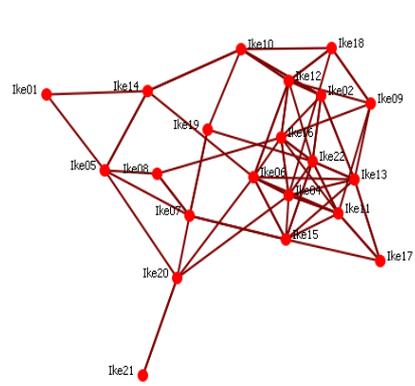


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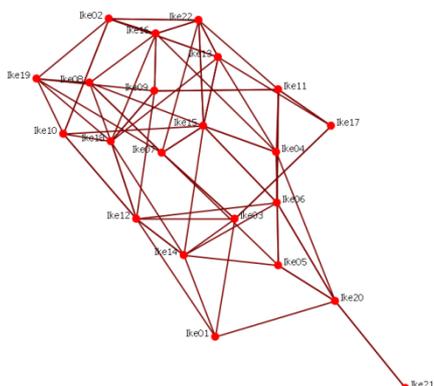


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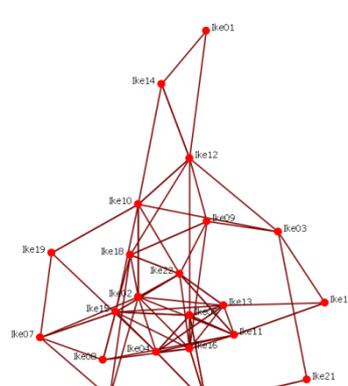
Friend Network



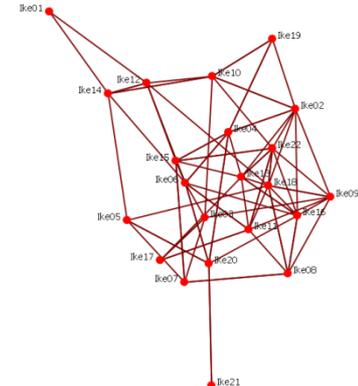
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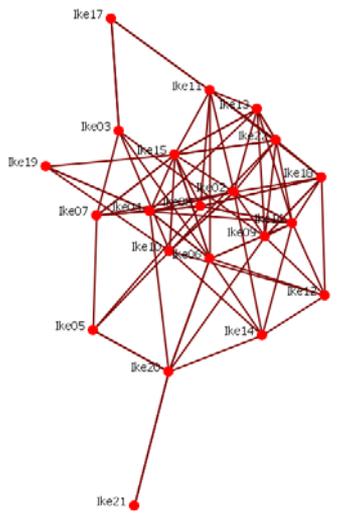
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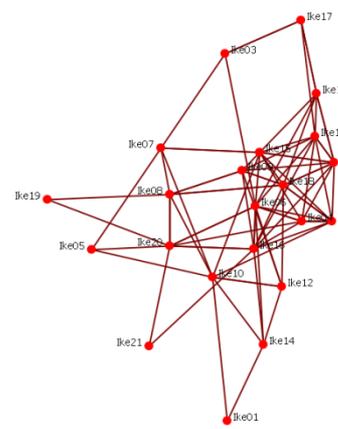
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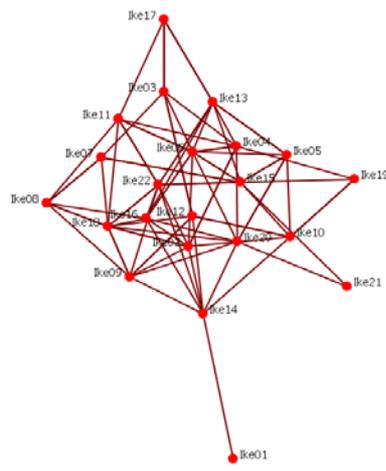
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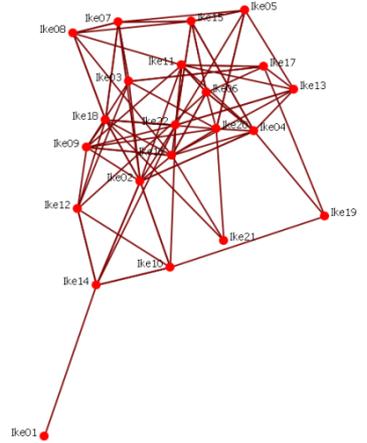
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Core Army Values

