



When Speed to Market Matters

Operationally Responsive Space



TacSat-1

Operational Experimentation

Technical Exploration
Operational Experimentation
Industrial Expansion

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SYNEXXUS **Operationally Responsive Space (ORS)**

- *Attributes of Responsive Space*
 - Tailorable payload and coverage for emerging operational needs
 - Ability to discretely field relevant assets into denied areas
 - Space assets as an organic part of the joint force
 - Cross-platform mission opportunities
 - Tactical control of payload
 - Low cost / risk tolerant
- ***Tiered System approach... it's not only about the payload***
 - Launch, Range Operations must be *Responsive*
 - Satellite Command & Control needs to be *Accessible*
 - Sensor access must be tactically *Available*

- ∅ The design of modern complex systems requires the means to cope with *uncertainty*.

*Absent an ability to predict the future, today's global challenges demands that a PEO's program possesses the capacity to **adapt** to dynamic conditions.*

*But mere **adaptation** without **relevant analysis** does not provide sufficient feedback.*

- ∅ Embedding into Programs the *impact of flexibility* provides decision makers with means to calculate the *value* of adaptivity within the “*Total System*” design.

- ∅ *Real Options* analysis provided *responsive, adaptive* and *staged decisions* for both executives and engineers when *designing, planning* and *building* networked and / or interdependent components within a complex system.



Ø *Real Options are decision opportunities to invest in, or cancel a Program's 'Real' operating assets. It provides leadership with the ability to change and optimize program management and system engineering choices over time as new information becomes available or as uncertainties are resolved.*

There are four options leadership can choose

1. Hold – continue to fund program as originally planned
2. Modify – continue funding but change the focus of funding
3. Expand – increase the level of funding and scope of project
4. Abandon – stop funding the program

But how does leadership place value on each option?



∅ *Factors that determine the **Real Value** of the program are:*

1. The intrinsic value of each option available or desired
2. The price to fund or continue to fund the program
3. Cost that sponsors are willing to pay
4. The opportunity cost of expenditures in the project
5. The time sponsors need to make a decision to chose an ‘option’
6. The volatility of asset’s value – a measure of how much the value of the program changes over time or uncertain future



- The *Business case*
 - macro and micro level project evaluation decisions regarding the ORS.
- The *Typical user*
 - determine the value of the ORS initiative for tactical and operational decision makers.
- The *Community of users*
 - determine the value of ORS to collective of users at the ‘market’ or ‘enterprise level’.



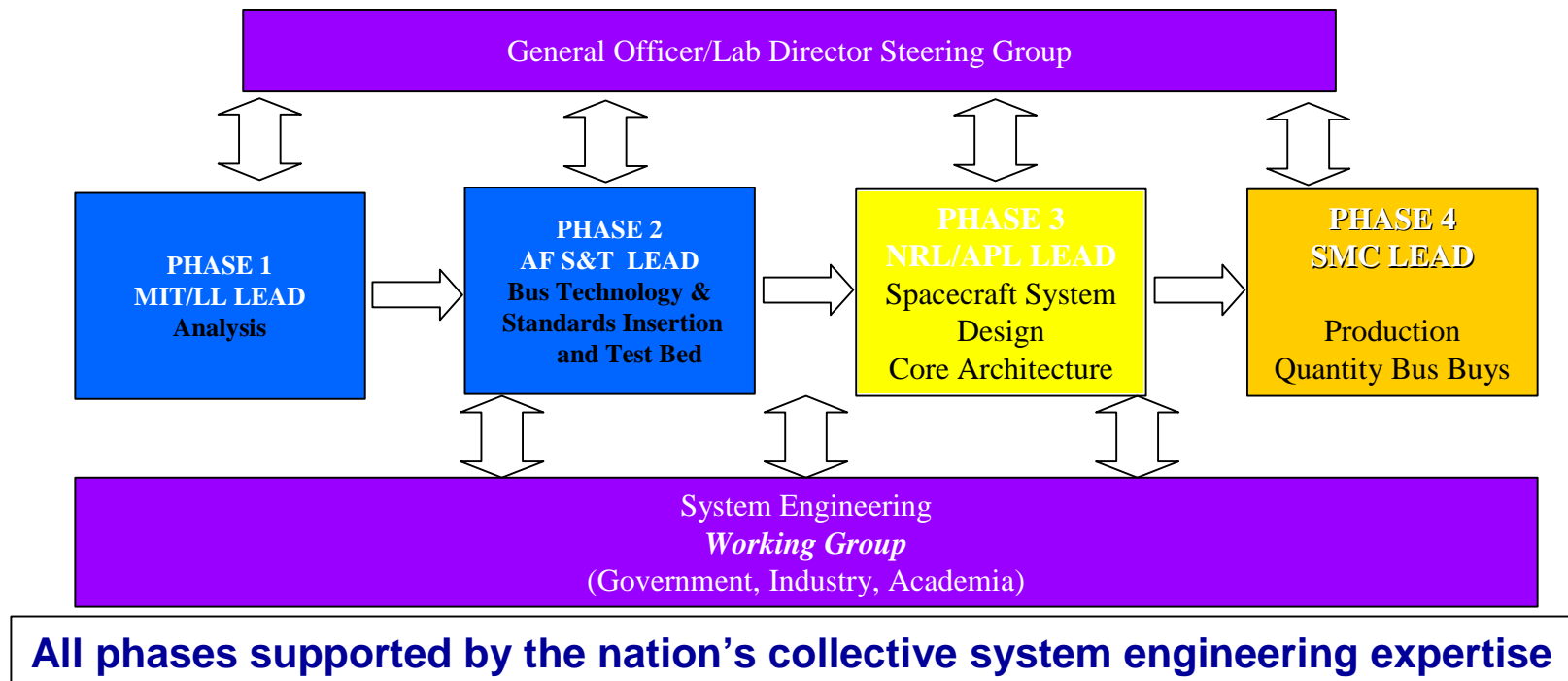
∅ Inputs to ROA

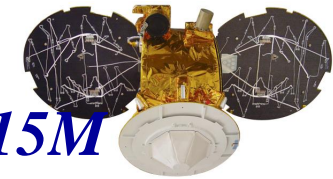
- **Explore** launch options, networks, sensors & bus
 - *Conduct analysis of costs and volatility*
- **Conduct** Limited Objective Experiments
 - *To test technology*
 - *Co-evolve ORS capabilities*
- **Implement** Operational Experiments
 - *To explore community of users and DoD/ DHS acceptance*

