



# U.S. Army Research Institute for the Behavioral and Social Sciences (ARI)

## Development of Measures to Assess Systems Thinking

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# Project Objectives

- To develop a model of systems thinking, specifically:
  - addressing systems thinking as an element of strategic thinking
  - identifying dimensions of systems thinking
  - developing behavioral indicators
- To create tools to assess systems thinking:
  - 1) A tool that is appropriate for assessment across multiple levels and contexts
  - 2) Exemplar tools that are context-specific
- To evaluate the psychometric properties of the assessment tools



# Defining Systems Thinking



- Systems thinking is a cognitive approach that applies a holistic perspective to identify and understand interrelationships and emergent properties among elements of complex systems.



Sackett, A.L., Karrasch, A.I., Weyhrauch, W.S., & Goldman, E.F. (2016). Enhancing the strategic capability of the Army: An investigation of strategic thinking tasks, skills, and development (Research Report 1995). Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences.



# Applications of Systems Thinking



- Educational: Systems thinking supports the objectives of a learning organization through specification of roles and interdependencies.
- Operational: Leaders at all levels must make sense of open, dynamic systems to facilitate problem-solving and decision-making.
- Organizational: Soldiers and leaders must understand their roles and interdependencies among roles within complex organizations, which supports understanding of team development and team lifecycles.
- Strategic: Leaders must understand and anticipate the impact of their decisions and actions at various levels of systems.



# Systems Thinking Competency Model Research Method



- Consulted scholarly literature on systems thinking
- Interviewed Professional Military Education (PME) instructors, officers assigned to operational units, and 4 academic systems thinking subject matter experts (SMEs)
- Drafted a systems thinking competency model
- Solicited feedback from PME instructors and operational officers
- Revised competency model based on feedback



# Systems Thinking: Emergent Themes in Literature



- Systems thinking is cognitive in nature and requires cognitive skills related to thinking and understanding.
- Systems thinking involves an attempt to understand the whole of a situation.
- Systems thinking involves understanding how various elements connect and interrelate.
- Based on systems thinking themes in the literature, we defined systems thinking as a cognitive approach that applies a holistic perspective to identify and understand interrelationships and emergent properties among elements.



# Demographic Data



- $N = 58$  Operational and Institutional participants
- Ranks ranged from CPT to COL
- Time spent in service ranged from 4 years to 30 years
- 66% completed a master's or a doctorate degree, 5% completed a professional degree, and 29% completed a bachelor's degree
- From 15 military occupational specialty (MOS) series, with most from MOSs associated with combat arms



# Summary of Results



- Most leaders report understanding of systems thinking as a general concept.
- Systems thinking develops over time but may require concerted effort.
- Differences among novice, intermediate, and expert systems thinkers concern system-specific and system-general knowledge, depth of knowledge, and communicating with and mentoring others.
- Systems thinking is often used on the job to operate and maintain systems, and to work within specific systems.
- Systems thinking skills should be developed at all levels but may increase in importance for more senior leaders.
- Benefits of engaging in systems thinking included improved information flow within units as well as increased organizational adaptability.



# Systems Thinking Competency Model



| Dimension                           | Definition   |
|-------------------------------------|--|
| Identifying Elements                | Identifies people, objects, locations, or concepts in an environment or situation that together serve a purpose as a whole or nested whole   |
| Understanding Dynamic Relationships | Conceptualizes nonlinear, bidirectional, and changing relationships among a set of elements that form a whole or nested whole  |
| Shifting Perspectives               | Recognizes how subordinate and superordinate levels relate to one another in a system, switching perspectives from one level to another as needed  |
| Identifying Holistic Patterns       | Understands the larger picture of a system and common systemic patterns  |
| Responding to Change                | Remains open to new information and takes multiple points of view when examining how a set of elements are related and interdependent; maintains a fluid and flexible concept of the boundaries that link elements |



# Multirater Assessment for Systems Thinking (MAST)



- Provides a way for leaders to learn more about how effectively they are using systems thinking when planning, solving problems, and making decisions
- Designed to be appropriate across multiple levels and contexts
- Results and feedback designed to:
  - highlight leader actions that demonstrate systems thinking
  - promote leader skill development
- Designed to be filled out by multiple raters but can also be completed by just one rater





