SYSTEMS ENGINEERING RESEARCH CENTER

AIRC | ACQUISITION INNOVATION RESEARCH CENTER

SERC PERSPECTIVE: AI4SE & SE4AI 2025

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GW

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NC State University
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CORE RESEARCH AREAS

Digital and Data-Driven Systems

Trusted Systems

Enterprises, Systems of Systems, and Missions

Workforce Development

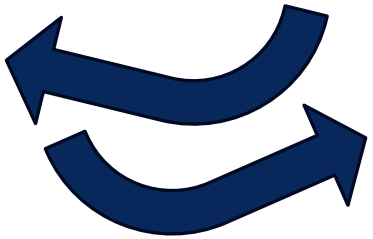
FRAMING AI & SE DISCUSSION

Role for Systems Engineers in AI space

AI4SE and **SE4AI**

Focuses on **application of AI in support of systems engineering practice and outcomes**, enabling enhanced decision-making, optimization, and efficient effort allocation.

Focuses on **leveraging systems engineering principles to develop AIES that are safe,** robust, and efficient AI systems, while extending them in response to the nature of AI enabled systems.

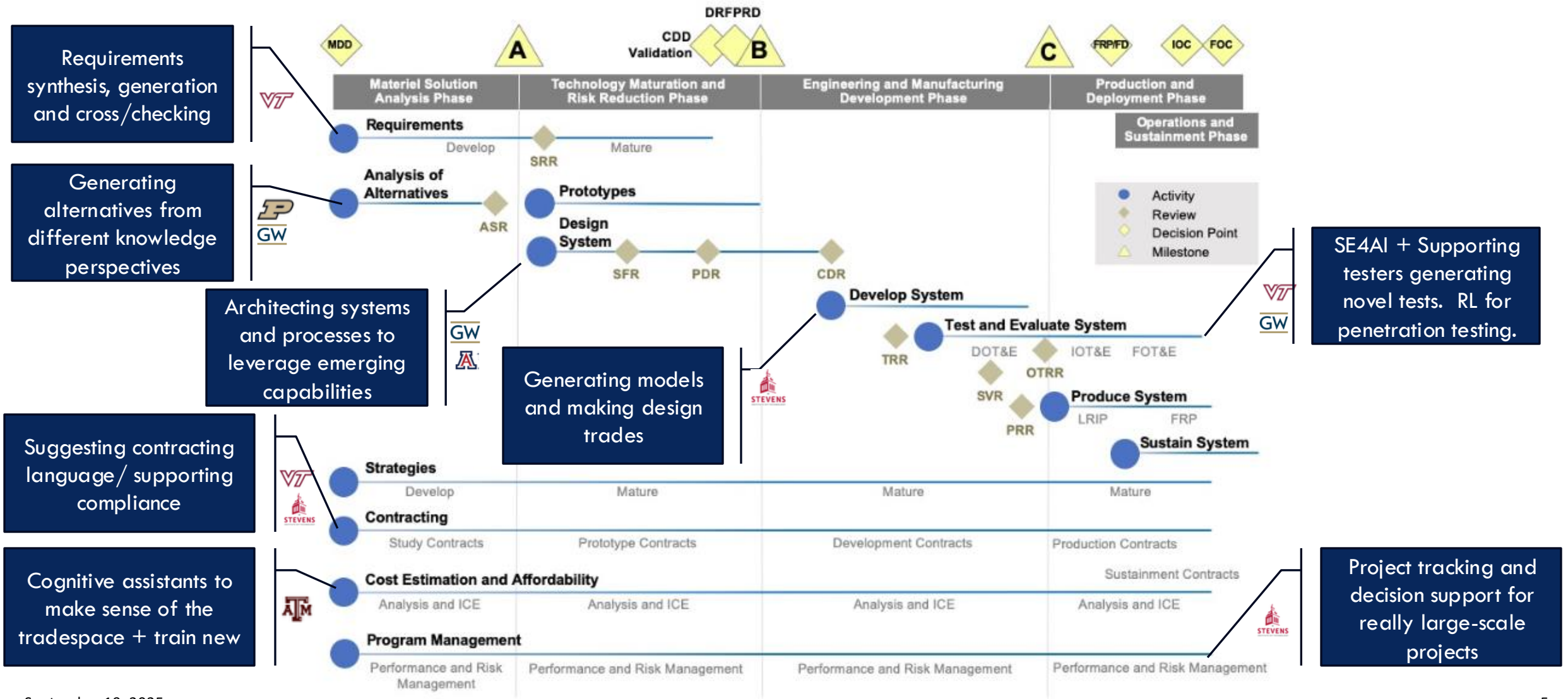


SE4AI applies to AI4SE too, but types of AI tools tend to be different

… and AI4SE might change what SEs do too.

WHERE CAN AI SUPPORT/AUGMENT HUMANS DECISION-MAKING NOW?

(Traditional) Lifecycle View of Major Capability Acquisition



TWO SNAPSHOTS OF ONGOING EFFORTS

EX1: LLM SUPPORT OF CORE SE TASKS: ARCHITECTURE GENERATOR

Efficiency, Accessibility, and Reproducibility

Artifact Generation
- Requirements documents, ICDs, ConCops, etc.

SysML Translation and Model Manipulation
- SysMLv1 to SysMLv2, Text-to-SysML, etc.

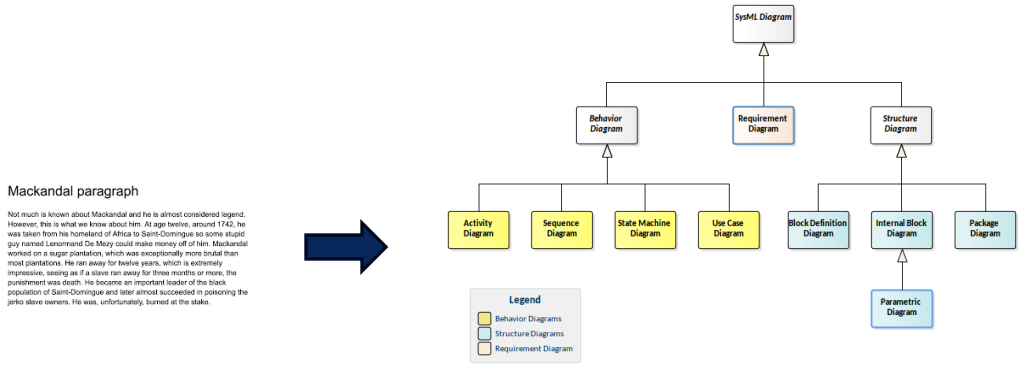
Model Interpretation
- Explain structural/behavioral models to non-expert stakeholders

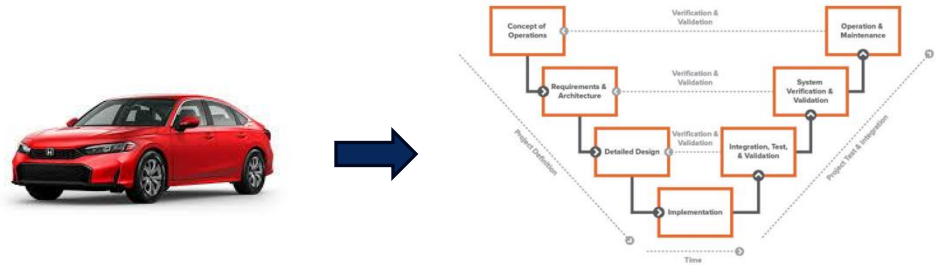
Knowledge Transfer
- Bridge communication between system modelers and SMEs

