BAE SYSTEMS

Welcome to BAE Systems

Mobility & Protection Systems, Sterling Heights, MI – October 2008

BAE SYSTEMS

Systems Engineering in New Vehicle Development

FTTS (Future Tactical Truck Systems)

Customer: US TACOM National Automotive Center (NAC), Warren Mi

Walter J. Budd
Chief Engineer
BAE M&PS
October 2008

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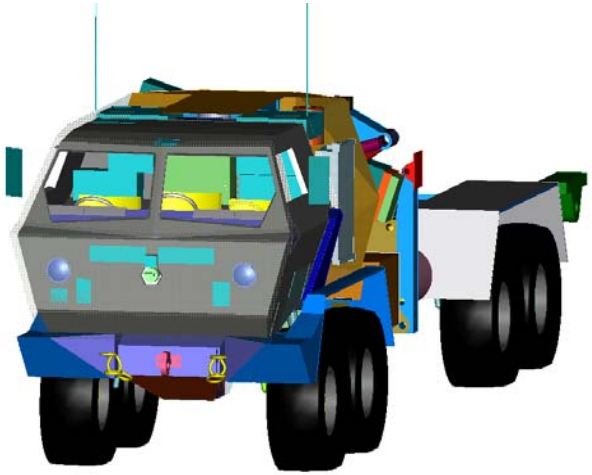
MSV - Maneuver Sustainment Vehicle

- 18 Month Project, Design, Build, Qualify New Vehicle
- Systems Engineering Approach
- Requirements Analysis
- Performance Parameters Linked Into Models



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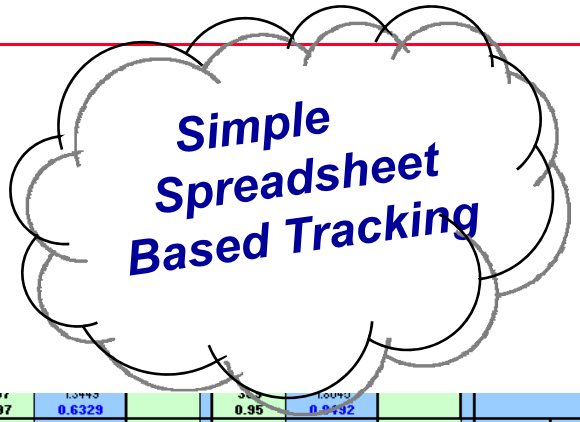
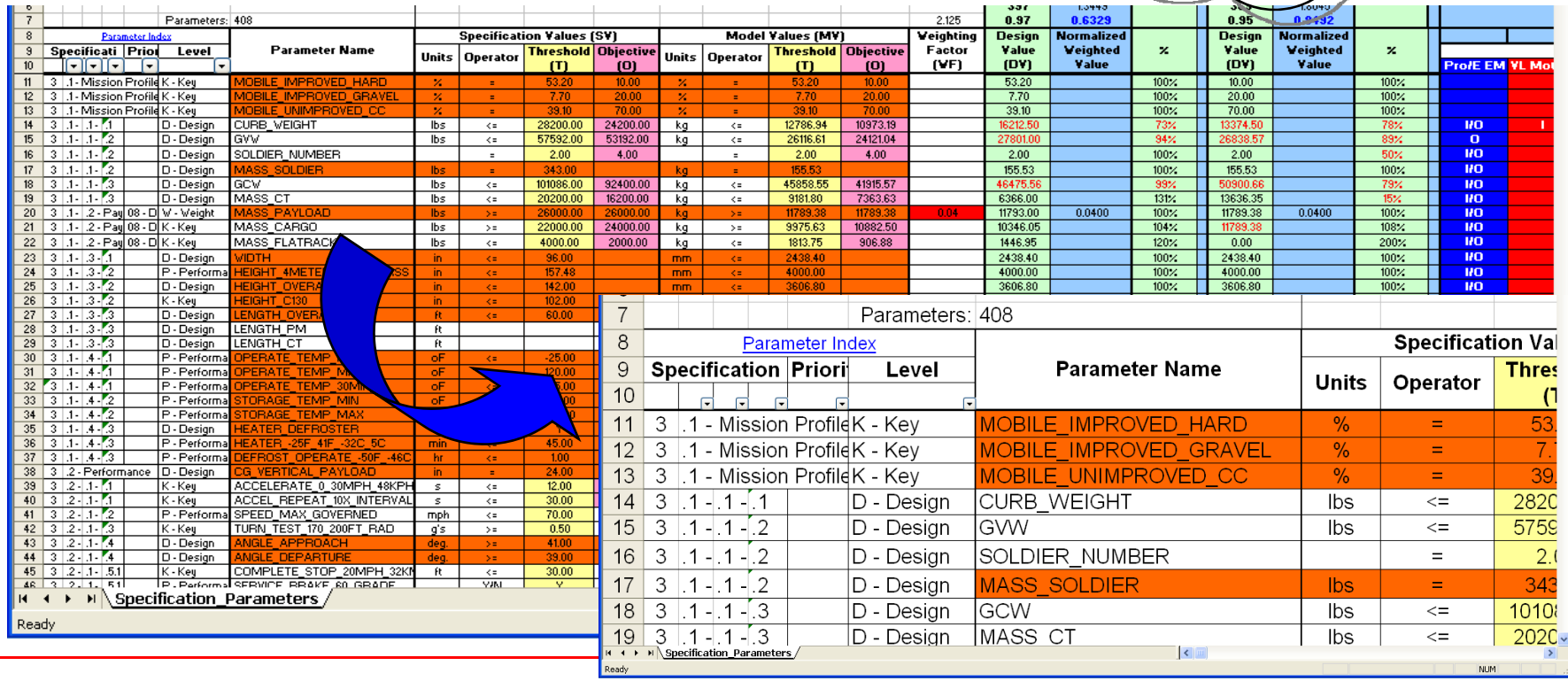
- **Process Began With Customer Supplied 92 Page Performance Requirement Document**
- **Our Engineers Developed and Tracked 408 Given and Derived Requirements**





