



UNITED STATES MILITARY ACADEMY
WEST POINT

Social networks as basic science for understanding human dimensions of military operations

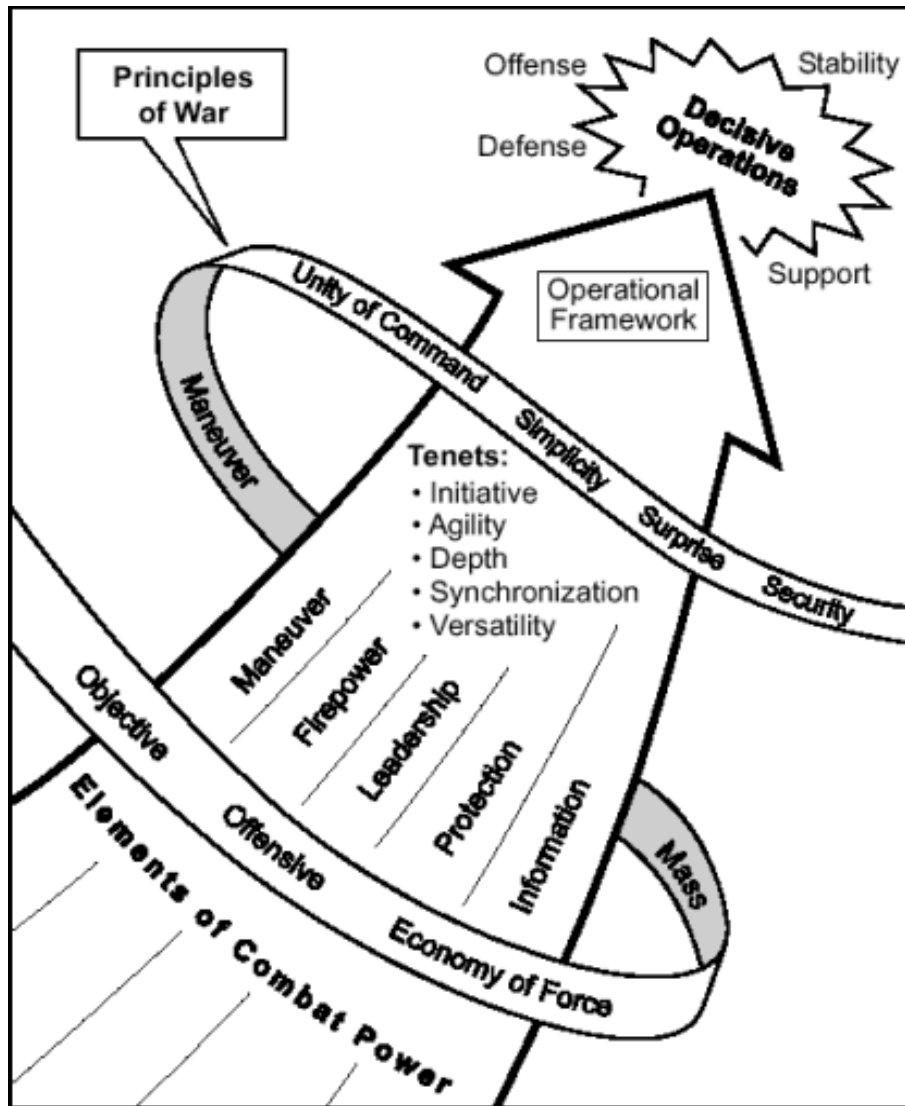
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The Future Information Environment



- Military is enhancing data collectors & sensors (drones & robots) -- producing a data deluge.
- All levels are overflowing with information that needs ordering, refining, fusing to be timely & accurate.
- Where is the human in this maze of new technology?