ORS Key elements for change

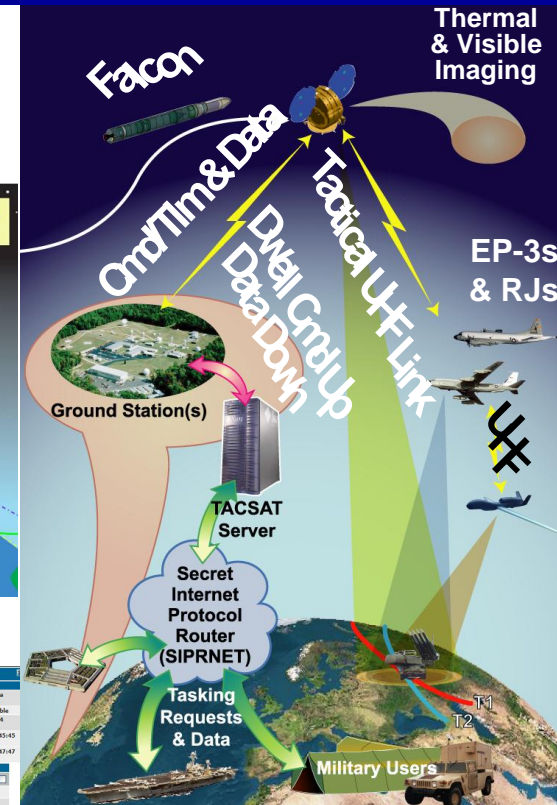
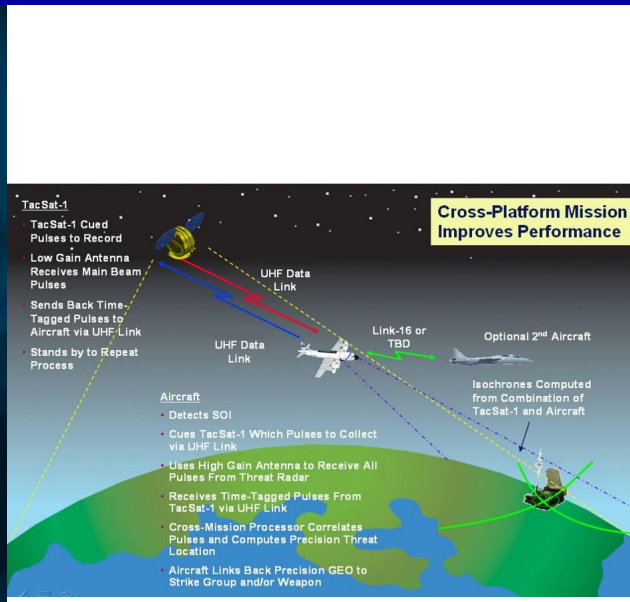
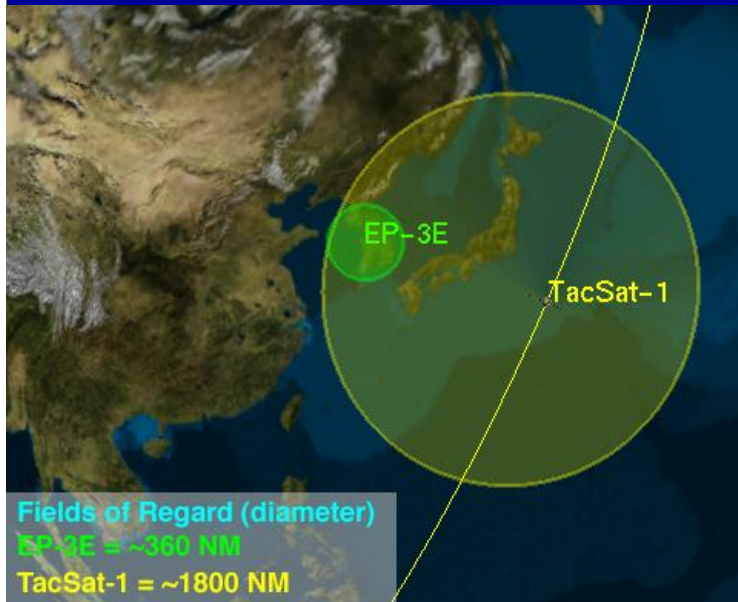
Modular Bus: Four Phase Development

- Phase 1 – **Analysis and Team Building (MIT/LL Led) -- COMPLETED**
- Phase 2 – **Test Bed and Standard Avionics (AFRL Led)**
- Phase 3 – **Gov't / Industry Prototype of ORS System Bus Standards**
 - (Naval Research Lab (NRL) & JHU Applied Physics Lab (APL) Led)
- Phase 4 – **Production Phase (SMC Led)**
 - **Leaderships Coordinated, Working Level Coordination Starting**





Concept to Operational Market - 12 Months / \$15M



UNCLASSIFIED

Home | Browse Data | Request Data | Information | Help

Username: Password:

Remember me Log On

Already registered? Get fast and easy access to your data - anytime, anywhere. Local host

Not registered? Register now

EP-3E and RJ direct access to TacSat-1 for real time RF collection

VMOC - Virtual Mission Operation Center for the Multi Sensor Network

VMOC is sponsored by **Force Transformation** Department of Defense

Why should you join VMOC?

- Tactical Access to Space
- SEI and AIS data collected from sea nodes
- Subscribe to data feeds
- User Collaboration
- Eliminate Information and Organizational Barriers

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UNCLASSIFIED

Advanced Search

Latitude DMS: Longitude DMS:

Search

Latitude DMS: Longitude DMS:

ELNKE HAWKBYE HAWKBYE
 CROMLEY FLAGKEMME SLEDEL
 MAPLAN NEWORLEANS
 MORRAN CRT

Capture Coordinates

Upper Left Latitude (DMS): 20 24 47 N Upper Left Longitude (DMS): 85 43 0 W
 Upper Right Latitude (DMS): 28 37 12 N Upper Right Longitude (DMS): 91 47 24 W

Target Lightings: Day

Comment:

Tag:

Note: This request will get all passes over the next 30 days

Submit#61302912 Jul 05
 Submit#61302912 Jul 05
 Submit#61302912 Jul 05
 Submit#61302912 Jul 05
 Submit#61302912 Jul 05
 Submit#61302912 Jul 05

