RESEARCH SUMMARY

Improving Sense-Making with Artificial Intelligence

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ISSUE

As the Department of the Air Force (DAF) pivots toward addressing peer threats, DAF sense-making processes must be able to handle the rapidly increasing proliferation of sensors and targets. We identified 20 challenges associated with scaling DAF sense-making processes in five key areas—collection orchestration, data access and sharing, data fusion and analysis, model management, and skills and training—and indicated where and how five major categories of current artificial intelligence (AI) capabilities could be used to address them.

APPROACH

To identify sense-making challenges, we conducted site visits with DAF sense-making organizations, including Air Operations Centers (AOCs); the DAF intelligence, surveillance, and reconnaissance (ISR) wings and groups that operate the DAF Distributed Common Ground System; and their U.S. Space Force (USSF) counterparts. To understand current AI capabilities, we interviewed Air Force Research Laboratory researchers and AI experts. To identify how these capabilities could be applied to these challenges, we conducted a Delphi elicitation exercise.

KEY FINDINGS

The table shows how AI capabilities can be combined to meet DAF sense-making challenges in the five key areas described earlier. These approaches are independent of mission threads and primarily deal with common processes of the intelligence cycle; we believe the DAF should take a mission-independent approach as much as possible. In addition, the following findings regarding the use of data and algorithms cut across all AI applications described in the table.

- **Datasets and knowledge representations need to be carefully curated.** High-quality datasets must be built with care and must also be associated with the right metadata to support object-based production (OBP) and subsequent algorithm development.

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- Analysts can and should anticipate AI failure modes. Understanding the limits of an AI system's training data or knowledge representation will help analysts anticipate errors and use the AI systems more effectively.
- Expert systems (ESs) can play an important role. The older forms of AI remain relevant.
- The DAF should pave the way for disruptive adoption. Disruptive AI will be needed later, but early adoption of nondisruptive AI can help prepare the DAF for greater change.

SUMMARY OF MAJOR FINDINGS BY SENSE-MAKING CHALLENGE TYPE

Challenge Area	Major Findings	CV	NLP	Plan	P/C	ES
Collection orchestration	NLP combined with ESs to elicit requirements and rephrase them into standard formats		●			●
	Planning systems to improve both deliberate and dynamic collections across multiple domains	○		●		
	CV to screen collections incapable of providing the required EEI	●				
Data access and sharing	Text classification combined with ESs to propose or confirm classification markings to assist in data transfer		●			●
	Multimodal system to assist in OBP/ontology development	○	●		○	○
Data fusion and analysis	NLP in an ESs framework to clean and condition processed data		●			●
	CV and NLP to assist tracking DOF across multiple sensor modalities and through chat/radio reports	●	○			
	P/C and Planning, with CV assistance, to anticipate future adversary movement	○		●	●	
Model management	NLP with ESs to parse code and manage adherence with cybersecurity regulations		●			●
Skills and training	ES to support customized training programs		○			●
	NLP and ESs to support knowledge management and assist knowledge transfer between units, shifts, and personnel		●			●

NOTE: CV = computer vision; DOF = disposition of forces; EEI = essential elements of information; NLP = natural language processing; P/C = prediction/classification; Plan = planning; ● = major/likely applicability; ○ = minor/possible applicability.

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RECOMMENDATIONS

- Follow a shared road map for developing sense-making capabilities. DAF ISR wings and their USSF counterparts should work with DAF Chief Data and AI Officer (CDAO) to develop a set of shared priorities for AI integration into sense-making based on Table S.1.
- Anticipate risks early. All DAF sense-making organizations should conduct risk assessments, such as social, technological, operational, political, economic, and sustainability analysis, for AI tools they propose. The DAF Chief Information Officer should ensure responsible AI-related tasks are executed for the sense-making domain.
- Respect tool fatigue sentiments. DAF ISR wings and AOCs should be selective in developing and adopting AI-powered tools for sense-making. They should prioritize those that fit into existing workflows and require them to provide less training support.
- Mitigate skill atrophy. The DAF CDAO should develop a plan to mitigate potential atrophy of sense-making skills resulting from AI adoption, which could include developing datasets to help train analysts and help them recognize useful data in the wild.

AI holds great promise for improving sense-making, and we believe that the approaches identified in this report can help guide investments in this area. In doing so, policymakers should consider the adoption and implementation issues identified in this report and elsewhere.

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