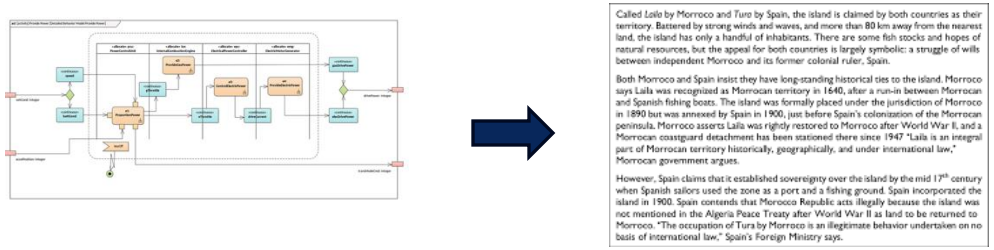
Concept Development
- Act as brainstorming partner using chain-of-thought prompts

Automation of Repetitive SE Tasks
- Generating traceability matrices from requirements to design elements, etc.

SysMLv2
- **Generation, manipulation, translation, etc.**

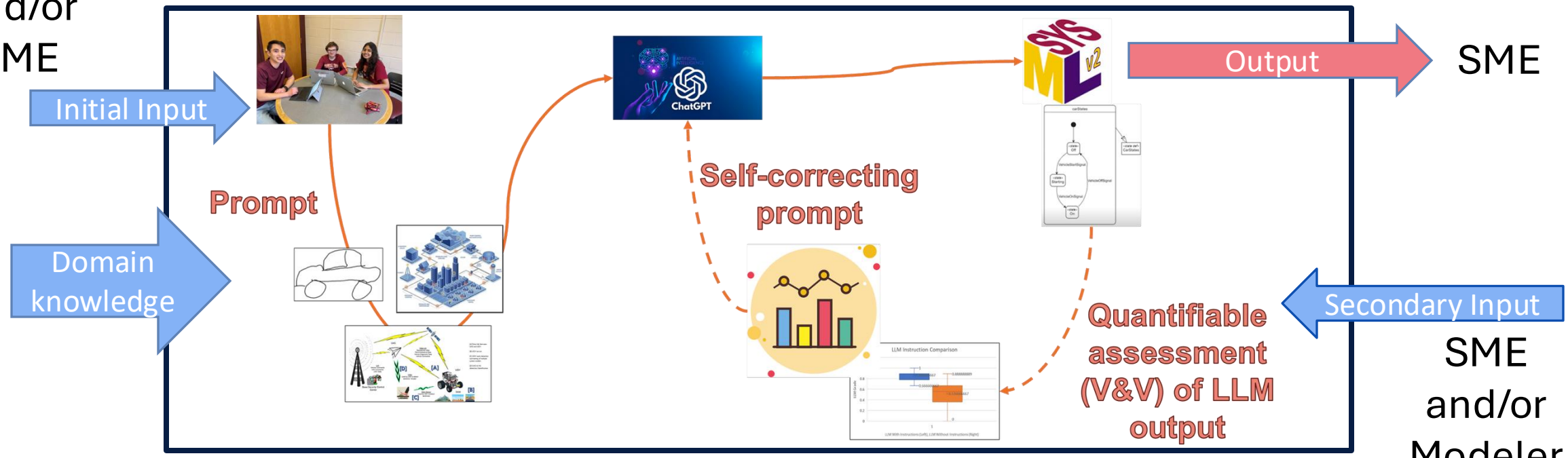






ARCHITECTURE GENERATOR

Modeler and/or SME



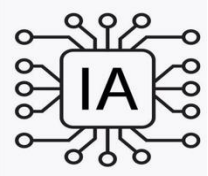
Thrusts

1. Text to text
2. Text/image to SysMLv2 code
3. SysML image/code to text
4. SysML V1 to V2
5. Systems engineering expertise

EX2: GENAI TOOLS TO SUPPORT CONTRACT MANAGEMENT TASKS

Problem: Many previously developed (technically effective) AI-based tools were not being adopted quickly. Wanted tools, or HAI tool-chains that supported core functions.

