

# Framework for Assessing Cost and Technology

*Integrating M&S into the Acquisition process*



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Framework for Assessing Cost and Technology (FACT)  
Integration with HSI  
Roadmap FY16-FY17





# The Framework for Assessing Cost and Technology (FACT)



- **Winner of the 2014 Secretary of the Navy Innovation Excellence Acquisition Team of the Year Award**, introduced a new systems engineering tool into the MCSC.
- FACT enables **rapid trade space and alternatives analysis** in support of United States Marine Corps (USMC).
- It is capable of conducting trade space analysis from Pre-Milestone “A” analysis of alternatives to system disposal.



17 November 2015 – Pentagon Auditorium , Washington D.C., 2014-2015 DON Acquisition Excellence Award Ceremony. "Innovation Excellence Acquisition Team of the Year." Members of Marine Corps Systems Command are presented the Innovation Excellence Acquisition Team of the Year award presented by The Honorable Sean J. Stackley and Chief of Naval Operations (CNO) Admiral John Richardson.  
Photo (Left to Right) Mr. Smerchansky (SES), The Honorable Sean J. Stackley, BGen Shrader, Capt J Lujan, Jane Bachman, John Raisbeck, Luis E. Velazquez, Tyson Kackley, Alexander Solomon, Maj J. Reynolds, Mike O'Neal, Chief of Naval Operations (CNO) Adm. John Richardson (Photo Steven Vozzola, Pentagon)



# FACT Capability Overview



Cost Model  
(Acquisition  
& LCCE)

Fuel  
Consumption

BOM / MAS  
Component  
Summation

...

...

Agnostic Model Interface

## Framework for Assessing Cost and Technology

### Capture Knowledge

Conceptualizing  
the System

Conceptualizing  
the Needs

Defining Part  
Interdependencies

### Execute Models

Monte Carlo  
Simulation

Automatic System  
Assembly

Concurrent  
Execution

### Collaborate

Near Real-Time  
Feedback<sup>†</sup>

Specific User Control  
& Permissions

Archived Changes &  
User Communication

### Visualize Data

Dynamic Data-  
Driven Displays

Intuitive Interactive  
Interfaces

Statistical &  
Visual Analytics

Extensible Data Interface

...

MRDB

MRDB Export

Static  
Visuals

...

...



\* There can be multiple models within these generic categories, e.g., cost models for both the life cycle and acquisition, each being its own "peg"

<sup>†</sup> Requires integrated models to be executable in near real-time



# Web Browser Interface



Mozilla Firefox Start Page - Mozilla Firefox

File Edit View History Bookmarks Tools Help

www.fact.gov (notional)

Home Configure Point Solution Design Tradespace Manage Vehicles Compare Vehicles Conduct Sensitivity Analysis

### Component Configuration

Car Domain

- Car
  - Tire
  - Transmission
  - Engine
  - Chassis
- Environment

#### Engine

Air to Fuel Ratio:	0	30	14.6
Throttle:	0	1	0.29
Combustion Wall Temperature:	250	800	400 K
Ivc:	100	300	53 deg
D_v:	0	150	41.2 mm
Exhaust Gas Pressure:	100	300	152 kPa
Ivo:	0	180	11 deg
Number of Cylinders:	1	12	6
Stroke:	0	250	78.8 mm
Mass:	0	500	300 kg
Conrod:	0	250	115 mm
Compression Ratio:	0	20	9.3

### Vehicle Performance

Acceleration	0	7.14	15	m/sec <sup>2</sup>
Power	0	0.16	0.32	1 kW
Engine Torque	0	30.62	62	Nm
Engine Mass	300	149.84	0	kg
Mass	1000	500	0	kg

### Capsule /Armor Configuration



# M&S/SE Tools Applied Across the Vehicle Lifecycle



Should cost

Will cost

Does cost (Acquisition)



Requirements Rationalization with Cost

Material Solution Analysis

Analysis of Alternatives

- Previous: focus on concept refinement using one-off custom tools
- Introducing Cost and RM&A and extending through life cycle through web-based, evolving tools

**Analysis of Alternatives**  
Rigorous systems engineering process applied to identify alternatives and modeling and simulation to analyze them

**Requirements Definition**  
Conduct requirements feasibility analysis and identify key tradeoffs during material solution analysis phase

**Source Selection**  
Toolset may be used to assist source selection planning

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**Tech. Roadmap**  
Technologies evaluated against functional architecture Requirements during technology development phase

