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Customer Success Is Our Mission

Mission Assurance and Systems Engineering

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October 25, 2005

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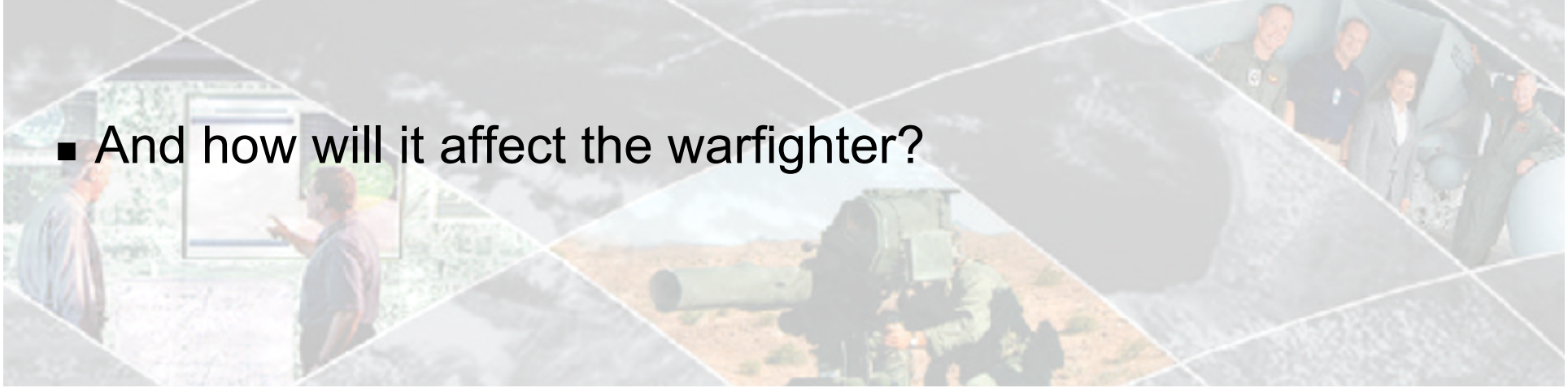
Introduction

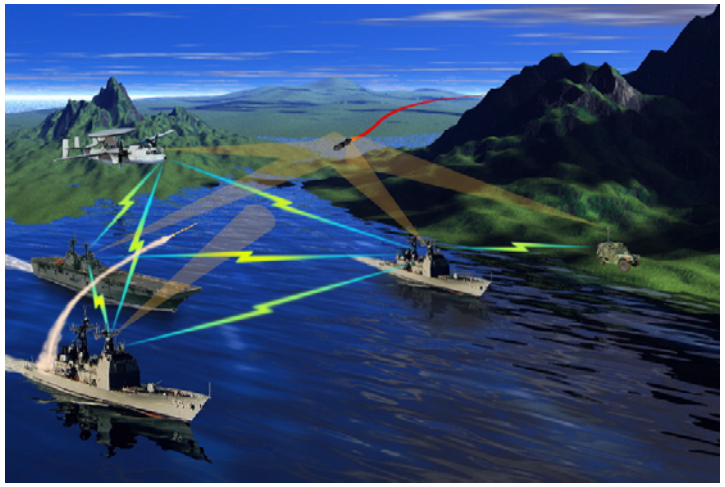
- Why Mission Assurance? Why now?
- What is the role of Systems Engineering in achieving Mission Assurance?
- What actions can we, as Systems Engineers, undertake?
- And how will it affect the warfighter?



Mission Assurance should be at the forefront of Systems Engineering.

Architecture and the Customer

- Warfighter now transformed to Peacekeeper
  - Do the system requirements change?
- NATO interoperability
  - JTRS
  - FCS
  - E-3 AWACS
  - F-35
- Intel time lag
  - Cannot afford one-day or one-hour delay of information
  - Must be seconds… IEDs, high-value target information
- Challenges
  - Need for Flexibility
  - Need for Speed
  - Need for Accuracy
  - Need for ASSURANCE



The Role of the ~~Warfighter~~… PeaceKeeper

- IEDs counter threats
  - Armoring Humvees
  - Trigger-signal jamming
- Fratricide and combat identification issues
- Killing of non-combatants
  - Collateral damage in peacekeeping missions
  - Precision munitions
- Example: Defective bullet-proof vests ("Faulty Body Armor May Have Endangered Bush," Associated Press, Sept. 26, 2005 by John Solomon)
  - Inadequate testing
  - Processing problems
  - Materials issues

It IS all about the warfighter.

