Georgia Tech Research Institute
Problem. Solved.

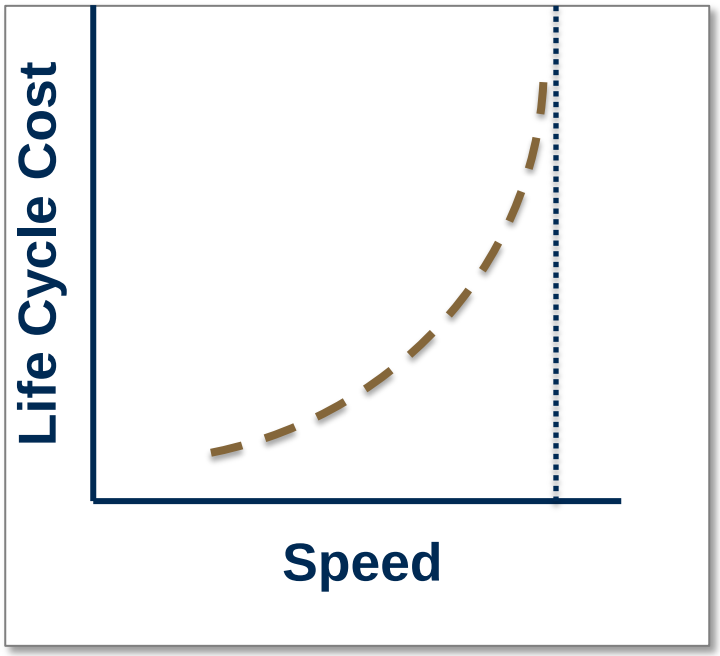
FACT: Enabling Systems Engineering as a Web Service

Daniel C. Browne
Tommer R. Ender, PhD
Georgia Tech Research Institute

LtCol Walt Yates
Michael O'Neal
Marine Corps Systems Command

Impact: Better Informed Decisions

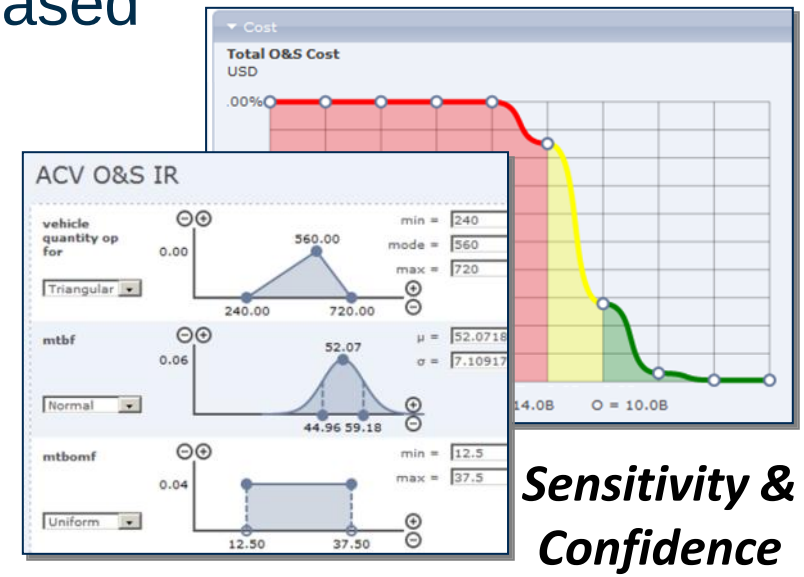
- Novel methodology to help engineers and acquisition professionals
- Understand interactions and identify implications
- Systems of Systems Engineering
- Address Cost and Reliability, Maintainability and Availability
- Manage decision consequences
- Risk Management



FACT enables identification of n^{th}-degree effects of Design Decisions

Framework for Assessing Cost & Technology

- **Collaborative Development:** browser-based tool enables analysis as a web service
- **Performance:** "black box" approach to performance models integration through metadata interface
- **Cost:** acquisition cost estimating relationships and trusted O&S cost model
- **Model Based Sys Eng:** Leveraging SysML and accepted systems engineering standards



