Challenges and Opportunities in Enhancing Department of Defense Ground Vehicle Capabilities through Digital Transformation

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Research Questions

- How does integrated digital transformation contribute to enhancing ground vehicle performance and operational readiness?
- How can data utilization be maximized to support decision-making within the Department of Defense?
- How might ground vehicle preparation be optimized to meet the challenges of extreme environments like the Arctic, considering factors including mobility, resilience, and performance?

Research Issues and Methodology

- Research Issues
  - Data Access and Ownership:
    - Understanding the challenges of accessing OEM data, especially during supplier transitions, and navigating complexities related to data rights and ownership.
  - Digital Transformation and Decision-Making:
    - Exploring digital transformation's impact on ground vehicle performance and decision-making in the DoD.
  - Testing and Evaluation Processes:
    - Examining the structured testing and evaluation processes within the DoD
- Methodology
  - Qualitative Interviews:
    - Gather insights from Army personnel and stakeholders through in-depth interviews.
  - Use Cases:
    - Examine specific vehicle procurement projects to assess practical implications.
  - Document Analysis:
    - Analyze Army regulations and acquisition guidelines to understand formal requirements.

Ground Vehicles in the Arctic Environment

- Vehicle Focus: Joint Light Tactical Vehicles (JLTVs)
- Activation of 11th Airborne Division in Alaska (2022)
- Strategic Alignment: Alignment of ground vehicle requirements
- Technological Considerations: Integration of digital modeling techniques
- Guideline Adherence: Adherence to comprehensive guidelines
- Challenging Environment:
  - Decentralized data and knowledge
  - Delicate balance of data ownership and access
  - Time constraints on decision making

JLTV

(Photo: Oshkosh Corporation/Sebastian Saarloos)

Effects of Different Environmental Conditions

High Temperature

- Differential expansion of dissimilar materials
- Increased rate of chemical reactions
  - Batteries deteriorate
  - Coatings may absorb sunlight
  - Damaging to energetic materials
- Lower lubricant viscosity
- Electronic circuit instability
- Outgassing

Rain

- Moisture in parts
- Corrosion
- Attenuation of electromagnetic radiation
- Reduced off-road mobility

Icing and Snow

- Reduced visibility
- Attenuates electromagnetic signals

High Humidity

- Triggers Condensation
- Initiates fogging
- Oxidation/corrosion
- Increased chemical reaction
- Changes in material properties
- Degrades optical and infrared properties
- Modifies lubricants' behavior
- Changes elasticity/plasticity

Low Temperature

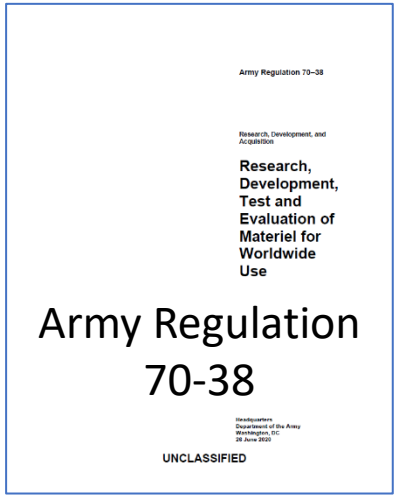
- Changes physical properties of materials
- Hardness and brittleness
- Differential contraction
- Increased viscosity
- Stiffening of shock mounts
- Condensation and freezing of water

High Elevation (low pressure)

- Liquids leak
- Lubrication capacity decreases
- Electrical breakdown
- Heat transfer is less efficient
- Liquids vaporize
- Less efficient combustion

Salt/Saltfog

- Acceleration of metallic corrosion
- Loss of mechanical and structural strength
- Surface deterioration
- Alteration of electric properties