# MAST



## Multirater Assessment for Systems Thinking (MAST) Score Sheet

| Dimension  | S<br>E<br>L<br>F | Supervisor/Instructor (S/I)                 |             |                          | Peers   |              |              |              |              |              |                           |  | Subordinates |             |             |             |             |                          | Dimension Average <sup>4</sup>         |
|--|------------------|---|-------------|--------------------------|---|--------------|--------------|--------------|--------------|--------------|---------------------------|--|--------------|-------------|-------------|-------------|-------------|--------------------------|--|
|  |                  | S/I Rater 1                                 | S/I Rater 2 | S/I Average <sup>1</sup> | Peer Rater 1                                    | Peer Rater 2 | Peer Rater 3 | Peer Rater 4 | Peer Rater 5 | Peer Rater 6 | Peer Average <sup>2</sup> | Sub Rater 1  | Sub Rater 2  | Sub Rater 3 | Sub Rater 4 | Sub Rater 5 | Sub Rater 6 | Sub Average <sup>3</sup> |  |
| Identifying Elements                                 |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |
| Understanding Dynamic Relationships                  |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |
| Shifting Perspectives                                |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |
| Identifying Holistic Patterns                        |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |
| Responding to Change                                 |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |
| Self Average <sup>5</sup> Across Dimensions>         |                  | S/I Average <sup>5</sup> Across Dimensions> |             |                          | Peer Average <sup>5</sup> Across Dimensions >>> |              |              |              |              |              |                           | Subordinate Average <sup>5</sup> Across Dimensions >>> |              |             |             |             |             |                          | Overall Dimension Average <sup>5</sup> |
| Overall Average <sup>8</sup> Across Rater Groups >>> |                  |   |             |                          |   |              |              |              |              |              |                           |  |              |             |             |             |             |                          |  |

<sup>1</sup>Add ratings across supervisor/instructors (if needed) within each dimension and divide by two.

<sup>2</sup>Add ratings across peers within each dimension and divide by the number of peer ratings.

<sup>3</sup>Add ratings across subordinates within each dimension and divide by the number of subordinate ratings.

<sup>4</sup>Add average rating from all rater types for a given dimension and divide by the number of rater types.

<sup>5</sup>Add ratings in the column and divide by five.

<sup>8</sup>Add averages from all rater types and divide by the number of rater types.

Areas for Improvement:

Strengths:

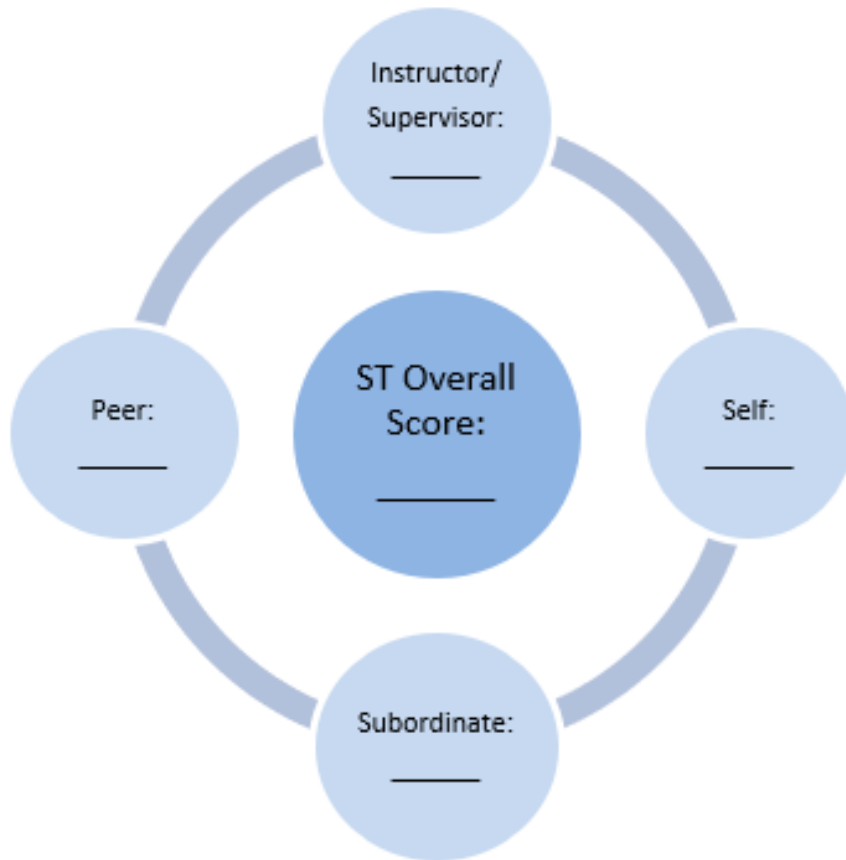


# MAST



## OVERALL SCORES BY RATER CATEGORY

Enter the final scores for each rating source below.



## OVERALL SCORES BY DIMENSION

Enter the final scores for each dimension below.