Sensitivity & Confidence Analysis

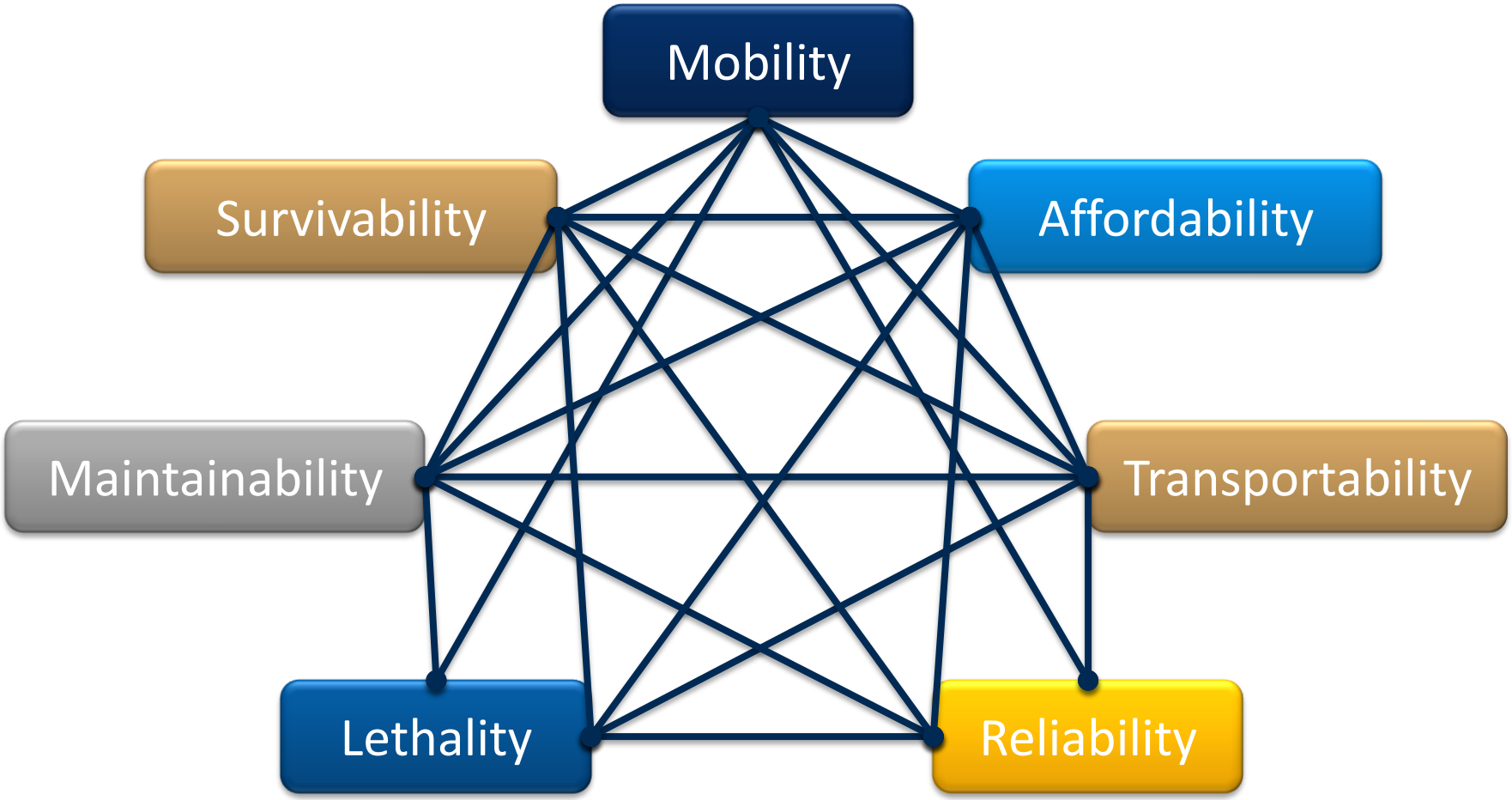
Dynamic Vehicle Comparison

	Alternative 1	Alternative 2
Land Range at Cruise (300.00 – 400.00)	243.83 mi	409.58 mi
Max Swim Speed (8.00 – 12.00)	7.89 mph	10.30 mph
Max Water Speed at 1' SWH (8.19 – 17.48)	3.47 knot	5.31 knot
Minimum HP Required to Maintain S (727.65 – 300.00)	670.20 hp	603.21 hp

Collaborative In- Browser 3-D Manipulation

Motivation

- The iterative process of engineering design followed by an analysis of cost and reliability is slow and inefficient



FACT Architecture Goals

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- Leverage DoD standards for discoverable and sharable data and services
- Services oriented approach for easy access and new functionality
- Unconstrained flexibility in model selection
- Effective configuration management to promote visibility of services and data via metadata standards
- Data sources and services pedigree according to VV&A best practices
- User Education on capabilities and technical foundations