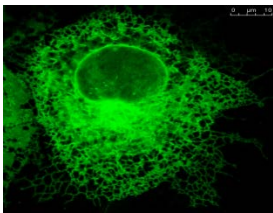
Mission Command Embraces Complex IS

- Future operations require broad, agile command to synchronize opns. MC embraces the complexity of operations to create that agility.
- MC defines roles -- Joint, Interagency, Intergovernmental partners & the human dimension.
- MC combines art of command & science of control. The art of command involves using information to understand, visualize, describe, direct, lead, develop teams. The science of control includes planning, preparing, executing, assessing, & conducting information opns, as well as cyber.
- MC builds information-savvy, agile teams that anticipate transitions, accept risk to create opportunities, plan on the move, adapt, innovate.

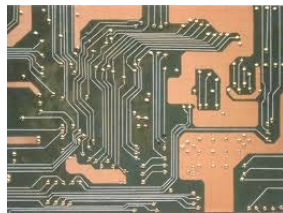


Model networks to understand and predict *systems of relationships* in terms of diffusion, influence, tipping points, feedback and emergence.

Biological



Physical



Geo-spatial



Social

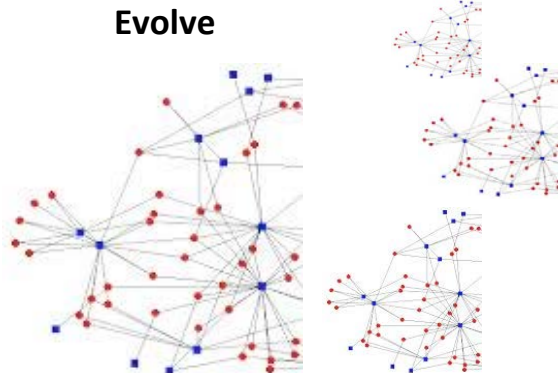


Diffusion & influence occurs over time, through modes, and dimensions; and with thresholds and reach that differ by attributes.

Attributes

- Demographics
- Affiliations
- Knowledge Beliefs
- Resources

Evolve



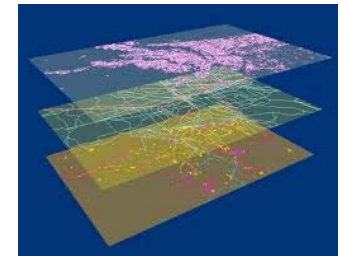
Multi-modal

- Biological
- Physical
- Social



- Location
- Political
- Hashtags
- Skills
- Knowledge
- Terrorist group

Multi-dimensional



Information, Cognition Social,
Physical, Biological

Use network analysis to explain phenomena and inform strategies intended to generate or spread information & knowledge, initiate or prepare for state shifts, and build or disrupt collaborative alliances ----- perform MC!





To develop measures, theories and models that capture cognitive and behavioral processes that lead to emergent phenomena in teams, organizations and populations

Research Thrusts

1. Method

- a) Scalability & Dimensionality
- b) Data Accuracy

2. Process

- (a) Belief & Behavior Change
- (b) Collaborative Decision-making





Methodological

✦ **Scalability & Dimensionality**

Identify overarching mechanisms that span scales and dimensions of human systems that will parameterize, model and predict both small group and big data network models.

• **Data Accuracy**

Build standardized approaches that account for data loss effects generated by common network sampling and simulation techniques on network models; and resulting inferences that link behaviors to the social structure.

Processes

• **Belief & Behavior Change**

Develop mechanistic understanding of opinion & behavior change associated with influence, contagion, and other social propagation processes; and develop intervention strategies that optimize these mechanisms to foster widespread and faster adoption or spread.

