The Role of Lead System Integrator (LSI)

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Changes Driving Security Transformation

- **Holistic View of Security – World-wide terrorism; pandemics; weapons proliferation; rogue nuclear states; energy dependence; insurgencies; environment; mass migration; regional conflicts; transnational threats; resource access (i.e., water, critical materials)**
- **New Missions – Homeland defense; missile defense; counterinsurgency; stability and reconstruction; civilian cybersecurity; non-kinetic situational influence of operations**
- **Unpredictability – Requiring agility, rapid responsiveness, broad-based capability**
- **Defense Budget Changes – From Equipment to Personnel, O&M and Homeland Security; frequent changes cloud spending outlook and planning**
- **Technological Changes – Info. tech, biotech, nano-tech, robotics, high-energy lasers, etc. - and every warfighter and platform a "node" in a system-of-systems**
- **Warfighting Changes – Net-Centric Warfare; Asymmetric warfare (bio, cyber, IEDs); Systems-of-Systems; Joint and coalition operations; evolving doctrine requiring frontline decision-making**
- **Intelligence Changes – Integrated data; open-sources; Language and culture understanding; real-time intel flow between soldier/sensors and command structure**
- **Industrial Changes – Horizontal & vertical integration; commercial high-tech advances; open networked innovation; off-shore manufacturing**
- **Globalization – Technology and industry are globalized; geo-politics and scope of threats requires security coalitions; DoD no longer the leader in all military technologies; global financial markets enable borderless investing**
- **Isolationist/Protectionist Moves – "Buy-American"; Berry Amendment; ITAR, export controls; restrictions on foreign scholars, students, and S&T workers**
- **China – Future adversary, Economic Competitor, or Global "Partner"**
- **Domestic Economics – Health care; demographics; budget and trade deficit**
- **Government Workforce – Aging; wrong skill mix; rules vs. judgment; "managers" vs. "doers"; difficult to attract and retain top people**
- **Industry Workforce – Aging, eroded systems engineering skills; difficult to attract and retain top S&T people**
- **Congressional Reaction to "need to reform" – From personal abuses and poor performance all leading to risk averse behavior**

Move to System-of-Systems (SoS)

- The military has adopted a new fighting doctrine known as Net-Centric Warfare (NCW)—platforms are networked into a SoSs.
- System-of-Systems acquisition provides the crosslink between the DoD's change of military doctrine and its need to modernize its current forces.
- The integrated nature of the SoS, centered around an extensive communications network, lays the groundwork for complete implementation of NCW.

The DoD defines a SoS as "a set or arrangement of systems that results when independent and useful systems are integrated into a larger system that delivers unique capabilities."

System-of-Systems (SoS)

A SoS is focused on a capability that is enduring, while mission and performance requirements change, the SoS will always require new systems to replace expiring assets. Generally a SoS will have the following features:

1. **Operational independence--**enables individual components to function autonomously, outside of the SoS, if necessary.
2. **Geographic distribution--**permits components to function in a coordinate manner even while geographically dispersed.
3. **Emergent behavior--**describes synergistic and new capabilities not inherent to the component systems individually, but that are attainable with their integration
4. **Evolutionary development--**acknowledges the potential growth in the capability of the SoS through modification of current components or the addition of new ones

With SoS development the DoD is able to optimize the capability of the SoS within cost constraints, rather than optimizing at weapon platforms—which could result in sub-optimization at the SoS level.