# Context-Based Systems Thinking Assessment



- Developed in partnership with Mission Command Training Program (MCTP)
- Assessment tool that is context-specific and requires specific knowledge to complete
- Questions regarding the warfighting functions (WfF) system in a Decisive Action Training Environment (DATE) scenario
- Concept is at the Coalition Forces Land Component Command (CFLCC level) and involves 3 different divisions



# CSTA



- Content
  - Maps, objectives, organization for a large-scale combat operation (LSCO) scenario
  - Multiple situation updates
  - 38 questions with multiple subparts



# CSTA



- Areas assessed
  - Recognizing the elements that are relevant in a given situation
  - Determining WfF interrelationships that must be considered when making decisions
  - Determining hierarchical relationships that must be considered when making decisions
  - Understanding the WfF system as a whole when making decisions
  - Considering the impact that situation changes have on the WfF system



# CSTA

## Situation Update 1

As part of the Coalition Forces Land Component Command (CFLCC) Phase (PH) IIIA, the 1<sup>st</sup> Infantry Division (1ID) is preparing to conduct a rearward passage of lines (RPOL) with the 430th Armored Brigade Combat Team (ABCT) of the Pirtuni Southern Command (PSC), in order to set the conditions for the isolation of the 86th Division Tactical Group (DTG). The 1ID commanding general (CG) is concerned with preparation for the PHIII fight, specifically maintaining situational awareness among the staff and synchronization with the Pirtuni 43rd DTG. E105 that runs north and south behind assembly area (AA) Kansas is considered a key main supply route (MSR) for CFLCC. The 110th Mobility Enhancement Brigade (MEB) maintains primary responsibility for ensuring E105 remains operational and accessible to CFLCC during all phases of the operation.

The Combined Operations and Intelligence Center (COIC) configuration for the 1ID has multiple components that reside within their respective planning tents, with the tents connected by portable hallways for in-person information sharing. Digital information is routinely shared via redundant mission command systems (MCS), but the 1ID commander prefers face-to-face discussions when possible. You are determining which staff sections and unit representatives will be part of the 1ID COIC configuration. Indicate whether each staff function or unit representative listed would be critical to include in the 1ID COIC configuration by circling Yes or No for each.

### Circle One

- |    |                  |     |    |
|----|------------------|-----|----|
| a. | Command section  | Yes | No |
| b. | Engineer section | Yes | No |
| c. | Civil Affairs    | Yes | No |
| d. | PSYOPS           | Yes | No |
| e. | G2               | Yes | No |
| f. | G33              | Yes | No |
| g. | G35              | Yes | No |
| h. | 101 DS           | Yes | No |
| i. | 1ID G3 Air       | Yes | No |