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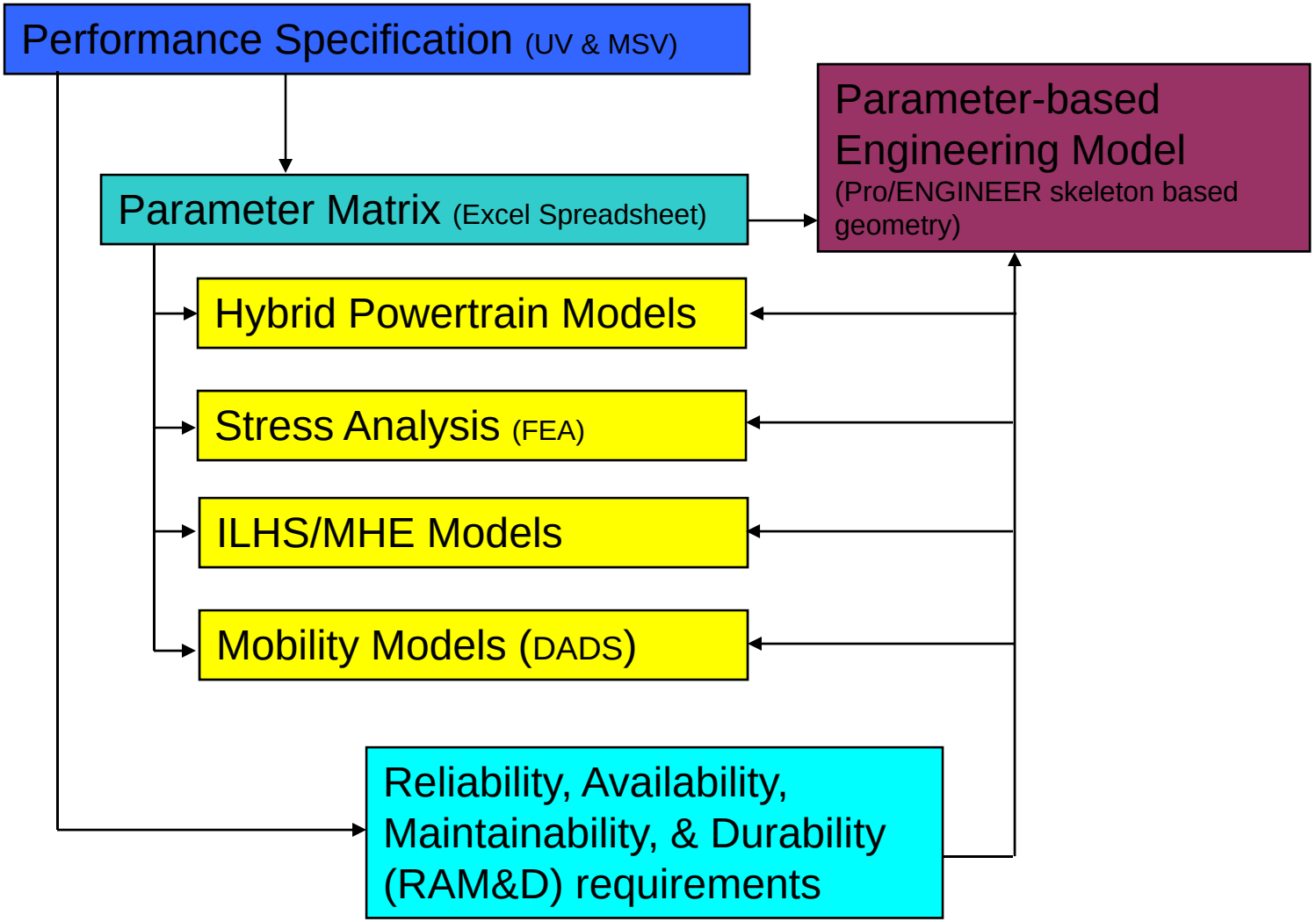
Performance Specification (UV & MSV)
Parameter Matrix (Excel Spreadsheet)
Parameter-based Engineering Model
(Pro/ENGINEER skeleton based geometry)
Hybrid Powertrain Models
Stress Analysis (FEA)
ILHS/MHE Models
Mobility Models (DADS)
Reliability, Availability, Maintainability, & Durability (RAM&D) requirements