Prior Workflow

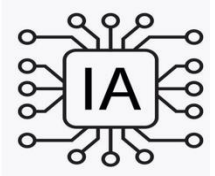


Tool identifies discrepancies (e.g., proposed labor rates/hours vs. billed) dumps in spreadsheet.

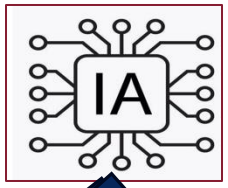
KO, reviews these and enforces (or doesn't enforce) with contractor.

Issue: lack of enforcement despite significant resources

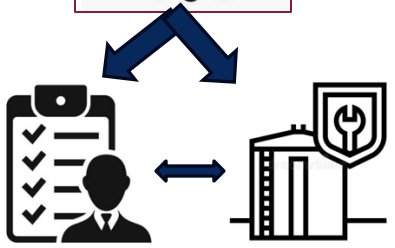
Alternative Workflow



Tool1 identifies discrepancies (e.g., proposed labor rates/hours vs. billed) dumps in spreadsheet.



Tool2 reviews discrepancies an email addressed to KO and contractor prompting an explanation



Potentially transforms adversarial to collaborative process to explain discrepancy

COMMON THEMES

"AI" are good at:

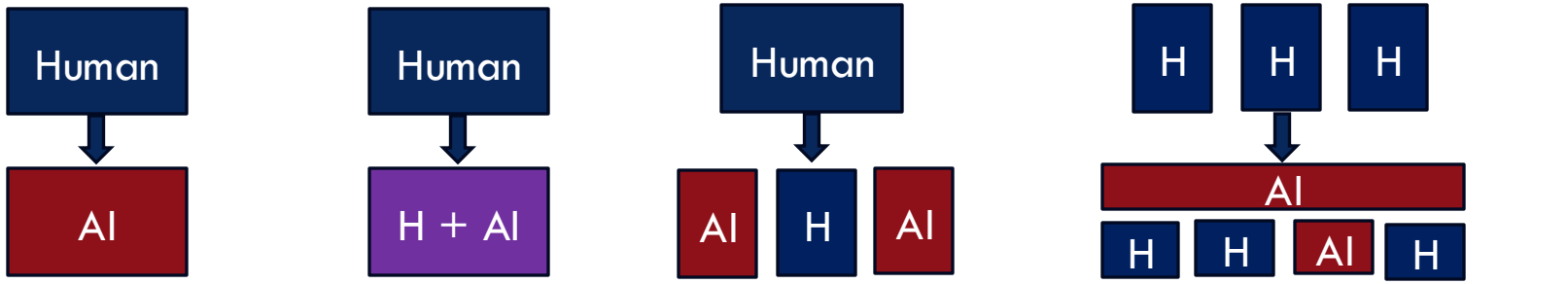
- Translating among concepts in different languages (incl. SysML)
- Scaling repetitive tasks, making it possible to pay attention to many more variables
- Identifying patterns within datasets
- Supporting interactive dashboards and data visualization more broadly

They're getting better at:

- Synthesizing text
- Generating artifacts, depending on the level of structure and correctness needed

