

The Implementation of Total System Performance Responsibility to Avoid a Weakened Systems Engineering Department

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Agenda

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Project Objective

The objective of this project is to develop a recommendation, or set of recommendations, for a more successful implementation of the Government hands-off management style of Total System Performance Responsibility (TSPR) to avoid a weakened Systems Engineering department within the Government

How Objective Will be Accomplished

- Key topics were researched in order to understand the environment in which TSPR was implemented, including:
 - Understanding acquisition discipline
 - Understanding how SE suffered during the acquisition reform era of the 1990's
 - Understanding how the idea of government hands-off management can be implemented to avoid the same pitfalls and achieve the benefits originally intended

Project Rationale

- Project was selected from a list compiled by the student and reviewed by advisors
- Project idea was developed based on merit and ability to meet course objectives
 - Meets course objectives by demonstrating mastery of:
 - SE process
 - Management in SE process
 - Application of lessons learned
 - Ethical issues
- The project made use of extensive document review in order to meet the objective above

Benefits of Project Results

- **Successful Acquisition of Systems at Reduced Cost**
 1. Better schedule and cost performance: The original motivation for TSPR
 - Original approach by the Government:
 - Removed many reporting/documentation requirements that were typically levied on contractors
 - Expected that the contractors use industry best practices and COTS hardware
 - » Contractors were often not familiar with managing these processes/setting the requirements for the commercial hardware
 - » Commercial hardware often did not perform as expected requiring costly measures to correct issues found late in the development cycle (26)
 - Reduced oversight man-power in the program offices to realize even more savings

Utilizing the lessons learned from past TSPR implementations, and modifying the execution of the process may lead to measurable schedule and cost improvements in the future

Benefits of Project Results

- **Successful Acquisition of Systems at Reduced Cost**
 - 2. Better Customer/Contractor Relationship
 - Oversight process based on a lack of trust and has been program focused as opposed to process improvement focused
 - TSPR intended to replace oversight with insight
 - Removed many reporting requirements, customer interactions, and process standards
 - Left contractors with little guidance as to the customer expectation
 - TSPR should not remove the customer from the vicinity of the contractor
 - Customer representatives should remain co-located if possible & maintain a high level of involvement/communication with the contractor
 - Onsite working groups leading up to milestone reviews will allow quicker decisions regarding milestone gates
 - Trust between the customer/contractor is very important when the contractor is taking on responsibilities that are viewed as outside the scope of their core competencies

Properly fulfilling the insight role would improve the customer/contractor relationship by allowing constant interaction, a better understanding of contractor performance and customer expectation, and allow the parties to build trust

Relation of Project Topic to Context

- Government
 - The Acquisition Reform (AR) period of the 1990's resulted in the Government:
 - Pursuing “faster, better, cheaper”
 - Increased dependence on contractors to deliver fully functioning systems
 - Was mandated with reducing their program office
 - With reductions Program Managers (PMs) lacked authority and experienced staff to clearly define and manage programs
 - Programs suffered from an overwhelming number of unfiltered requirements
 - Inadequate compensation of SE's in the government acquisition workforce
 - TSPR has not been carried over to the upgraded 2000's series known as Acquisition Excellence (AE)

TSPR could be implemented with the current rebuilding of the acquisition workforce if recommendations contained within this project were utilized

Relation of Project Topic to Context

- Contractors
 - The reduction in oversight that came with TSPR contracts left contractors with:
 - Limited reporting requirements and standards
 - Requirement to implement their “best practices” on new programs
 - Need to fill the gap created in the Government SE workforce
 - Large user communities to filter requirements from

Consolidation program responsibilities under one prime integrator sounds logical, but many critics feel this transferred responsibilities beyond the areas of the integrators core competencies (17)