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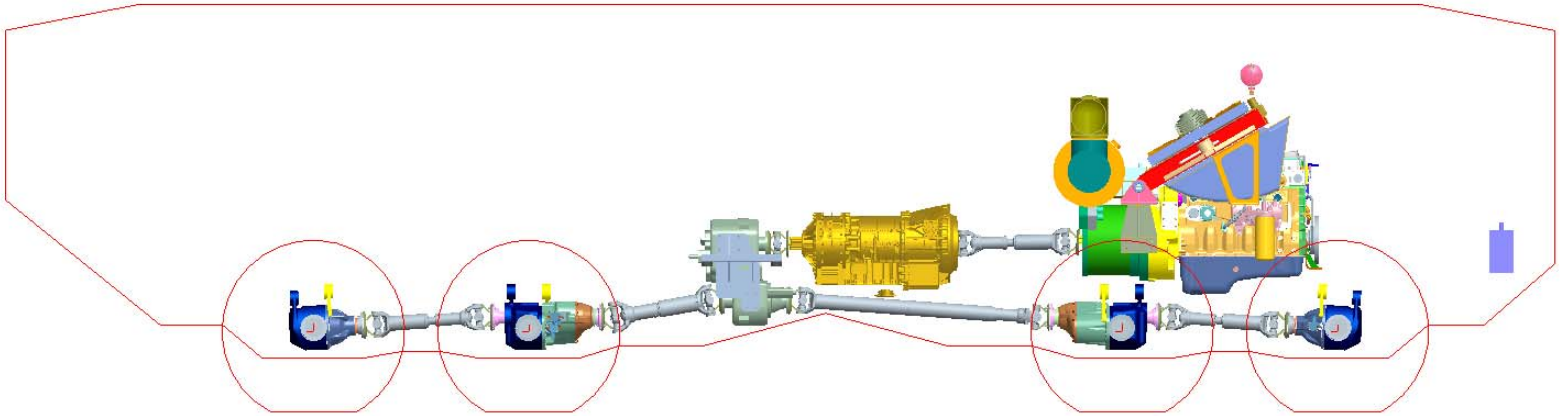
Propulsion Modules



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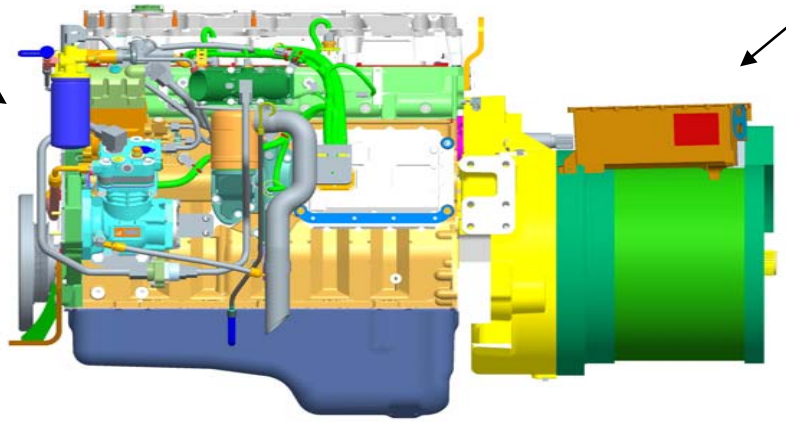
Power Generation