These apply across a wide range of ***tasks*** across defense acquisition…

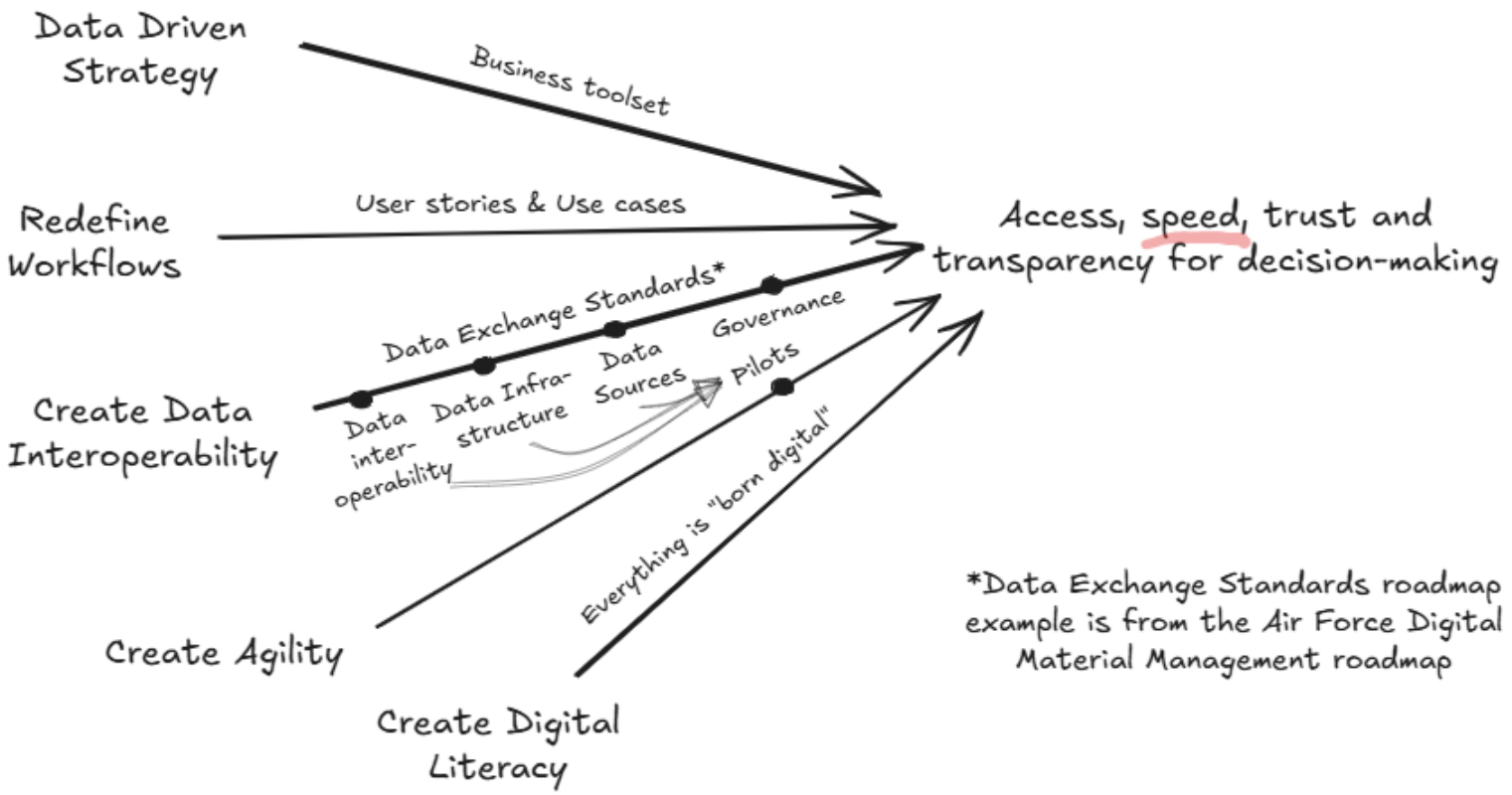
… but, most tasks that humans do require some of each lists + judgement and prioritization



Replacement | Augmentation | Task Remapping | Task "System" Remapping

TOWARDS DIGITAL TRANSFORMATION

DIGITAL TRANSFORMATION BEYOND NEW DATA AND TOOLS



Structural (Syntactic)