Army Regulation 70–38

Research, Development, and Acquisition

Research, Development, Test and Evaluation of Materiel for Worldwide Use

Army Regulation 70-38

Headquarters Department of the Army Washington, DC 26 June 2020

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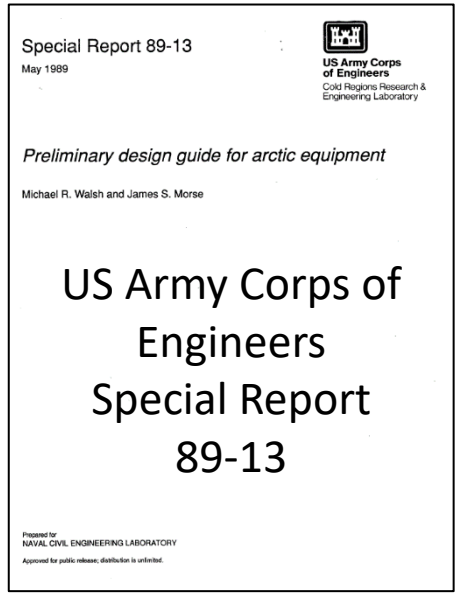
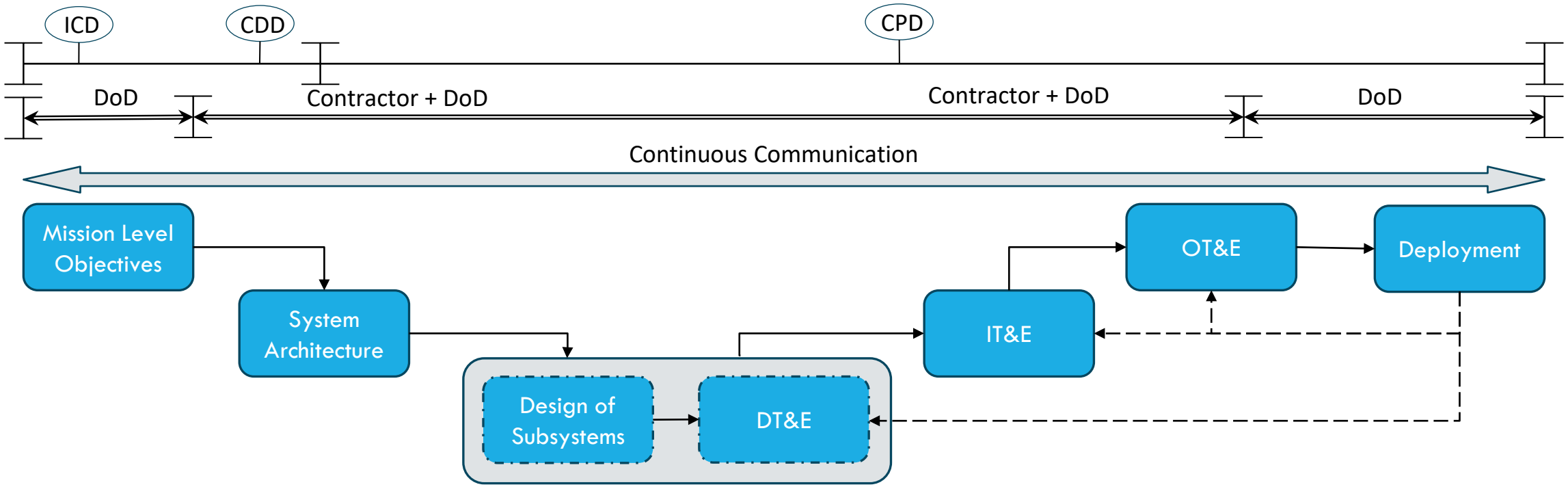
Equipment Affected in Arctic Environments

Assembly	Mechanical	Electrical	Fluid	Structural
Power source	-	Battery, cables, Fuse, Connector	Acid	Mount
Starter system	Switch, belt, bearings	Glow plugs, cables, fuses, relays, alternator	Lubricants	Mount
Fuel system	O-rings, filter, seals, fuel lines, bearings, valves	Fuel pressure sensor, solenoid valves, motor	Fuel	Fuel tank
Engine	Rings, bearings, gaskets, O-rings, springs, chain drive, seals, valve guides	Glow plugs	Sealants	Engine mounts
Lubrication system	Seals, o-rings, bearings, piping, filters, connectors	Pressure sensors, level sensors, temperature sensors	Lubricants	-
Exhaust	Fasteners	Exhaust gas pressure sensor	-	-
Controls	Switches, governor	Switches, meters, connectors, voltage regulator	-	-
Gearbox/clutch	Bearings, seals, spring, gasket, coupling	-	-	-
Generator	Bearings, seals, brushes, springs, coupling	Wiring, coil, stator, connectors, field detector	-	Mounts
Frame mount	Fasteners, bushings	Grounding strap	-	Frame anchors, mounts
Cooling system	Seals, bearings, hoses, fan, radiator	Wiring, temperature sensors, liquid level sensors	Coolant	Mounts



Data Generated Throughout the Acquisition Process



ICD: Initial Capabilities Document
CDD: Capability Development Document
CPD: Capability Production Document

DT&E: Developmental Test & Evaluation
IT&E: Integration Test & Evaluation
OT&E: Operational Test & Evaluation

Summary and Next Steps

- Summary
  - Analyzed a use case
    - Changes in requirements and equipment components affected by Arctic environments
    - Additions of attachments (e.g., Arctic kits)
  - Examined specific scenarios
    - Preparation for use in new environment: Timeframe -- hours to few days
    - Redesign: Timeframe -- days to months
  - Data generated at various stages throughout the acquisition process
    - ICDs, CDDs, CPDs
    - CAD models, FEA models, and test data
- Next Steps
  - Digital data capture
    - Obtain and analyze digital models of ICDs, CDDs, CPDs, and standards (i.e., AR 70-38).
    - Create abstract digital models (i.e., meta-models) of vehicle systems.
  - Data utilization for reasoning and decision making
    - Execute what-if scenarios for different climate conditions.