Request Data

Task Name: Daytime image over New Orleans

Satellite: TacSat-1

Sensor: Visible

Configuration: Visible Image

Target Region: 30.0423 N 90.051 W

Upper Left Longitude (DMS): 85 43 0 W
 Lower Right Longitude (DMS): 91 47 24 W

Request Results

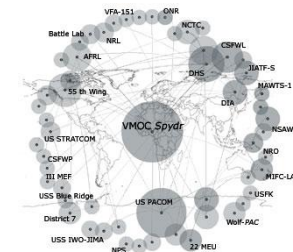
Task Name	Daytime Image over New Orleans	Target Region	Area
2607042 OCT 05 00:21	Visible Image	30.0423 N 90.051 W	18.48
2708482 OCT 05 00:43	Visible Image	30.0423 N 90.051 W	13.88
2804292 OCT 05 00:50	Visible Image	30.0423 N 90.051 W	8.73
2904052 OCT 05 00:51	Visible Image	30.0423 N 90.051 W	2.8
3119222 OCT 05 00:08	Visible Image	30.0423 N 90.051 W	33.61
0115012 NOV 05 00:35	Visible Image	30.0423 N 90.051 W	28.86
0214412 NOV 05 00:48	Visible Image	30.0423 N 90.051 W	43.63

Available Observation Passes (Please select)

Task Name	Daytime Image over New Orleans	Target Region	Area
1908462 OCT 03	Scheduled	0588	%
1916102 OCT 05	Scheduled	0592	%
0223022 OCT 05	Scheduled	0231	%
0229492 OCT 05	Scheduled	0230	%
3118392 DEC 49	Scheduled	0236	%
3118592 DEC 49	Scheduled	0235	%
3118392 DEC 49	Scheduled	0234	%



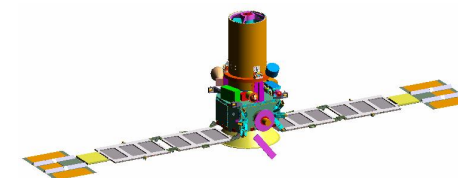
Technical & Operational Objectives



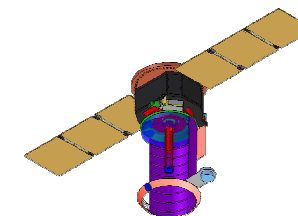
- TacSat-1
 - Navy Led Experiment for OSD\OFT
 - Tactical RF Payloads & UHF Cross-Platform Link
 - Low Resolution Visible & IR Cameras
 - SIPRNET Exploitation using VMOC Software
 - Spacecraft: Completed in 1 Year for \$9.3M+Surplus Parts
 - SMC Pathfinding a New Launch Assurance Process
 - Launch: Maiden Flight of Falcon in Spring 2006
- TacSat-2
 - Air Force Led Experiment
 - Tactical Imaging (AF) & RF (Navy) Payloads
 - Tactical CDL & UHF Links
 - Multiple Science Payloads
 - SIPRNET Exploitation using VMOC Software
 - Good Spiral Development. Launch Fall 2006.
- TacSat-3
 - Began First Joint Process for Selection, Led by AFSPC
 - Air Force Led Experiment
 - AF/Army Hyperspectral Primary Payload
 - Navy Secondary Data-X Payload for IP-Based Buoy Comms
- TacSat-4 in Planning Process
 - Navy payload -- “Comms on the Move”/Data-X and BFT
 - Launch 12/07



