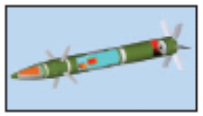
Complex Acquisition Programs Face Significant Challenges in Balancing Cost, Performance, Schedule and Risk to successfully deliver needed capabilities on time, and on budget

Program		Initial investment	Initial quantity	Latest investment	Latest quantity	Percent unit cost increase
Joint Strike Fighter		$183.6 billion	2,866 aircraft	$198.6 billion	2,457 aircraft	26.2
Future Combat Systems		79.8 billion	15 units	108 billion	15 units	35.2
F/A-22 Raptor		78.4 billion	648 aircraft	73.1 billion	279 aircraft	116.5
Evolved Expendable Launch Vehicle		14.9 billion	181 vehicles	27.8 billion	138 vehicles	143.8
Space Based Infrared System High		3.9 billion	5 satellites	9.9 billion	5 satellites	149.9
Expeditionary Fighting Vehicle		7.9 billion	1,025 vehicles	9.5 billion	1,025 vehicles	21.0
Extended Range Guided Munition		389.3 million	8,570 munitions	598.4 million	3,141 munitions	319.4

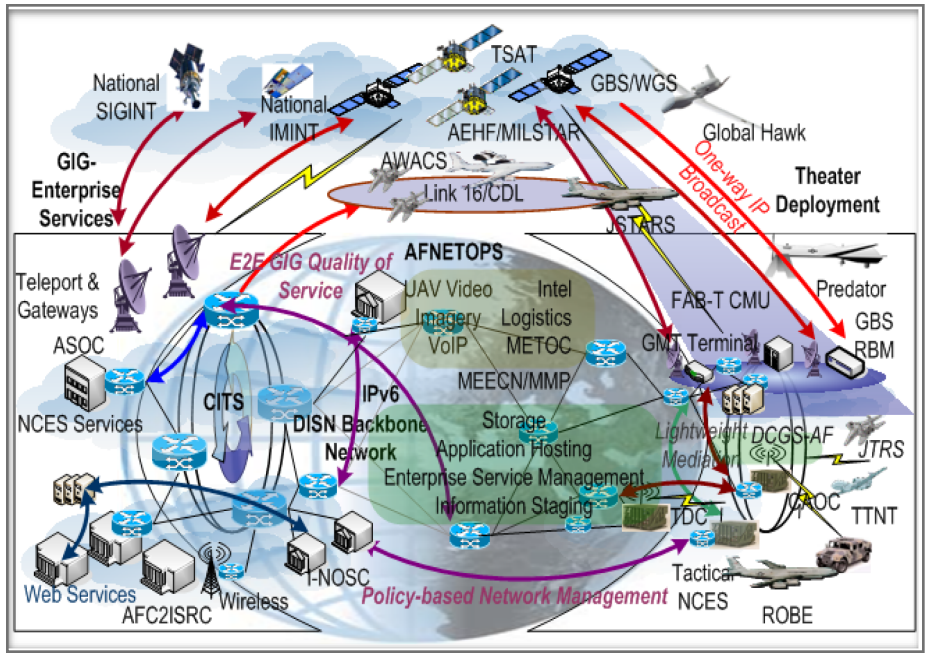
26 programs:

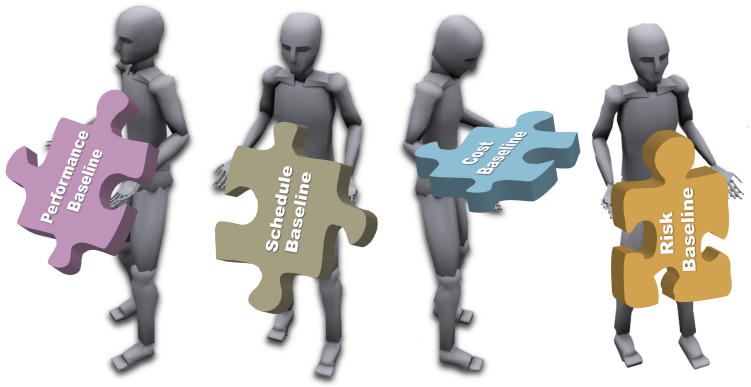
- 14.5% or $70B cost increase from $479.8B to $548.9B
- 20.8% increase in average program execution time from 94.9 months to 114.7 months
- Quantities reduced from initial plans in 10 programs

Source: GAO-05-301, DEFENSE ACQUISITIONS: Assessments of Selected Major Weapon Programs; "U.S. Government Accountability Office, http://www.gao.gov"

Program managers need to balance cost, performance, schedule, and risk

- Modern systems are complex and developed across multiple acquisitions with disparate schedules, budgets, requirements sources, and risks
- Cost, performance, schedule and risk baseline management:
  - Require different skills and training
  - Have different nomenclature, processes, etc.
  - Are often managed by different teams
- As a result, program baselines are often disconnected and decisions are not made with a consistent understanding of all impacts





Booz Allen Hamilton has analyzed acquisition programs from multiple perspectives

Insight and experience from former senior government officials

- 1999-2000: Space Industrial Base Study (SIBS), USD(AT&L) and NRO Sponsors (portions releasable)
- 2001-2002: Space R&D Industrial Base Study (SRDIBS), DUSD(IP) and NRO Sponsors (unclassified portions releasable)
- 2002: Space Systems Development Growth Analysis, Air Force Sponsor (portions releasable but entire study is on limited basis with government permission)
- 2001-2003: Series of individual mini-studies, like Radiation Hardened Parts, DUSD(IP) Sponsor (not releasable)
- 2003: Commercial Imagery Industrial Base Study (CIIBS), NRO and NGA Sponsors releasable on limited basis with government permission)
- 2003: Small Satellite Industrial Base Study (SSIBS), NRO and DARPA Sponsors (releasable on limited basis with gove
- 2003 DUS
- 2004: Solid Rocket Motor Study (SRM) IBS, DUSD(IP) Sponsor (most not releasable – contains other company proprietary)
- 2004: Enabling Assured Space Access, USD(AT&L) and SAF/US Sponsors (most not releasable – contains other company proprietary)
- 2003-2006: Defense Industrial Base Capabilities Study (DIBCS), DUSD(IP) Sponsor (releasable)
- 2006: Intercontinental Ballistic Missile IBS, Air Force Sponsor (releasable on limited basis with government permission)
- 2006-2007: Launch Mission Assurance Assessment Study, Air Force and NRO Sponsors (releasable on limited basis with government permission)
- 2007: Space Industry Export Control Impact Assessment,

In-depth research from numerous industrial base studies

DAIMLERCHRYSLER · HARRIS · EMBRAER · Raytheon · LOCKHEED MARTIN (We never forget who we're working for®) · CATERPILLAR · Honeywell · NORTHROP GRUMMAN (DEFINING THE FUTURE) · BOEING · CHANGE. CHICAGO HOUSING AUTHORITY · GENERAL DYNAMICS · Battelle · Ford

