

The Important Role of “Context” in the Practical Design and Operation of Systems that Mix Human and Artificial Intelligence

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Human-AI Collaboration - Challenge for SE

- Human and AI must collaborate as a team
- Human intuition + AI computational power
- Growing need for safe societal design, test, and deployment of Humans+AI
- Creates new challenge for Systems Engineering



Tu, Z., Y. Jiang, H. Yan, Y. Leng, C. Fu (2026) Design, modeling, control, and evaluation of a wearable Centaur robot for load-carrying walking assistance
The International Journal of Robotics Research

Shortfall in Traditional Systems Engineering

Limitations of traditional System Engineering practice for Human+AI Design, Test, Deploy

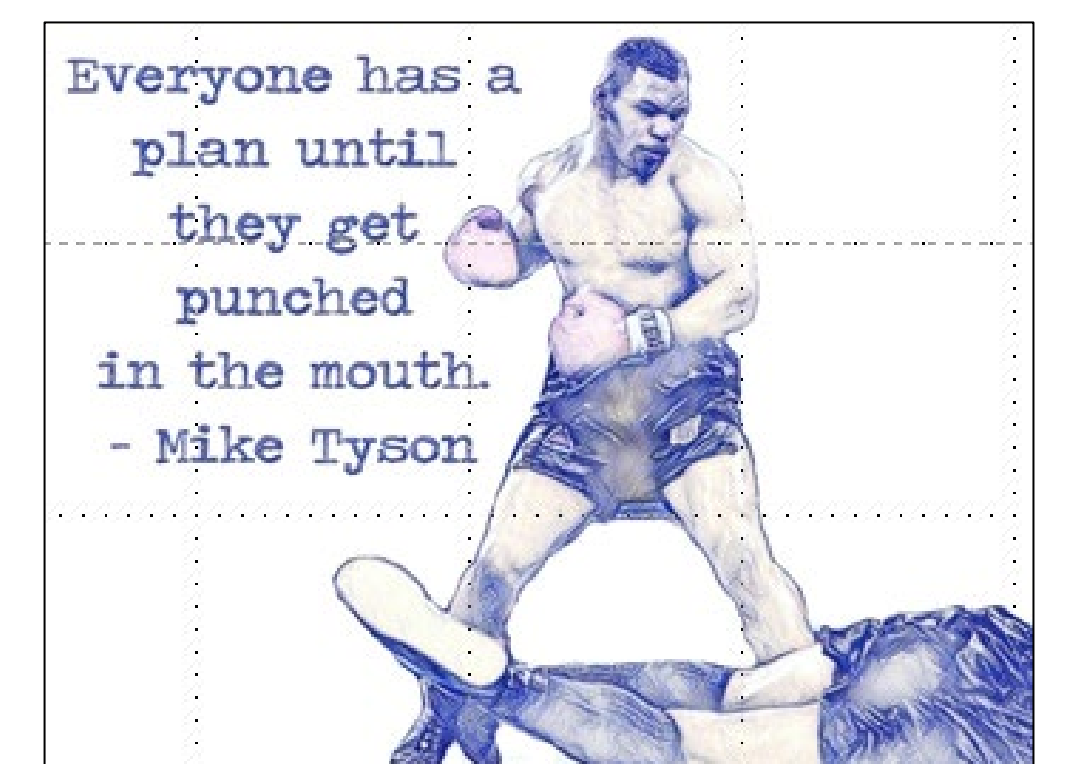
1. Prescribed Task vs. Actual Activity “blind-spot”
2. Context-free AI outputs (i.e. AI does not understand the Context)
3. Separation of people, technology, and organizations
4. Static Concept of Operations (CONOPS)

Results

- Fragile human-AI collaboration
- Reduced adaptability
- Increased risk of coordination failures

Culprit: Prescribed Tasks vs. Actual Activities

- Plans rarely match operational reality
 - System Engineering assumes rigid *Prescribed Tasks*. Real-world mission-level operations require *flexible Activities*
- Humans adapt to:
 - Variations of the situation
 - Unexpected events
 - Uncertainty
 - Time pressure
 - Coordination issues