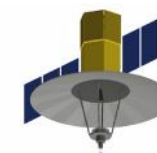
TacSat-1 at NRL



**TacSat-2 / Roadrunner
Picture from AFRL & MSI**



**TacSat-3 Received Go on 10/04
Concept Design from AFRL**



**TacSat-4 in Planning Phase
Early Concept from NRL**

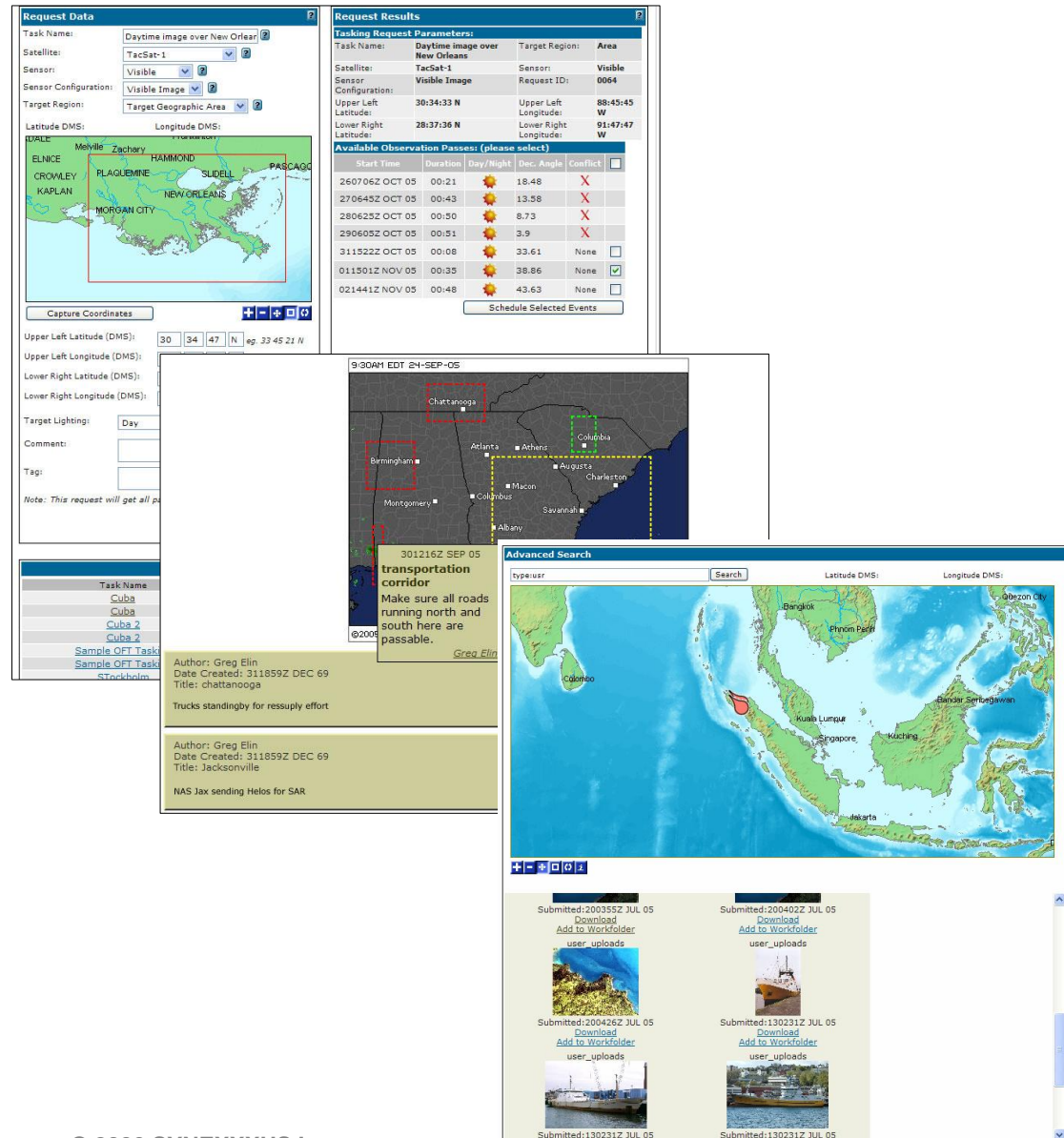


TACSAT Tasking & Collaboration Gateway

Virtual Mission Operation Center (VMOC)

- SIPRNET Site:
 - <http://tacsat.nrl-dc.navy.smil.mil>
- Web Portal to sensors, data and info available on the SIPRNET
 - Task for data
 - Multi-Sensor Capable
 - Retrieve and View data
 - Collaborate & Disseminate data
- Community of users with direct access to sensors independent of organizational boundaries
- Sensors that are currently accessible via the VMOC
 - TacSat-1
 - Tethered Aerostat ELINT Payload

- **Subscriptions**
 - Allows for filtering and wide distribution of data
 - View all user subscriptions and data feeds
- **Work Folders**
 - Allows for collaboration of relevant data
 - Access to all Work Folders
- **Annotations**
 - Allows users to add value to incoming data
- **Search**
- **Tasking**
 - Task for Sensor Data
 - Instantly know if tasking request is possible
 - View all tasking requests
 - Collaborate for best sensor management



The screenshot displays the SYNEXXUS web application interface, which is divided into several sections:

- Request Data:** A form for creating a tasking request. Fields include Task Name (Daytime image over New Orleans), Satellite (TacSat-1), Sensor (Visible Image), Target Region (Target Geographic Area), and a map of the New Orleans area with a red bounding box. It also shows coordinate input fields for Upper Left and Lower Right Latitude/Longitude, Target Lighting (Day), and a Comment field.
- Request Results:** A table showing tasking request parameters and available observation passes.

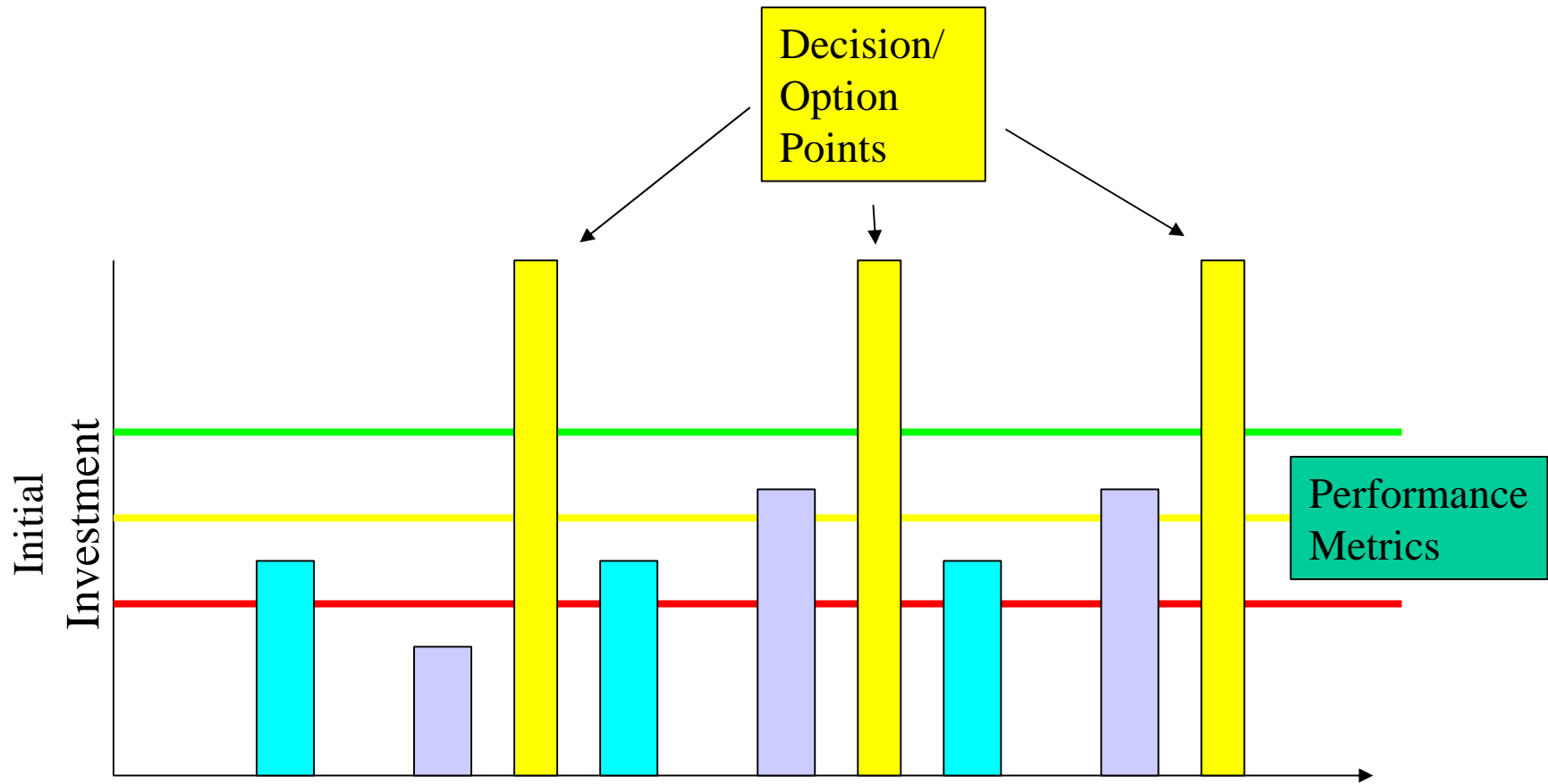
Task Name	Daytime Image over New Orleans	Target Region	Area
Satellite:	TacSat-1	Sensor:	Visible
Sensor:	Visible Image	Request ID:	0064
Configuration:		Upper Left Latitude:	30:34:33 N
		Upper Left Longitude:	88:45:45 W
		Lower Right Latitude:	28:37:36 N
		Lower Right Longitude:	91:47:47 W

