ILI Capabilities/Application: Data Integration/OTD

Working Group 4 - Expanding In-Line Inspection Capabilities & Application

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Data Integration

High Level Challenge:
“Data integration to support more informed identification, characterization and fitness for purpose of anomalies”

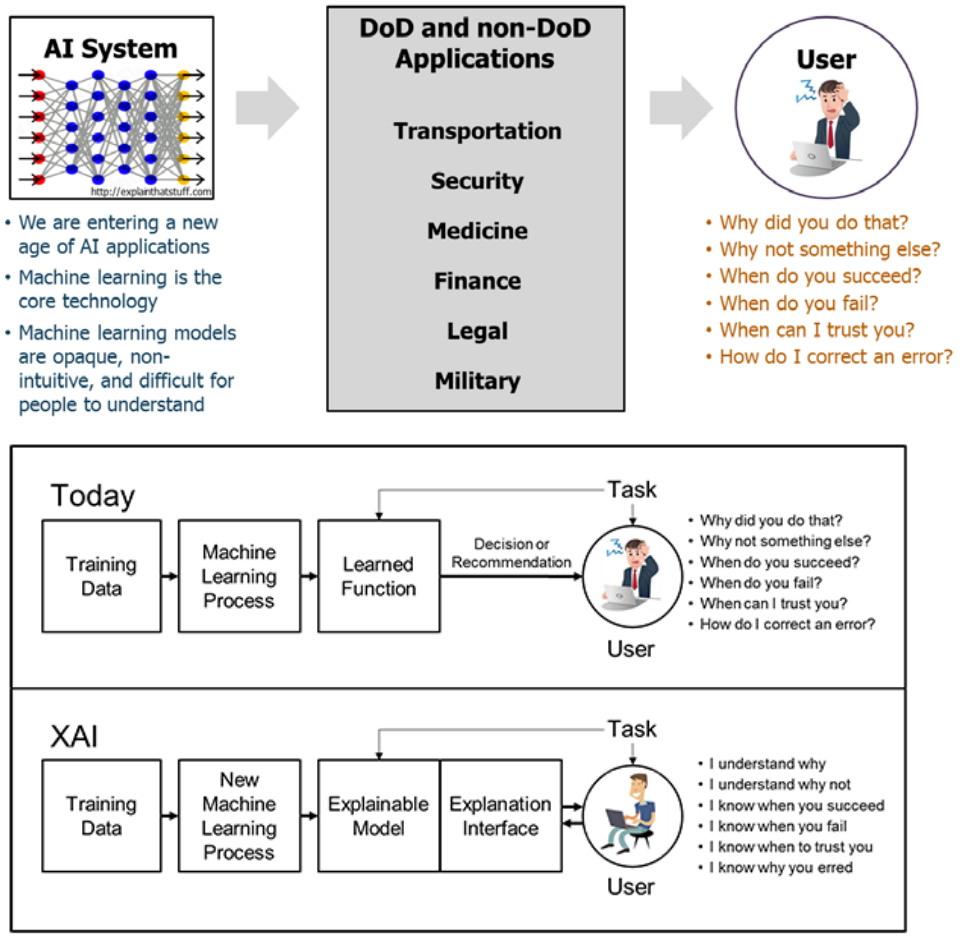
Sub-Challenges

- Uncertainty
- Disparate data sources
- Competing objectives
- How to support human decision makers in achieving their goals

Explainable AI (DARPA Program)

The Explainable AI (XAI) program aims to create a suite of machine learning techniques that:

- Produce more explainable models, while maintaining a high level of learning performance (prediction accuracy); and
- Enable human users to understand, appropriately trust, and effectively manage the emerging generation of artificially intelligent partners.



