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# Acquiring Maintainable AI-Enabled Systems

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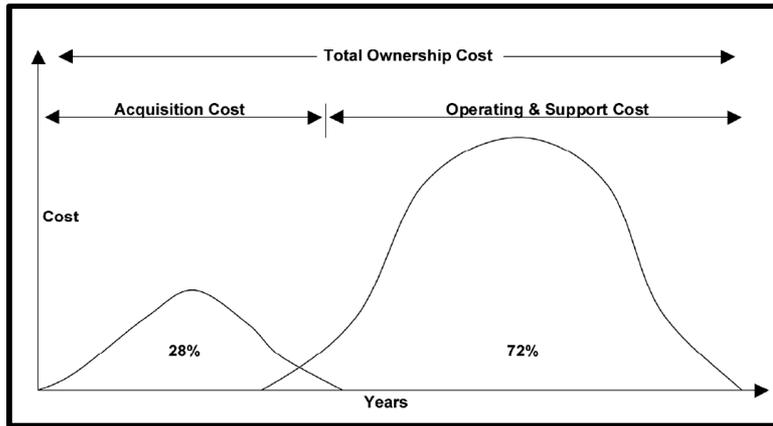
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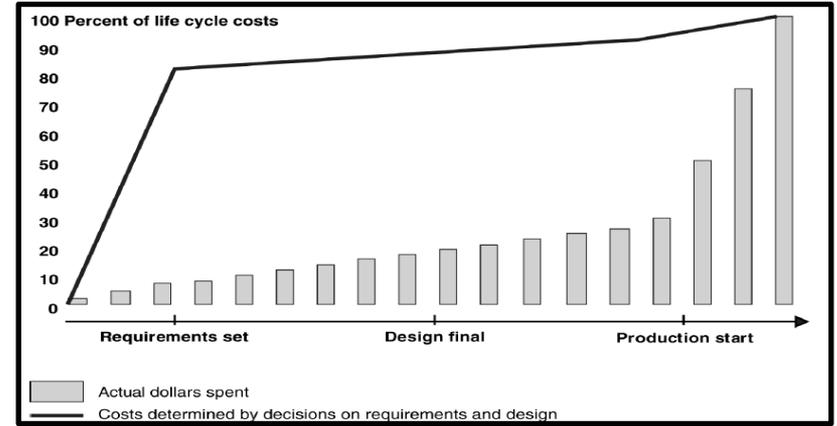
What are the sustainment considerations for Department of Defense AI-enabled systems?



## Research Issue: DoD Instructions and Guidebooks lack AI sustainment considerations...



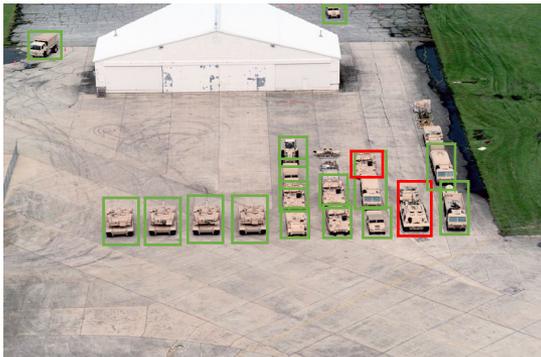
Nominal Life-Cycle Cost of Typical DOD Acquisition Program with a 30-Year Service Life. Source: Schinasi (2003).



Percent of Operating and Support Costs Determined at Various Points in the Acquisition Process. Source: Schinasi (2003).