Start Time	Duration	Day/Night	Dec. Angle	Coefficient
260706Z OCT 05	00:21		18.48	X
270645Z OCT 05	00:43		13.58	X
280625Z OCT 05	00:50		8.73	X
290605Z OCT 05	00:51		3.9	X
311522Z OCT 05	00:08		33.61	None
011501Z NOV 05	00:35		38.86	None
021441Z NOV 05	00:48		43.63	None
- Advanced Search:** A search interface with a map of Southeast Asia showing various cities like Bangkok, Pinon Perai, Kuala Lumpur, Singapore, Kuching, Bander Serbagawan, and Jakarta. It includes input fields for Latitude DMS and Longitude DMS.
- Annotations:** A map of the Southeastern United States with a red box around Chattanooga. A text annotation reads: "301216Z SEP 05 transportation corridor. Make sure all roads running north and south here are passable. Greg Elin". Below the map, there are two author entries:
 - Author: Greg Elin, Date Created: 311859Z DEC 69, Title: chattanooga, Trucks standingby for resupply effort.
 - Author: Greg Elin, Date Created: 311859Z DEC 69, Title: Jacksonville, NAS Jax sending Helos for SAR.
- Task List:** A table listing task names and their authors:

Task Name	Author
Cuba	Cuba
Cuba	Cuba
Cuba 2	Cuba 2
Cuba 2	Cuba 2
Sample OFT Task	Sample OFT Task
Stockholm	Stockholm
- Image Gallery:** A grid of six image thumbnails, each with a "Download" link and an "Add to Workfolder" link. The images show various scenes, including a boat and a landscape.



- Ø ***Gain / maintain joint maritime superiority***
- Ø ***Show-case tactical access to space***
- Ø ***Incorporate / Correlate with existing C4I systems***
- Ø
- Ø ***Develop concepts of operations***



- Expand —
- Hold —
- Abandon —



∅ *Step 1: Build an Investment Decision Tree*

∅

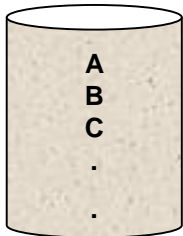
probabilities

∅ *Step 3: Apply a spreadsheet cash-flow model at each tree endpoint*

- *calculate NPV using the risk-free rate and “Roll back” the tree to determine the optimal strategy and its associated value*

1. List of strategies to evaluate

RISK IDENTIFICATION

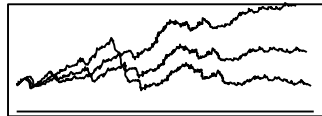


...which have already been through qualitative screening

2. Base case projections for each strategy

RISK PREDICTION

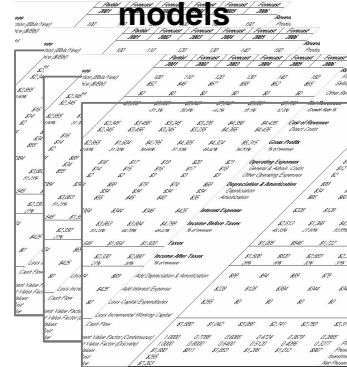
Historical Data Gathering
Time Series Forecasting



...with the assistance of time-series forecasting and historical data...

3. Develop static financial models

RISK MODELING



...generate a series of static base case financial (discounted cash flow) models for each strategy...

Traditional analysis stops here!

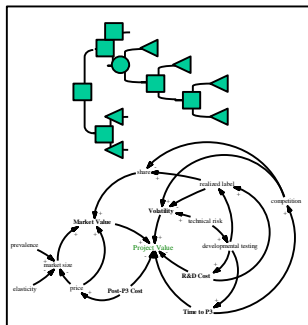
4. Dynamic Monte Carlo simulation

RISK ANALYSIS



5. Frame Real Options

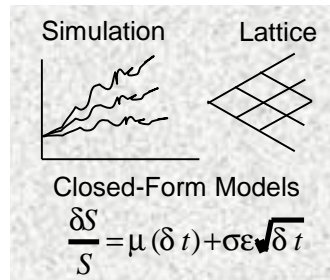
RISK MITIGATION



...the relevant projects are chosen for Real Options analysis and the program or portfolio Real Options are framed...

6. Options analytics, simulation and optimization

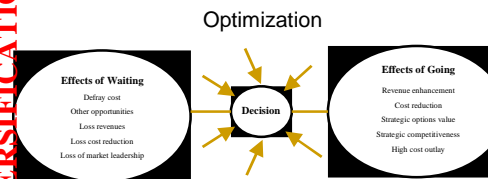
RISK HEDGING



...Real Options analytics are calculated through binomial lattices and closed-form partial-differential models with simulation...