Hybrid System

CAT C9
1600 RPM
1850 N.m
450 Hp



UQM
1900 RPM
600 N.m
160 Hp

Combined Peak Torque

2446 N-m (1804 ft-lbf) @ 1600 RPM

Combined Peak Power

610 HP (455 kW) @ 2300 RPM

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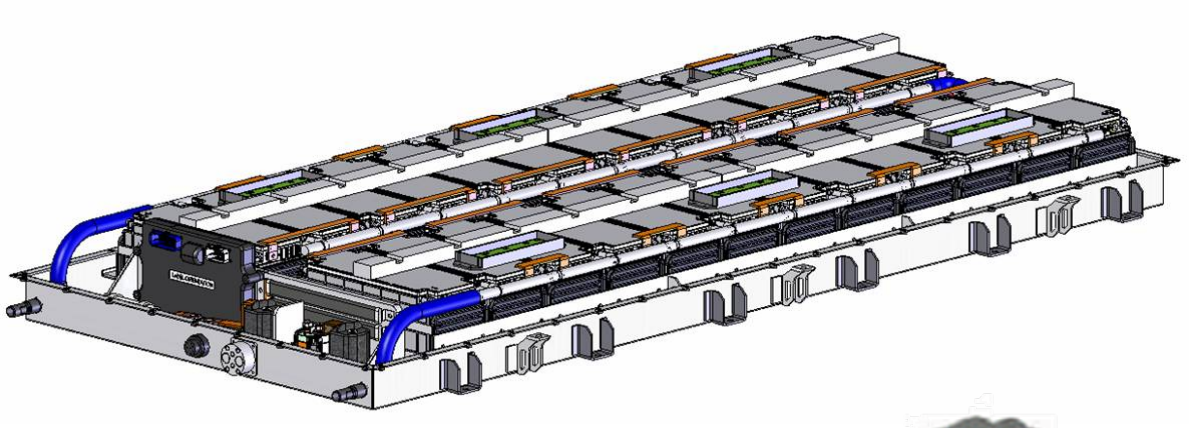
Battery Pack

Four, 45A*h NiMH Batteries Used To Support The Hybrid Power Requirements



MANUFACTURER		COBASYS
TYPE		NiMH
MODEL		4500 SERIES
VOLTAGE	V	336
CAPACITY	Ah	45
COOLING		LIQUID, INTEGRATED
DRY WEIGHT	Kg	330
No. of BATTERIES		28
DIMENSIONS: L x W x H	MM	1900 x 600 x 310

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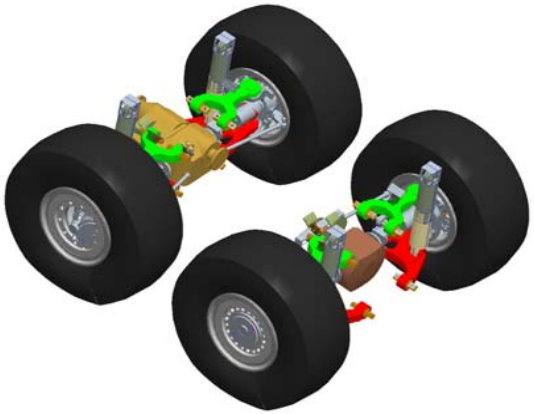
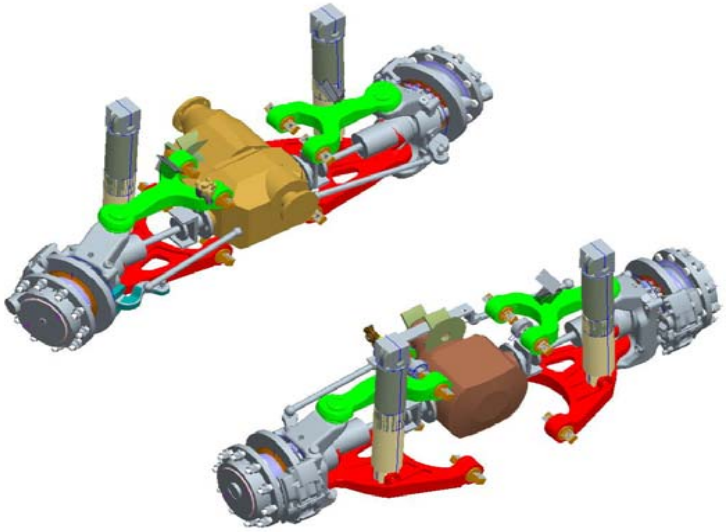
Custom Designed Independent Suspension Axles