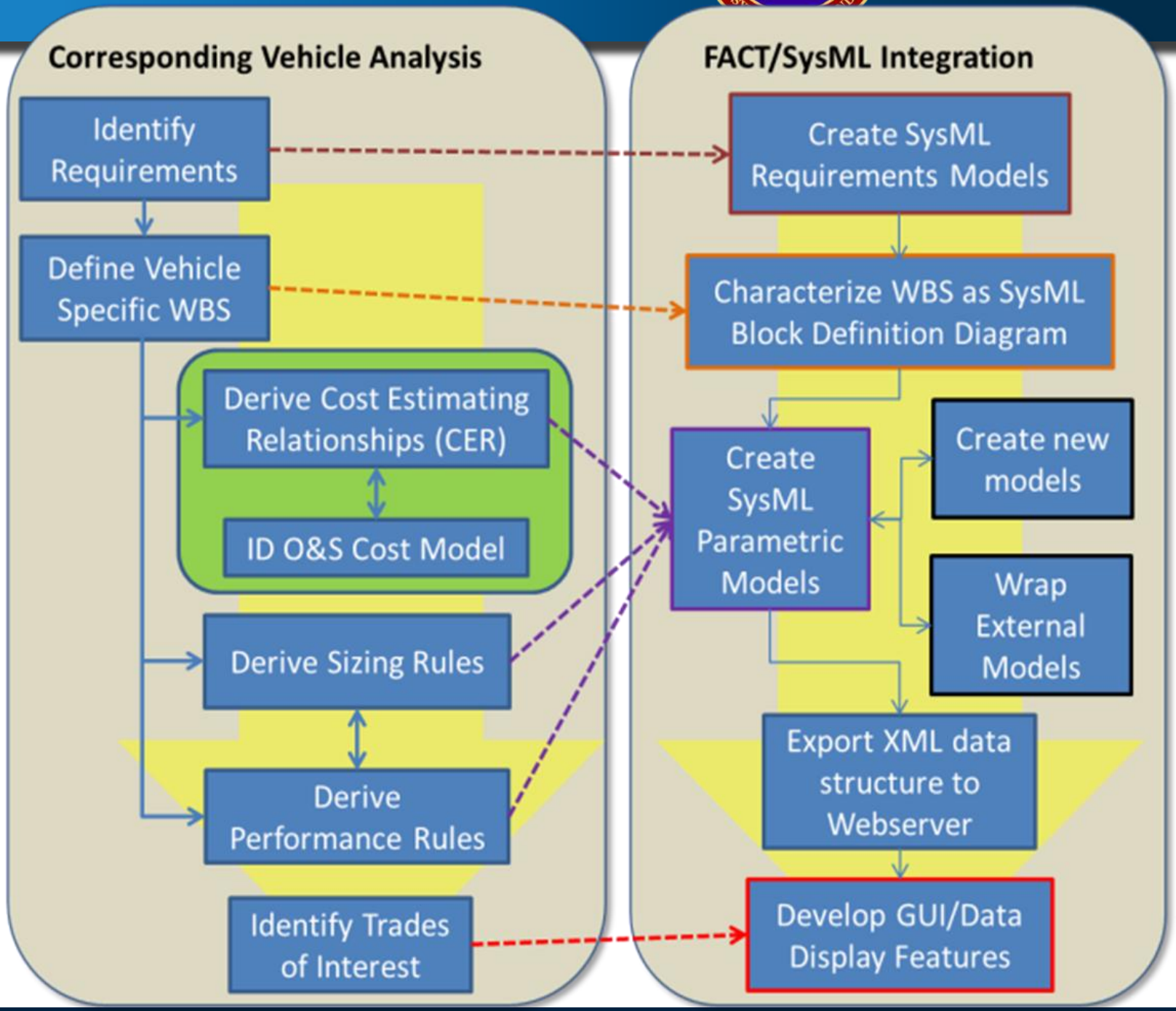
Enable Systems Engineering as a Web Service

Architecture Considerations

- **Scalability:** increasing numbers of concurrent users
- **Performance:** near real-time experience
- **Persistence:** future retrieval
- **Data homogenization:** standards-based approach
- **Computational engine:** agnostic to underlying models
- **Collaboration:** user's viewing same data in real-time
- **Redundancy:** rapid access to data and backup
- **Client footprint:** (near-)zero client install

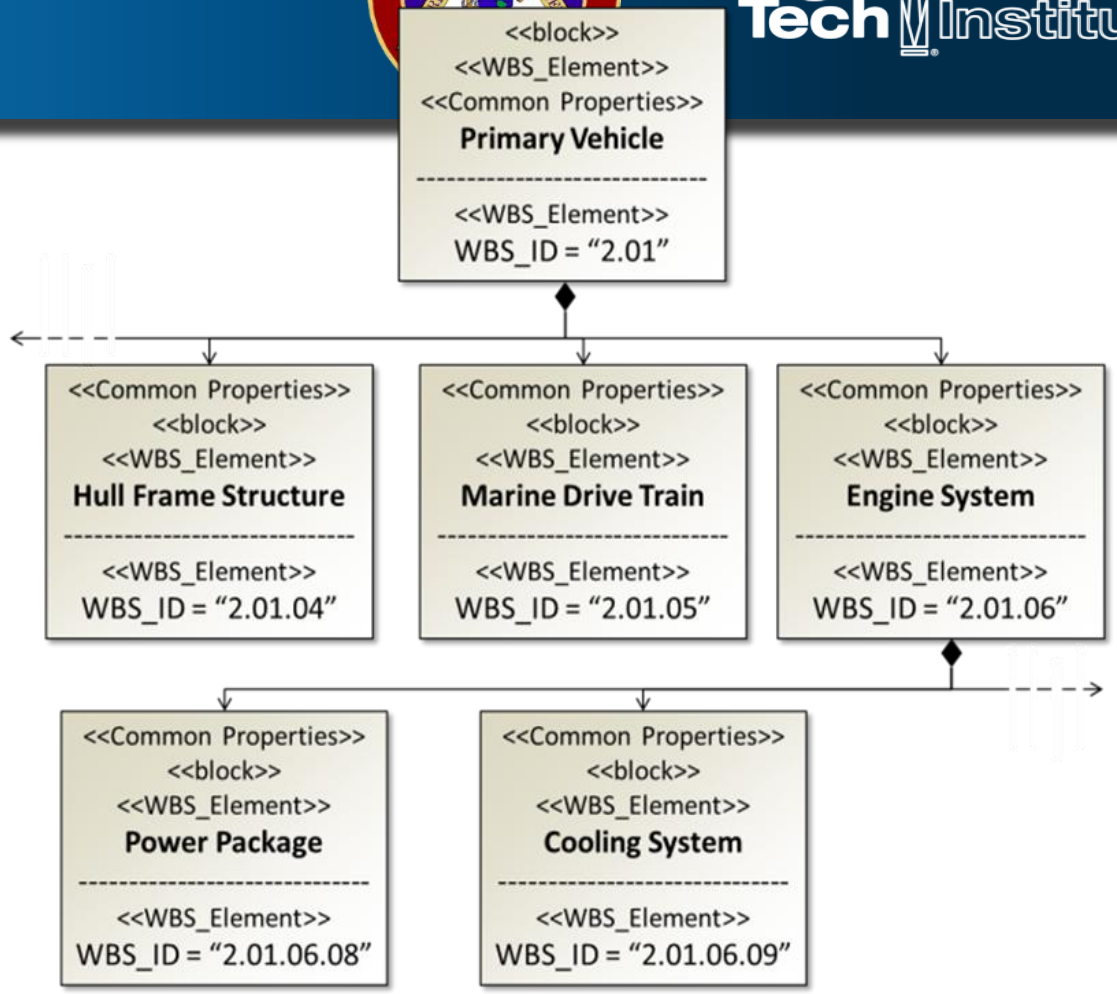
Extensible framework allows for wide variety of applications