All Data Sources are Valid Inputs

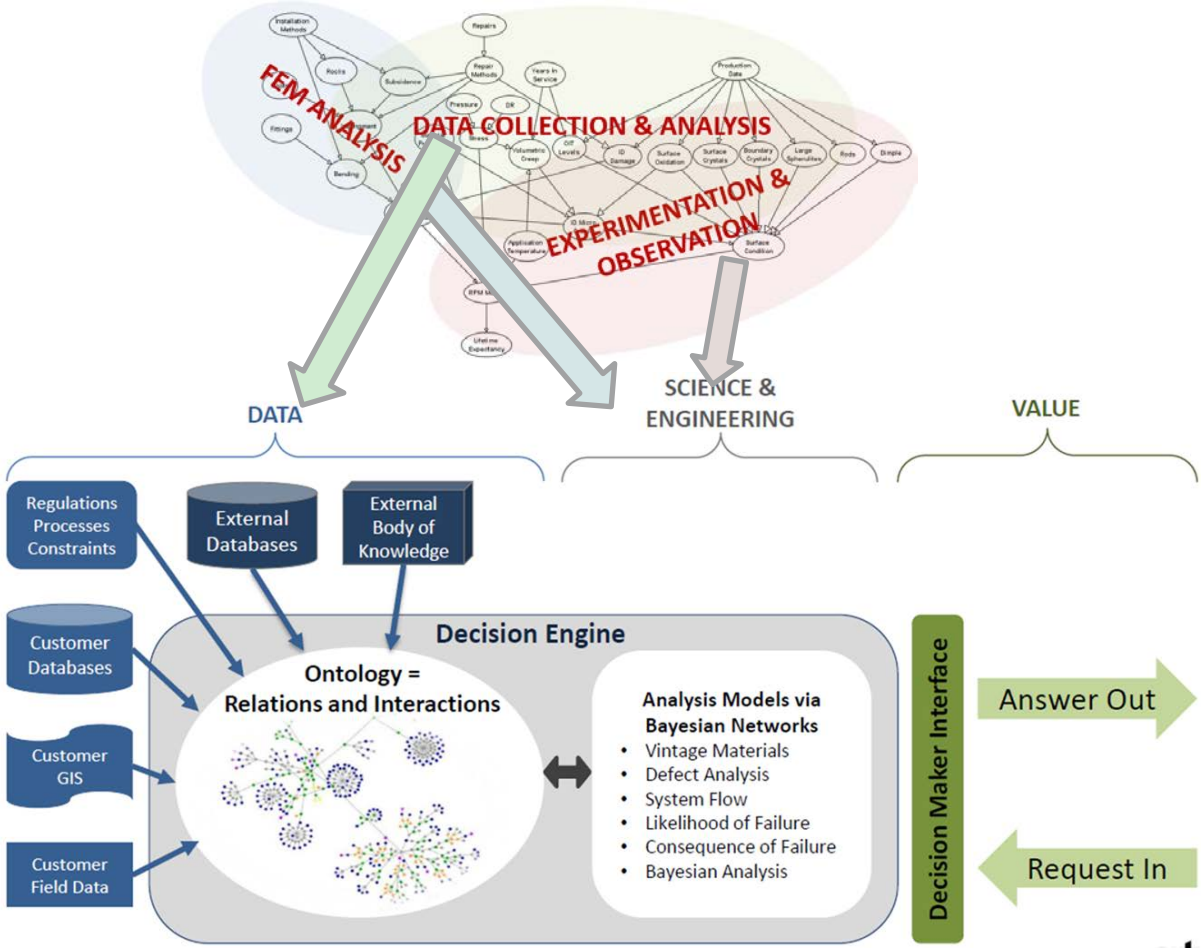
Develop analysis methods that:

- Weight all available data sources correctly
- Provide coherent synthesis of all data sources
- Recognize subject matter expertise
- Emphasize the human interface
- Recommend multiple options for mitigation of problems to subject matter experts

Causal Modelling, Intelligent Data Collection/Analytics

Encourage network methods that are ideally suited to:

- Addressing interactions
- Dealing with sparse data
- Incorporating big data
- Learning with each iteration
- Providing forensic reasoning to identify root causes
- Providing probabilistic prediction of future states