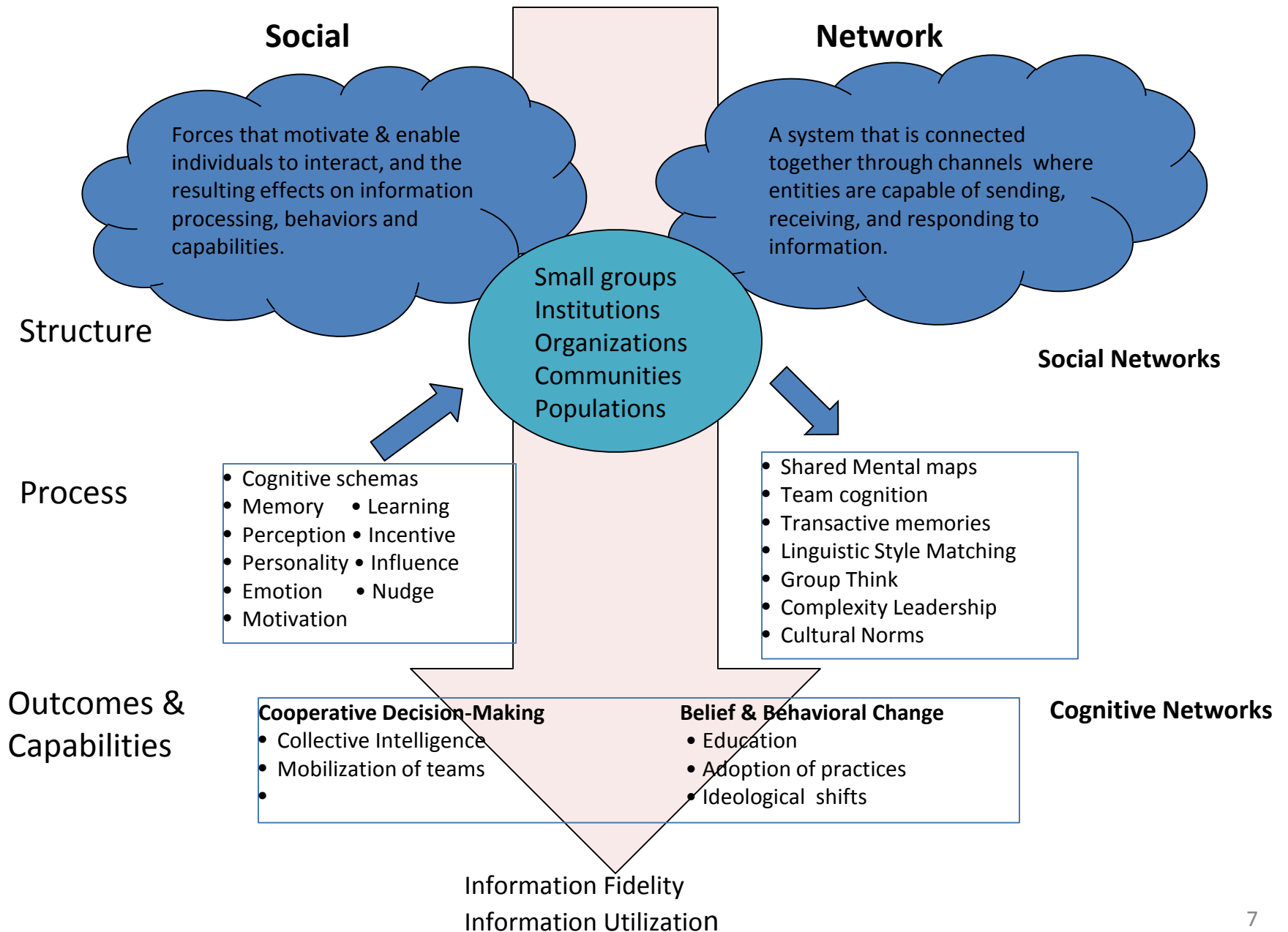
• **Collective Decision Making**

Develop fundamental theories and models to predict, evaluate and simulate how teams organize, exchange information, build knowledge, influence, adapt, learn, and build consensus using cooperative strategies and emergent capabilities.

Integrate techniques from mathematical, statistical, and computational sciences to social structural measures and theories to discover and parameterize fundamental processes underlying human phenomena.



Research Framework for Social & Cognitive Networks Program





Scientific Opportunity:

Integrate advances in a) organizational and cognitive sciences in group dynamics, linguistic processes, & collective intelligence, in b) mathematics in modeling multi and interdependent systems, and in c) social complexity theories to understand emergent capabilities of teams.

