SMART Conceptual Site Models

Managing and Communicating Data Uncertainty

John Sohl – CEO

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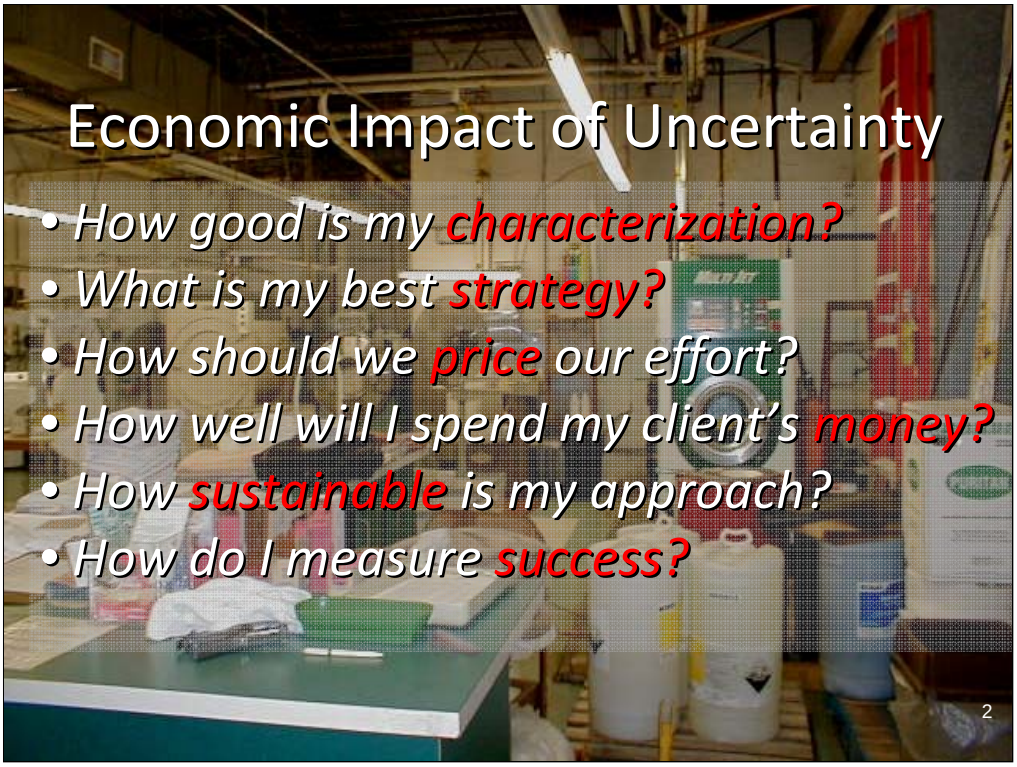
www.columbiatechnologies.com


Economic Impact of Uncertainty
• How good is my characterization?
• What is my best strategy?
• How should we price our effort?
• How well will I spend my client's money?
• How sustainable is my approach?
• How do I measure success?
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Factors Affecting Clarity of the CSM

courtesy of Robert Howe Tetra Tech EMI

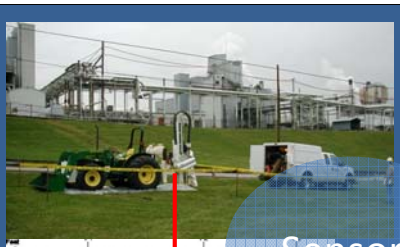
A team's ability to build an adequate CSM to arrive at a consensus vision may depend on the following key factors:

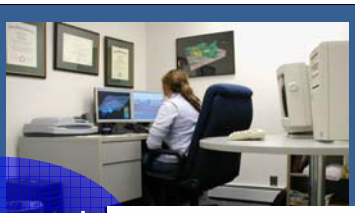
1) **Clarity of CSM presentation**
2) **Amount of data available for the site**
3) **Clarity of the intended reuse**
4) **Stakeholder expectations and past experiences**
5) **Economic and time constraints.**

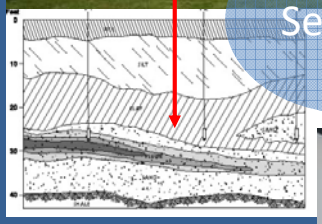
Triad Site Management Toolset

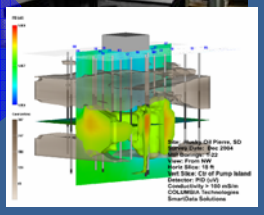
courtesy of Tom Palaia CH2M HILL

- To enable efficient selection of a site management strategy within the short duration of a Triad project, a core set of decision support tools are needed to assist project team members. The toolset described in this presentation includes:
  - A geospatial database to compile and visualize collaborative data sets,
  - A three-dimensional visualization and animation system to illustrate contaminant fate and transport, and
  - A multi-criteria decision support tool to assist with, among many tasks, analysis of site conceptual model (SCM) certainty and selection of a site management strategy.