- Independent Suspension SLA
- Axel Differential Ratio: 2.077
- Wheel Hub Planetary Ratio: 3.55
- Hydraulic Disc Brakes - ABS

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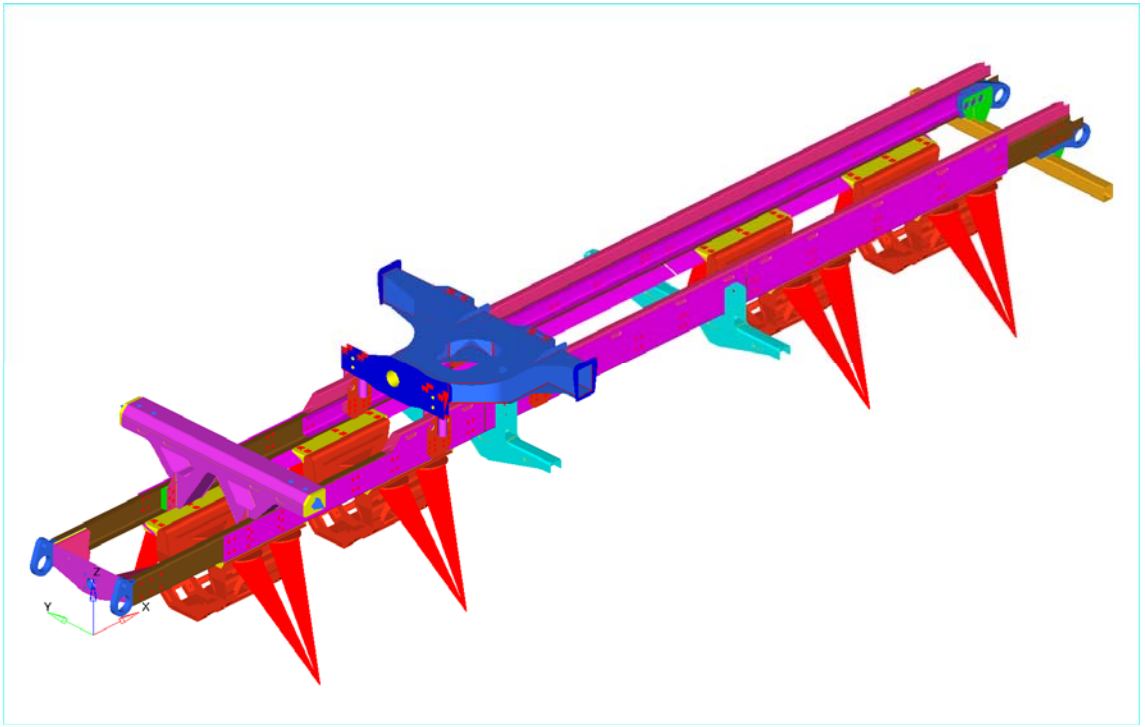
All-New Frame

Was Required

Inputs from:

- **Automotive Loads**
- **13 Ton Load Carry**
- **Lift/Unload 13 Ton Cargo**



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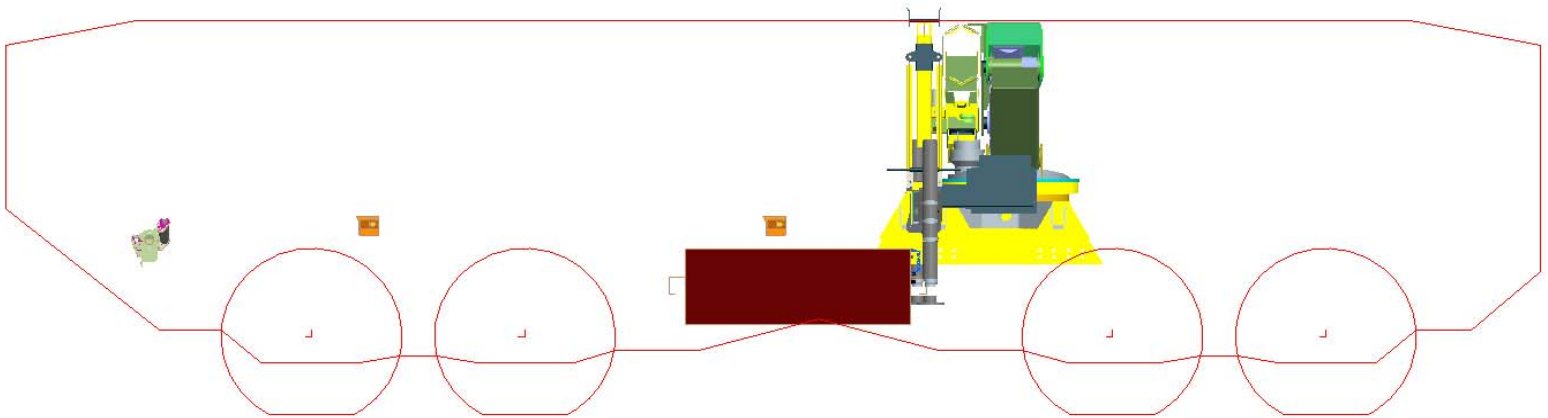
Material Handling Equipment