Understanding and benchmarking of commercial best practices

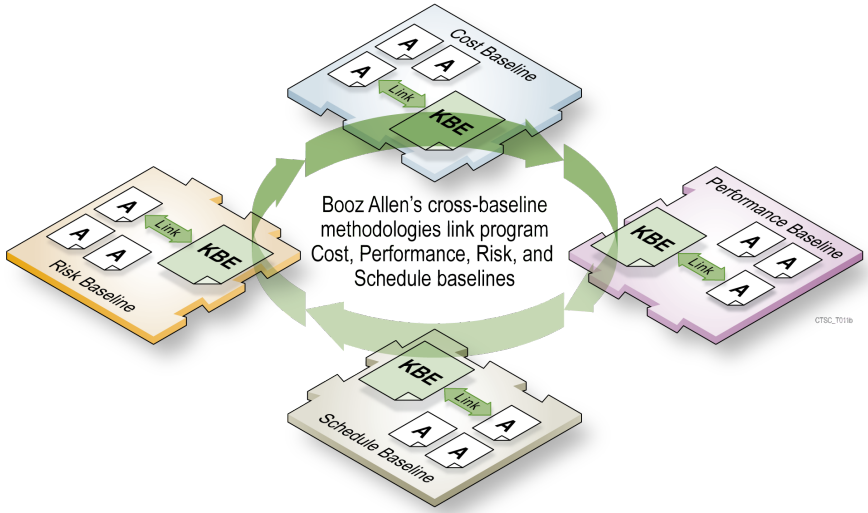
Customer	Program	Description	Eng Services	Eng Support	Tech Support	Provisg and Log	Mod and Sim	CM/DM	Arch Support	Test and Eval	Scty Eng & Cert	CBP	COTS Int	IMP/IMS	Tech Reviews
USN SPAWAR	PMS MSA (formerly PMTO)	Navy C4ISR/IT SE Prime	●	●	●	●		●	●	●	●			●	●
USA CERDEC I2WD	TEFOS / ETOSS	Army C4ISR SE Prime	●	●	●	●	●	●	●	●	●	●		●	●
AFSPC/NRO	Space Radar	AA&S and SE&I Sub (2 contracts)	●	●			●		●	●				●	●
AFMC ESC	CMPO	Crypto Mod SE Prime	●	●	●	●	●	●		●	●	●		●	●
SMC	LBSD	A&AS	●	●	●	●	●	●	●	●	●	●		●	●
SMC/MCX	TSAT	SATCOM SE&I Prime	●	●	●	●	●	●	●	●	●		●	●	●
SMC/MCJ	MILSATCOM JTEO	Engineering & Technical Support	●	●	●			●	●	●		●	●		●
USA	FCS SETA	Programmatic & Technical Support Sub	●	●	●	●		●	●	●				●	●
USA CELCMC	S3	C4ISR Engineering & Support Prime	●	●	●	●	●	●	●	●	●	●	●	●	●
DISA	DoD Teleport System	Systems Eng & Program Mgmt Support	●	●	●	●		●	●	●	●	●	●	●	●
DISA	NOWF	DISN Network Eng; HW/SW COTS Intgrtn	●	●	●			●	●	●	●			●	●
DISA	ADNET Plus	Information Systems Engineering	●	●	●			●	●	●	●	●			●
DIA	JIVA SI	Software Integration	●	●	●	●	●	●	●	●					
NSA	IAMAC	Information Assurance SE&I	●	●	●					●					
NGA	GEOSCOUT	SE, Transformation, & Test Sub	●	●	●	●	●	●	●	●	●	●		●	●

Practical experience from >$1B engineering work annually

TBI™ links baseline data to enable consistent evaluation of impacts across key program dimensions

- Ensures that program decisions are based on systematic, integrated understanding of cost, schedule, operational, technical, and risk factors
- Facilitates the development of alternatives to support decision-making
  - Identifies right people to be in the room
  - Can make quicker decisions because there is the sense

    the appropriate data is available and the data is of a known quality
- Provides an understanding of:
  - Baseline maturity
  - Baseline relationships
  - Impacts of program changes on the baselines
- Enables:
  - Baseline improvement
  - Informed decision making



TBI™ yields both initial & ongoing benefits

- Initial benefit from creating, evaluating and maturing the baselines
  - Assessing existing individual baselines identifies areas for improvement
  - Creating well structured initial baselines or maturing existing baselines enables better program management
  - Linking baselines via an innovative technique called the TBI-Index, identifies issues/disconnects related to baseline maturity, scope, and inconsistencies
- Ongoing benefit from utilizing program baselines linked via the TBI-Index
  - Provides a consistent cost, performance, schedule, and risk infrastructure
  - Ensures consistent and cross-cutting impact analysis of every change proposal presented to the configuration change board
  - Assists decision makers in making a more informed decision
  - Captures "What-If" results in terms of impact to the individual baselines and highlights unintended consequences
- TBI is a flexible methodology:
  - It does not limit the number or type of baselines a program has
  - It works with a programs existing baseline databases
  - It can be utilized at any point in a program's life cycle

TBI is a partnership between your systems engineering team and the Booz Allen TBI team

- TBI can be implemented and provide benefits at program initiation or at any point in the program life cycle
- Most programs already have a requirement to establish and maintain program baselines
  - Cost
  - Performance
  - Schedule
  - Risk
  - Others…
- TBI Practitioner Training ensures your team understands and is able to execute the methodology
- TBI Core Team provides:
  - Support for methodology, including tailoring for your program
  - Help with selection and implementation of appropriate infrastructure/tools
  - Lessons learned and best practices across programs

Representative TBI Baseline Artifacts

Performance

- ORD
- Operational Baseline
- SoS Spec
- Requirements
- Specifications
- Interface Control Documents
- HW Design
  - Drawings
- SW Detailed Design
  - SW Design Docs
  - Database Design Docs
  - SW Version Description
- Verification Plans
- Initial Operational Test & Evaluation Plan
- Architecture