7. Portfolio optimization and asset allocation

RISK DIVERSIFICATION

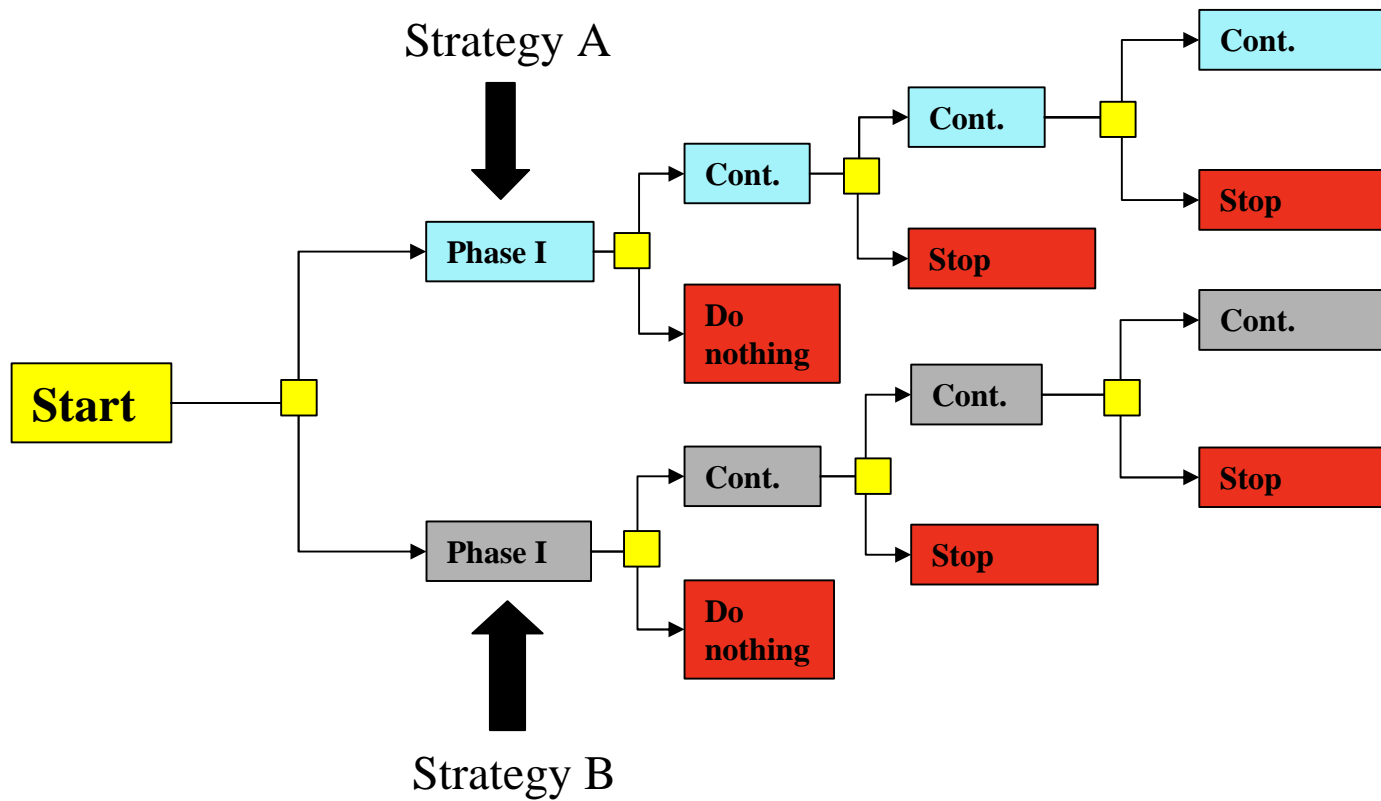


...stochastic optimization is the next optional step if multiple strategies exist that requires efficient asset allocation given budgetary constraints... useful for strategic portfolio management...

8. Report Summary

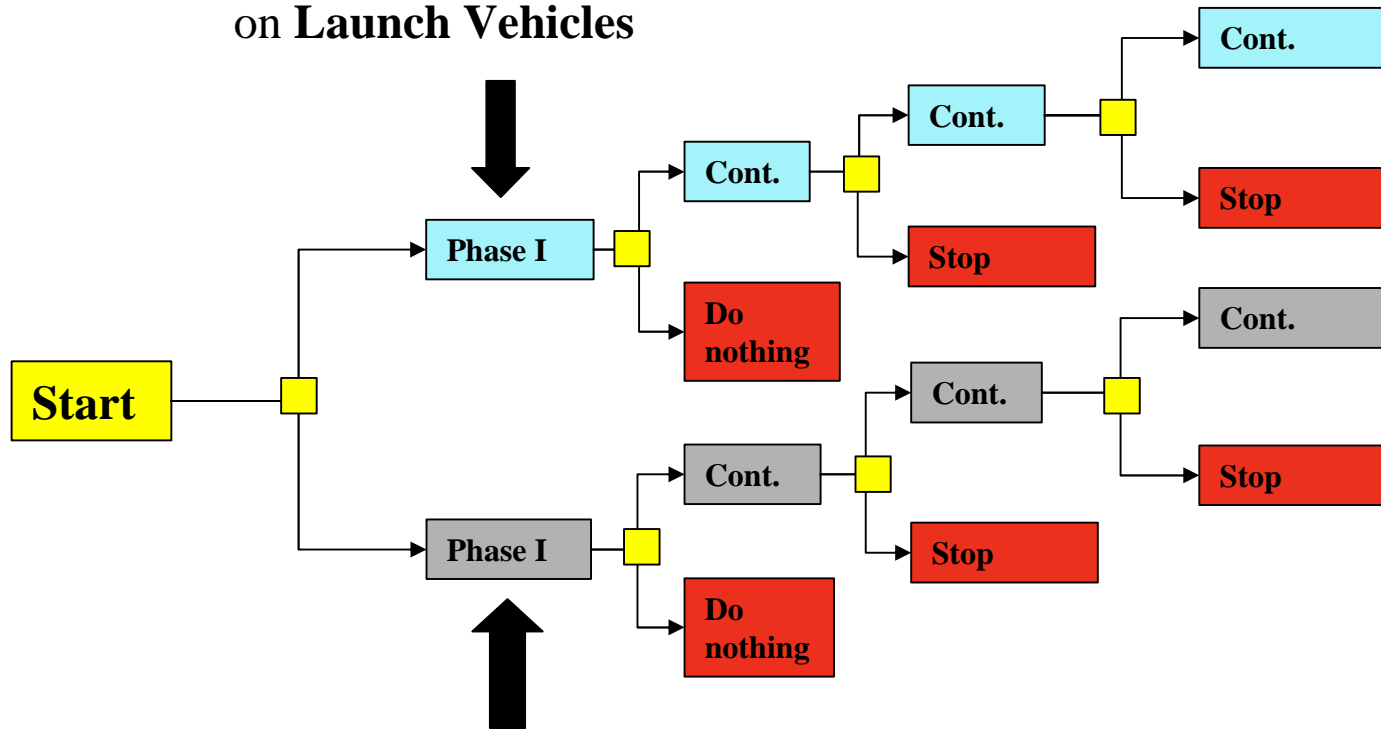
RISK MANAGEMENT

...create reports, make decisions, and do it all again iteratively or use GA...