Project Approach

- In order to develop recommendations for improved implementation of TSPR, it was necessary to understand how TSPR was executed and which programs really employed TSPR
- During the 1990's more than just TSPR being implemented as acquisition reform, Reduction of Total Ownership Cost (RTOC) & Performance Based Logistics (PBL) were also utilized
 - RTOC is an initiative in which 30 DOD programs served as pilots to test new ways to reduce lifetime cost of defense systems
 - PBL is intended to reduce Gov. manpower required for logistics and maintenance
 - Differentiation was necessary to clearly define which programs should be used to draw lessons learned from
- Research was conducted to differentiate between TSPR, TSPR used in PBL, and RTOC

Programs for Study

Program	TSPR	R-TOC PBL	Comments
Vance AFB Support Contracts		X	
ICBM	X		AF was given ability to award TSPR contract to remove themselves from the Prime Integrator role.
Apache Helicopter		X	
Joint National Test Facility		X	Insufficient resources; research indicates PBL
Joint Direct Attack Munitions		X	Did not use TSPR according to (6)
F-117		X	
Consolidated Spacelift Range Operations (EELV)	X		
Integrated Space Command & Control		X	Command & Control, not hardware acquisition process
SBIRS	X		
Joint Air to Surface Standoff Missiles (JASSM)	X		
C-17		X	
TBMCS	X		
Deepwater Project	X		
Cheyenne Mountain		X	Logistics support (contractor integrates support for the complex in conjunction with Cheyenne's operations)

Project Results as Related to Objectives

- **Successful TSPR Implementation Features**
 - Two of the program implementations of TSPR researched were determined to be successful:
 - Intercontinental Ballistic Missile (ICBM)
 - Joint Air to Surface Standoff Missile (JASSM)
 - Both have implemented TSPR with positive results
 - The programs were able to reduce program cost without a negative impact on the systems engineering function

Successful TSPR Implementations

– ICBM

• Program History

- Since 1954 the SPO had acted as the Prime Integrator for the ICBM system
- The SPO managed/responsible for:
 - » Systems Engineering/Technical Assistance (SE/TA) contractor to aid in requirements management
 - » All associate contractors
 - » Integrating all portions of the system (occasionally used a systems integration contractor)
- Resulted in a very large program office and engineering support team to maintain the system throughout the lifecycle
- Very manpower-intensive, with budget cuts was becoming unaffordable for the Air Force (AF) (29)



Successful TSPR Implementations

– ICBM

• Effects of TSPR

- In 1996 the AF approved the use of TSPR and allowed the acquisition process to begin to select a prime integration contractor
- In 1997 the AF awarded the contract to the former SE/TA (TRW) as a one-year basic contract with the option to renew the contract 14 times
- The AF had a price goal reduction of 20% over the 15 year lifetime of the contract.
- As new prime integrator, TRW would be responsible for detecting potential system problems before they occur, developing mitigation plans, and presenting this information to the government for potential action (30)

Responsibility was successfully transferred to the contractor with measurable performance metrics being met and cost in the program office being reduced

Successful TSPR Implementations

– JASSM

• Program History

- The Joint Air to Surface Standoff Missile (JASSM) Program started in 1996 to replace the cancelled Tri-Service Standoff Attack Missile (TSSAM) program that was severely over budget
 - » The AF initially considered proposals from seven different contractors
 - » Work leading up to the release of the Request for Proposal (RFP) saw intense interaction between all contractors and the gov. team (46)
- The AF & Navy developed a 5 year schedule for development, production, and initial deployment of JASSM, and specified only 3 key performance parameters for the system: range, missile mission effectiveness, and carrier operability

Requirements & cost expectations were a result of a unprecedented partnership the gov. team had developed with industry, the war fighters, and the DoD acquisition community



Successful TSPR Implementations

– JASSM

• Effects of TSPR

- To facilitate success the Government:
 - » Eliminated unneeded military standards and specifications
 - » Relied on already mature missile technologies for the design
 - » Limited changes in performance requirements
- Engineering Manufacturing Development (EMD) time reduced to 55 months (historically 128 month average on missile programs)
- While the program experienced technical difficulties and a cost breach due to doubling the amount of missiles to be procured, the overall implementation of TSPR has gone well
 - » The Gov. and Contractor joined together in problem solving teams
 - » Gov. is involved directly in providing insight, recognizing problems, and taking actions to mitigate further consequences