Risk

- Risk Register
- Risk Mitigation Plans

Schedule

- Integrated Master Plan
- Integrated Master Schedule
- EVM Milestones

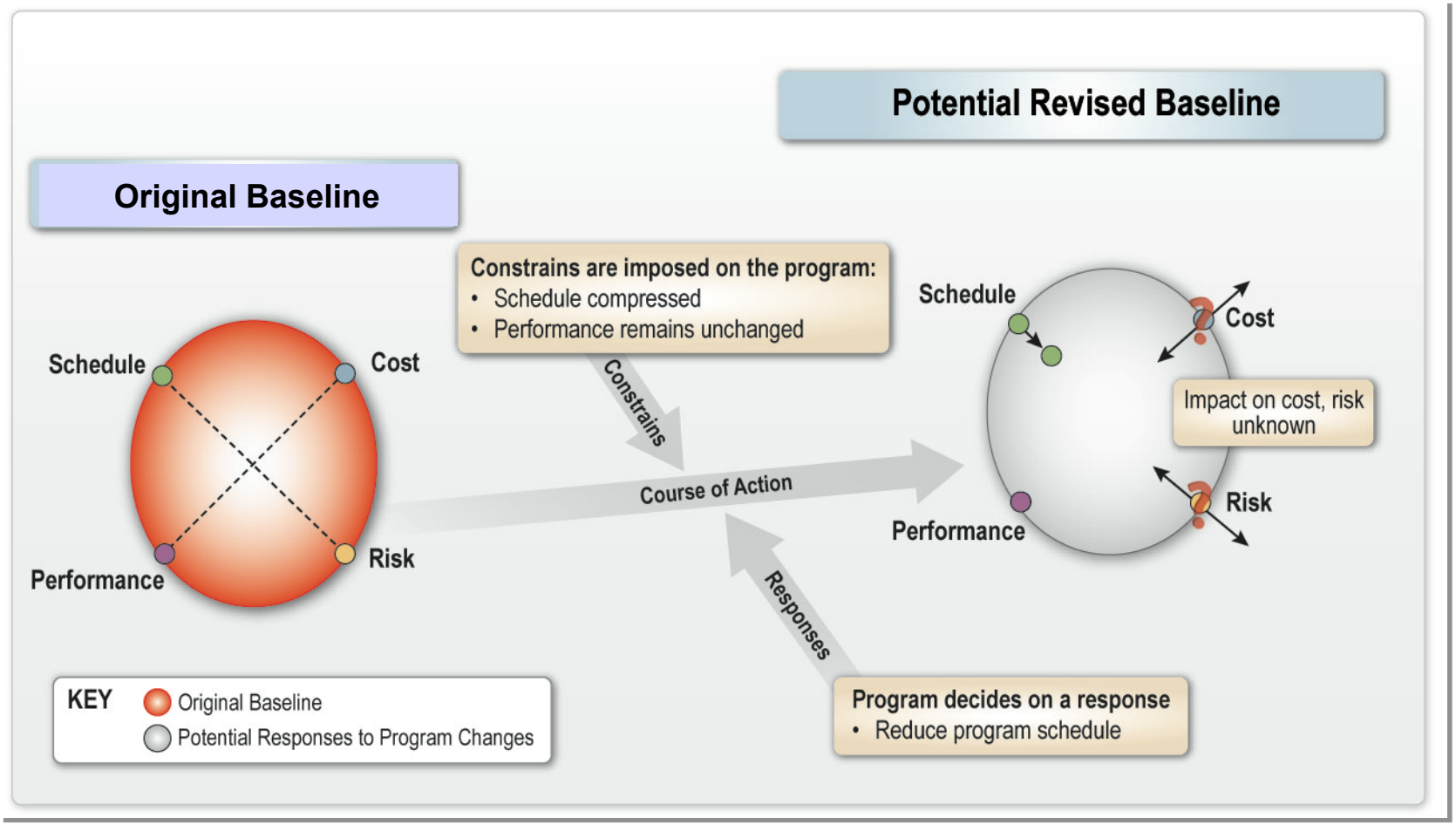
Cost

- Budget
- Program Office Estimate
- Program Budget
- Program Performance Baseline
- Contractor Cost Estimate
- Contractor Budget
- Contractor Performance Baseline
- Independent Cost Estimate
- CARD

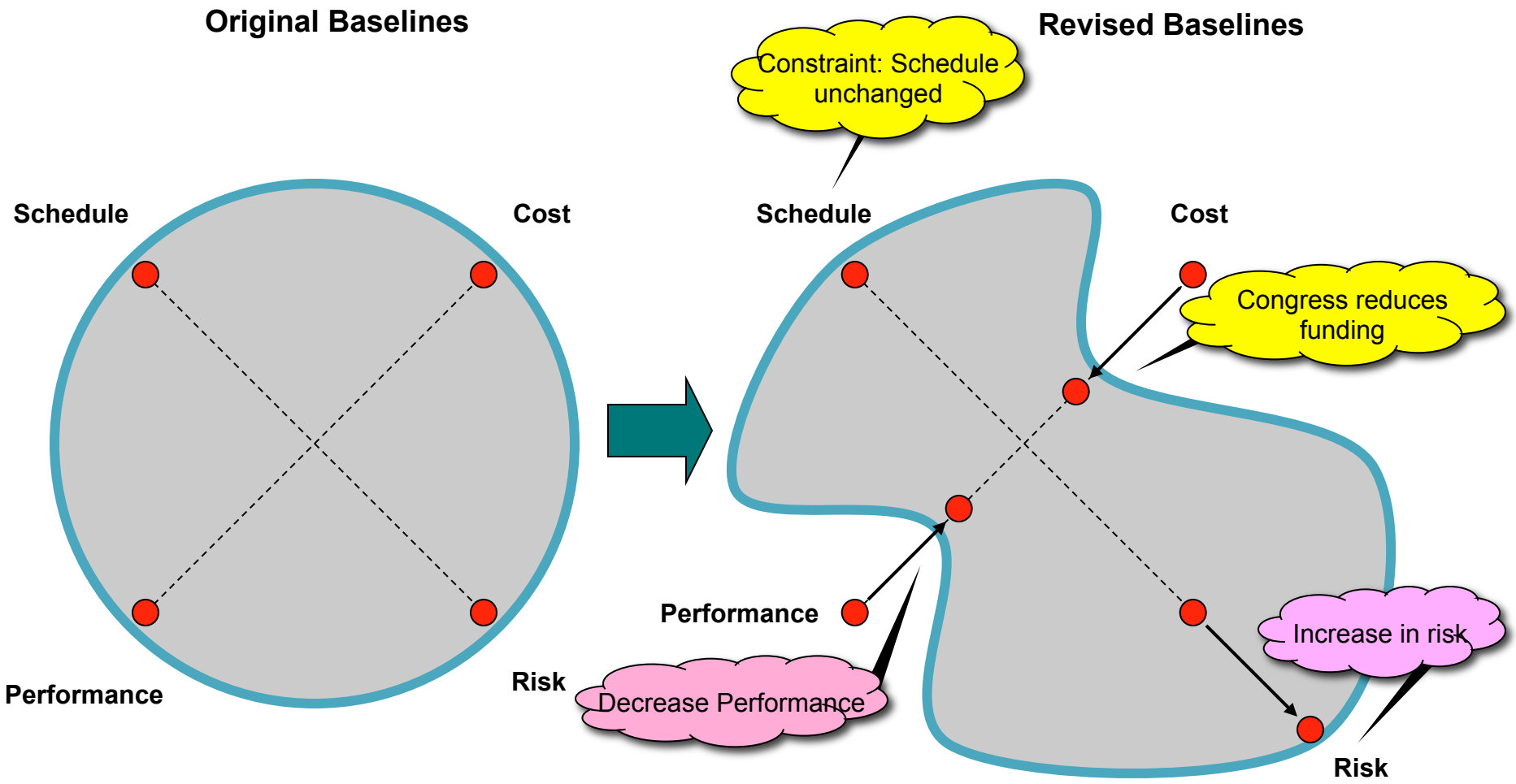
Programmatic

- Program Management Plan
- SEMP
- SEP
- WBS
- TPM Measurement Plan
- TEMP
- Risk Management Plan
- Subcontract Mgmt Plans