Decision/
Option
Points

Strategy A: Increase Spending
on **Launch Vehicles**



Strategy B: Increase Spending
on **Sensor Capabilities**

Is the Program
Delivering as
Expected?
Limited
Objective
Experiments,
DoD/ DHS
Exercises

Ø *Step 2: Identify Risks as Public or Private & Assign probabilities*

- *There are several types of **Uncertainty** / **Risk** that are relevant to decisions regarding investing in a capability.*

1. Threat Uncertainty

Arises if we are unsure of the current and/or future demand for ORS

2. Technical Uncertainty

Arises if we are unsure of the functionality of the underlying technology needed to create the ORS

3. Operational Uncertainty

Arises if we are unsure if the Program will have the appropriate capability necessary to fully meet uncertain futures and / or threats.



SpreadSheet

Project Begins at End of Year	0
Current Year	0

Technical Feasibility	
Years Required	4.6
Costs Incurred at End of Year	4.6
Cash Flow	
Research	\$ (12,308)
Design	\$ (13,192)
Experimentation	\$ (12,506)
Professional Overhead	\$ (5,373)
Net Cash Flow	\$ (43,380)
Discounted at COC	\$ (26,800)
Phase Length	
Triangular Distribution	4.6
Minimum	1.0
Likeliest	4.0
Maximum	7.0
Phase Transition Probability	
Triangular Distribution	73.44%
Minimum	70.00%
Likeliest	75.00%
Maximum	80.00%

Timeline	4.6
-----------------	-----

Technical Feasibility	
Cash Flow	Sunk
Process Length	4.0
Transition	0.7

Manufacturability	
Years Required	1.7
Costs Incurred at End of Year	6.3
Cash Flow	
Process Design	\$ (13,497)
Testing	\$ (17,467)
Analysis	\$ (10,074)
Professional Overhead	\$ (6,559)
Net Cash Flow	\$ (47,597)
Discounted at COC	\$ (24,737)
Phase Length	
Triangular Distribution	1.7
Minimum	1.0
Likeliest	2.0
Maximum	3.0
Phase Transition Probability	
Triangular Distribution	82.68%
Minimum	80.00%
Likeliest	87.00%
Maximum	94.00%

Timeline	6.3
-----------------	-----

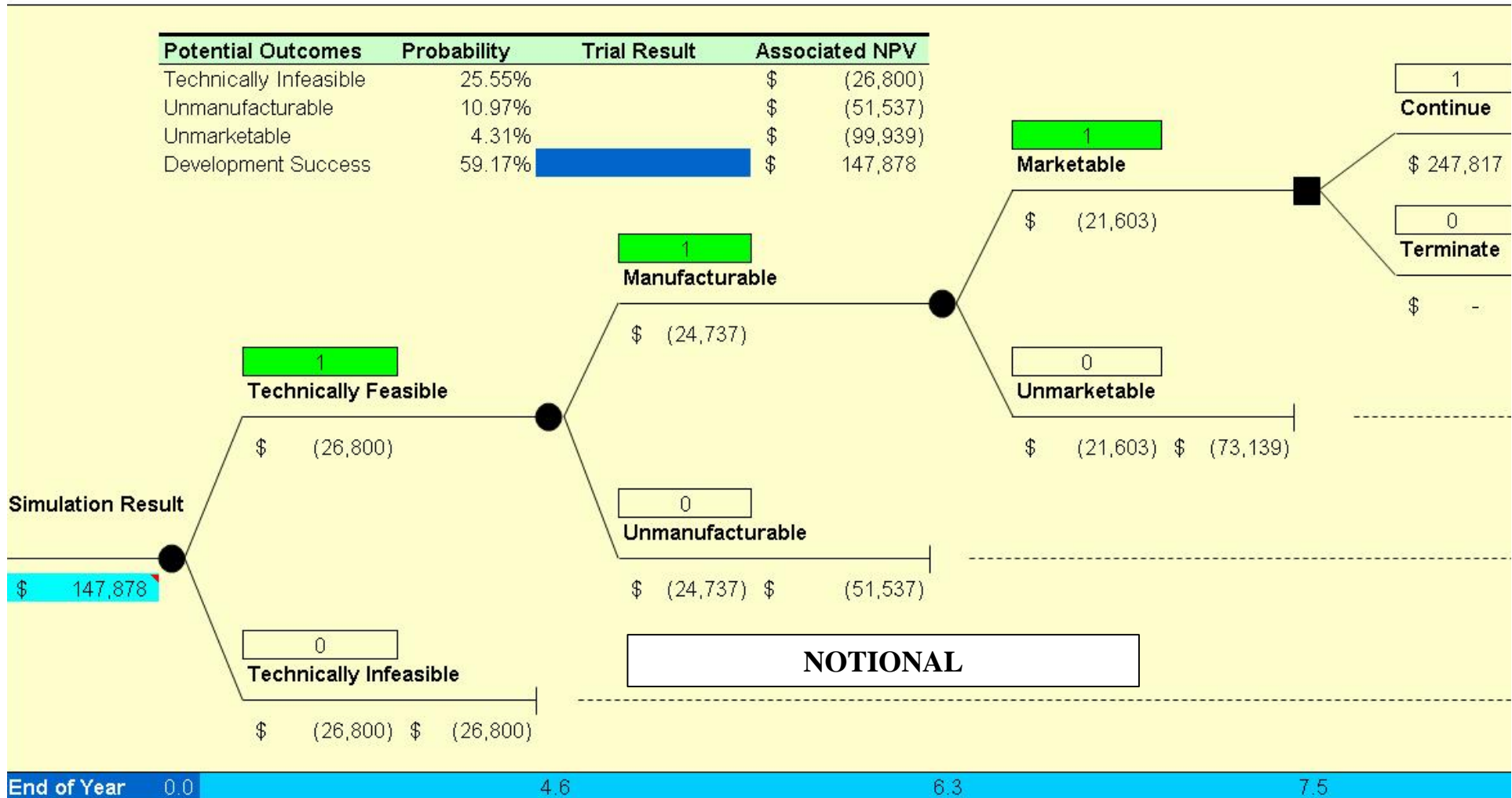
Manufacturability	
Cash Flow	Sunk
Process Length	2.0
Transition	0.8

Marketability	
Years Required	1.2
Costs Incurred at End of Year	7.5
Cash Flow	
Study Definition	\$ (5,284)
Data Gathering	\$ (9,284)
Analysis	\$ (28,236)
Professional Overhead	\$ (4,295)
Net Cash Flow	\$ (47,099)
Discounted at COC	\$ (21,603)
Phase Length	
Triangular Distribution	1.2
Minimum	0.5
Likeliest	1.0
Maximum	1.5
Phase Transition Probability	
Triangular Distribution	90.92%
Minimum	85.00%
Likeliest	89.00%
Maximum	95.00%