- Army Values – key to organizational success

Army Values Scale:

1. Duty, honor, country are the core principles that guide my behavior.
2. I will uphold Army policies and order to the best of my abilities, even when I don't agree with them.
3. In general, my views around politics and social issues are in line with the Army's policies.
4. If I hear friends criticizing the Army's efforts in the War on Terror, I will most likely speak up to defend the Army's actions.

- Results
 - 81% Agree or Strongly agree; 19% Disagree
 - 13% increase in agreement over 6 months

NETWORK DYNAMICS				NETWORK DYNAMICS			
	Parameter	Std Error	Conv		Parameter	Std Error	Conv
Team Leader Network				Friend Network			
outdegree (density)	-0.45	0.27	0.009	outdegree (density)	-1.11	0.19	-0.003
reciprocity	0.11	0.13	0.063	reciprocity	1.04	0.15	-0.024
transitive triplets	0.02	0.07	0.034	transitive triplets	0.02	0.07	0.010
3-cycles	0.09	0.07	0.020	3-cycles	0.08	0.09	0.030
balance	0.21	0.04	-0.007	balance	0.11	0.03	0.020
<i>Army Value similarity</i>	<i>0.37</i>	<i>0.81</i>	<i>0.001</i>	Rank similarity	0.19	0.13	0.040
				<i>Army Value similarity</i>	<i>1.42</i>	<i>1.04</i>	<i>0.020</i>
Military Leader Network				BEHAVIORAL DYNAMICS (Army Values)			
outdegree (density)	-0.56	0.21	0.031	linear shape	0.10	0.12	0.030
reciprocity	0.01	0.15	0.019	quadratic shape	-0.34	0.11	0.074
transitive triplets	0.05	0.06	0.013	effect from Rank	0.05	0.26	0.032
3-cycles	0.05	0.07	0.024	effect from Tours	-0.52	0.24	0.011
balance	0.20	0.04	-0.071				
<i>Army Value similarity</i>	<i>0.48</i>	<i>0.88</i>	<i>0.063</i>				



IkeNet Results

- Personal, Organizational Leadership, and Military Leadership reflect unique network relationships
 - Military and Team Leadership networks are more centralized, but change steadily over time
 - Friend network structures, less centralized and more steady
 - Few overlaps of key individuals across networks
- Army Values
 - More important in personal rather than professional relationships
 - Combat tours have a positive effect on Army Values
- Army values more salient for friendship selection, and friendship is more stable
- Important because we think internalization of Army values will drive cultural and normative changes

III. Community & Cultural Networks

- Community networks frame ideologies and mobilize social movements
- Formalize models of societies to account for the connectivity of people, information, and resources through social-cognitive, cultural and spatial systems.
 - Minerva
 - Social Media: Protests to Riots
 - Hidden Hand: Historical political networks in Tanzania

Minerva

The Minerva Research Initiative: to build understanding of **social, cultural, and political dynamics that shape regions of strategic interest around the world.**

- USMA's Minerva Projects:

- ◆ ***“Social Structures in the Muslim World”***

Dept of Behavioral Sciences & Leadership

Evaluate **evolution of social networks structures within the Muslim world** to provide insight into *how cultural norms and extreme Islamist ideologies are born and maintained.*

- ◆ ***“Cultural Topologies of African Villages”***

Dept of Human Geography

Examine the **interactions among social, political and spatial systems** to include governments, clans, tribes, and families to *characterize and model stable and productive systems develop and sustain themselves.*