If baselines are not integrated, the complete impact of potential changes cannot be evaluated effectively



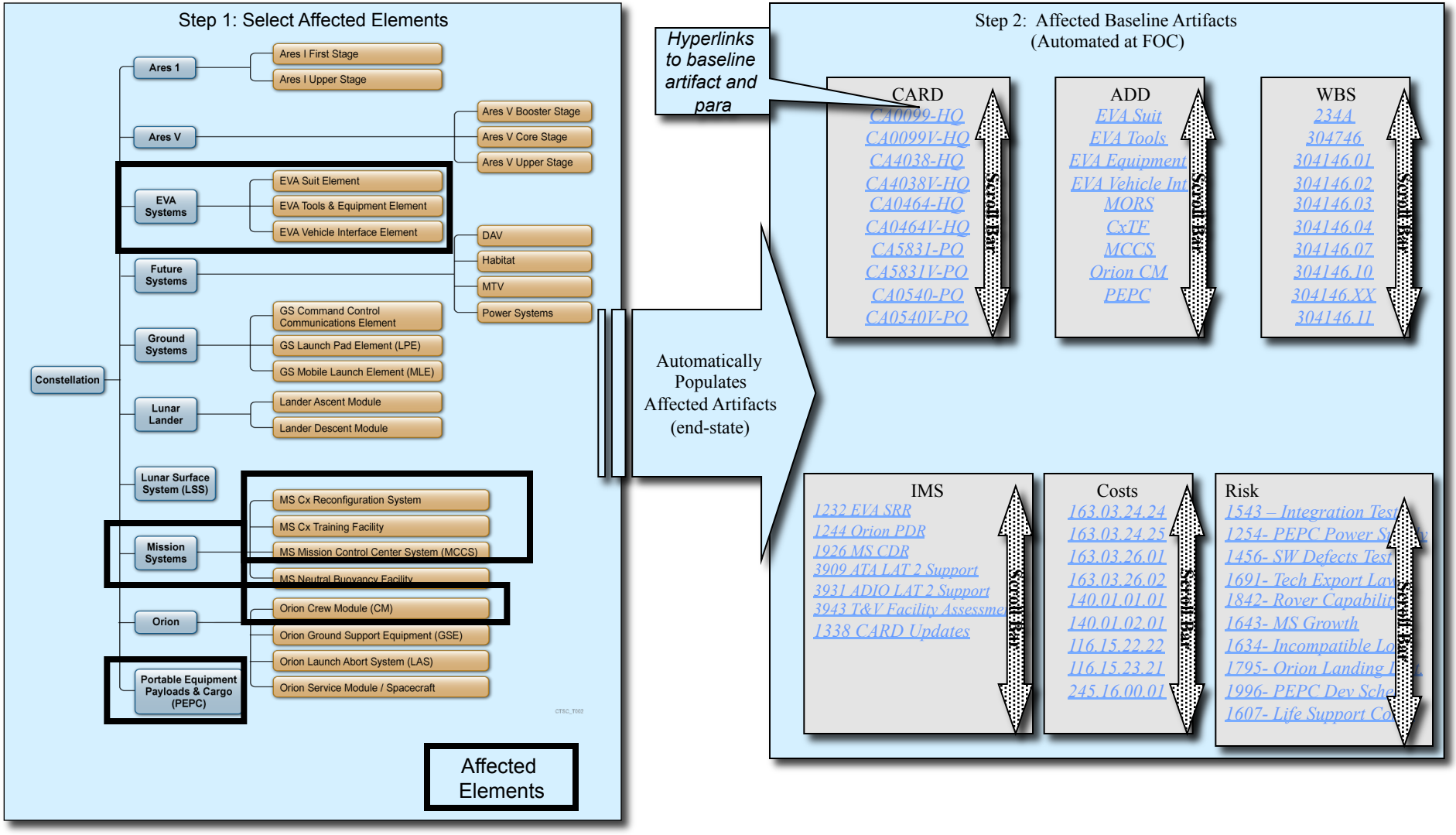
TBI™ provides an objective view of a program's state and impacts due to baseline changes