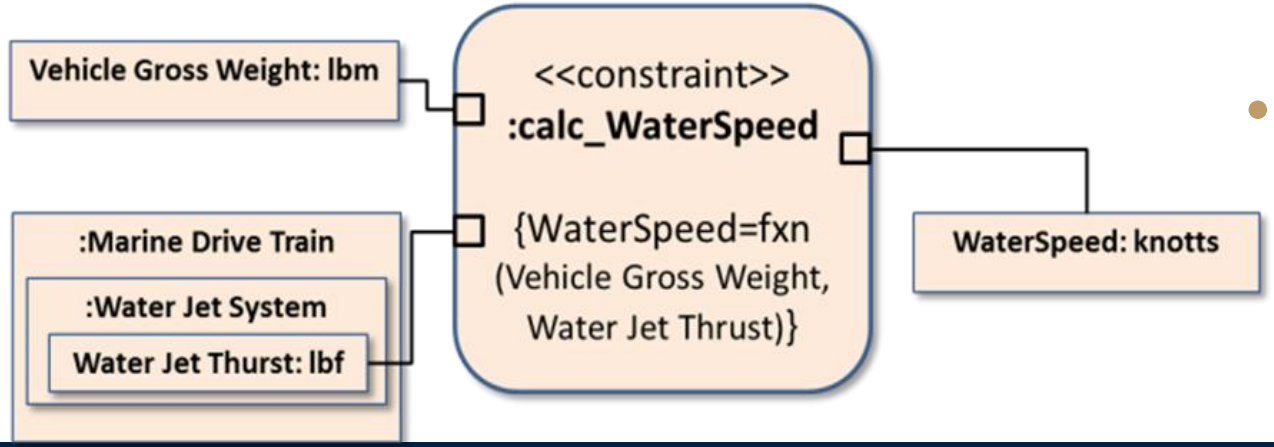
System Properties as SysML Models



System Characterization

- Block Definition Diagrams used to represent physical decomposition as per MIL-STD-881A