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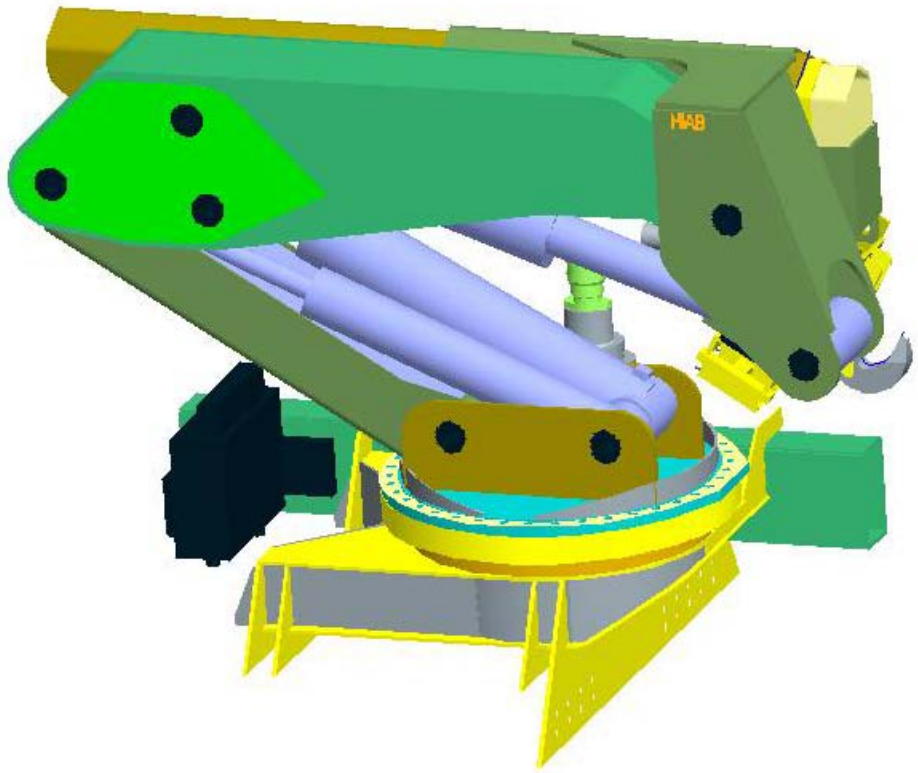

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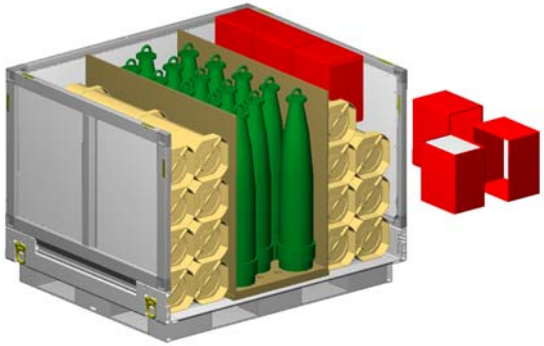
Get supplies to the soldiers as quickly and as safely as possible