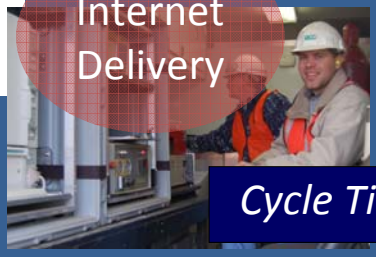




Sensors

Advanced Analytics

Internet Delivery



Cycle Time = Minutes

Technology provides accuracy and real time information

U.S. Patent No. 7,058,509

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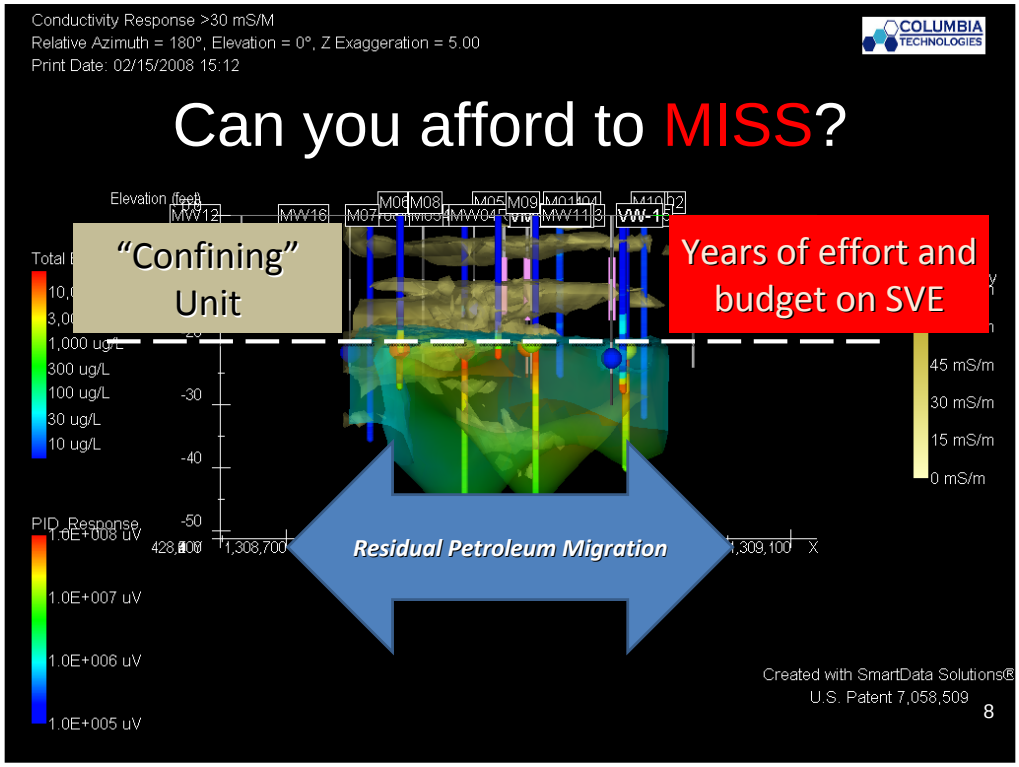
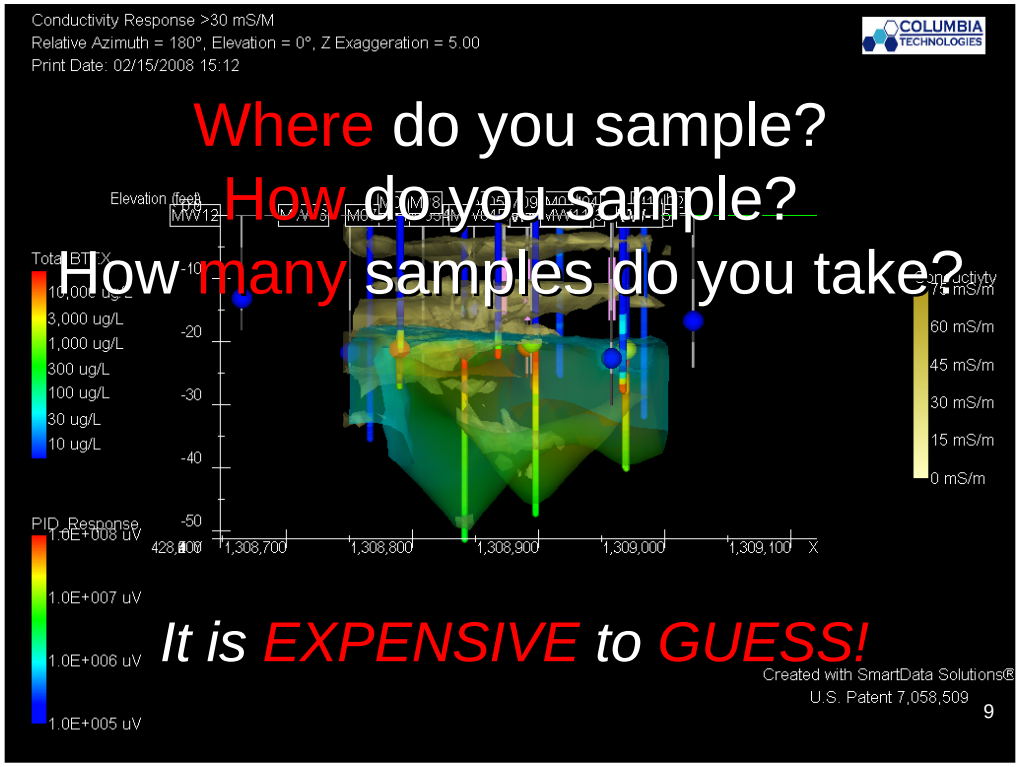
What's the Value Proposition?

$$$

#1 - High Resolution

The greatest source of error and therefore risk of failure, poor remedial performance, and loss of capital in site characterization is the existence of data gaps.