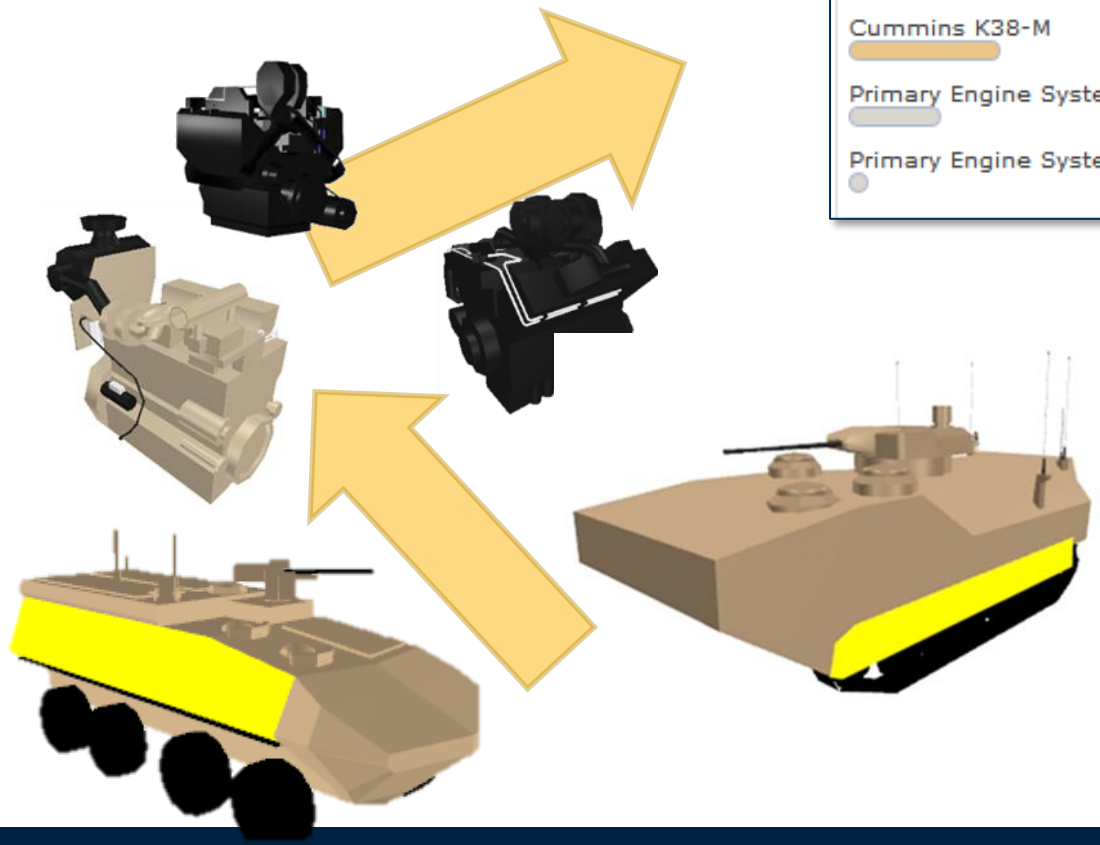


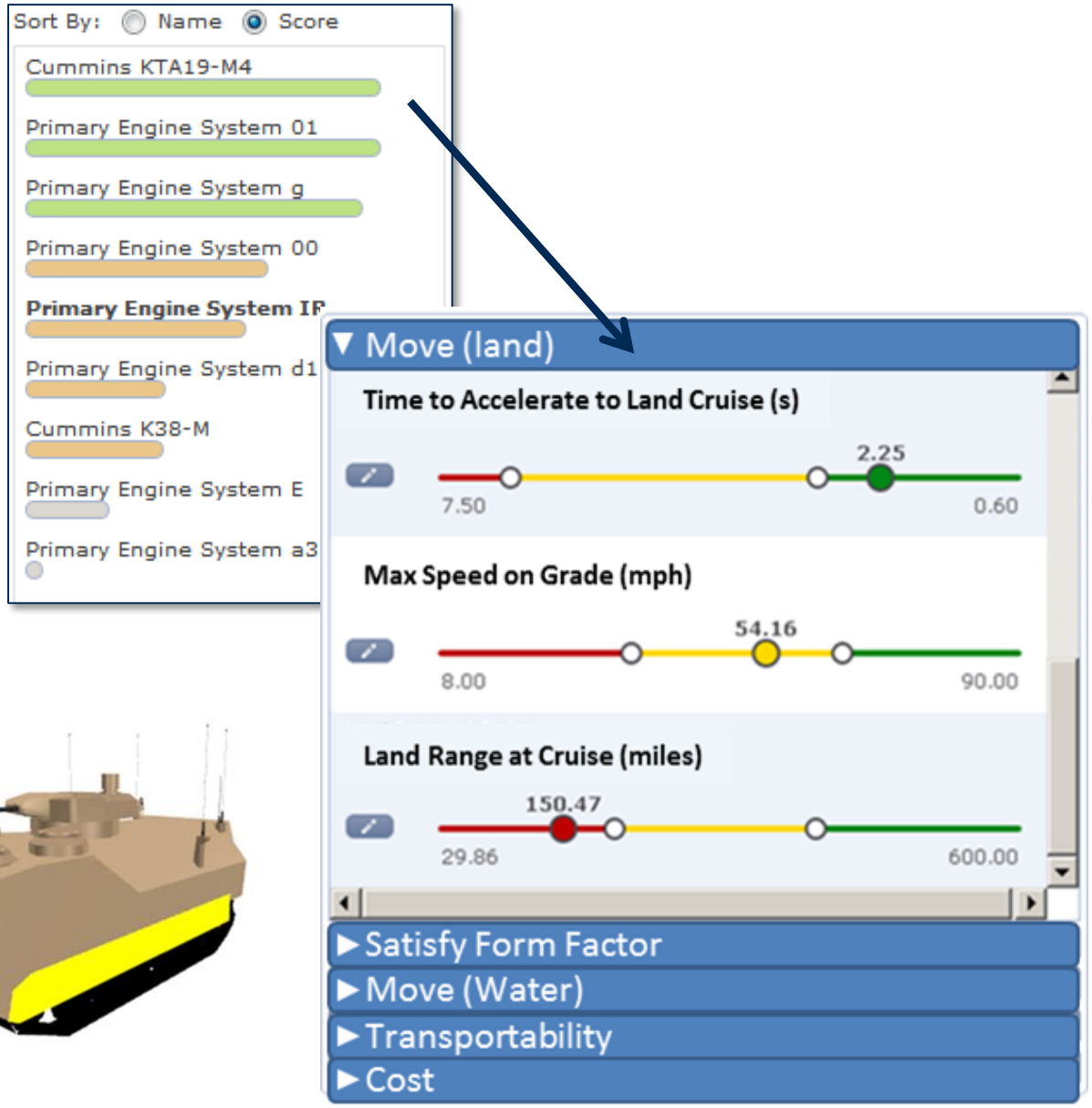


- Parametric Diagrams capture performance relationships

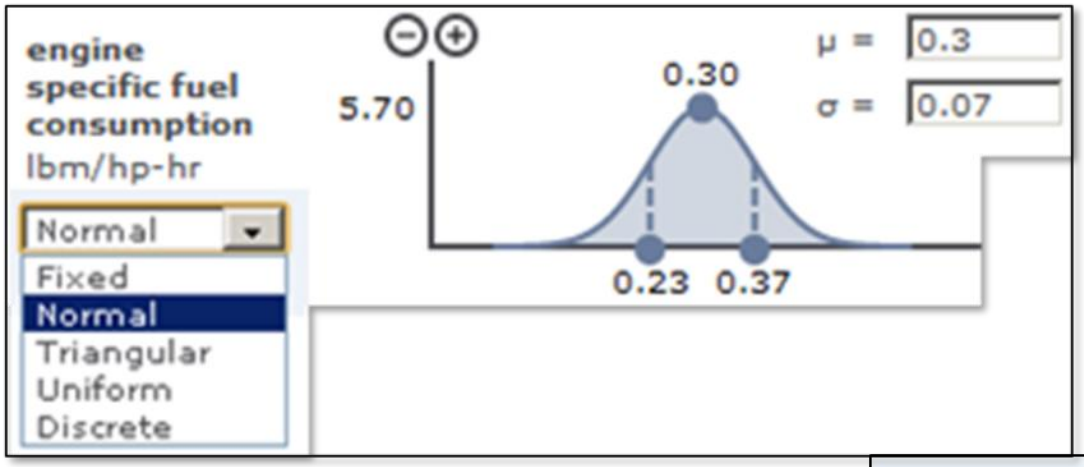
Point Solution Configuration