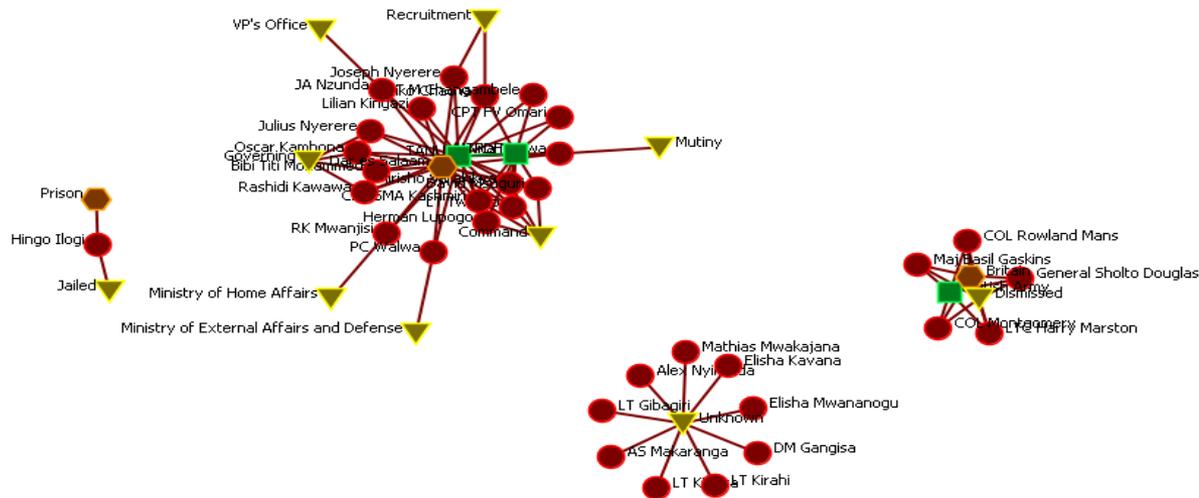
“New Framework for Modeling Social Data”

- Social media (SM) allows for increased dissemination rate and widespread reach of information exchange
 - individuals and groups are able to build ideological momentum, mobilize campaigns, and coordinate activities with efficiency never seen before.
- SM allows researchers to collect vast quantities of multiple sources of communication data
 - Twitter, FB, email, web networks, video surveillance, ‘smart’ name badges, biological and industrial sensor data
- Need for large-scale efforts:
 1. Map the social data landscape and flow patterns to suggest key players, integration capabilities and required oversight
 2. Develop an empirically-based framework that will guide the formulation of a quantitative model of a SM network
 3. Build a theoretically driven model that incorporates social dynamics, thresholds, and tipping points to understand how social movements go from protest to riots.

Project submitted to ARO (Army Research Offices) for funding; PI's: Kate Coronges (Behavioral Sciences, USMA) & Hilary Fletcher (Math, USMA), collaboration with Johns Hopkins Physics Lab

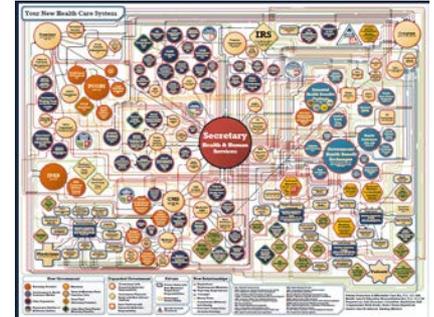
The Hidden Hand of History

- unique structure of the political-military construct of the country created a network of party members, military men, and government bureaucrats that served to buttress the state against the social and economic shocks of the 1970s, 80s, and 90s to explain period of civil-military stability in Tanzania.