Timeline	7.5
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Marketability	
Cash Flow	Sunk
Process Length	1.0
Transition	0.9

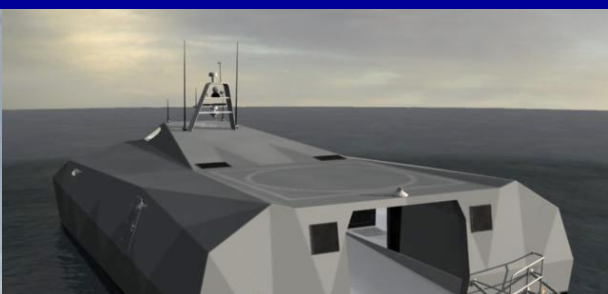
NOTIONAL



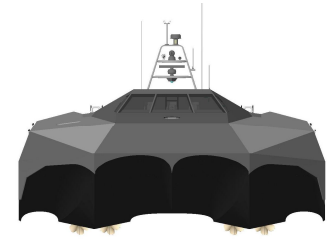


- **Real Options Analysis was feasible to evaluate ORS**
 - *Applying ROA methods required that we integrate market and non-market information types.*
 - *Market information can be obtained and analyzed using standard ROA methods.*
 - *Non-market information can be obtained from experimentation and knowledge solicitation and can be analyzed using decision tree methods.*
- **Challenges:**
 - *Obtaining credible and accurate objective and subjective estimates*
 - *Communicating process and results from a complicated evaluation process to larger audience*
 - *Obtaining DoD acceptance of non-traditional evaluation method*

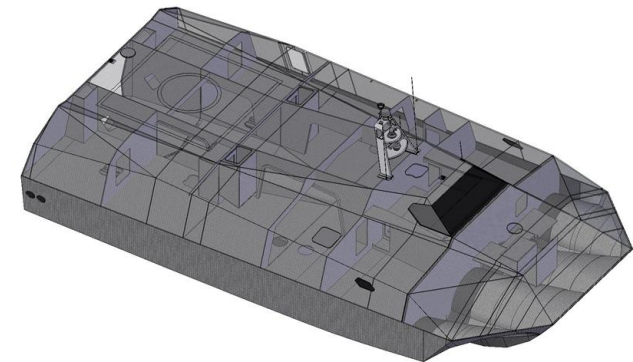
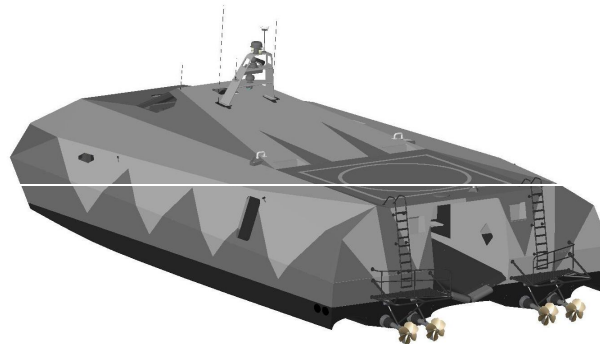
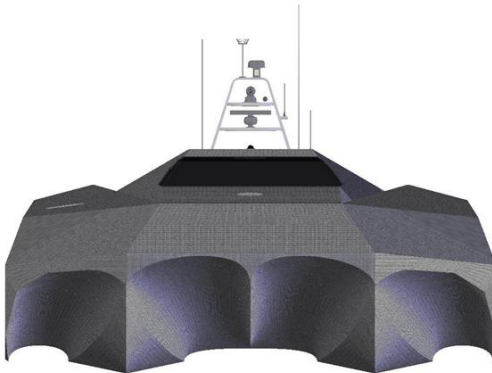
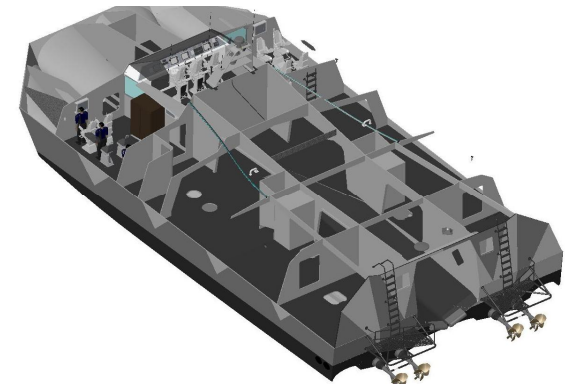
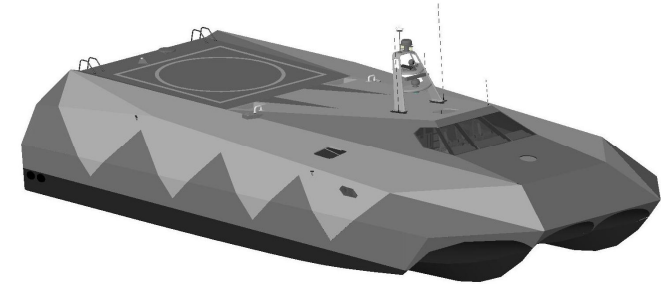
Concept to Operational Market
15 Months / \$12.6 M



Technical and Operational Objectives



- Dimensions: 88.6 x 40 ft
- Draft: 2.5 ft
- Manning: 15 (3 Crew / 12 Passengers w/ SPECWAR Load out)
- Displacement: 60 LT Full Load / 67 LT Max load
- Payload: Cargo - 15 LT / Fuel - 16 LT / Area - 2000 sq ft
- Max Speed: 50 + kts - SS0
- Cruise Speed: 40 + kts - SS4
- Range Max Speed: 500 + nm @ full load
- Range Cruise Spd: 750 + nm @ full load
- Reduced crew shock (30-50%) / Improved Sea keeping
- All-Carbon Reinforced Fiber construction (largest US built)
- 11m RHIB launch & retrieval (up to SS3)
- UAV / USV / UUV launch, retrieval & C2
- Reduced Wake & Drag / Non Mechanical Dynamic Lift Hull
- Electronic Keel - Networked Data Bus for austere environments / HA-DR



When Speed to Market Matters