**Inform Acquisition Decisions**  
Modify tools to verify candidate system performance and technologies through M&S enabling contractor oversight

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**Tech. Readiness Assessment**  
Determine if Critical Technology Elements exist and impact system maturity

**Sustainment Support**  
Addition of reliability, logistical, and life cycle cost modeling to support deployment



# Human Systems Engineering Analysis Tool (HEAT)



- Developed under the SBIR Program by Harmonia Holdings Group, LLC, a company with a history building of HSI/Human Computer Interface (HCI) design tools that informed the design of HEAT.
- HEAT, is an **optional software module** installed into FACT for **HSI impact detection, analysis, prediction, comparison, and reporting**.
- HEAT also **catalogs HSI artifacts** (e.g. risks, user feedback, etc.) through a program's lifecycle in a repository to support evidence for final certification and reuse of lessons learned.
- HEAT's support of HSI is **not limited to any platform** and works for any hardware or software system which supports human habitation or provides a human interface (e.g., knobs/buttons, wearable computers, instrument panels in vehicles).



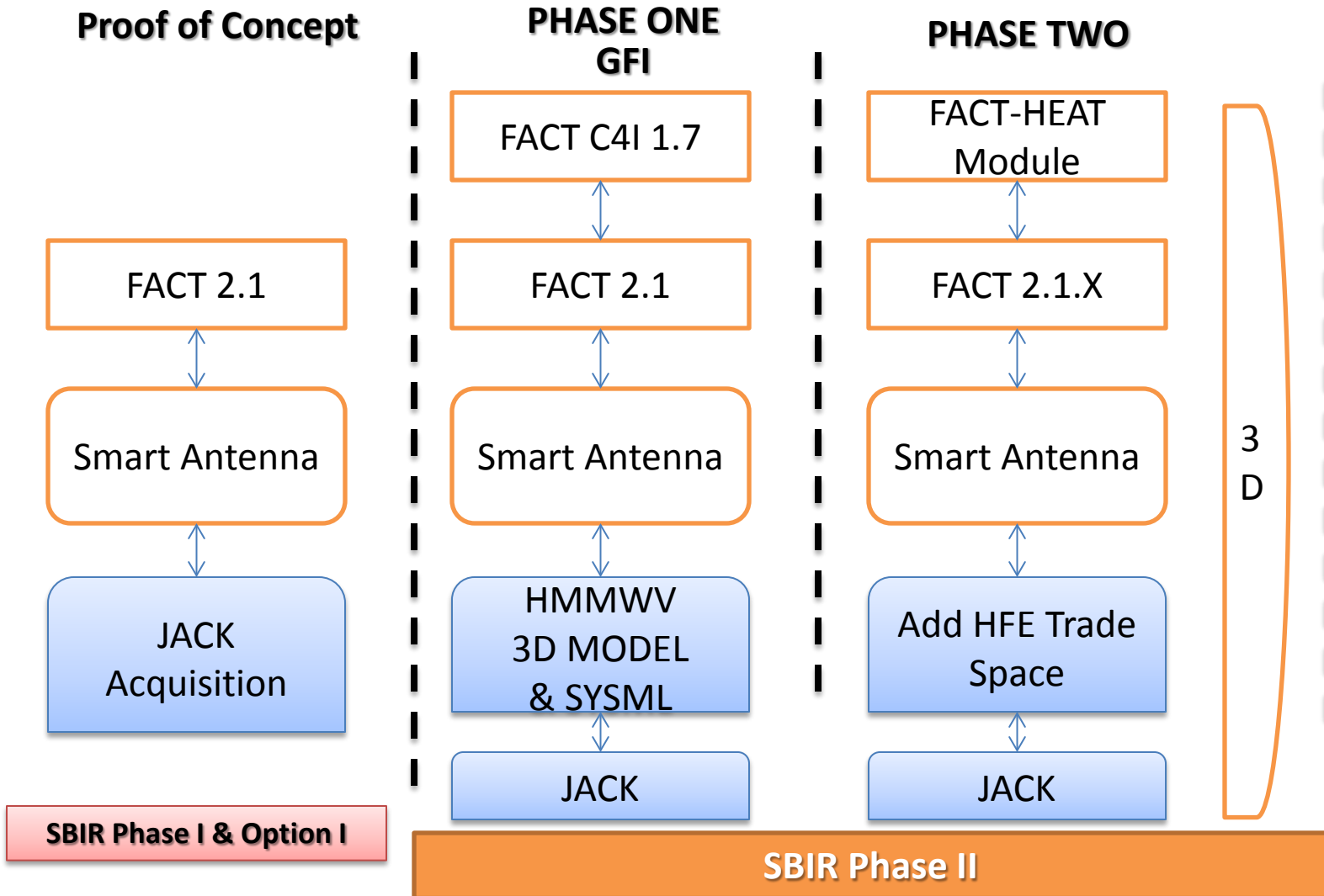
# Use Case



A Naval Engineer is working on the design of a habitable space (e.g. cockpit, workstation, etc.) and wants HEAT to help him check if there are any impacts on an operator in that space.

