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The Art of NRO Systems Architecting

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The Art of Systems Architecting, Maier & Rechtin, 2009



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Organization

- Architecting in Business & Government
 - Problem solving in the GOVT
 - Engineering Purity has no place in GOVT
 - What do you hire the GOVT to do?
- The Political Process & Systems Architecting
 - Politics are real; get used to it. [FOL #1]
 - Cost is king. [FOL #2]
 - Get some friends and keep them. [FOL #3]
 - Technical failures get political fast. [FOL #4]
 - Engineers don't run the GOVT. [FOL #5]
 - Who REALLY is the GOVT's customer?

p.361: "If the politics don't fly, the system never will."



A trip to NYC

- In 2006, 6 of the 8 NRO Chief Scientists took a trip to see Cooke & Fox the architecture firm.
- “Do you have an architect?” “We do!”
- “What’s their training?” “He’s an engineer.”
- “That’s where you went wrong; engineering is about solving problems. Architecting is about envisaging the possible.”
- Does that mean engineers can’t be architects?

p.356: “...more about the problem as about the solution.”



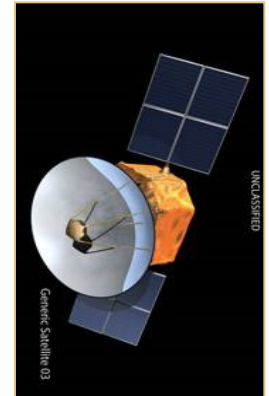
Organizing the Program

- GOVT defines the strategic intent [WHAT]
 - NSA & NGA are critical to define the need
 - DOD & ODNI must issue orders to build
 - NRO responds to the needs with boundaries
- CONT define the system solution [HOW]
 - Maximize the return on investment
 - Produce what is asked for, at a fair price
 - Continually offer improvements
- FFRDC assesses the value [WHY]
 - Provide technical depth beyond the GOVT
 - Assess the cost/benefit
 - Define what improvements might be needed



The National Reconnaissance Office

- We acquire and operate the most capable set of satellite intelligence collection platforms ever built
- We provide SIGINT and GEOINT intelligence data in support of IC, DoD, DHS, and other Partners
 - SIGINT: From space, we provide the ability to eavesdrop on enemy communications signals, electronic signals from enemy weapons systems, and other signals of growing relevance in the post-Cold War environment.
 - GEOINT: NRO systems provide imagery and other data to support the application of Geographic Information Systems for a variety of missions, including precision targeting and battlespace awareness.
- We support covert and high priority operations





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The NRO Mission



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NRO Role in Operational Intelligence



1. COLLECTION REQUIREMENTS

2. PRIORITY GUIDANCE

3. PRIORITIZED COLLECTION REQUIREMENTS

4. SATELLITE COMMANDS / DATA RETURN

5. RAW DATA

6. EXPLOITED INTELLIGENCE

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What's the need?

- “We want to know where the forest fires are.”
- US Forest Service gets surprised every year.
- When do they occur?
- What conditions cause them?
- How do we predict them?
- Where do we search for them?
- How do we alert people to the risks?

With due respect to the fictional SMAD “FireSat” program.



What's the solution?

- “We’ll give you a FireSat.”
- System Requirements
 - Survive in LEO for 5 years
 - Cost less than \$100M
 - Launch on a EELV Medium (United Space Launch)
 - Integrate into the existing USFS network
- Augmentations
 - Don’t you want 10 years of operation?
 - Would you like to share the cost with others?