The goal of saving cost and schedule over TSSAM and other missile defense programs has been met, and therefore using TSPR as an acquisition method for JASSM is considered successful

Project Results as Related to Objectives

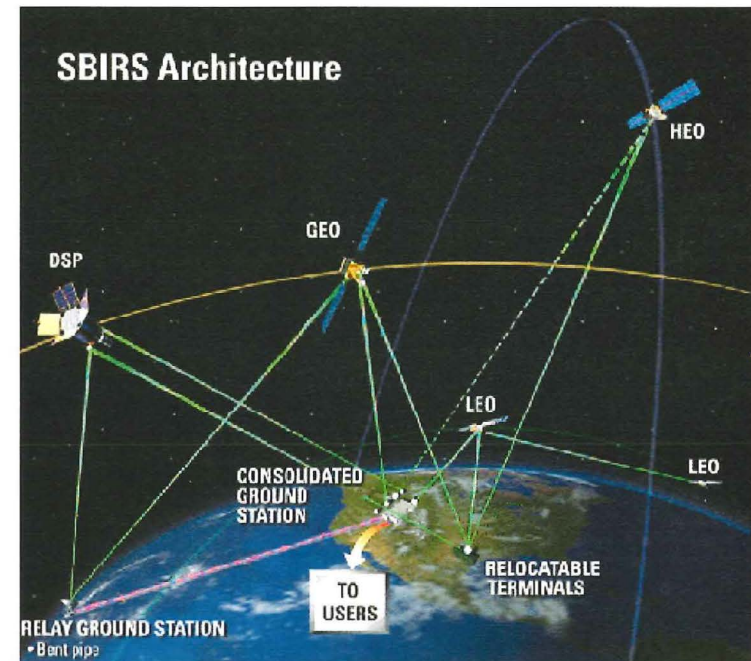
- **Unsuccessful TSPR Implementation Features**
 - Four of the program implementations of TSPR researched were determined to be unsuccessful:
 - Space Based Infrared System (SBIRS)
 - The Evolved Expendable Launch Vehicle (EELV)
 - Theater Battle Management Core System (TBMCS)
 - Deepwater Program
 - All attempted to implement TSPR, but have done so with negative results
 - Programs were unable to reduce cost or schedule while at the same time operating with reduced oversight to meet the requirements and objectives of the acquisition

Unsuccessful TSPR Implementations

– Space Based Infrared System (SBIRS)

• Program History

- SBIRS began in 1996 at the height of the acquisition reform era
- From the beginning the program has been burdened by immature technology, unstable funding, unclear requirements, and underestimates of complexity that all led to cost and schedule increases (37)



Unsuccessful TSPR Implementations

– SBIRS

• Effects of TSPR

- During early program phases, the Program Office exerted no control over the requirements management process
- In a system-of-systems (SoS) setting the fall out of this method is larger than on a single system
- By 2001 the growing cost and schedule variances, and rapid depletion of management reserve funds, led the to the formation of an Independent Review Team (IRT)
- A restructured contract was put into effect , but the system still suffers from decisions made and a lack of early systems engineering support

Multiple restructurings of the program have helped the Government regain control of the program, but lack of early SE support, inconsistent funding, and poor reporting processes have resulted in an unsuccessful implementation of TSPR

TSPR Implementation Recommendations

- System of System (SoS) Implementation Recommendations
 - Require a disciplined acquisition and management process be in place
 - Government needs well trained personnel to define, manage, and evaluate these programs
 - Outsourcing these responsibilities causes difficulty in coordination between multiple PM's, management of schedules, budgets, and narrow system focus (12)

1. Re-establish the SE ability within the Government & implement a disciplined SE process on SoS programs
2. Make SE responsible for requirements management on SoS programs, and utilize them as the central location for requirements management and updates

TSPR Implementation Recommendations

- Requirements Management Recommendations

- It is important that the PM maintains authority over and accountability for requirements during the early phases
- Many that have studied recent Gov. acquisition feel the government has “critical and valuable contributions to make” in the area of requirements generation, management, and control (7)