Traditional vs. SoS engineering

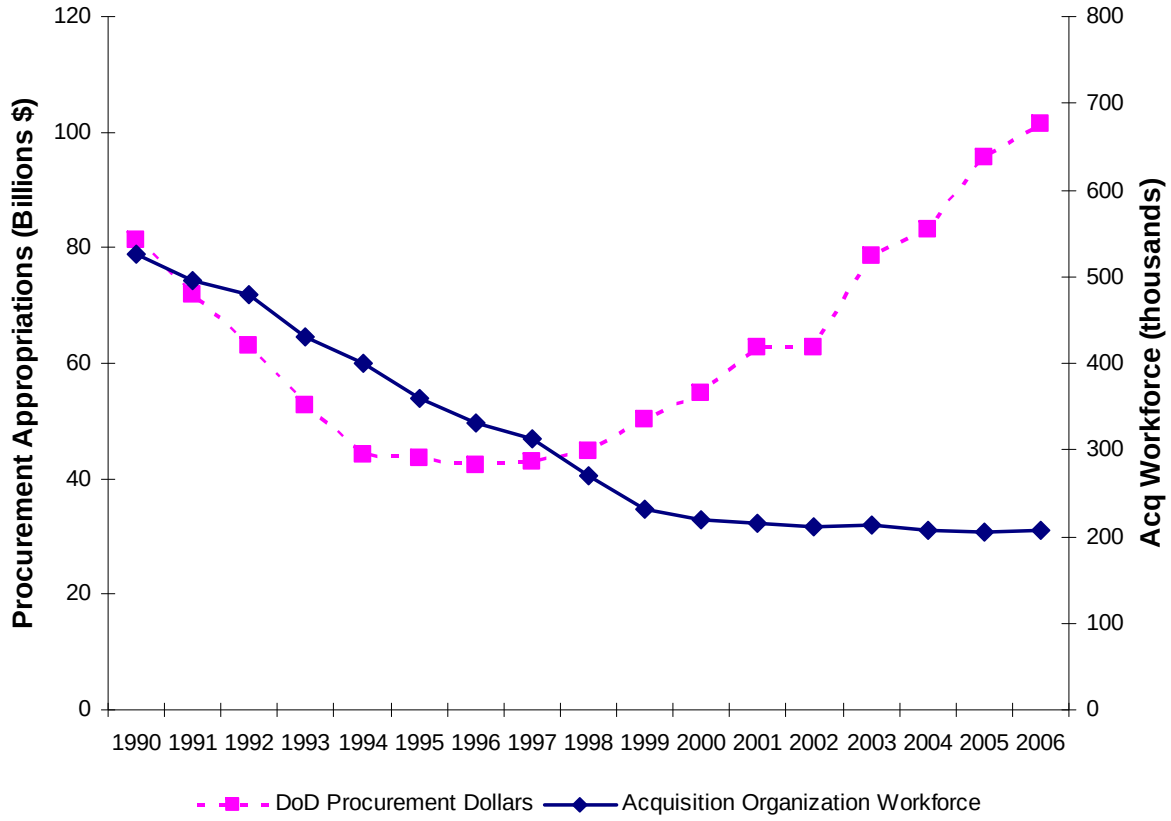
Significant differences exist between traditional and SoS engineering

	Traditional Engineering	SOS Engineering
Goal	Optimized system	Capability
Lifetime	Specific design lifetime	Indefinite lifetime
Design Requirements	Bounded	Unbounded
Size	Single system	Multiple systems
Governance	One dominant influence	Multiple, overlapping spheres of influence
Interdependent Development	Rare	Common

Challenges to SoS Acquisition

- The scale, complexity, and interconnected/interdependent nature of SoS
  - An inconsistent understanding of the term SoS and its implications
  - The lack of a standard approach to SoS engineering
  - Choosing or selecting interface standards
  - The requirement to ensure adequate adaptability
  - Testing at the SoS level
  - Information Assurance
- Extant budget and affordability processes for SoS (within DoD or Congress) still platform focused
  - Budget instability can also create significant program ripples
- The number and skill of system engineers, integrator, managers

Reduced Acquisition Workforce



Source of workforce data: DoD IG Report D-2000-088 Feb 29, 2000 & DoD IG Report D-2006-073 April 17, 2006

Source of budget data: Annual Defense Reports, available at http://www.dod.mil/execsec/adr_intro.html. Procurement supplementals for FY2005 and FY2006 not yet reflected in Annual Defense Reports were obtained from Congressional Research Service Reports. (Defense Science Board, 2008)

Lead System Integration (LSI)

- Complexity of SoS development requires a single entity to properly manage development, integration, and risks
- DoD employed private contractors as Lead System Integrators believing that it did not have the organic capability
- In some cases, contractor LSIs also have been given broad, government-like authority
  - development of individual system requirements,
  - contracting for their development and procurement
  - coordination of development schedules and efforts
- The degree of authority and responsibility given to an LSI, however, depends upon the program in question

Regardless of the authority the government delegates to the LSI, the government is still responsible for the program and must oversee the actions of the LSI and retain final decision authority

Private contractor as LSI

- In contrast to the government, private firms generally have
  - Ability to attract and retain the required technical expertise in much greater numbers than is the government, and as a result have greater capacity, capability, and flexibility
  - Competitive pressure, when contracts are properly structured
  - Access to more innovative technologies
  - Greater latitude when subcontracting due to greater budgetary flexibility
- As a result, a private LSI potentially provides the government with a flexible and an adaptable partner in SoS acquisition

Fears regarding use of a LSI

- Critics of LSI principally fear the entity infringes upon inherently governmental functions
  - **Loss of control--**government avoids its primary responsibility, without being able to provide adequate oversight of the LSI
  - **Conflict of Interest--**LSI has a strong incentive to take actions beneficial to the firm, at the expense of the government's interests
  - **Transparency--**Gov't may have insufficient visibility into program aspects such as program costs, optimization studies, source selections
  - **Competition--**May limit the option for future competition
- Proponents of LSI believe that the fears of critics are either unfounded or can be addressed by proper government oversight