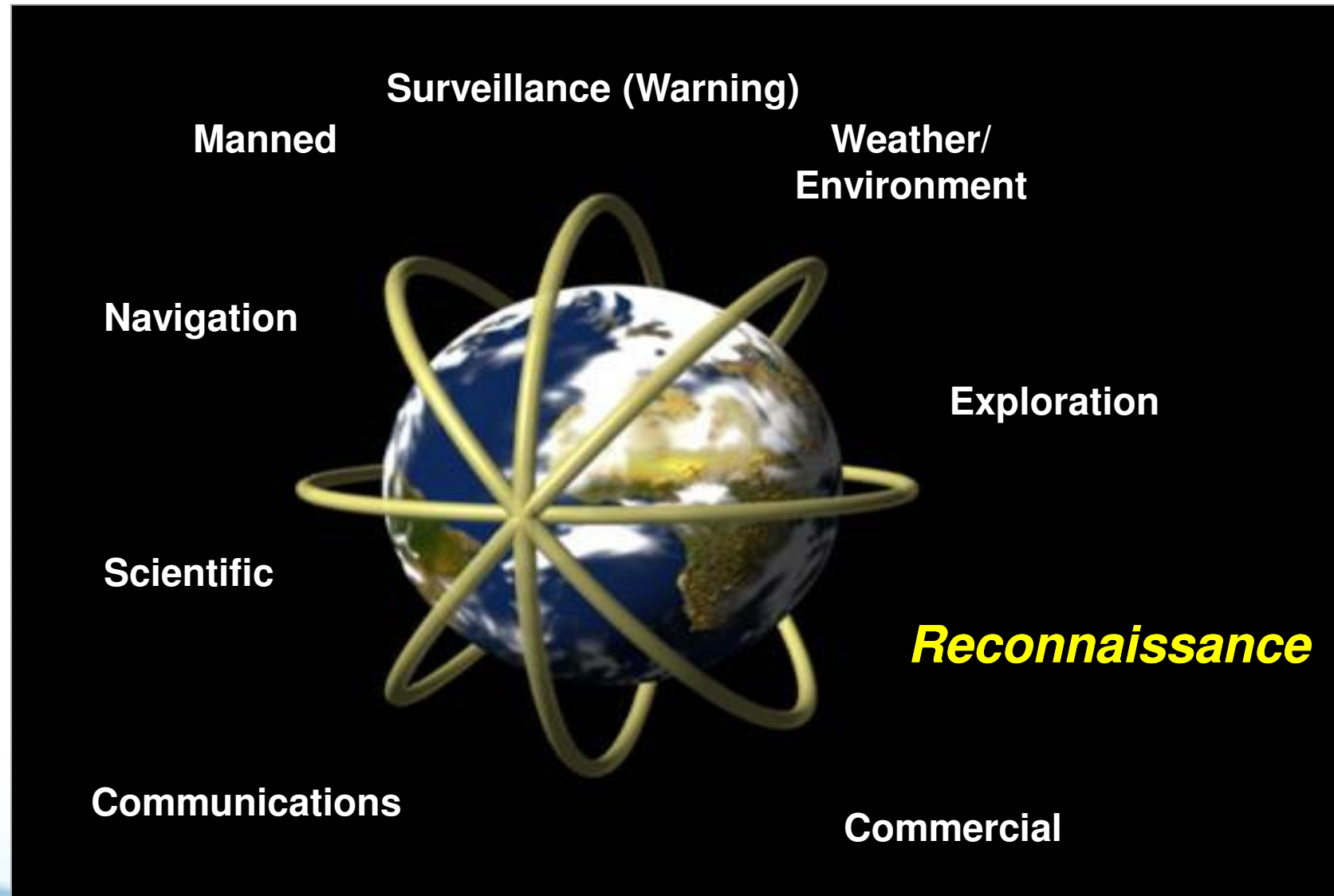
Verification

- Does the plan hold?
- Are there pitfalls to be considered?
- How have others solved similar problems?
- Where does the system end?
 - Spacecraft
 - Space/Ground
 - Space/Ground/User
- Stay one step ahead of the customer



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U.S. National Space Missions



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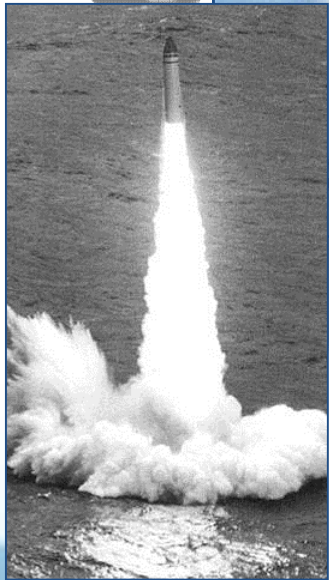
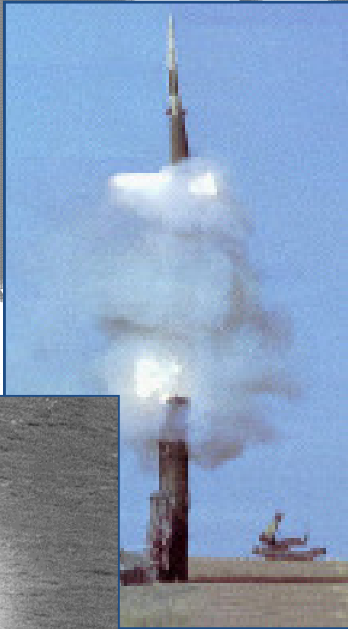
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Traditional Missions

ARMS CONTROL



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INDICATIONS AND WARNING



MONITORING FOREIGN MILITARY FORCES



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Attacking Hard Problems



- Counter the IED threat
- Neutralize terrorists
- Warn of enemy attacks
- Prevent WMD proliferation
- Prevent drug trafficking
- Support Natural Disaster Response



The [International] Space Station

- Who does what?
- Who currently supplies the ISS?
- What's the ISS population?
- Apollo derailed [I]SS until the 1980s
 - What other program motivated the ISS?
 - Was there another way to solve the problem?
 - Could there have been better politics?
 - Once a path was started, could it be changed?



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The “Right” Solution

- If 2 is good, is not 10 better?
 - Start with the end in mind – the budget.
 - Envisage the need based on that boundary.
 - Present the idea back to congress.
 - Do NOT lobby; answer their questions.
- Budgets generally come 1 year at a time.
 - Keeping the program “sold” [How?]
 - 5-year plans help...set expectations [Limitations?]
 - 2 year R&D is good...with limits [Problems?]



NASA's Brilliance

- “No bucks, no Buck Rogers.”
- 14 major Centers in 14 influential states
 - Aircraft development; NASA Langley [VA]
 - Technical subsystems; NASA Glenn [OH]
 - Space operations; NASA Johnson [TX]
 - Rocket development; NASA Edwards [CA]
- Why have they not returned to the moon?
- Why is Mars so hard to get to?



Technology is NOT always your friend

- Is more better, really?
- What approaches could help ensure success?
 - Dual technical paths
 - Multiple contractors
 - Constituencies
- When do introduce new technology?
 - Before you start? The middle?
 - “Spiral Development”



Engineers DON'T run the GOVT

- Engineers always strive for “The Truth.”
 - There should be “an equation.”
 - Can all risks and challenges be quantified?
 - Stubborn will get your program killed.
- Accept that truth is not always right.
 - Sooner is better?
 - Later is worth the wait?
 - What if money disappears?



NRO Systems Engineering

- Dedicated to the finest
 - Excellent engineering goals
 - Best educated space crew...and that's the GOVT
 - Closest thing to a company in the GOVT
- Two dedicated customers
 - They don't always like us; but they trust us.
 - Our mission is clear...just build working spacecraft.
 - Our reach is wide...DHS to Intelligence to DOD

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