1. Give PMs the authority to make decisions regarding trade space and need for requirements clarification/changes, and define their relationship with the SE's in order to communicate and execute requirements clarification/changes
2. Re-establish the SE function in the Government to perform the upfront requirements definition and aid the PM in requirements management throughout the program lifetime

TSPR Implementation Recommendations

- Risk Management Recommendations
 - TSPR effectively transfers program risk, with risk sharing should come success sharing
 - The contractor must have enough control of the system to assume management of the risk
 - A well established risk management process must be in place with both Gov. and industry team members
 - It is recognized that risk identification and responsible management is an inherent Gov. responsibility, and should be managed by the PM and SE functions regardless of TSPR use (20)
-
1. Re-establish the SE function in the Government to assess program and requirements risk
 2. Develop a clear structure for risk and success sharing in the contract
 3. Develop a clear reporting method and timeframe for risk to be communicated to the customer, and establish working groups in which risks are regularly reviewed and worked

TSPR Implementation Recommendations

- Ethical Concern Recommendations
 - Ethical concerns were not explicitly addressed as problems discovered in the TSPR process implementation

1. No specific recommendations are required to address ethical concerns within TSPR, as reporting on the process has not produced any ethical concerns tied to this process

TSPR Implementation Recommendations

- Quality and Lean Process Recommendations
 - Intentions of TSPR align with the lean initiatives of minimizing “necessary waste” on a program by reducing bureaucratic oversight and reporting requirements
 - Companies need standards, best practices, and a formalized reporting structure in place prior to the removal of Gov. reporting requirements to manage their new responsibilities under TSPR (18)
 - By selectively implementing lean principles, the efficiency originally intended by TSPR may be realized
 - Clear lines of accountability and authority for engineers and leadership, and minimizing handoffs between parties can contribute to improved flow and management (6, 63)
 - Frequent and formal interactive events, team continuity, and clear effective communication channels are all lean enablers that should be adopted on programs to realize savings and improved program performance (63)
-
1. Re-establish of minimal necessary standards and specification to aid in the management and reporting of program performance
 2. Selectively implement lean enablers during the acquisition process to assign clear accountability and authority; improve interaction between customer, contractor, and internal parties to minimize confusion and time lost to rework; provide team continuity

TSPR Implementation Recommendations

- Cost & Schedule Improvement Recommendations
 - Cost savings efforts should focus on developing strong, long-term partnerships in industry (3)
 - Structured approval and control of requirements changes throughout the program to aid in reducing cost growth & program instability that result from a lack of proper SE at the start of a program (6, 20, 37, 41)
 - Reports suggest the DoD has too many programs in its portfolio at one time, and cannot properly fund all of them, especially when problems arise that require addition time and money (16)
-
1. Re-establish the SE function in the Gov. to aid in cost estimating and early development of sound requirements to minimize change later & reduce disruptions to schedule and cost
 2. DoD to better manage program portfolio to keep funding consistent and as expected during a program lifecycle
 3. Create long term relationships with contractors such that trust is developed and reporting/cost/ schedule requirements are clearly understood
 4. Standardize cost and schedule tracking process to give most accurate view possible of program performance

Conclusion

- The 1990's AR initiated as TSPR has not been carried over to the upgraded 2000's series known as Acquisition Excellence (AE)
- The theory of Government removing unnecessary reporting requirements and reducing the program office is sound if responsibility is properly handed off to industry
 - Must maintain basic reporting requirements
 - Must stay involved with contractor team to provide program and requirements clarification and support as necessary
 - Fulfill the insight role
- In future Acquisition Reform initiatives, features of TSPR could be implemented to reduce cost if the Government Systems Engineering department is properly staffed and able to support PM's and contractors

Questions?