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Mission Assurance

- How does Systems Engineering relate to Mission Assurance?
  - Systems Engineering, Architecture, Processes, Cycle time all are inherently part of Mission Assurance.
  - The challenge is focusing System Engineering, Architecture and Process on Mission Assurance.
  - It's all about Mission Assurance: the product has to do what it's supposed to do when it's supposed to do it.
  - The challenge is doing the right amount of system engineering and developing the right architecture while still following good process and meeting the required cycle time.
  - The result is a product with its most important attribute: Mission Assurance.

System Engineering is the glue that brings everything together to achieve Mission Assurance.

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Systems Engineering/Mission Assurance

- System Engineering must become Mission Assurance Centric
  - – Improve internal processes
    - CMMI, ISO, MAP
  - – Architecture
    - Open Architecture enabled
    - P3I & Spiral Capable- top level
  - – Customer involvement
    - Customer (procuring community through to the warfighter)
    - Know what you are buying, and get what you bought!
    - Deliver on our designs throughout the life cycle

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The Warfighter

- Does the product meet the warfighter's needs?
  - Is it adaptable for use in the field?
  - What is the cost of architectural consideration, and how do you plan for the unanticipated need?
    - A proven, flexible & open architecture
  - How are products being used in a different way than originally planned?
    - Warfighter versus Peacekeeper
  - How do we manage quick reaction needs? ACTDs, etc.
    - How do these architectures affect Mission Assurance?
    - What needs change as the mission changes?
      - Global Hawk, Predator, Boeing X35/X45 each have a varying need for flexibility.

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The Warfighter

- How does Mission Assurance and Systems Architecture affect the warfighter?
  - Command and control at the soldier level
  - UAVs for the soldier, not just the battlefield commander
    - Provides more control and awareness for the user
    - Drives need to provide on-demand, real-time Intel in seconds, not minutes or hours
  - UAVs carrying weapons
    - Hellfire (shoulder-fired missile)
    - JDAM (Joint Direct Attack Munition, precision-guided bomb)
    - GBU-15 (General Bomb Unit)
  - Communications gear on the ground
    - Need for radio interoperability between services and civil space (JTRS)
    - Example: a downed Air Force pilot has to be able to call Army ground forces
    - Example: Iraqi police: Example: ***Katrina***

Warfighter's need is <u>right now & it must work.</u>

Increasing Mission Assurance capabilities

- An orthogonal approach
  - Better union between warfighter and application
    - Capture intent
    - Get away from designed-in mission limits
    - Involve warfighter in entire process so it's understood
      - Drill down / visualization
      - Technology to reason *and communicate* as the warfighter would
      - Product team becomes part of the *mission team*
- *These can be combined with dynamic & adaptable systems*
  - Dynamic systems *require* increased integrated capabilities
  - Adaptable to new warfighter needs in the Field

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One Approach: Reliability

- We can manage risk by making a reliable product
  - Warfighter must know how the equipment works in the field
  - Warfighter must have a simple, intuitive interface to the equipment
    - Usable under stress
    - Usable even when distracted
  - Performance of product must match contract capabilities
    - Contract must project unanticipated conditions (Spiral, P3I)
    - Over-design adds safety margins, but also costs… Must be Balanced
  - Boost MTBF
    - Built-in Redundancy
    - Fault Tolerance / High Availability
    - Adaptability/survivability

The cost of reliability should be measured in lives saved

One Chess Master Noted…

- "When I play [chess], the pieces get in the way." (paraphrased)
  - Famous for a strategy of offering the opponent superior trades in exchange for positional advantages, leading to victory
- What is the lesson here for "Mission Assurance"?

Common wisdom may not be the winning move.

Another Way to Formulate Mission Assurance

- Make sure there is more than one path to mission success
  - That there ARE other places to “allocate resources”
  - High redundancies may lead to cheaper technologies
    - Dumb bullets and a machine gun
    - Swarm Theory
      - Semi-autonomous control wherein a group of UAVs will automatically follow a general path chosen by the leader, which would be the real-time remote-controlled UAV, and is being explored to offset the issues with remotely controlling multiple UAVs in a small squadron – practically impossible.
- Remote Building Search Example
  - Really smart, expensive, autonomous robot
  - Non-autonomous (cheaper) robot, that fails if radio contact lost
  - Lots of “cheap” autonomous robots that work together (e.g., *Minority Report*)
  - Sensor cloud
    - Individual low lifetime (minutes) and low reliability
      - BUT COLLECTIVELY SOLVE PROBLEM FAST & CHEAP

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Potential for "Discontinuous Change"