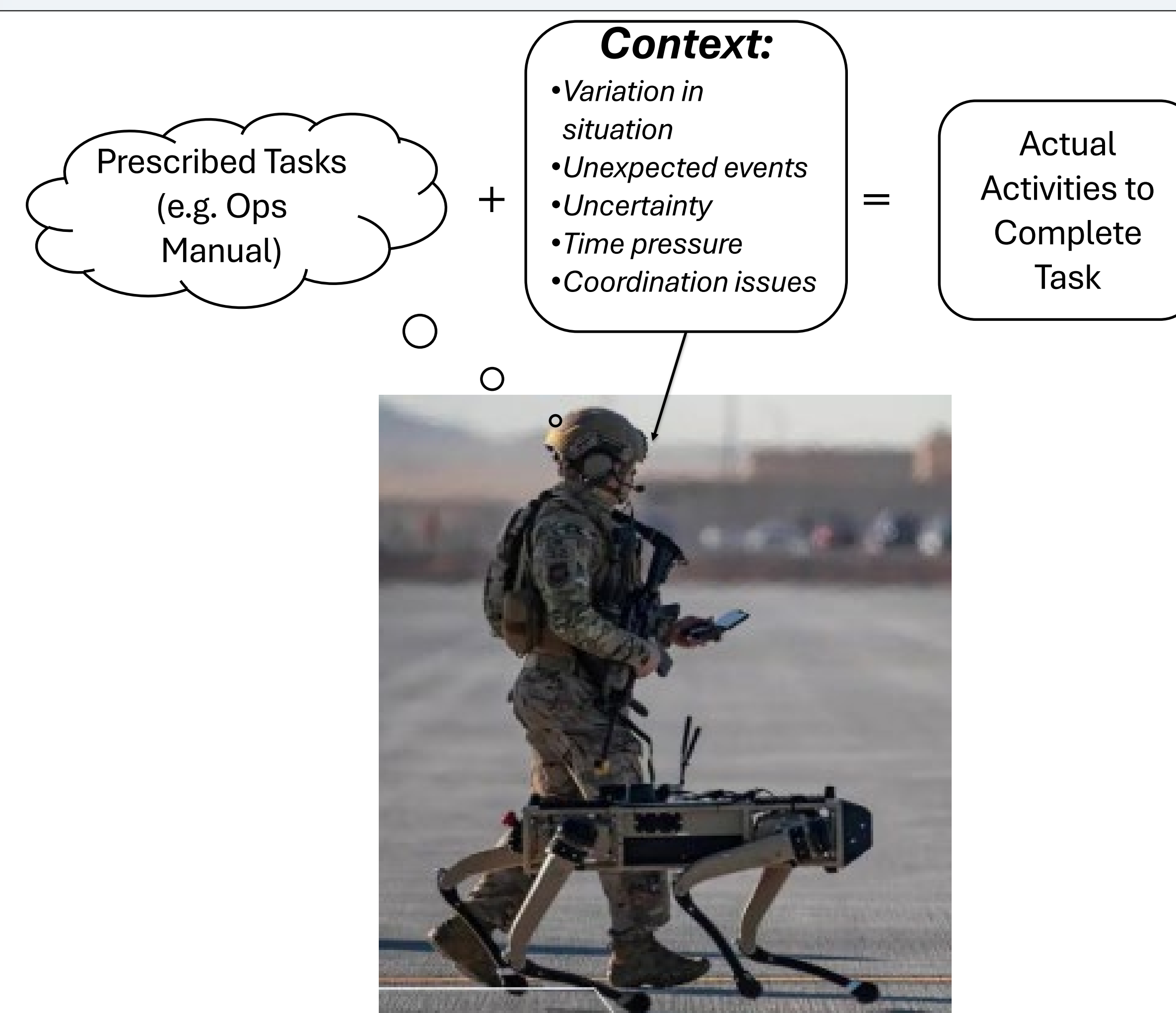
- MH-AIS must support adaptation
- Success depends on managing gap between Prescribed Tasks and Actual Activities

Boy, G. A. (2026). Systemic Cognition: On the Complexity of Context. *Systems*, 14(7), 851.
<https://doi.org/10.3390/systems14070851>

“Context” Specification Can Close the Gap

- Context: “Environmental, operational, organizational, and societal conditions that influence decisions, performance, and safety”
- *Context* connects Prescribed Tasks to (real-world) *Actual Activities*
 - Primary system architecture element
 - Improves flexibility and adaptability
 - Manages unexpected situations
 - Enables interpretation of AI behavior
 - Supports resilient human-AI teamwork

“Context” Connects Tasks to Actual Activities



Four Levels of “Context” Specification

1. Physical Environmental State Context (PESC)
 - Sensors , real-time conditions
 - e.g. Endsley, 1995; Leveson, 2011
2. Operational Context (OpsC)
 - Procedures and training
 - Human expertise and judgment
 - e.g. Reason, 1990; Hollnagel, 2012
3. Organizational Context (OrgC)
 - Policies and governance
 - Risk tolerance and resources
 - Rasmussen, 1997
4. Macro-Environmental Context (MEC)
 - Regulatory and geopolitical factors
 - Economic, cultural, and technological trends