- Configure systems from the “bottom up”
- Quickly assess impacts on metrics



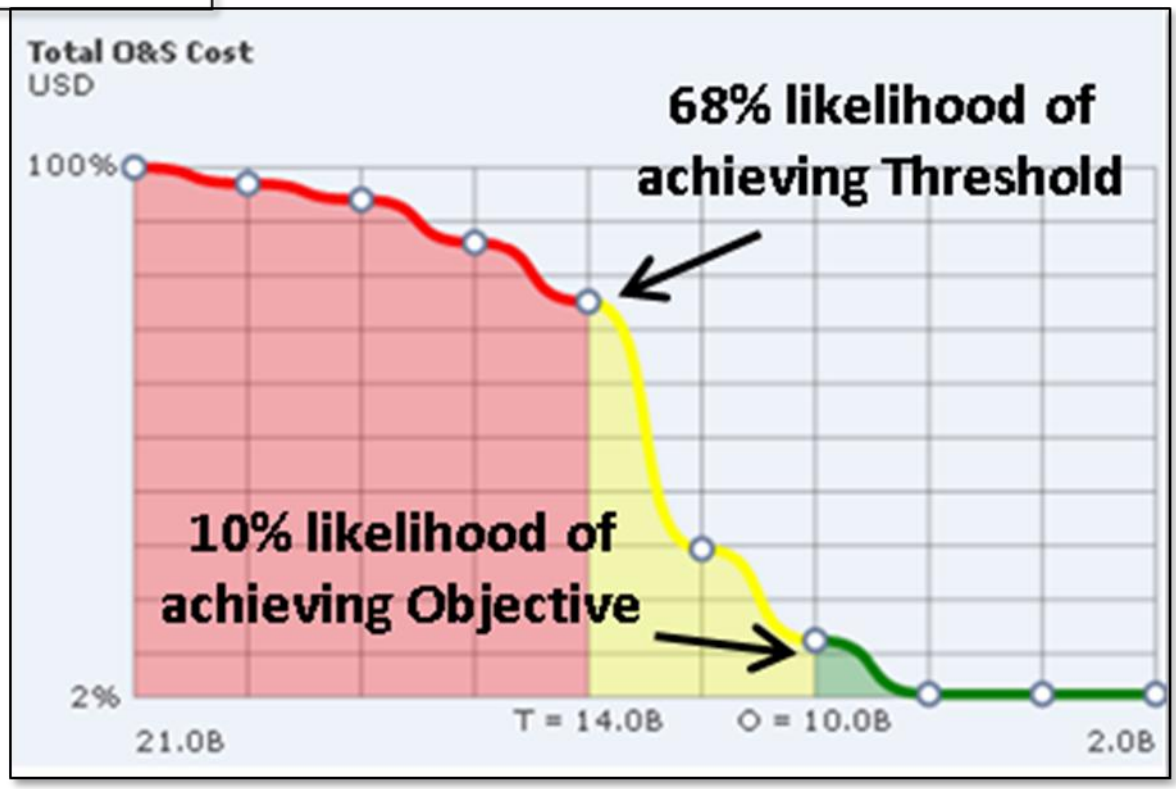


Tradespace: Confidence Analysis



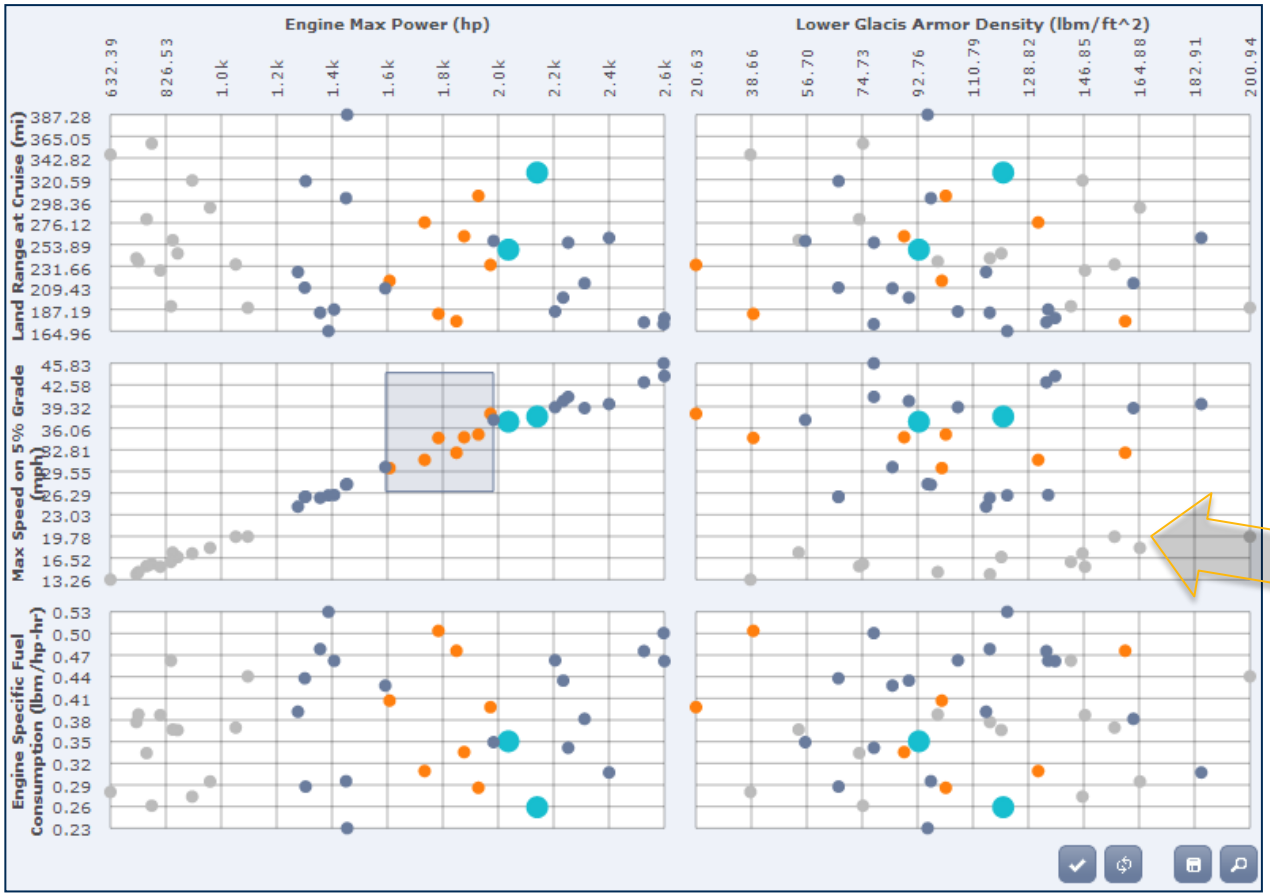
- Subject Matter Expert distributions