- Clay Cristensen (*Innovator's Dilemma)* talks about disruptive changes as those that are initially cheaper solutions to existing technologies, but undermine the usual "catering to the high end of the market" mentality – subsequently undercutting existing (and often leading) providers.
- Changes to Mission Assurance may undercut existing products *but also open new markets*
  - A potential opportunity to
    - Change Doctrine
      - Work with Our Customer on the real problems, not just address the issues with existing solutions
    - Be seen as a real leader
      - By helping Our Customer redefine their needs, we become a "trusted partner"
      - Differentiation of mission/product

P(Mission Success) as a QoS Issue

- If we treat our probability of mission success as a Quality of Service
  - It becomes an independent variable, for which dynamic systems solutions are possible
    - C3I impact
    - Network impact
    - Doctrine/Training impact
  - Need Customer Buy-In

Recast Mission Success as a Systems/technology problem.

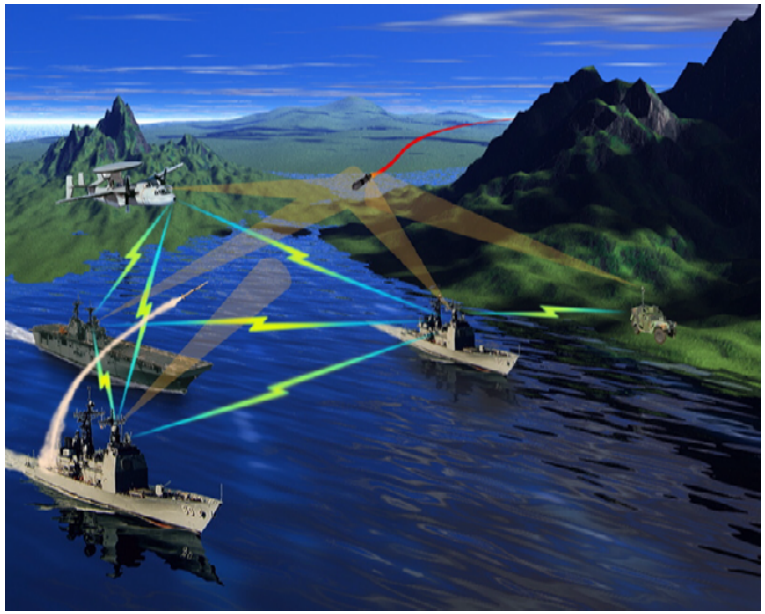
Architecture

- How does architecture impact Mission Assurance?
  - Transition from ACTD to warfighter to peacekeeper
    - Global Hawk
    - Predator
      - Monthly changes to requirements
    - E8/JSTARS program (went quickly from development to production)
    - Boeing X35/X45 Platform
    - Non-lethal weapons - New technology too quickly deployed? Or not quick enoug
      - Active Denial Systems (High-Power Microwaves)
      - Tasers
      - Rubber Bullets
    - High-power laser environment
      - Solid state laser
      - Chemical laser

Products may not be used the same way throughout the entire product lifecycle.

Product Lifecycle

- Peer reviews and customer involvement in the requirements definition cycle have not examined the lifecycle costs adequately
  - Lifecycle CAIV analysis
  - Requirements management throughout the program
  - Technical upgrades & improvement
  - End-of-Life disposal



We need speed with Discipline.

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Quick Reaction Programs

- When is quick too quick?
  - ACTDs and Demonstration programs
    - Do we adequately plan for success?
    - Do we bring in the “ilities” on these ACTDs early enough?
    - Do we get enamored by the technology instead of focusing on user needs?
    - Are we doing the right amount of systems engineering up-front to help provide Mission Assurance?
    - Are we building-in the right architecture?
      - Expandable
      - Flexible
  - The need for speed needs to be balanced with the need for process discipline
    - If you need it bad, you will likely get it bad…

There has to be a balance between good process and program speed.

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Mission Assurance Summary

- Mission Assurance is the application of:
  - Technology
  - Architecture
  - Process
  - Discipline
  - Commitment
  - Innovation
  - Warfighter Involvement

No Doubt it will work!

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Mission Assurance – Standards and Specs

- MIL SPEC 9858A
  - Clear Quality guidelines on design and development; Quality standards
- Mil-Specs used to guide industry in common standards
  - Guidelines for everything from development to production & field Support
- Willoughby Best Manufacturing Practices – Navy Guidelines
  - http://www.bmpcoe.org/index.html
- Military Design Guidelines
  - http://hfetag.dtic.mil/hfs_docs.html
- Missile Defense Agency Mission Assurance Plan
  - MDA-QS-001-MAP

We must address the disciplines that made Systems Engineering great!