Back-Up Charts

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Unsuccessful TSPR Implementations

– Evolved Expendable Launch Vehicle (EELV)

• Program History

- The EELV program traces its roots to the mid 1980's when it was anticipated that commercial satellite launch demand would continue to grow, and service to space would develop to meet the market need
- With this expectation the Government eliminated much of the oversight and specifications it once imposed on the launch vehicle community
- Evolved into TSPR in the 1990's as the AF and NASA removed themselves from their involvement in the design, production, quality, operations of the system. They would now simply purchase launch vehicles as needed with limited insight into how the system was developed (31)
 - » With the market expectation this approach seemed to be a logical cost saving measure



Unsuccessful TSPR Implementations

– EELV

• Program History (cont)

- The commercial launch demand dwindled in the late 1990's and has not since increased, resulting in:
 - » Increase in unit cost for launch vehicles
 - » Need for continued Government support to maintain the industry staff and ensure reliable access to space
- The Government had hoped that the competition would support two vehicle providers – Boeing with the Delta IV and Lockheed-Martin with the Atlas V – when the market did not produce the expected demand, the Government was forced to allow the merging of the two into United Launch Alliance (ULA)
 - » Effectively eliminating competition in the US launch vehicle market (31)
 - » ULA has been able to meet the launch vehicle needs of the Government thus far, but cost and schedule have not been driven down
 - » Cost increases exceeded the 25% over program objectives level, triggering a Nunn-McCurdy breach in which Congress had to recertify the program as critical to national security (32)

Unsuccessful TSPR Implementations

– EELV

• Effects of TSPR

- Due to the Government's lack of participation in the program, they were unable to aid the companies in any way other than providing monetary support
- Launch vehicle development is highly experiential, and lack of Government SE involvement raises concerns such as:
 - » Many of the specifications and regulations that were in place prior to TSPR were implemented based on lessons learned (no longer being utilized)
- For brand new launch vehicle development there will be a lack of:
 - » Experienced engineers
 - » Design rules due to previous elimination
 - » Technicians skilled in hardware fabrication
- Those left behind will still feel the cost and schedule pressure from the short sighted decisions of the 1990's (31)

Unsuccessful TSPR Implementations

– EELV

• Effects of TSPR

- To address these issues steps have been taken to ensure access to space in the future:
 - » After the Nunn-McCurdy breach, DOD took initiatives to reduce hardware risk, improve producibility, focus on SE processes, and ensure availability of critical staff and facilities (32)
 - » The DOD is still not requiring reporting regarding technology, design, and production maturity data and therefore are unable to comment or address those issues
 - » The AF now engages in daily interaction with both companies in order to gain insight into the readiness of the vehicles as well as potential cost and schedule issues (32)

Unsuccessful TSPR Implementations

– EELV

- **Effects of TSPR (cont)**

- This TSPR implementation removed the Government from:
 - » Interaction during design, quality control, and operations, as well as not requiring cost or earned value management data
 - » The oversight role, and did not follow through with implementation of the insight partnership with the contractors
- Not until it was too late was the Government re-engaged and required to provide monetary support to keep the business alive and assure access to space
- The EELV program office felt that too many responsibilities were placed on the contractor, and not enough on the Government (26)

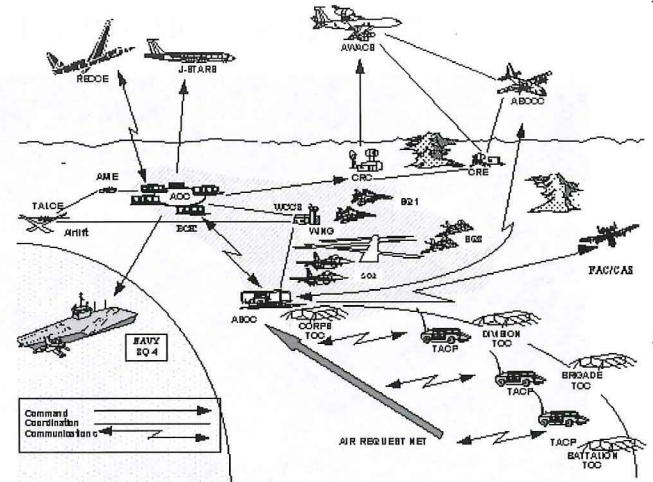
TSPR was implemented with the negative impacts of loss of design discipline, lack of cost and schedule knowledge, and last minute support to ensure key personnel were available in order to produce the vehicle, and negatively impacted the experienced manpower available to support the program