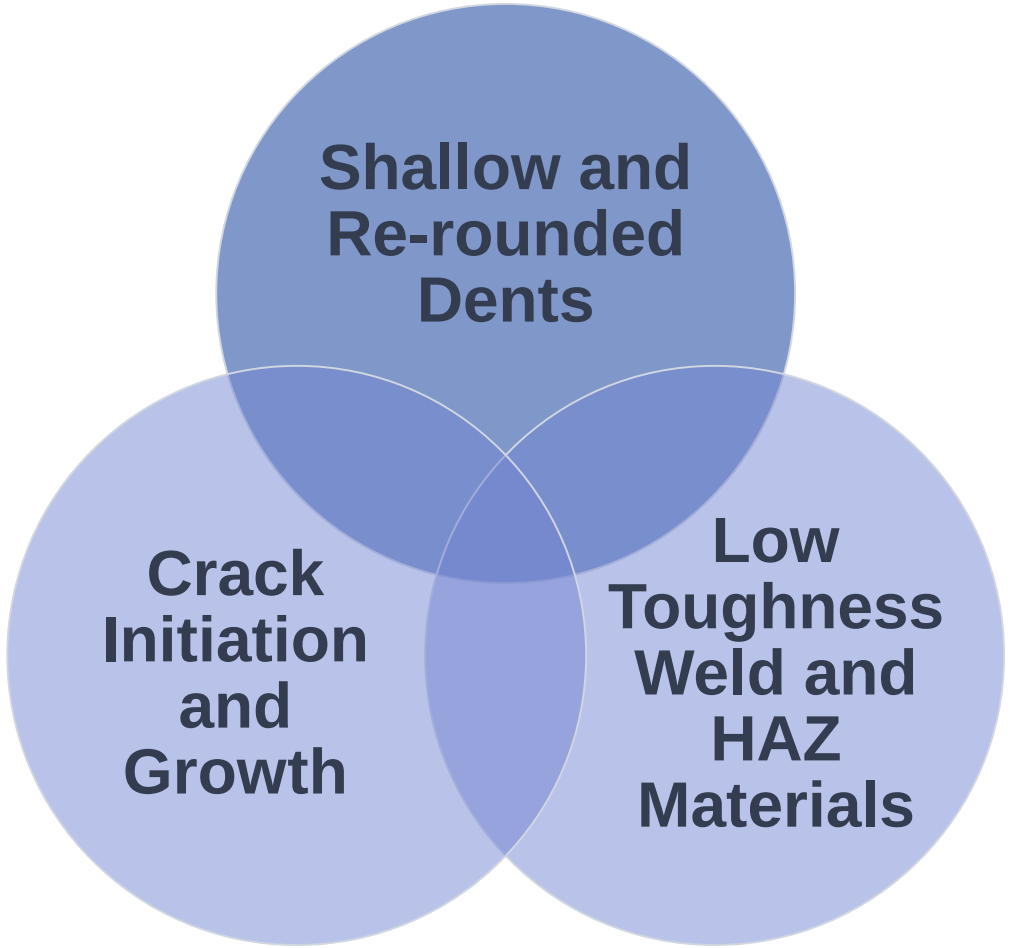
Past, Current and Future Work

There is a large body of previous work on:

- Inspection technologies
- Interactions
- Risk modelling

There are current projects addressing uncertainty in inspection methods and next generation of inspection technologies

Interacting/Overlapping Threat Gaps



> **Develop analysis methods that:**

- Weight and properly synthesize all data sources
- Recognize subject matter expertise
- Understand physical and mechanical interactions of defects and material property gradients/zones.
- Recommend multiple options for mitigation of problems to subject matter experts

Suggestions for Future Work

- **There is a body of previous work on**
  - Critical crack determination and the relation to inspection detection limits
  - Crack initiation and growth as a function of pressure changes
  - Failure mode determination between stable leak and rupture

- **Future work should address data synthesis of modeling and inspection data for dent, crack, and material threat interactions:**
  - Shallow and re-rounded dents (cold work, cracking, etc.)
  - Crack initiation and growth (within shallow/re-rounded dented and low toughness zones)
  - Crack/dent response to low toughness weld and heat affected zone material properties