Deepwater

- Objective: Replace the entire Coast Guard fleet with one modern SoS
- Original contract called for
  - Development of 15 major classes of ship and air vehicles
  - Delivery of over 450 new or modernized assets
  - Comprehensive C4ISR system

Deepwater Contract

- LSI chosen was Integrated Coast Guard Systems (a partnership between Lockheed Martin and Northrop Grumman)
- Contract worth up to $24 billion dollars over 30 years.
  - 5yr contract can be renewed up to five times with a maximum contract length of five years
- Deepwater contract had some unusual features:
  - Granted LSI great flexibility to determine program outcomes
  - Performance-based agreement that held the contractor accountable for its development decisions.
  - Complex structure, including numerous subcontracts types using different contract vehicles

Deepwater Development

- The program experienced many development problems, to include:
  - Conversion of legacy ships (from 110' to 123') cancelled, after two ships experienced hull buckling.
  - Due to this failure, the Coast Guard ordered the acceleration of the Fast Response Cutter (from a 2018 delivery date to 2007).
  - Significant cost overruns and schedule delays lead to the eventual termination of the ship.
- Due to criticism of Deepwater, the Coast Guard took over LSI responsibilities in April 2007, but retained the services of the Lockheed Martin-Northrop Grumman partnership.

Future Combat Systems

- The “Army’s first full-spectrum modernization in nearly 40 years” (US Army 2007)
  - Will eventually field 15 brigades
- The Army has dubbed this configuration “14+1+1”: fourteen weapons platforms, plus the advanced information network, plus the soldier

Non-Line-of-Sight Cannon

FCS Contract

- The LSI is Boeing, which has subcontracted management responsibilities with Science Applications International Corporation (SAIC)
- The Program Manager has make/buy oversight
- Originally an OTA contract with a high 10% fixed-fee, plus up to 5% in incentive awards of 15%
- Program came under congressional scrutiny for the high fixed fee, and potential conflict of interests
- Subsequently restructured to a CPFF and CPIF FAR-based contract with a fixed-fee of 3% and incentive award up to 12%

Future Combat Systems

The program has been restructured three times:

1. July 2004: Program restructured to meet new post-9/11 legislative requirements
   - Expanded mission portfolio
   - Rapid deployment through spiral development
2. Early 2007: Program restructured to maintain program costs within the new funding levels established in 2006.
   - Reduced the scope of FCS
   - Reduced number of assets to be purchased
   - Reduced the production rate for assets.
3. April 2009: Secretary Gates proposed budget for FY2010 cut heavy vehicles and refocused on other elements such as, ISR, Robots, C3, etc.

Congress Reacts

2008 Defense Authorization Bill (PL No: 110-181), Sec. 802. Lead Systems Integrators.

- Prohibits the Department of Defense from awarding new contracts for lead systems integrator functions beginning Oct. 1, 2010
- The bill also places an immediate ban on such arrangements for programs that are not yet in low-rate initial production

Findings

- DoD is committed to SoS development
- SoS engineering and integration is a complex undertaking
- SoS development is still a maturing discipline
- LSI programs have experienced technical difficulty for a variety of reasons to include:
  - Requirements growth in response to expanded mission profiles
  - Programs were accelerated—often based more on optimism than best engineering practices, resulting in development problems
  - Programs were started without a sufficient knowledge base—delay or failure of one platform has a negative ripple on the entire SoS

Preliminary Findings (cont)

- The government does not have the organic capability or capacity to perform the extensive systems engineering and integration tasks required by SoS
- The government needs objective/independent systems engineering and architecture advice from firms willing to take hardware/software exclusion contracts
- Despite retaining final decision authority, the government has not consistently provided effective oversight of private LSIs
- The greatest concern regarding the use of LSI is the government's delegation of "inherently governmental functions"
- A potential conflict of interests exists for private LSIs.
- Unified leadership of the system-of-system integration affords the best chance of successful completion

Recommendations

1. The government should continue development of SoS programs that offers significant benefits over individual acquisition projects
2. The government must assume the LSI responsibility
3. The government must effectively partner with the private sector to adequately perform the LSI function.
   - The DoD must provide better oversight and write contracts that are better defined.
   - The DoD should accelerate its efforts to recruit, hire, and retain the required systems engineering and program management human capital for program development and oversight
   - The government should plan to competitively award a “LSI support” contract to a firm capable of independent systems engineering, systems architecture, and systems costing
   - The government should enforce hardware and software exclusion provisions for the system-of-system integration contracts
   - Encourage the development of independent private sector systems engineering capability
4. Congress should modify the prohibition on the use of LSIs to permit LSI pilot programs to examine and evaluate strategies to fully leverage private sector capacity