Unsuccessful TSPR Implementations

- Theater Battle Management Core System (TBMCS)

- **Program History**

- TBMCS is a joint service venture to provide battle field awareness and management across the military services
- Considered a follow on system, much of the rigor typically given to joint military acquisition programs was missing from this venture & not given its own:
 - » Operational Requirements Document
 - » Concept of Operations (ConOps)
 - » Done to minimize bureaucratic delays in the normal DOD requirements generation process/accreditation as a joint program (54)
- As a joint service program TBMCS would be employed in a SoS and have to use:
 - » High levels of third party integration
 - » COTS and GFE



Unsuccessful TSPR Implementations

– TBMCS

• Effects of TSPR

- A top level description was provided in a Technical Requirements Document
 - » Prime integrator was continually fed additional requirements from the operational user community
- Functional requirements from GFE were driven back into the system and a flexibility requirement (so new capabilities could evolve) meant the system requirements were very fluid
- Impact to the overall SoS:
 - » Requirements were now being inserted in multiple locations and not flowing back to the system-level baseline so the overall impact could be assessed
- Resulted in the discovery of a major problem in Operational Testing with the intelligence database from which the system was relying upon, and ultimately translated into an eight-month schedule slip (54)



Unsuccessful TSPR Implementations

– TBMCS

• Effects of TSPR

- After the Operational Testing failure the AF established a new baseline and instituted:
 - » More Government oversight
 - » Joint SE process to aid in risk management
 - » Development of a bottom-up schedule that was based on system maturity (54)
 - » Periodic reviews with clear entrance/exit criteria to help the prime integrator in situations where they lacked control over component products
 - » A new program office – contractor working relationship
 - » Design reviews that included both operational and engineering activities helped the program improve collaboration (54)
 - » On-line requirements database allowing for a central location for all stakeholders to view requirements and participate in the newly adopted Spiral Development Integrated Product Team (IPT)
 - » A new System Engineering IPT (54)

Unsuccessful TSPR Implementations

– TBMCS

• Effects of TSPR

- With the Government re-engaged in the program and working with the prime integrator:
 - » The SE process is disciplined & repeatable with clearly defined roles and responsibilities
 - » The Government maintains ultimate control over requirements and utilizes joint management upgrades to successfully release follow on versions
- Despite improvements, the TSPR implementation on this program is considered unsuccessful because:
 - » The integrator received 90 percent of their hardware as GFE
 - » No ConOps was provided for a system expected to accommodate joint service utilization, incorporate existing systems, and providing flexibility for future enhancements
 - » The prime integrator had no flexibility to develop the system using best practices, and struggled to manage requirements coming from multiple stakeholders and levels
 - » Once the Government re-engaged in the management process and took ownership of the requirements the program was able to get on track for a successful implementation

Overall, TBMCS showed that when the requirements process is relaxed, an even more disciplined SE process is necessary, and when prioritizing needs and requirements of multiple services, the Government is in the best position to manage the SE role

Unsuccessful TSPR Implementations

– Deepwater

• Program History

- The Coast Guard's Integrated Deepwater System (or Deepwater) is a replenishment program for the aging deepwater assets
- With expanded responsibilities after 9/11, and fleet very close to or already exceeding its expected service life, the Coast Guard (CG) began an acquisition program to replace the deteriorating aircraft, cutters, and unmanned aerial vehicles
- The acquisition was initiated in 1996 at the height of the reform period, and a contract was awarded in 2002