- The user will load the system's CAD file into CAD JS and click the HEAT button.
- The user will be presented with a mock interface to step him through the rest of the process:
  1. HEAT adds icons in the parts tree that are human-related;
  2. User selects a part (e.g. console) of interest;
  3. HEAT adds a human reservation to the 3D model in the form of a 3D rectangle roughly the size of a 95<sup>th</sup> percentile male to the part;
  4. HEAT centers 3D model on the part with the human rectangle positioned appropriately;
  5. User clicks 'Run collision detection';
  6. User receives visual results.

# Software Integration and Build Continuum





# FACT & HSI

## 120 DAYS FACT 1.7 C4I into FACT 2.1.X

- **Day 1 to 5**
- **15 January**

Developer to Provide 3D CAD Model HMWVV (HMWVV CAD and Step File)

### Day 1 to 30

Developer to review IDE, API, and Coding of existing FACT 2.1

- **Day 30**
- **19 February**

Demonstration and Roadmap

### March

Phase I ends

- **Day 6 to 100**

**Vendor to migrate FACT 1.7 to**

**Develop and document USE Case**

**(FACT with an external model and surrogate modeling)**

- FACT from Concept->WBS->SYSML<->CAD<->STEP FILE<->Python<->AngularJS<->Mongo
- Documentation details concept vehicle being introduced into the FACT framework
- Methodology of decomposing a concept to be integrated into a model such as FACT 2.1.X
- Developer how to connect to the CM CodeBeamer from IDE Eclipse
- Use the Vagrant scripts to build up the version of FACT to the designated version required (CentOS baseline to FACT 2.1.X)
  
- How make changes to python in FACT 2.1.X
- How to migrate a CAD design into FACT
- How to make changes to Angular JS in FACT 2.1.X
- How to map step file data from CAD to the different SYSML and WBS attributes
- How to make changes to MongoDB in FACT 2.1.X
- How to aggregate multiple step file to a designated WBS
- How to manipulate the FACT API to make a data call to the external webservices
- How to conduct testing of the product in FACT 2.1.X
- How to build a surrogate model into FACT 2.1.X

### March

SIAT M&S Division IPR

PHASE

ONE

TWO



# Considerations for a FACT Module Integration in general

**FACT**

**New Module**

**Government**

Provide

FACT User & Developer Accounts

FACT Development Documentation & CM

Users for Usability Testing (Throughout)

Requirements From Domain SMEs

**Developer**

Provide

Detail Requirements

Design

Code

Unit Testing

Usability Testing

Integration Testing

**HSI HPT**

Involvement

Identify New Participant(s)