applied to variables of interest
- Monte Carlo Sampling

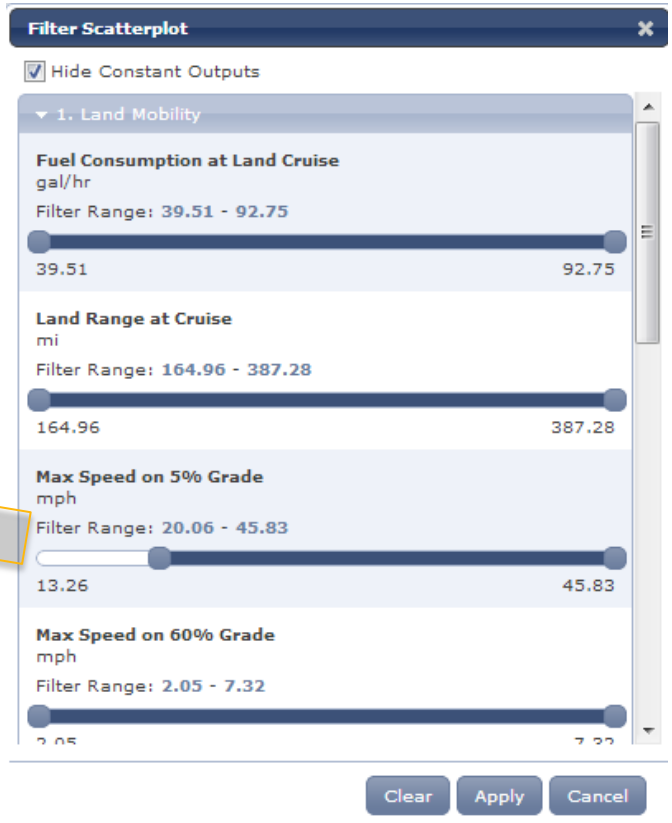
- Probability (PDF) and Cumulative Distribution Functions (CDF) quantify uncertainty of reaching thresholds and objectives