Structure Data for Machine-Readability and Exchange

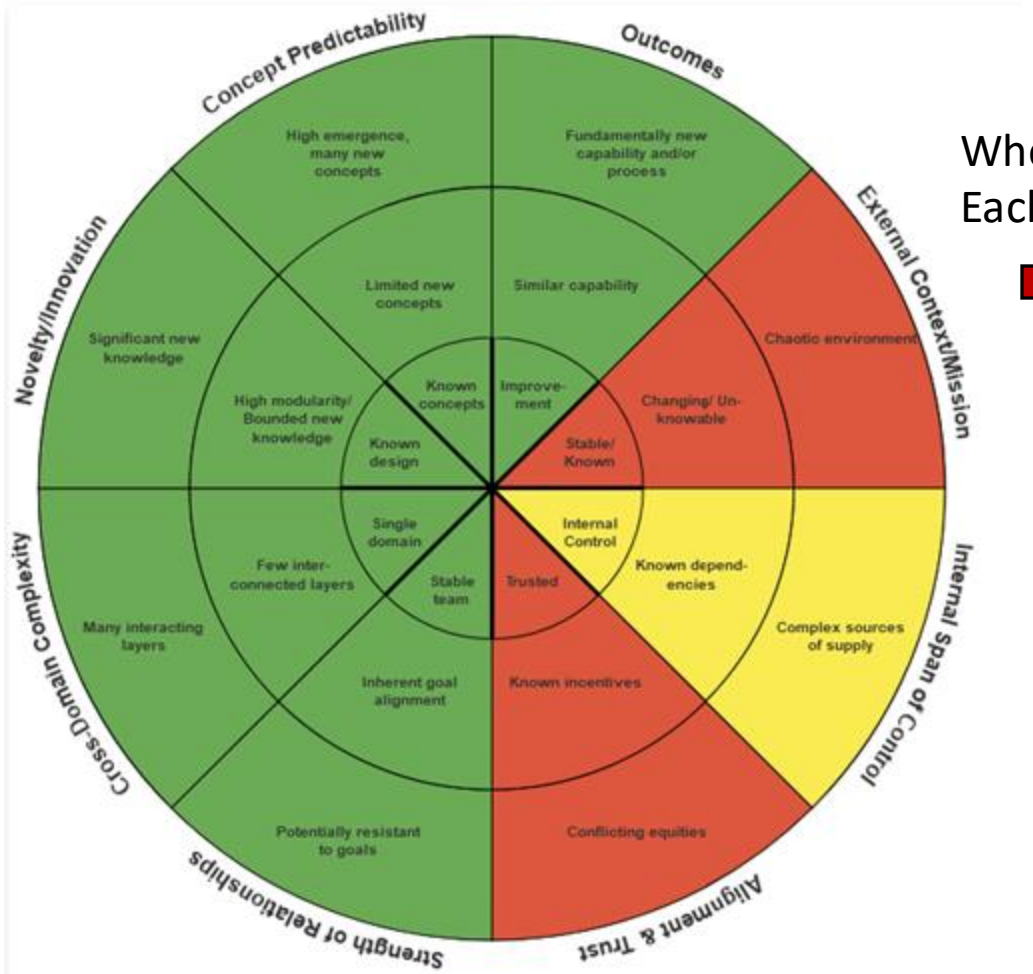
Semantic

Provide Consistent Meaning and Understanding for Computation, Synthesis, and Actionability

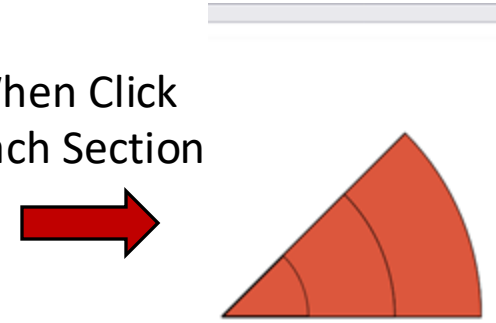
Pragmatic (Workflow)