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- **Load/Unload Cargo**

- **Load/Unload Trailer**

- **Load/Unload ISO Containers**

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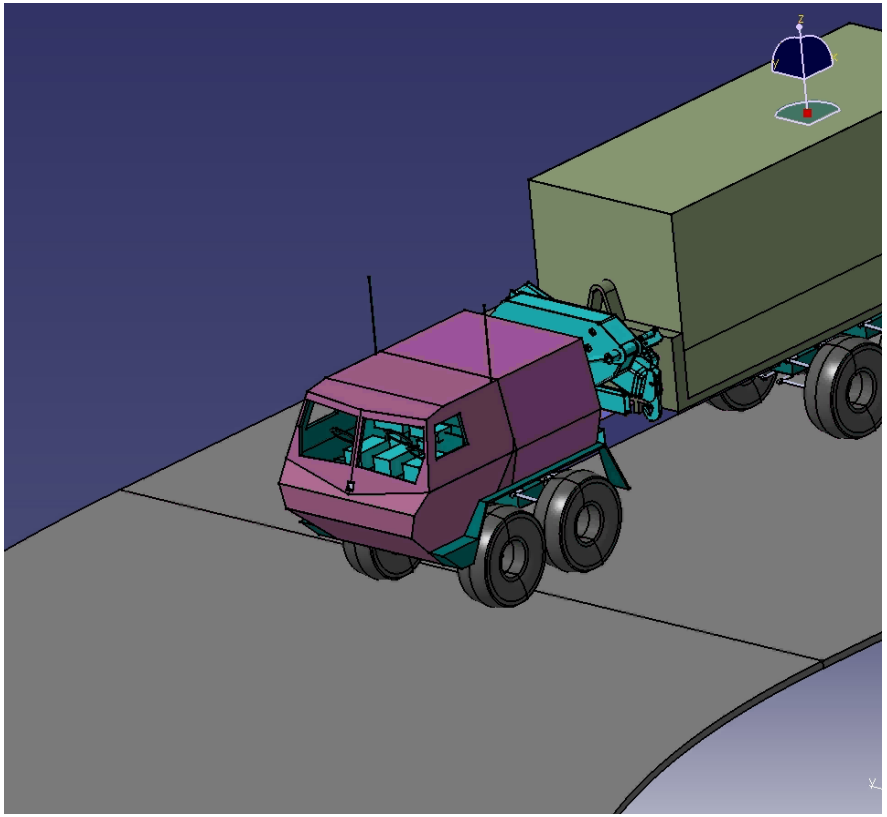
Challenge

- *Create* multibody simulation that represents several truck and suspension variants
- *Different* suspension designs (not just parameter values)
- Make it *easy* to run different trucks on all possible roads and obstacles



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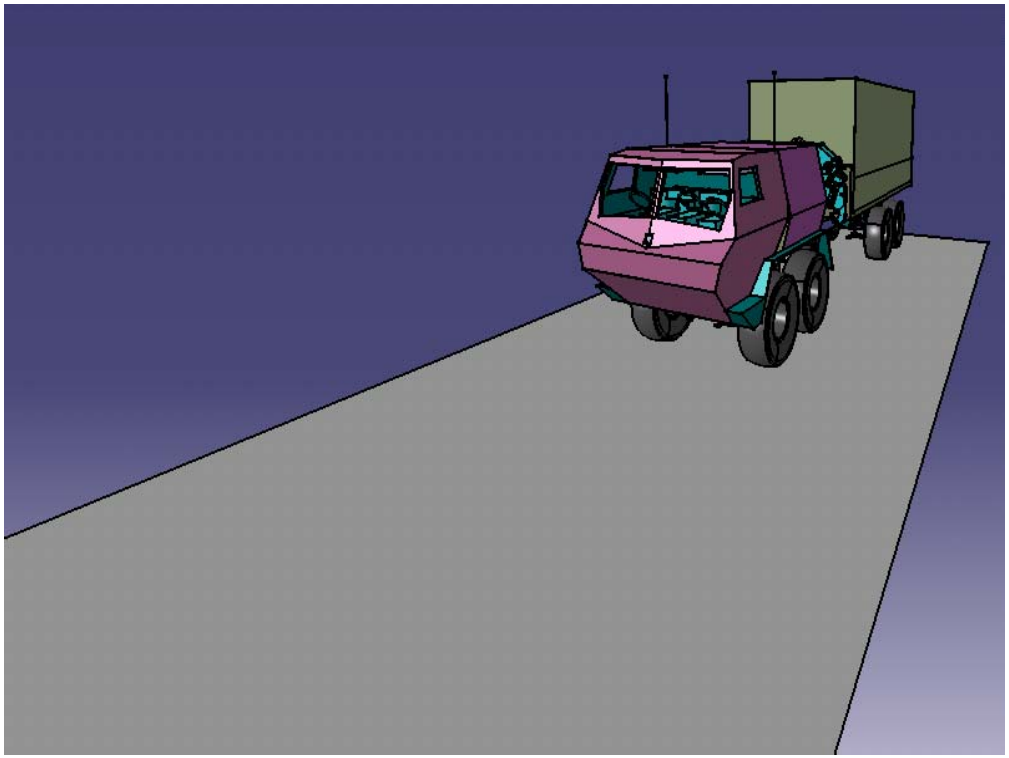
- Model as a series of rigid bodies with joints and force elements
- Tire forces modeled for both hard and soft surfaces
- Driving scenarios to test limit handling in loaded condition