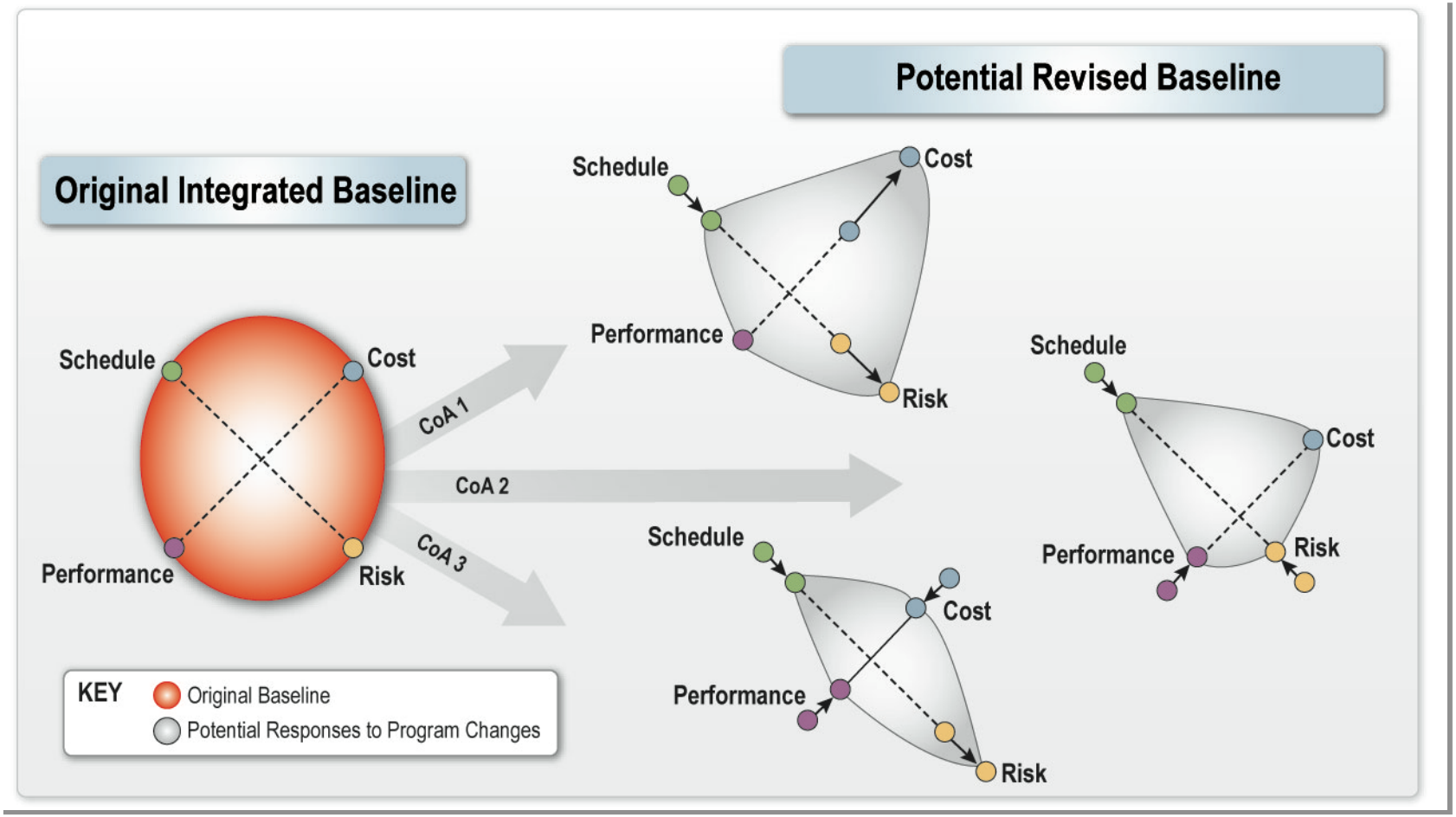
The TBI-Index

- The TBI-Index is a numbering scheme based on the physical realization of the system, i.e., the product components (hardware, software, people, …) of the system to be developed
- In a perfect world the TBI-Index would be the program WBS
- We found that many program WBSs were not appropriate for TBI
  - Not based on the products that need to be developed (i.e., not physics based)
  - Some are based on organizations, others on functions the system will perform
  - Not consistent across entire program
  - Unwieldy numbering schemes
  - Gaps
- Due to contract or political reasons it is often difficult to refine the WBS
- We recommend developing a product-based TBI-Index — if it maps one-to-one with the WBS, so much better

TBI™ Index provides 'rosetta stone' for linking baseline artifacts



TBI™ enables the program manager to quickly evaluate all impacts of multiple courses of action



TBI™ takes a phased approach

The TBI methodology can be used for programs at all life cycle stages

Phase I

TBI Foundation

- **Assess baselines (existing programs)**
  - Identify & catalog individual baseline artifacts
  - Assess baseline completeness, accuracy & validity
  - Recommend baseline improvements
- **Create or Mature baselines**
  - Develop plan to **create (new program) or mature (existing program)** baselines
  - Implement plan to **create / mature** baselines & processes
- **Integrate baselines**
  - Develop a WBS **(new program)**
  - Develop TBI-index (may be same as WBS)
  - Develop TBI data model
  - Map baseline artifacts to TBI-index

Phase II

TBI Sustainment

- **Maintain integrated baselines**
  - As changes to baselines occur maintain mapping to TBI-index
- **Update TBI dashboards & management reports**
  - Develop a set of dashboards & reports to meet management needs
  - Ensure currency of data is appropriate for program needs

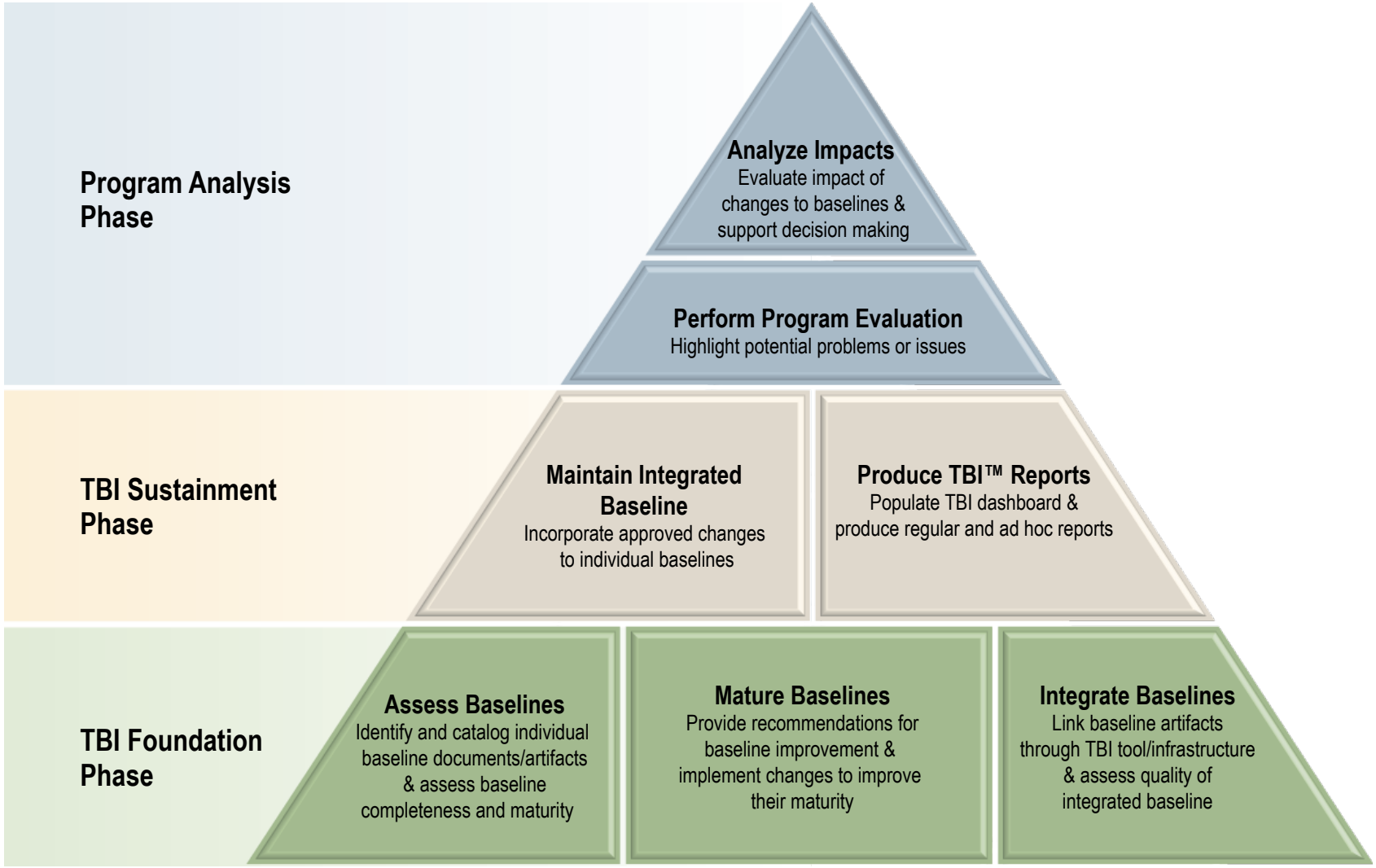
Phase III

Program Analysis

- **Perform program evaluations**
  - Highlight potential program issues
  - Identify baseline gaps, clusters, inconsistencies, overlaps
- **Analyze impacts of program changes**
  - Evaluate impacts of program changes across all program baselines
  - Provide insights for multiple COAs