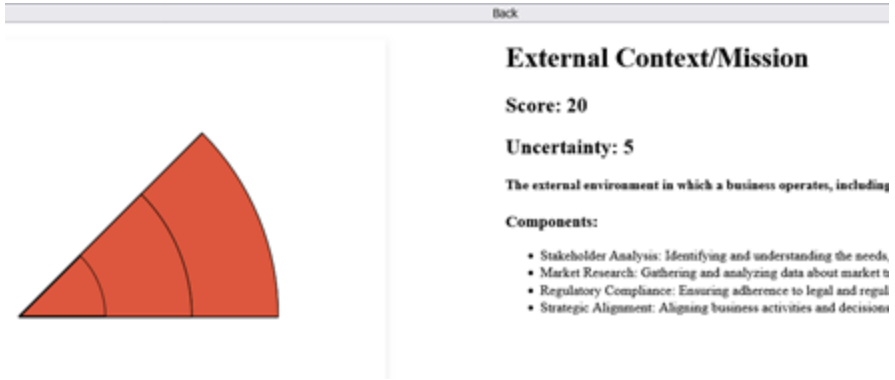
Integrate these concepts in the Context of Enabling Workflow

AI4SE STORY: DECISION-SUPPORT EX4: LLM DRIVEN DASHBOARDS



When Click Each Section

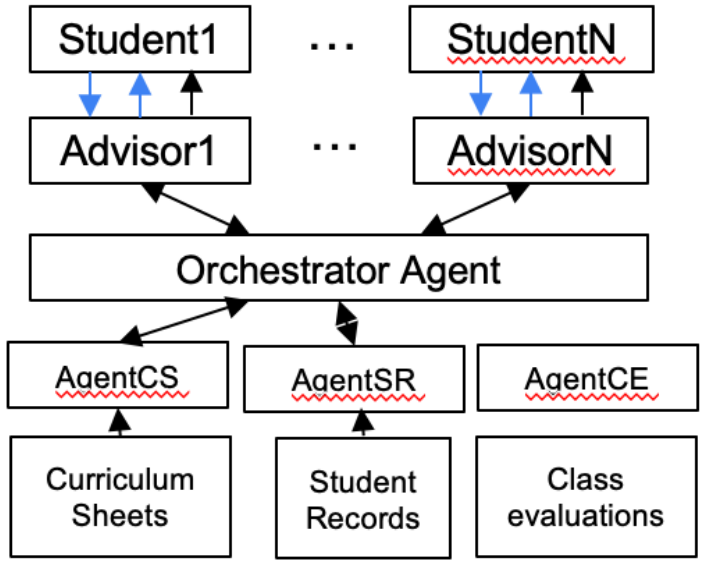




SE4AI STORY: ARCHITECTING WORKFLOWS EX3: HAI INTEGRATION IN WORK

Two (of many) example workflow integrations of AI-supported student advising

1. AI in the background



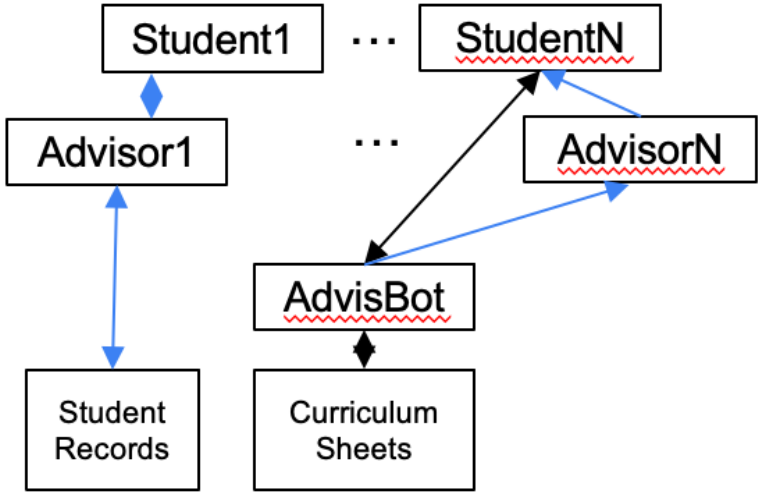
Key Structural Differences:

a) Who decides what is a good question for an advisor vs. AI

b) Whether students have direct engagement with AI (opportunity to mitigate risk)

c) Scope of access to sensitive data for AI agents (opportunities to intermingle/disclose)