- Modeling and Experimental Research
 - Synchronized communication; mental maps - *Team Cognition*
 - Emergent capabilities of groups – *Collective Intelligence*
 - Structural topologies - *Science of Team Science*
 - Predictability of collective phenomena - *Science of Success*
- Methodological advances
 - Multiplex, multilayer, interdependent networks – Network Mathematics/ Statistical Sociology
- Theoretical advances
 - Complexity Leadership; Social influence theories





- Increased reliance on small teams
- Teams define common objectives, develop and implement strategies, evaluate and adjust together
 - Humanitarian aid, disaster relief, intelligence gathering, security, community coalitions, technological infrastructure, education, public opinion campaigns
- Army as a “Team of teams”
 - Mission Command: subordinate leaders “exercising disciplined initiative” i.e., commander uses units as teams



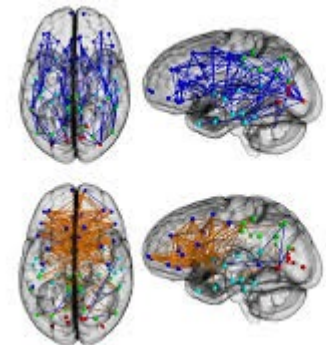
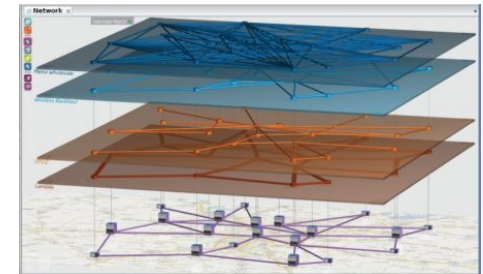


Objective:

- Develop fundamental theories and models to predict, evaluate, measure and simulate how teams organize, exchange information, build knowledge, influence, adapt, learn, and build consensus using cooperative strategies and emergent capabilities.

Research Concentration Areas:

- Create a theoretically driven quantitative analytical framework for decision-making and productivity of collaborative teams;
- Develop constructs and mechanisms that measure collaboration, such as interdisciplinarity, adaptability, cooperation, to include processes, e.g., turn-taking, cohesion, group intelligence, etc.
- Build models that consider teams as complex systems that include dependencies, feedback, and emergence of multiple dimensions
- Identify or create empirical or simulated data sets for guiding the research and for verification and validation (V&V) of the theory, constructs, and models



Social Informatics Thrusts

- Developing meaningful, measurable, and quantifiable models and metrics for technology-mediated social realms
 - Developing a set of theories that hold true in technology-mediated social realms
- **Algorithms & Evaluation Criteria**
 - Developing a set of scalable algorithms that effectively formalize social theories and models
 - Developing a set of theories and evaluation criteria for algorithms operating in technology-mediated social realms

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Human Quantification & Theory

- Developing meaningful, measurable, and quantifiable models & metrics for technology-mediated social realms
 - Perception & interpretation
 - Trust & deception
 - Influence & intervention
 - Tie strength
- Developing a set of theories that hold true in technology-mediated social realms
 - Social learning theory
 - Theories of social identity
 - Theories of group formation & processes
 - Collective action

Algorithms & Evaluation Criteria

- Developing a set of scalable algorithms that effectively formalize social theories and models
 - Community detection
 - Graph mining
 - Identity management
 - Link prediction
 - ...
- Developing a set of theories and evaluation criteria for algorithms operating in technology-mediated social realms
 - Theoretical justifications & axiomatic approaches
 - Computability and predictability in social realms
 - Sampling and probing
 - Evaluation criteria for graph + X (e.g., contextual graphs, dynamics, ...)
 - ...