... and the ML-models in AI *need* to be sustained

Training



Object Detection ML-model

Inference

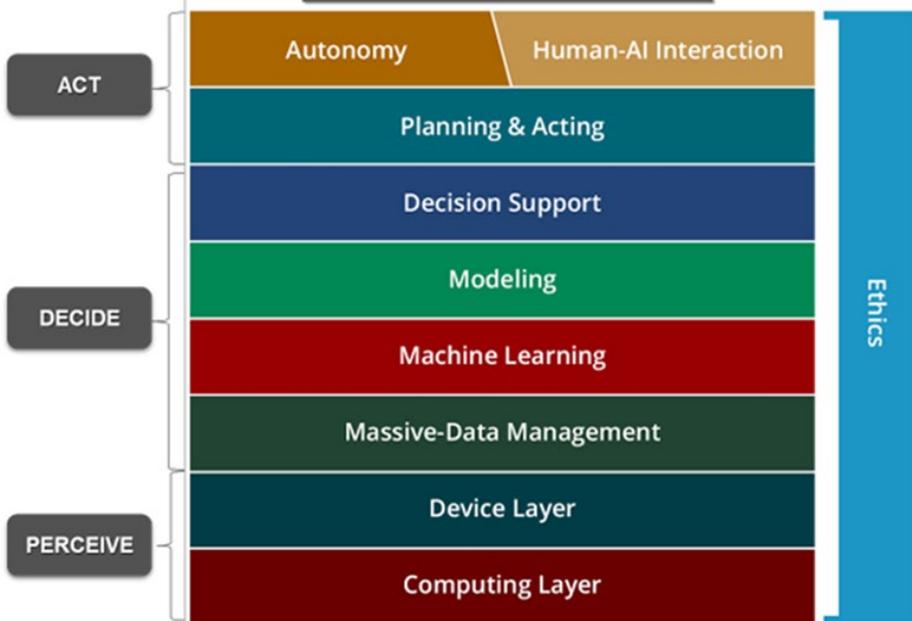




# Research Methodology

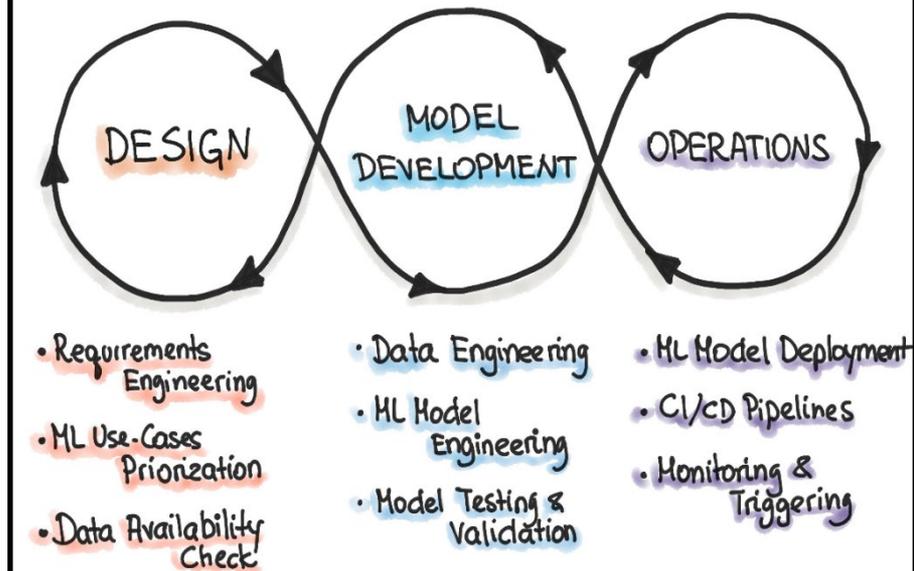
- Understand what drives AI-enabled systems and their maintenance
- Understand Industry best practices and Academic work on ML in use
- The emergence of the MLOps paradigm

## The AI Stack



Carnegie Mellon University's AI stack, depicting the necessary components of an AI-enabled system. Source: Moore (2018).

## MLOps



Core components of MLOps and their relationships. Source: Visengeriyeva (2023, March 30).



## Technical Considerations for Maintaining an AI-enabled System

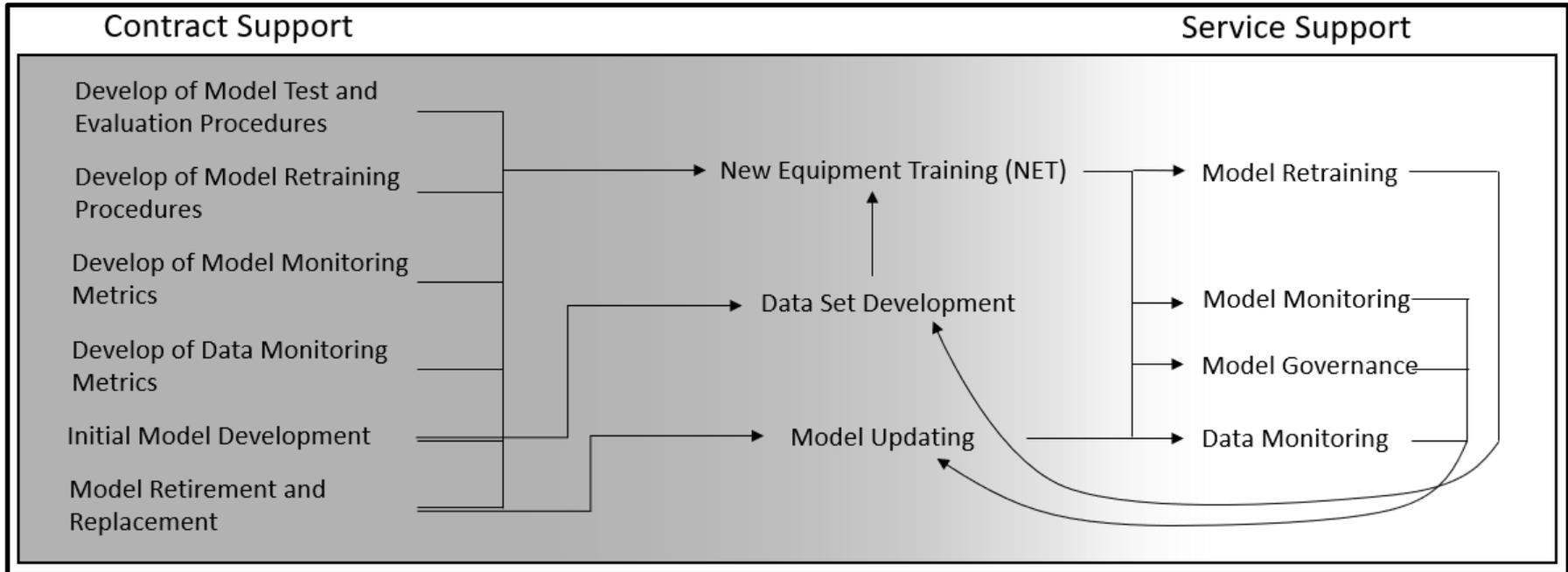
- Necessary Components
  - Model retraining – up to daily in complex environment
  - Designing test and evaluation scheme
  - Necessary model retraining procedures (active learning, fine tuning)
- Current Approaches to Maintaining an AI-enabled System
  - Contractor servicing
  - ML-as-a-Service (MaaS)
  - In house servicing

## Program Considerations for Maintaining an AI-enabled System

- Different than traditional hardware and software systems
  - Maintenance “touch time” frequency
  - Product within a Product
- Intellectual Property and Data
  - Limited, Government Purpose, or Unlimited rights – varies by funding



# Recommendation: Hybrid Sustainment Approach



## **ML model sustainment tasks in a hybrid maintenance plan, with associated dependencies between contractor and service maintenance tasks**

- Data Rights – limited for only organic, most likely government purpose rights
- ML Model Touch-Time Analysis – future research for product support business case analysis

AI-enabled system sustainment planning is crucial and should start now