Unsuccessful TSPR Implementations

– Deepwater

• Program History

- Traditionally, the CG replaces classes of ships or aircraft through a series of individual acquisitions
- For the Deepwater acquisition they used a SoS approach in which they would employ a single acquisition to purchase an integrated, modernized package (55)
- The SoS approach was chosen to maximize the likelihood the CG receives the most integrated system possible to meet their three overarching goals of:
 - » Maximizing operational effectiveness
 - » Minimize total ownership cost
 - » Satisfy the customer (the customer is represented by operational commanders, aircraft pilots, cutter crews, and maintenance personnel) (55)

Unsuccessful TSPR Implementations

– Deepwater

• Program History

- The program was awarded in 2002 to Integrated Coast Guard Systems (ICGS) who would serve as the prime integrator for the Deepwater assets
 - » ICGS signed Lockheed Martin and Northrop Grumman as the two main subcontractors for production of the systems
- The prime integrator is tasked with:
 - » Identifying which portions of the SoS are required
 - » Order in which they shall be delivered
 - » Deliver the products to meet the mission requirements. (55)

Unsuccessful TSPR Implementations

– Deepwater

• Program History

- Mission requirements include the ability to:
 - » Respond to 90 percent of all distress incidents within 2 hours
 - » Detect and track targets of any material such that the probability of detection is at least 90 percent for small targets
 - » Respond to/participate in National Emergency Response Operations within 48 hours (55)
- Even before the contract was awarded the Government Accountability Office (GAO) identified risk areas the program would face including:
 - » Overall management of program
 - » Key management and oversight processes not being implemented
 - » Methods for tracking system integrator performance not available in advance of contract award

Unsuccessful TSPR Implementations

– Deepwater

• Effects of TSPR

- Within the programs first year, the CG was unable to:
 - » Measure, quantifiably, the system integrators performance
 - » Project a timeframe to which they could hold the contractor accountable
 - » Prove that competition was maximized within the subcontracts
 - » Prove the acquisition approach was more cost effective than the traditional method (55)
- In 2004, the CG was considering increasing the program pace, the GAO again evaluated the program and reported many of the key management issues had yet to be addressed or effectively implemented
- The CG was still not receiving schedule updates from the prime, and could not report on the degree to which the program was on track
 - » Accelerating the pace of the program was highly inadvisable, and the GAO strongly suggested a list of recommendations that should be implemented in place of accelerating the schedule (55)

Unsuccessful TSPR Implementations

- **Deepwater**

- **Effects of TSPR**

- When the CG was finally able to take an assessment of the prime integrators performance, they found:
 - » The roles and responsibilities were unclear in many portions of the team
 - » Stove-piped decision making processes
 - » Lack of decision making authority within the teams
 - » The two main subcontractors were maintaining separate databases for their system segments
 - Without a customer SE entity to assist in maintaining a central requirements database, each contractor developed their own - in which resided decisions that would ultimately impact the entire SoS, with no way of flowing back to the top level system (56)

Unsuccessful TSPR Implementations

- **Deepwater**

- **Effects of TSPR**

- No system-level guidance describing how the individual pieces would be integrated
 - This role should have been taken over by the prime integrator under TSPR
 - » Even with CG involvement, the contractors and prime integrator are often reluctant to work closely together or merge processes (57)
 - IPTs have struggled since 2001 to understand their role and decision making authority, and have been largely ineffective in bringing the contractors together
 - Steps have been taken to improve IPT performance, but the latest reports show that insufficient progress has been made and collaboration is mostly inconsistent (57)

Unsuccessful TSPR Implementations

- **Deepwater**

- **Effects of TSPR**

- The program schedule has been extended by 5 years and the cost increased from \$17 billion to \$24 billion.
 - Providing only operational requirements, and being almost fully removed from all oversight functions including schedule, cost, and performance evaluation, have all been detrimental to the CG's ability to run the acquisition program
 - A lack of SE from the customer, and disjointed efforts between the prime and sub-contractors have resulted in traceability issues across the SoS development

Overall, the attempt to reduce cost and acquire a closely integrated system has proven unsuccessful. Recent attempts to get the management construct back on track have shown positive progress, but without more CG involvement it is likely the IPTs will continue to struggle with requirements flow and effective collaboration needed to make the Deepwater program successful.