IV. Officer Training

- Network approaches are important for modeling, predicting, and influencing complex systems
- Requires cultural shifts:
 - Join the community of professional intellectualism, integrate this into being an officer
 - Improve Interdisciplinary thinking – Give cadets tools – methods and framework for how to identify and model complex problems



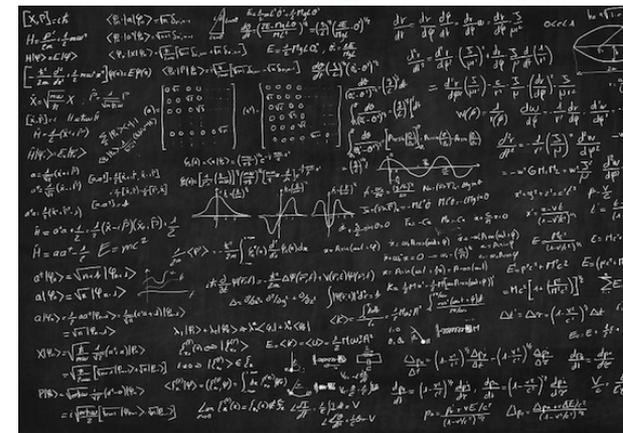
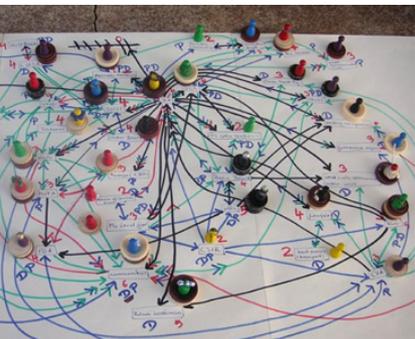
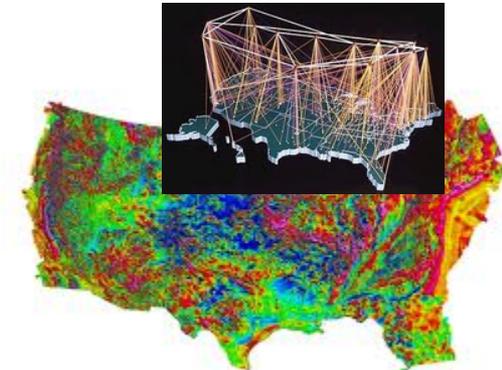
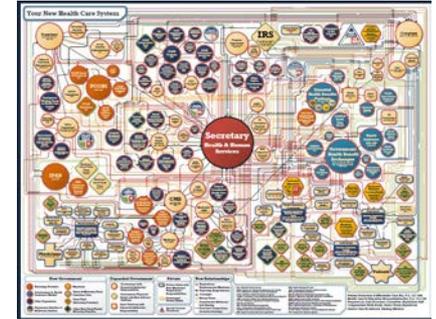
Training officers

- Curriculum:
 - Course: “SNA for Public Policy” focuses on how to integrate quantitative and qualitative methods to model complex systems. Use network science to help understand and create strategies for policies :



- (1) health care, (2) cyber & information, (3) education, (4) raw materials, i.e., energy, food, water.

- Research Centers @ USMA:
 - Network Science Center brings together researchers from Sociology, Math, History, Biology, & Economics
- Internships
 - >15 cadets NS-related internships



Social Structural Perspectives



Military Unit Cohesion & Policy

Community & Cultural Networks



Phishing

DADT

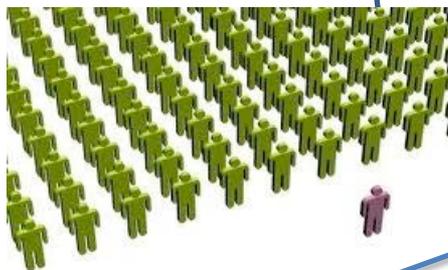
PTSD

Social media

Minerva

Organizational Leadership & Performance

Officer Education

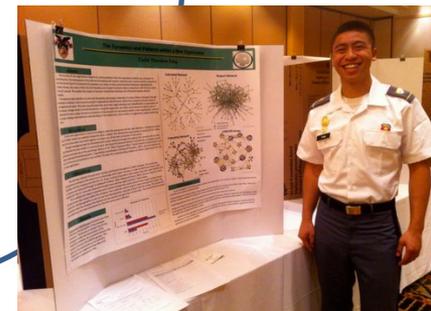


IkeNET

-CLeNS

Network Modeling

Interdisciplinary Training



Thank You