A Computational Modeling Approach to Organizational Effectiveness: Mapping the Effects of Leadership, Group Structure, and Environmental Shocks

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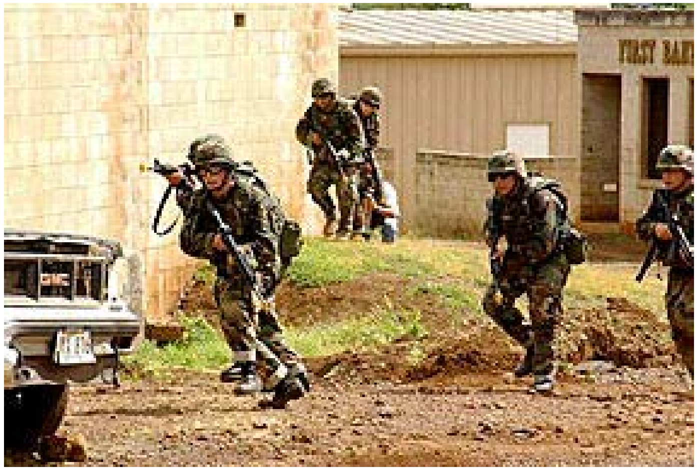
Agenda

- Problem Background & Current Research Gaps
- Theoretical Foundation & Research Goals
  - Computational model of team & org. effectiveness
  - Team composition, processes, & outcomes
  - Leadership within teams
  - Leadership between teams
- Research Approach

Problem Background

- Team members with diverse attributes and backgrounds need to work together effectively
- Leadership is critical for aligning individual behaviors to enhance team processes with team and multiteam system (MTS) outcomes
- Teams and MTSs must be capable of absorbing unforeseen shocks from the environment



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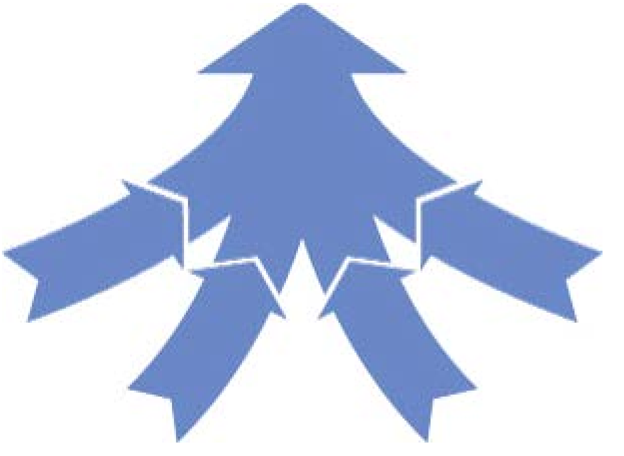
Current Research Gaps

Research needs to capture bottom-up processes which contribute to team, MTS, and organizational effectiveness

“A phenomenon is emergent when it originates in the cognition, affect, behaviors, or other characteristics of individuals, is amplified by their interactions, and manifests as a higher-level, collective phenomenon” (Kozlowski & Klein, 2000, p. 55).



Current Research Gaps

Research is needed that captures the dynamic relationships between leadership processes and unit composition across multiple organizational levels and over time.

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Current Research Gaps

Research is needed that directly assesses the resiliency and adaptability of teams and MTSs to disturbances in the operational environment

3 Year Project - Overview

- Phase 1: Development and refinement of a computational simulation that represents diverse team members performing a team task *(within team)*
- Phase 2: Embed this team within a multiteam system composed of other teams working towards a common goal *(between team)*
- Phase 3: Examine resilience and adaptability of teams and MTSs when local and global shocks are introduced

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Computational Modeling (CM) Agent-Based Simulation (ABS)

- Is a theoretically-grounded depiction of a phenomenon that can be used to characterize the mechanisms by which a dynamic process unfolds (Busemeyer & Townsend, 1993; Hulin & Ilgen, 2000)
- Utilizes mathematical relations or logical if-then statements to specify how a system changes from one time point to the next (Harrison, Lin, Carroll, & Carley, 2007; Vancouver, Tamanini, & Yoder, 2010; Vancouver, Weinhardt, & Schmidt, 2010)
- Can incorporate a large number of process mechanisms that underlie emergence and team process dynamics, making it possible to conduct "virtual experiments" to examine a full theoretical space (Kozlowski et al., 2013)

Why CM / ABS?