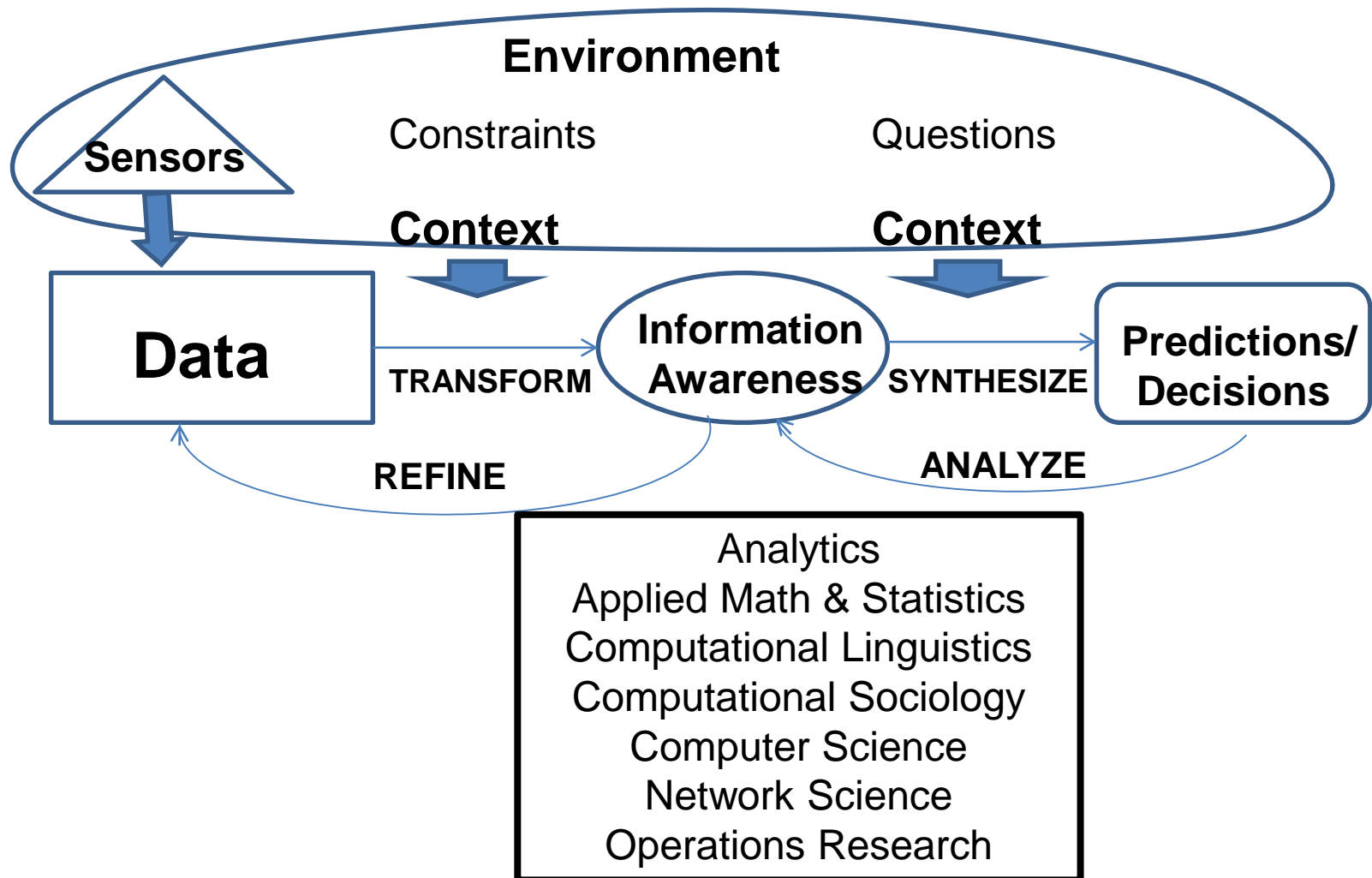
What is needed

A system that...

- Spans several fields of knowledge
- Natural interface
- Can be a useful participant in the planning and analysis process



Interdisciplinary, Non-reductive Model for future Information Processing (building a Watson)



Building Watson from the Network Science Multi-layered Framework