Improved program decision making over time

TBI™ takes a phased approach to build program insight and analysis



Benefits of Each TBI Phase

- **Foundation Phase** - Initial benefit from evaluating and maturing the baselines
  - Assessing individual baselines identifies areas for improvement
  - Creating appropriate baselines or maturing existing baselines enables better program management
  - Linking baselines identifies issues/disconnects related to baseline maturity, scope, and inconsistencies
- **Sustainment Phase -** Synchronizes CM processes on all program baselines
  - Provides a consistent cost, performance, schedule, and risk infrastructure
  - Delivers understandable program knowledge at all levels in the program
- **Program Analysis Phase** - Ongoing benefit from utilizing the linked baselines
  - Ensures consistent and cross-cutting impact analysis of every change proposal presented to the configuration change board
  - Assists decision makers in making a more informed decision
  - Captures "What-If" results in terms of impact to the individual baselines and highlights unintended consequences

Governance

- Agreements, NDAs, OCI constrains, MOAs
- Lines of authority
- Enterprise Architecture
- Policy

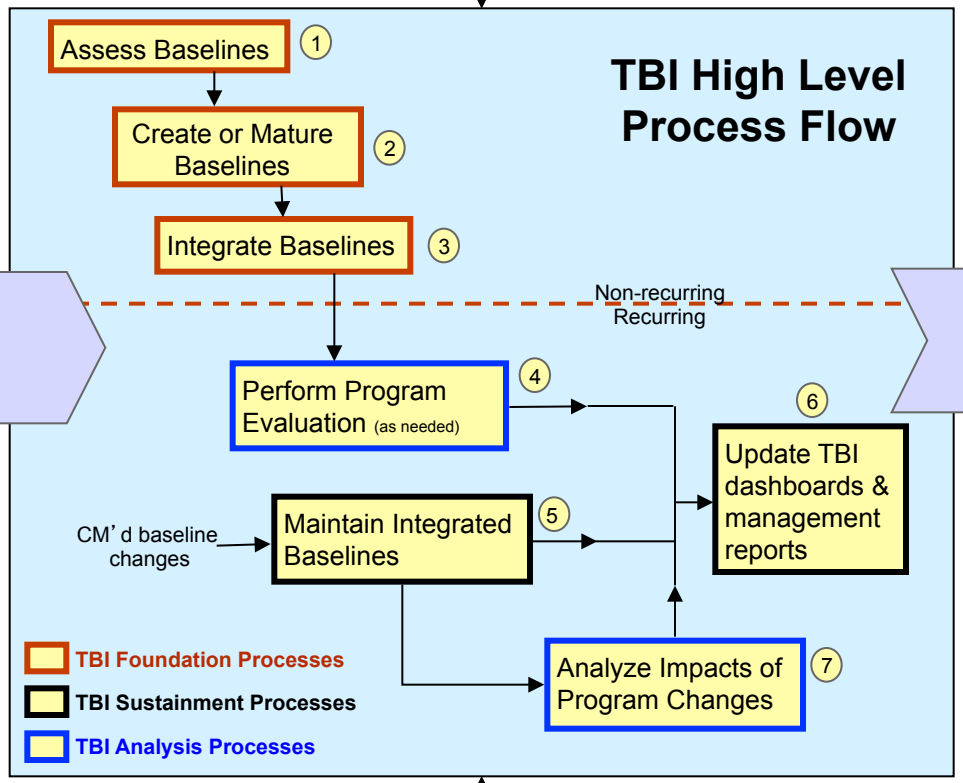
Metrics

- % of WBS mapped to each baseline
- # Program Issues Surfaced using TBI
- # of TBI Analysis Reports
- TBI Implementation resources

Inputs

- Client Approval
- Program SME access
- Program Documentation
- Program baseline products
  - Cost
  - Schedule
  - Requirements
  - Architecture
  - CONOPS
  - Risks
  - WBS
- Baseline changes from program CM processes

TBI High Level Process Flow



Outputs

- TBI-Index
- Integrated Baseline
- Insight into program & baseline maturity
- Recommendations for improvement of program baselines & processes
- Comprehensive analyses of alternatives for program changes (includes changes CM will need to approve to implement each alternative)

Skills

- System Engineering
- Program Management
- Functional Expertise (Risk, Cost, Schedule, Reqt's, Architecture, …)
- Program Assessment
- Decision Analysis
- TBI methodology
- Domain understanding

Tools

- Individual Baseline Tools (Requirements, Architecture, Technical Performance Measures (TPMs), Cost, Schedule, Risk, …)
- TBI Infrastructure Tool
- Decision Analysis Tools
- Program Assessment Tools

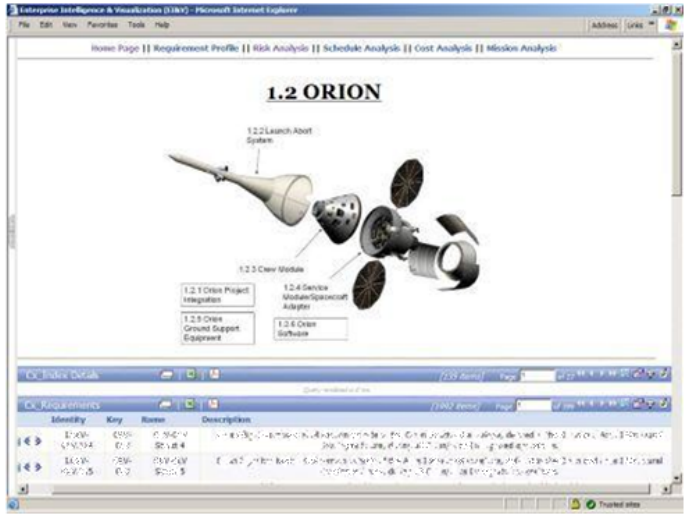
TBI™ is a tailorable approach that meets the unique needs of our clients

- **Constellation Program, National Aeronautics and Space Administration (NASA)**
  - Booz Allen developed a product based TBI™ Index to assess integration and development of all system components, including the Ares launch vehicle, Orion crew module, ground systems, and others across all baselines
  - TBI™ processes ***identified inconsistencies*** in individual baselines, ***exposed gaps*** in the mapping of baselines to the TBI Index and ***facilitated correction*** of these issues