Tradespace: Scatterplot

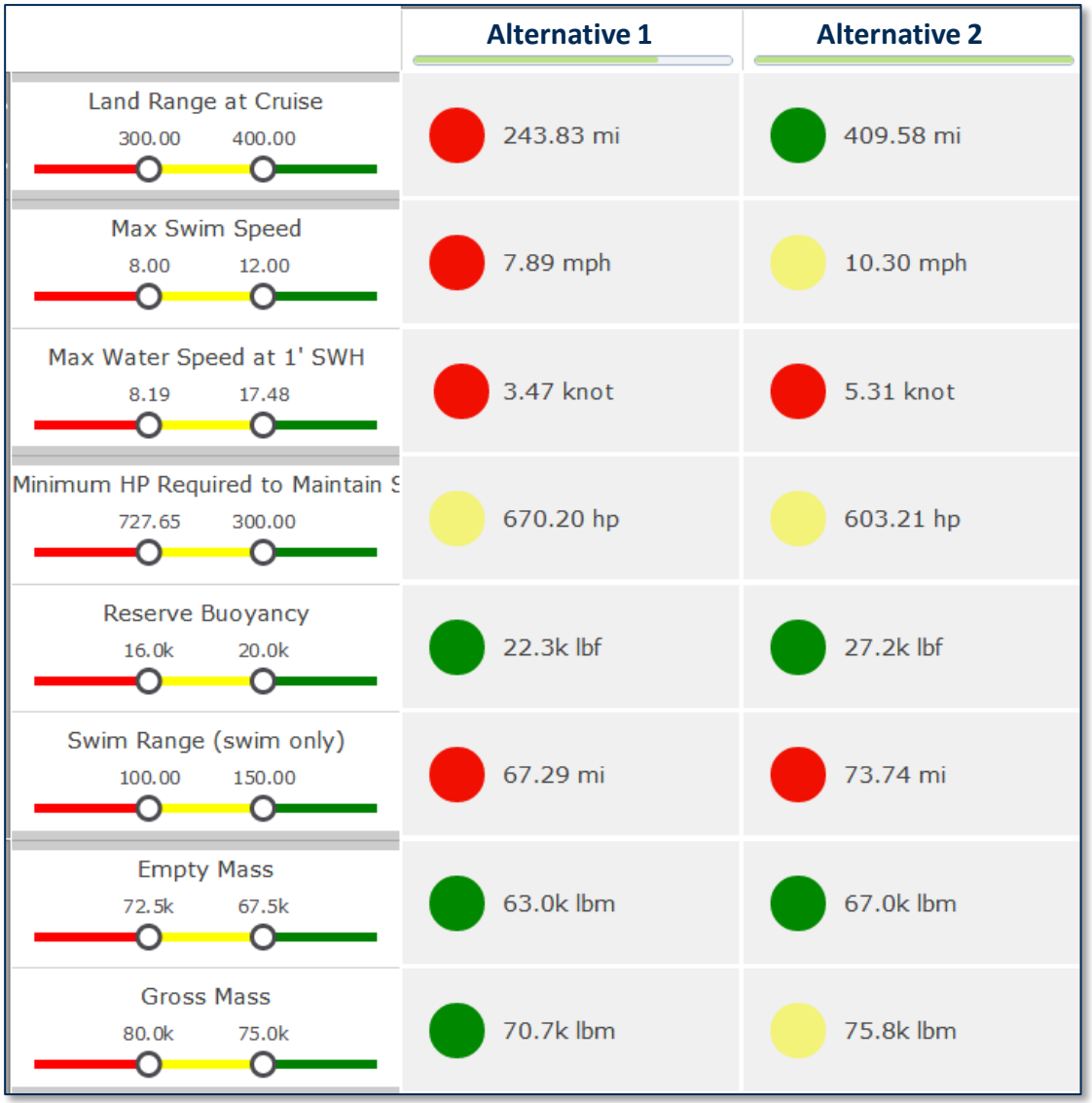
- Same SME inputs as Confidence Analysis
- Filter solutions “top down” by requirements
- Save configurations for comparison





Comparing System Alternatives

- Standard stoplight chart lists all requirements as rows and alternatives as columns
- Utilizes collaborative capability by updating requirement thresholds and objectives, alternative output metrics, and requirement importance in real-time



Contributions

- Government owned framework based on open source software and open standards
- Traceable capability across life cycle
- Trade space analysis during system concept development and guiding technology development
- Metadata to discover and leverage assets and to enhance interface interoperability
- Real-time decision maker collaboration
- Provides a basis to address the “should” and “will” cost questions

Conclusions

- Open architecture web service to provide rapid exploration of design tradespace
- SysML standard to characterize any system and process
- Collaborative web-browser framework for near real-time analysis
- Design parameter trades including performance, reliability, and cost of a system design

Next Steps

- Develop open source collaborative development framework
- Integration with Decision Component Registry modeling and simulation catalogue
- Apply open source distributed version control software and tools
- Apply methods and processes inherent within FACT beyond ground vehicles




Contact

Daniel C. Browne
FACT Software Lead
Georgia Tech Research Institute
daniel.browne@gtri.gatech.edu
404-407-7264

LtCol Walt Yates
Project Manager, FACT
Marine Corps Systems Command
william.yates@usmc.mil
703-432-3791

Tommer R. Ender, PhD
GTRI FACT Project Manager
Georgia Tech Research Institute
tommer.ender@gtri.gatech.edu
404-407-8639

Michael O'Neal
M&S Lead
Marine Corps Systems Command
michael.oneal1@usmc.mil
703-432-4373