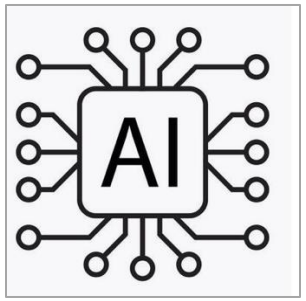
2. Available ChatBot



Same AI-capability, very different performance-risk tradeoffs, ”systems” T&E

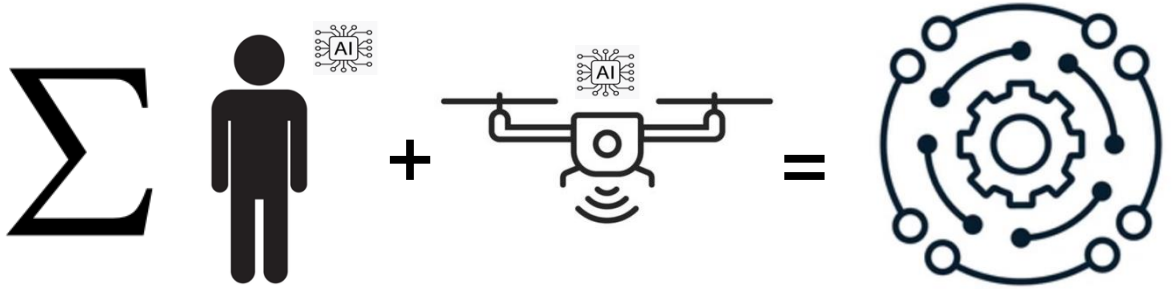
CALIBRATED TRUST + WORKFORCE

Is the "AI" trustworthy?



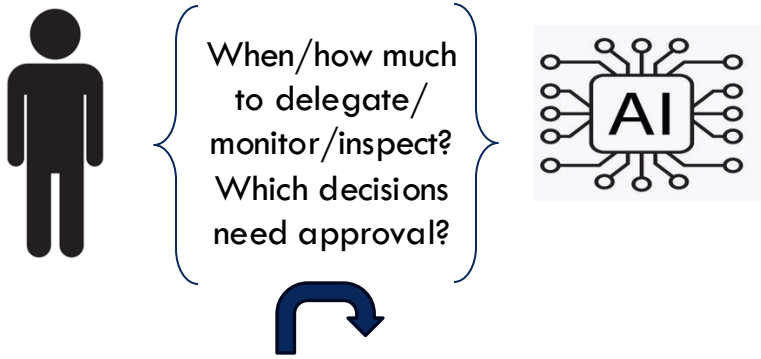
System is

more than AI



Trust is relational

(and human)



Implications for each action, and over time for, e.g., formation of judgement

CONCLUDING THOUGHTS

- AI is not itself a capability; it is (potentially) a critical enabler of:
  - Many new warfighting capabilities; and overall efficiency and effectiveness of the Enterprise
  - Need to have confidence that AIES will work when needed, in accordance with legal principles and without introducing new sources of vulnerability. This hinges on humans-AIs interaction at scale.
- Opportunities at multiple levels:
  - Task: Existing AI can identify patterns, translate, template, generate and to some extent synthesize. Reliability concerns can be mitigated via workflow integration.
  - Individual workflow: Humans and AI have different strengths; optimal mapping is unlikely to be 1:1 on existing tasks. Characterizing structure and risk/performance tradeoffs is key.
  - System scale: Traditional org design was constrained by decision-maker attention. AI fundamentally changes that. Opportunity to re-think core processes, with AI support.
  - Workforce: New tasks and new modes of HAI integration creates need for different skills. LLMs can be transformative for training and up-skilling too.

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