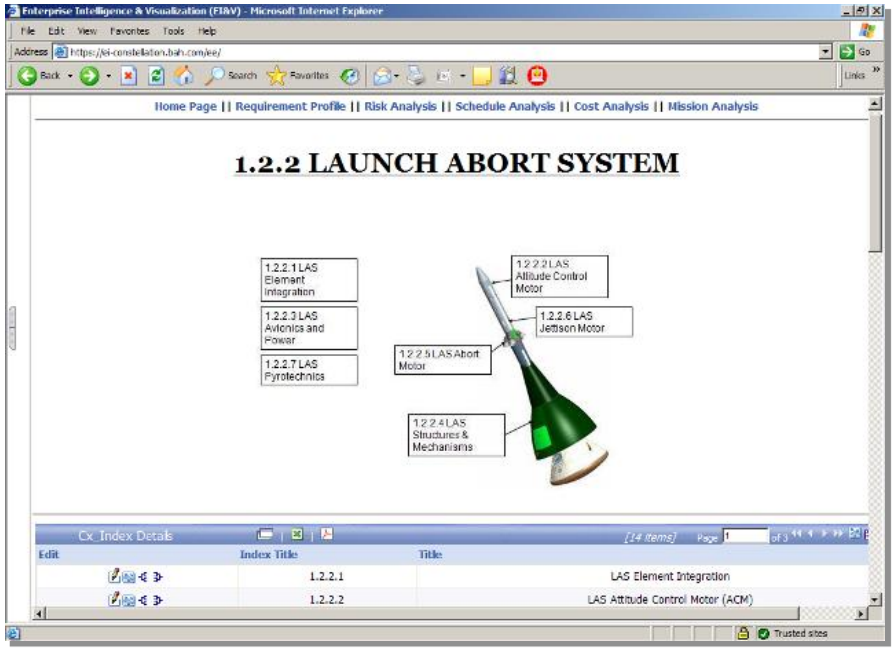
- **Transformational Satellite Communications (TSAT) System, MILSATCOM Systems Wing (MCSW)**
  - Booz Allen organized data from all baselines within a TBI™ index in order to assess work activities and technology across the space, terminal, control, legacy segments as well as across all systems engineering efforts
  - TBI™ processes enabled the TSAT SE&I team to ***identify impact*** of removing specific capabilities leading to ***improved decisions*** about mission and architecture

Baseline Data Management Using Enterprise Elements

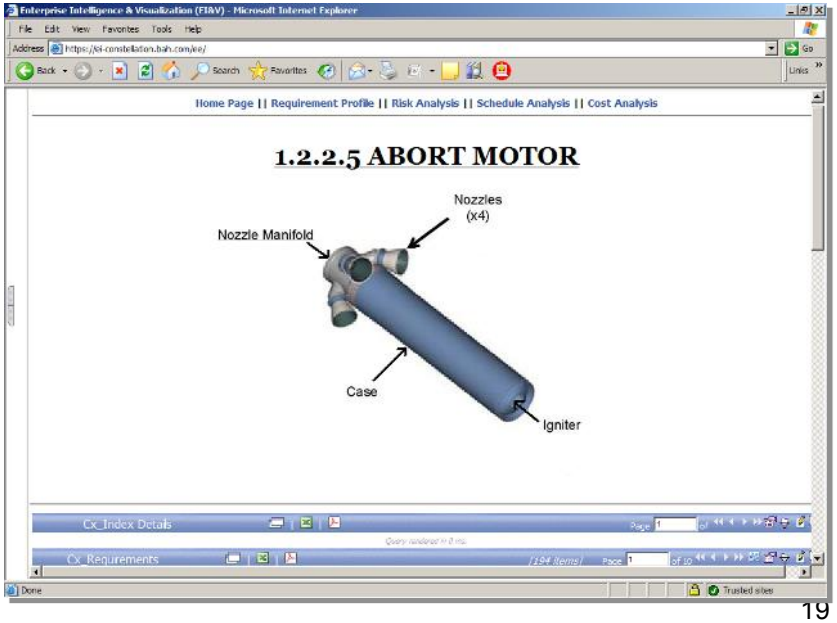
- TBI Methodology utilizes Enterprise Elements to manage baseline data
  - Commercial-Off-The-Shelf
  - Web based, with Oracle back end
  - Individual User Access Control and data rights
  - Highly customizable (HTML)
  - SQL Query based data retrieval
- EE Facilitates
  - Complete capture of all data elements
  - Understanding of data relationships (i.e. n^{th} degree effects)
  - Focused, complete dataset for baseline impact analysis
  - Metric reporting of data



EE Tool Allows User to Drill Down to Lower Levels of Data



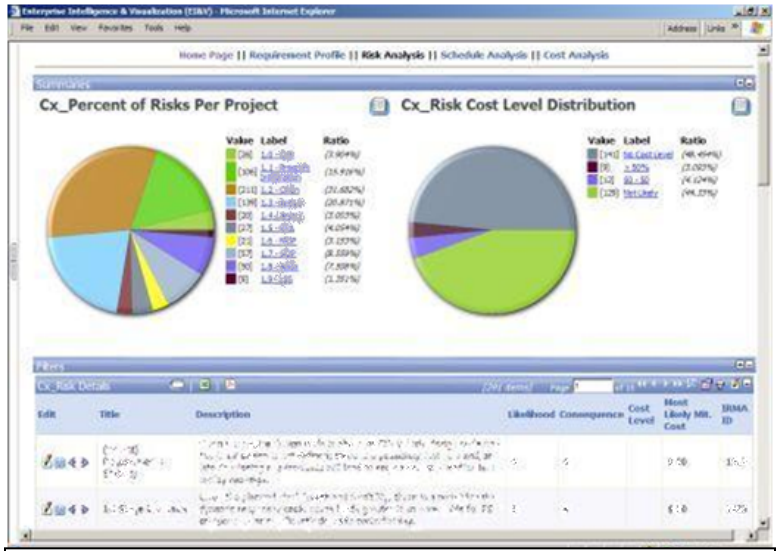
- Clicking on the Launch Abort Systems provides all linked baseline data to the system
- User can then quickly see all requirements, architecture, operations, risks, schedule, and cost associated with the system

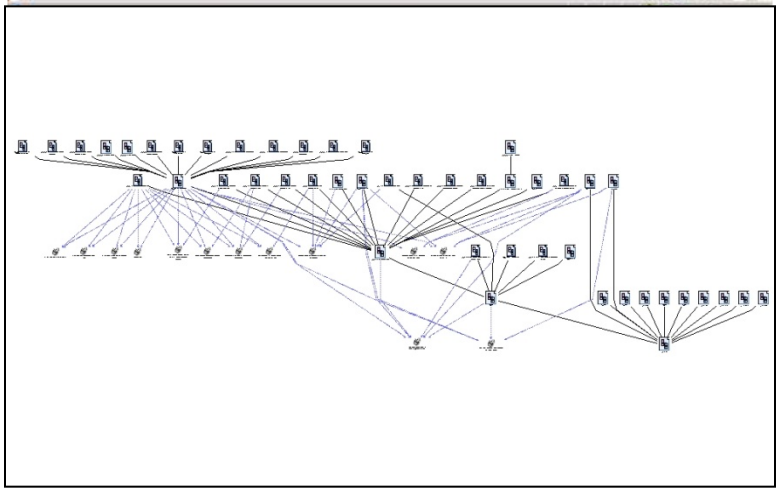


- Clicking on the Abort Motor provides all linked baseline data to the element
- User can then quickly see all requirements, architecture, operations, risks, schedule, and cost associated with the system

Baseline Data Management Using Enterprise Elements

- Additional Features
  - Creation of custom metamodels for data entry
  - Establish linkages between data elements
  - Diagramming feature to visualize relationships among data elements
  - HTML Web Portals for customized display of data (i.e. dashboards)
  - Data Metric/graph generation





How do you know a program needs TBI?