Cross-Module Participation

Maintaining FACT Module Consistency

User-feedback Integration



**FACT**

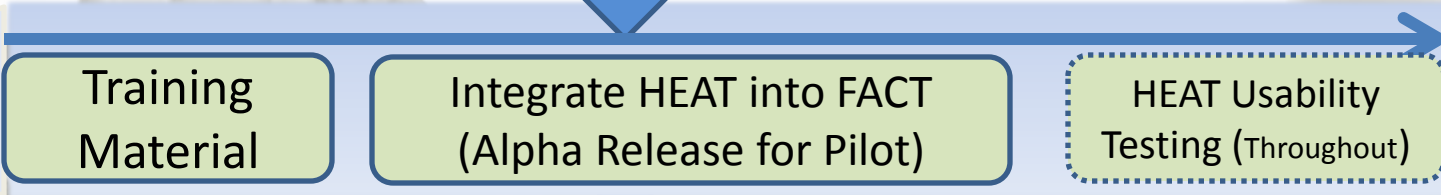
**HEAT  
FY16-FY17**

TBD  
Module

TBD  
Module

**Baseline**

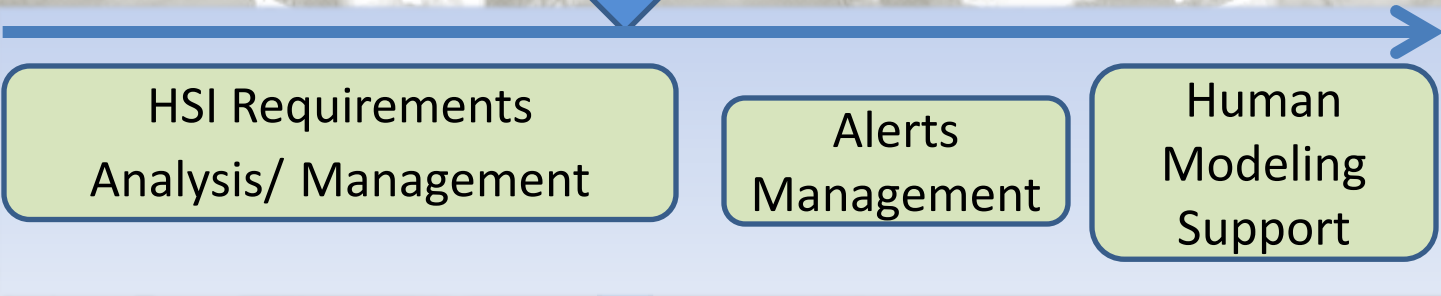
FY16  
QRTs 1-2



**Phase I  
Option**

**Functional**

FY16 QRT 3-  
FY17 QRT 2



**Phase II**

**Extended**

FY17  
QRTs 2-4



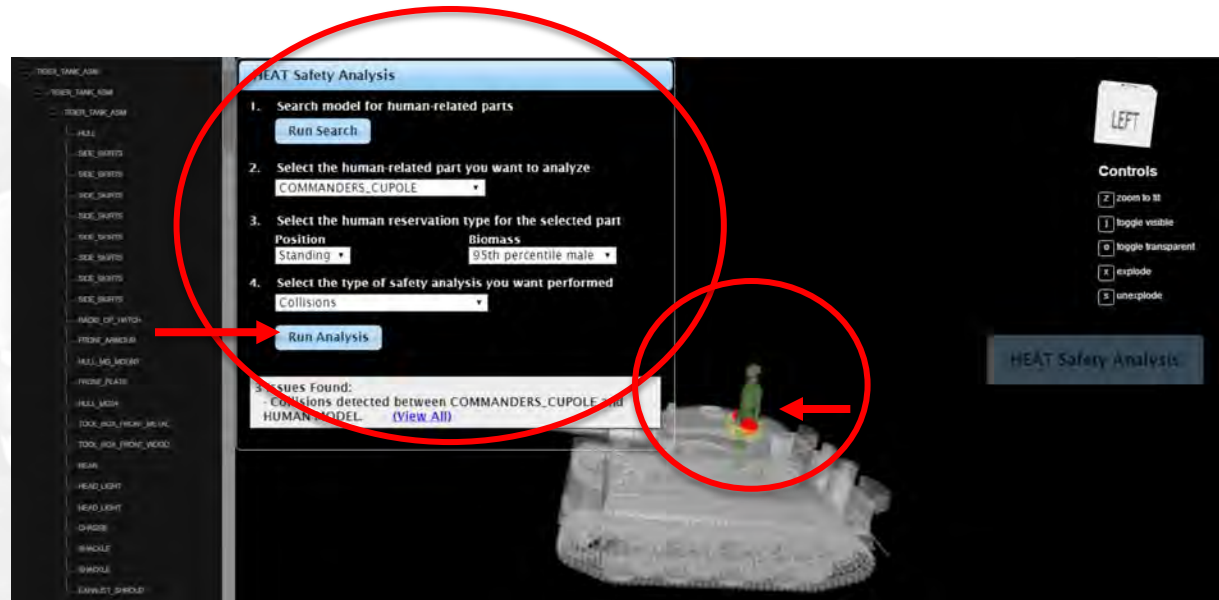
**Phase II  
Option**



# Prototype



- **Select** the type of safety analysis you want to run
- HEAT to **find** what issues it can on its own and utilize an HMT for more precise analysis and for dynamic properties such as movement or fatigue over time
- **Review** the issues found textually and in the model
- Issues would be **logged** in the HEAT repository for lessons-learned



Note: We show multiple choices to illustrate additional types of analysis we COULD investigate for support, but currently the Human Modeling Tool (Jack) provides only collision analysis, though additional manual analysis can be done using some of their dynamic and advanced modules