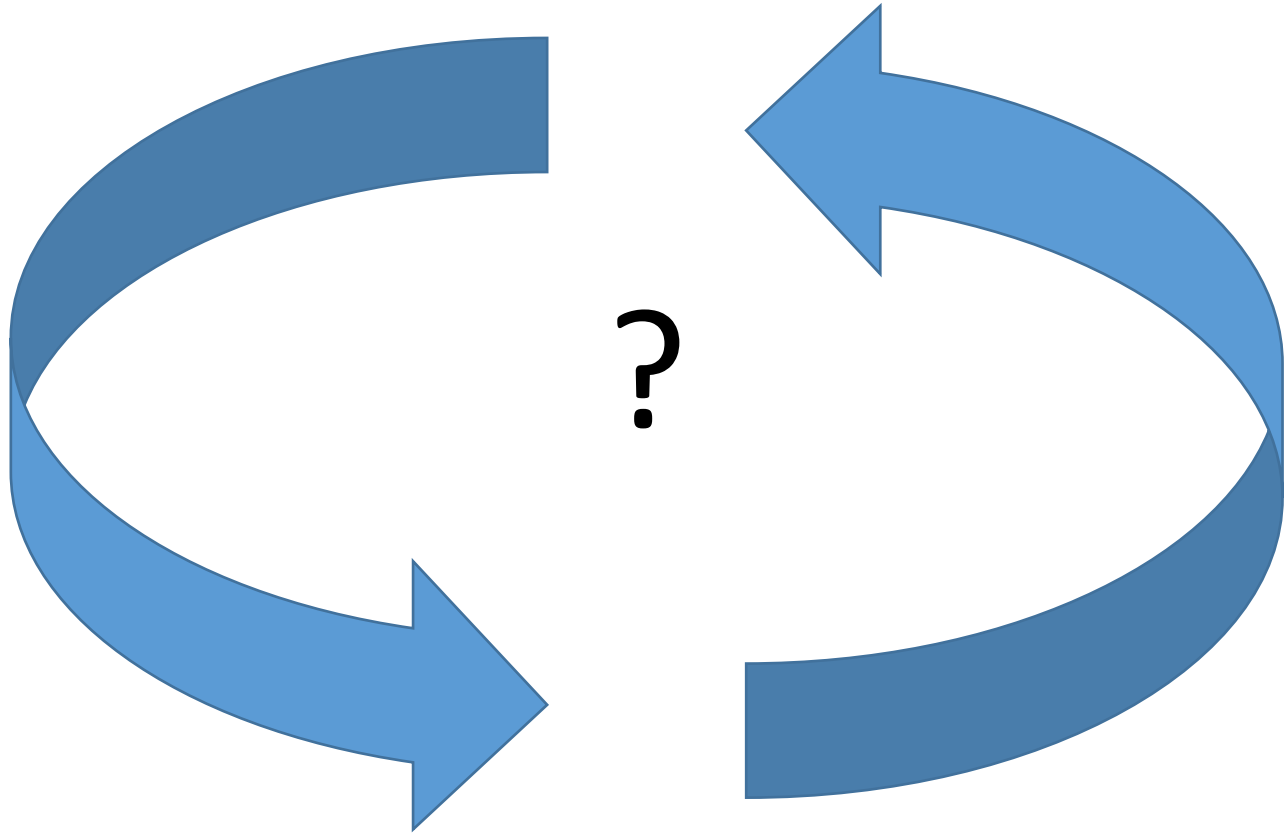
# Project Status and Collaborators



- Technical Report about systems thinking competency model currently under review
- Research Product documenting MAST currently under review
- Testing MAST's reliability and validity
- Revising CSTA based on SME feedback
- Personnel Decisions Research Institutes (PDRI)
  - Dr. Michelle Wisecarver
  - Ms. Chelsey Byrd
  - Dr. Cory Adis
  - Ms. Lia Engelsted
- Mission Command Training Program (MCTP)
  - MAJ Chris Allen



# Questions





# Appendix: Identifying Elements



| Definition  | Identifies people, objects, locations, events, or concepts in an environment or situation that function together as an integrated whole   |
|---|---|
| <p>This dimension involves cognitive activities that are demonstrated by an Army leader describing or discussing:</p> | <ol style="list-style-type: none"> <li>1. Stakeholders relevant to a situation</li> <li>2. Resources needed for a mission</li> <li>3. Relevant aspects of a problem</li> <li>4. Critical elements (people, objects, location, events, concepts) that are important to the operational environment</li> <li>5. Distinguishing critical elements within the system from those that are less critical</li> </ol> |



# Appendix: Understanding Dynamic Relationships



| Definition  | Understands complex causal and correlational relationships among a set of elements that form an integrated whole  |
|---|---|
| <p>This dimension involves cognitive activities that are demonstrated by an Army leader describing or discussing:</p> | <ol style="list-style-type: none"> <li>1. Complex connections among multiple elements in the environment when developing a plan</li> <li>2. Hidden, unusual, or nonlinear relationships among elements in the environment</li> <li>3. Second- and third-order effects that may affect the unit or the mission</li> <li>4. How the introduction of new factors in the environment will change existing relationships in a system</li> <li>5. How to use feedback loops to determine the impact of decisions and actions</li> </ol> |



# Appendix: Shifting Perspectives



| Definition  | Takes perspectives from different subsystems or levels of a system and switches perspectives as needed  |
|---|---|
| <p>This dimension involves cognitive activities that are demonstrated by an Army leader describing or discussing:</p> | <ol style="list-style-type: none"> <li>1. Both big-picture information and details as necessary when briefing a plan</li> <li>2. How decisions at one level or unit affect other levels or units</li> <li>3. How actions of a specific group affect the mission of the larger organization</li> <li>4. How to effectively coordinate actions between units and headquarters</li> <li>5. The roles and impacts of multiple groups working in a system</li> </ol> |



# Appendix: Identifying Holistic Patterns



| Definition  | Understands the larger picture of a system and common systemic patterns                         |
|---|---|
| <p>This dimension involves cognitive activities that are demonstrated by an Army leader describing or discussing:</p> | 1. A situation or problem as a whole  |
|   | 2. A mission plan from a big-picture view, rather than just from the perspective of one element |
|   | 3. Patterns that emerge between elements within an operational environment                      |
|   | 4. The development of a graphic or a model to better understand and communicate the problem     |



# Appendix: Responding to Change



|   |   |
|---|---|
| <p><b>Definition</b></p>  | <p>Remains open to emerging information and updates understanding of system as needed; maintains a flexible concept of the system boundaries</p>  |
| <p>This dimension involves cognitive activities that are demonstrated by an Army leader describing or discussing:</p> | <ol style="list-style-type: none"> <li>1. Emerging information that should be considered in order to understand a situation</li> <li>2. Taking multiple points of view in order to expand their understanding of a situation</li> <li>3. Changes to plans or approaches that are needed due to changing circumstances</li> <li>4. The need to change the stakeholders involved in solving a problem or making a decision when the situation changes</li> <li>5. Redefining the critical elements in the environment as new information emerges</li> </ol> |

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