- **Complexity**
  - Multiple organizations or people working on each baseline
  - Technology complexity
  - Contract complexity
- **Enduring program**
  - Program will be in execution much longer than:
    - Normal staff tenure
    - Term of stakeholders
- **Major perturbations likely**
  - Unstable political environment
  - Pace of technology change
  - Mission needs is evolving

For more information, contact these members of the TBI team

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Backups

Baseline Assessment & Maturation ensures that all baseline artifacts have been identified and are of sufficient maturity for linking

INPUTS
- Stakeholder buyin
- Program Access
- TBI Project Plan
- TBI Overview
- Program Overview
- Individual Baseline Artifacts & Supporting Documentation
- Individual Baseline Completeness, Quality and Maturity Criteria

GOVERNANCE
- Agreements, NDA, MOU, project procedures
- Constraints (IA, standards, policy)
- Client leadership support

METRICS
- Baseline Products Completeness Rating against Criteria
- Baseline Maturity Rating against Criteria

STEP 1 Program Orientation → **STEP 2** Collect Relevant Baseline Data → **STEP 3** Assess & Mature Individual Baselines

SKILLS
- Systems Engineering
- Functional Expertise
- Domain Understanding
- TBI Process Expertise

TOOLS
- MS Office Products
- Program Control Tools
- Data Collection Plan

OUTPUTS
- Complete view of baselines
- Improvement of Individual baselines
- Baseline Artifact Catalog
- TBI Readiness Assessment
- Recommendations for maturing individual baselines

In Baseline Integration process, the TBI Index is developed and key baseline elements are linked for the first time

GOVERNANCE
- Agreements, NDA, MOU, project procedures
- Constraints (IA, standards, policy)
- Client leadership support

METRICS
- Baseline Products Completeness Rating against Criteria
- Baseline Maturity Rating against Criteria

INPUTS
- Work Breakdown Structure
- Baseline Artifact Catalog
  - Cost Estimate
  - IMS
  - Architecture/System Design Description
  - Requirements
  - Risk Register
- Integrated Baseline Quality & Maturity Criteria

STEP 1 Develop TBI Index

STEP 2 Map Individual Baselines to TBI Index

STEP 3 Integrate Baselines in TBI Infrastructure

STEP 4 Assess Integrated Baseline Quality & Maturity

OUTPUTS
- Definition of links and interdependencies
- Silos eliminated
- TBI Index
- Integrated Baseline
- Integrated Baseline Assessment of Quality & Maturity
- Recommendations for Integrated Baseline Improvement

SKILLS
- Systems Engineering
- Functional Expertise
- Domain Understanding
- TBI Process Expertise
- TBI Infrastructure Tool Expertise

TOOLS
- MS Office Products
- Individual Baseline Tools (cost models, schedule tools, reqts mgt tools, etc.)
- TBI infrastructure tool

High Level Program Evaluation highlights potential problems or issues that are uncovered through evaluation of the integrated baseline

INPUTS
- Integrated Baseline
- Program Evaluation Criteria and Metrics
  - Standard (tailored)
  - Stakeholder-defined

GOVERNANCE
- Agreements, NDA, MOU, project procedures
- Constraints (IA, standards, policy)
- Client leadership support

METRICS
- Program Confidence Level

STEP 1
Evaluate Program Status & Maturity

→

STEP 2
Recommend Program Actions

SKILLS
- Systems Engineering
- Functional Expertise
- Domain Understanding
- TBI Process Expertise

TOOLS
- MS Office Products
- TBI Infrastructure Tool
- Program Assessment Techniques & Tools

OUTPUTS
- Integrated view of total program
- Highlight potential problems or issues
- TBI Program Evaluation
- Recommendations for Program Improvement

Integrated Baseline Maintenance & Reporting ensures that changes to program baselines are captured

INPUTS
- TBI Index
- Integrated Baseline
- Individual Baseline Updates
  - Cost
  - Performance
  - Schedule
  - Risk
- Reporting Requirements
  - Standard
  - Stakeholder-defined
  - Ad hoc
- TBI Dashboard (template)

GOVERNANCE
- Program Change Control & Configuration Management Processes
- Program Reporting Requirements

METRICS
- Updated Integrated Baseline mapping completeness %
- Updated Integrated Baseline Quality & Maturity Evaluation against Criteria

STEP 1
Incorporate Baseline Updates in Integrated Baseline

→

STEP 2
Validate Updated Integrated Baseline

→

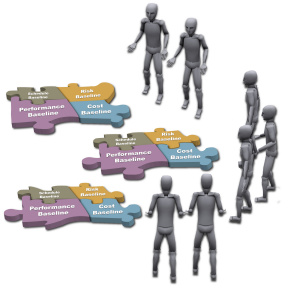
STEP 3
Generate Reports & Metrics

SKILLS
- Systems Engineering
- Functional Expertise
- Domain Understanding
- TBI Process Expertise
- TBI Infrastructure Tool Expertise

TOOLS
- MS Office Products
- Individual Baseline Tools (cost models, schedule tools, reqts mgt tools, etc.)
- TBI infrastructure tool

OUTPUTS
- Ensures program baselines remain in sync in the face of changes
- Periodic Program Status Reports
  - Standard
  - Stakeholder-defined
- Ad hoc Reports
- TBI Dashboard (populated)
- TBI Baseline Update Summary Report
- Archive of superseded baseline artifacts

Impact Analysis provides decision makers with insight into the effects of perturbations to all baselines



GOVERNANCE
- Program Change Control & Configuration Management Process

METRICS
- Decision analysis confidence level

INPUTs
- TBI Index
- Integrated Baseline
- Problem Statement for Potential Program Change
- Potential Individual Baseline Changes

STEP 1 Assess Problem Statement, Change Stimulus

STEP 2 Identify Alternatives

STEP 3a Conduct Qualitative Trade Study

STEP 4 Select and Recommend Implementation

STEP 3b Downselect Alternatives

STEP 3c Conduct Quantitative Trade Study

OUTPUTs
- Integrated program decision making
- Understanding of all implications of proposed changes
- Alternative TBI Index Options
- Qualitative Trade Study Results
- Quantitative Trade Study Results
- Program Change Request for Selected Alternative

SKILLS
- Systems Engineering
- Functional Expertise
- Domain Understanding
- TBI Process Expertise
- TBI Infrastructure Tool Expertise
- Decision Analysis Expertise

TOOLS
- MS Office Products
- Individual Baseline Tools (cost models, schedule tools, reqts mgt tools, etc.)
- Decision Analysis Techniques and Tools