- Precise specification of core mechanisms
  - Sparse, but complex, vs. complicated models
  - Core mechanisms are key leverage points
- "Virtual" experimentation with large samples
- Examine a "full" theoretical space
- Obtain variability on all key constructs
  - "real world" data typically does not sample variability at the extremes or low base-rates
- Modeling results provide key targets for verification research with human data

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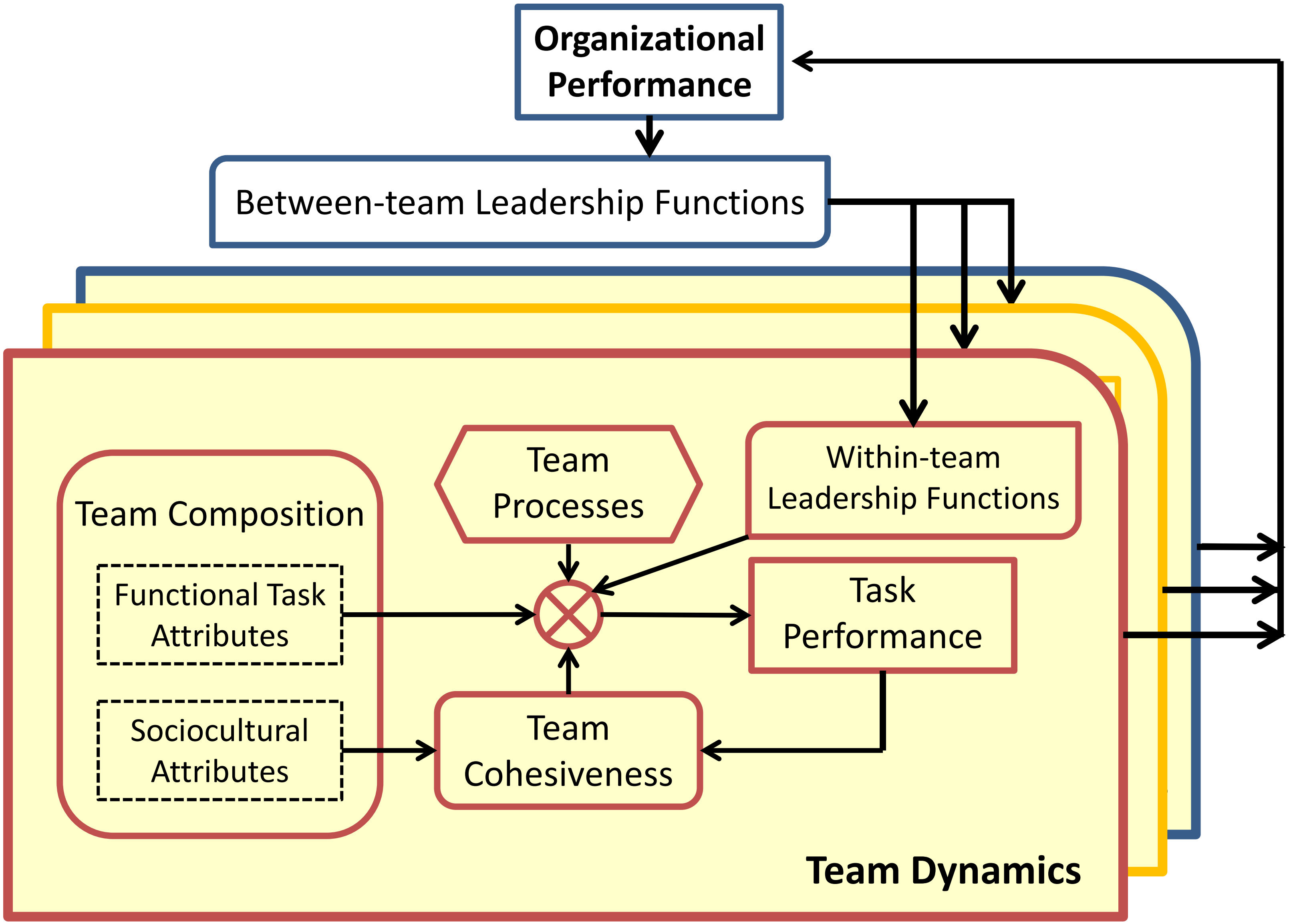
CM / ABS Requirements

- ***Precise*** theoretical model of emergence mechanisms
  - Must be able to specify the mechanisms ("rules") in mathematical terms (e.g., each BOID rule is mathematically specified)
  - Most OP/B "word-based" theories will require better specification
- Realistic parameter estimates for the mechanisms
  - Need values to represent the "real" phenomenon
- Intensive longitudinal, full "theoretical" designs
  - Large-scale designs; 1000's of agents; 1000's of iterations
  - Computational power is a constraint … but not a major one
  - Simulations can take hours, days, or weeks to run
  - Current modeling work uses the MSU HPCC

This Project:
Team & Organizational Effectiveness



CM / ABS: Guiding Principles

- Agents (individuals) nested in teams that are nested in MTS
- Agent behaviors/interactions are stochastic and bounded only by procedural rules
- Computational model will contain both exogenous variables (e.g., sex of person) and endogenous variables (e.g., team cohesiveness)
- Goal is to simulate targeted phenomena with minimal number of fundamental concepts and relationships ("generative sufficiency")

Implications

- Virtual experiments will provide a basis for specifying fundamental principles that drive dynamic interconnections among leadership, team structures, member composition, and their adaptability to shocks
- Results will provide ARI decision-makers grounded, evidence-based tools to identify most promising research directions and potential ROI
- Results can provide insight into the effectiveness of current or envisioned leadership practices under a range of operating conditions
- Provides predictive tools to make informed decisions about critical personnel and organizational choices