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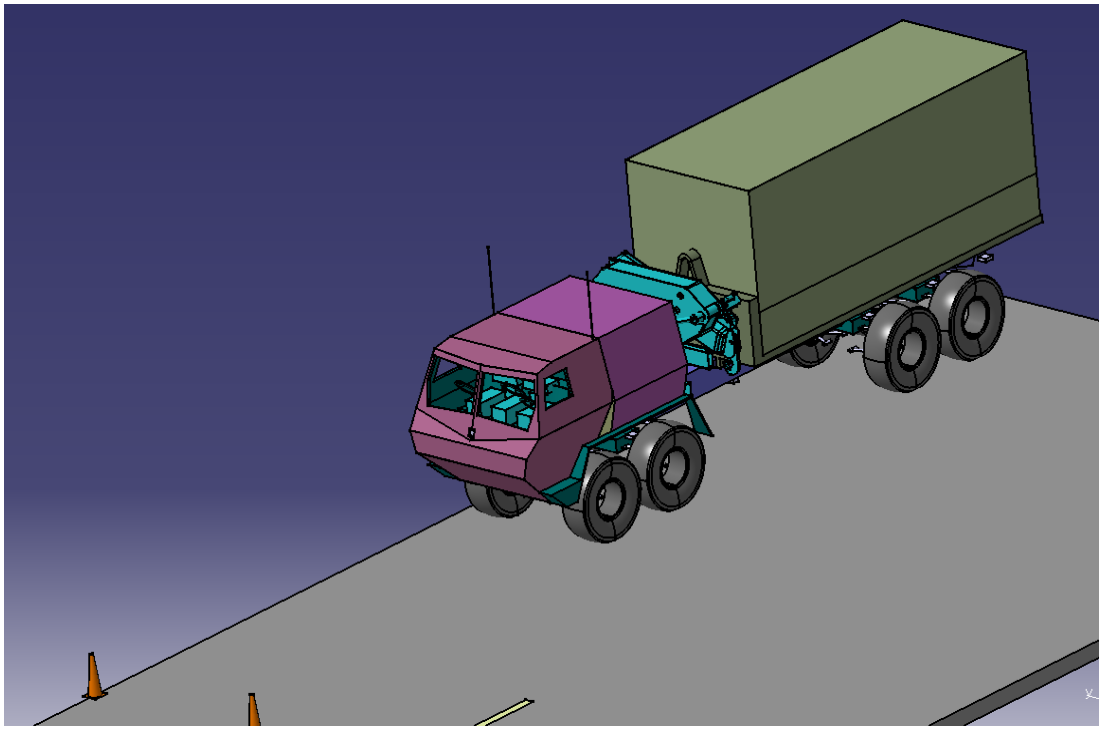
- Lane change stability test
- Predict handling stability and peak roll and lateral accelerations



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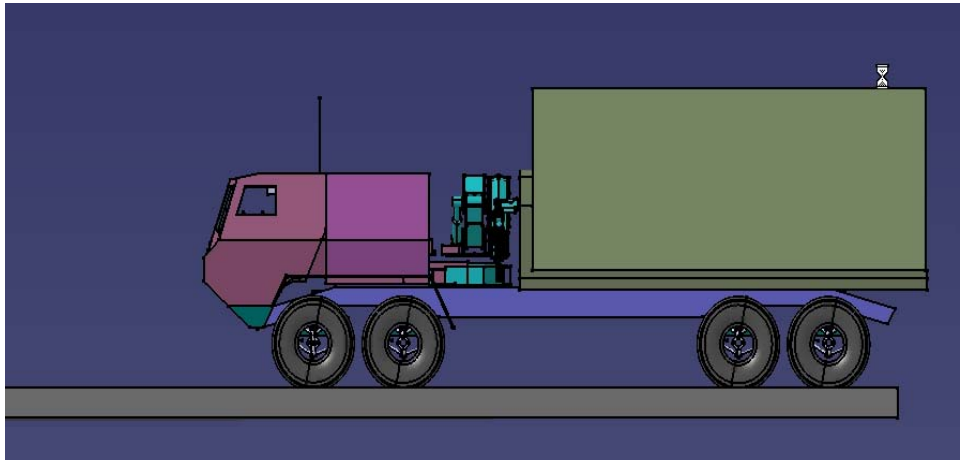
- Predict roll, sliding and dynamic loads
- Verify safe operating limit for field tests
- Avoid dangerous tests that could endanger drivers and prototype equipment



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MSV: Measured and tested to the limits

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Core Team

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- Lessons Learned
  - Value Of The Systems Engineering Process
  - Importance Of Model Validation
  - Benefits To BAE Systems
  - Benefits To The Customer

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