Conductivity Response >30 mS/M
Relative Azimuth = 180°, Elevation = 0°, Z Exaggeration = 5.00
Print Date: 02/15/2008 15:12
COLUMBIA TECHNOLOGIES
Can you afford to MISS?
"Confining" Unit
Years of effort and budget on SVE
Residual Petroleum Migration
Elevation (feet)
MW12
MW16
M06
M08
M05
M09
MW11
-30
-40
-50
1,308,700
1,309,100
X
1,000 ug/L
300 ug/L
100 ug/L
30 ug/L
10 ug/L
45 mS/m
30 mS/m
15 mS/m
0 mS/m
PID Response
1.0E+008 uV
1.0E+007 uV
1.0E+006 uV
1.0E+005 uV
Created with SmartData Solutions®
U.S. Patent 7,058,509
8


Conductivity Response >30 mS/M
Relative Azimuth = 180°, Elevation = 0°, Z Exaggeration = 5.00
Print Date: 02/15/2008 15:12
COLUMBIA TECHNOLOGIES
Where do you sample?
How do you sample?
How many samples do you take?
Elevation (feet)
MW12
Total BTEX
10,000 ug/L
3,000 ug/L
1,000 ug/L
300 ug/L
100 ug/L
30 ug/L
10 ug/L
-10
-20
-30
-40
-50
1,308,700
1,308,800
1,308,900
1,309,000
1,309,100
X
Conductivity
75 mS/m
60 mS/m
45 mS/m
30 mS/m
15 mS/m
0 mS/m
PID Response
1.0E+008 uV
1.0E+007 uV
1.0E+006 uV
1.0E+005 uV
It is EXPENSIVE to GUESS!
Created with SmartData Solutions®
U.S. Patent 7,058,509
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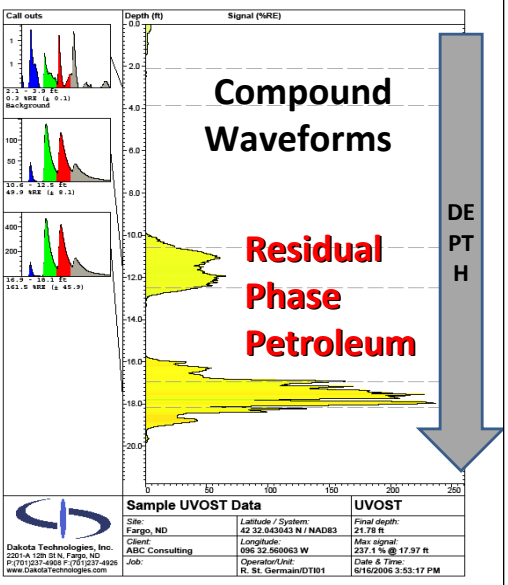
High Resolution Sensor Data

- Compound specific
- Stratigraphic
- Minimal data gaps
- Real time
- Digital
- Easy to communicate
- Low economic cost



#2 - Speed

Speed enables the Triad team to identify and close data gaps with little or no additional cost in *real time*.

#3 - Communication

Easy to understand.
Easy to involve all stakeholders.
Easy to communicate globally.

#4 – Cost Alternatives

Cost of remedial implementation?
Cost of traditional characterization?
Cost of rework or failure?

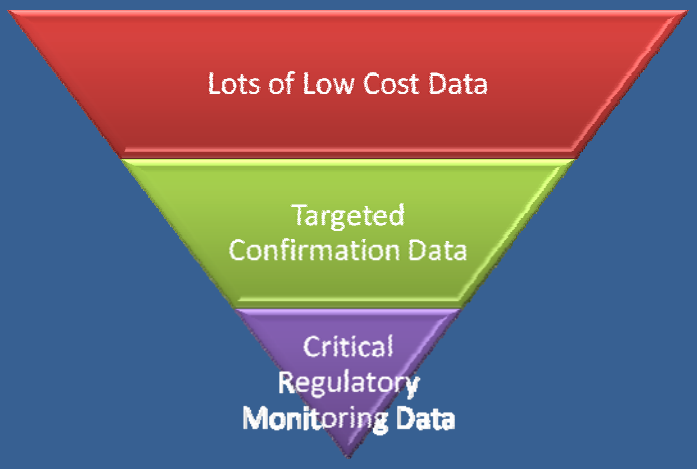
vs. the incremental
cost of high resolution characterization?

What is the Cost of Error?

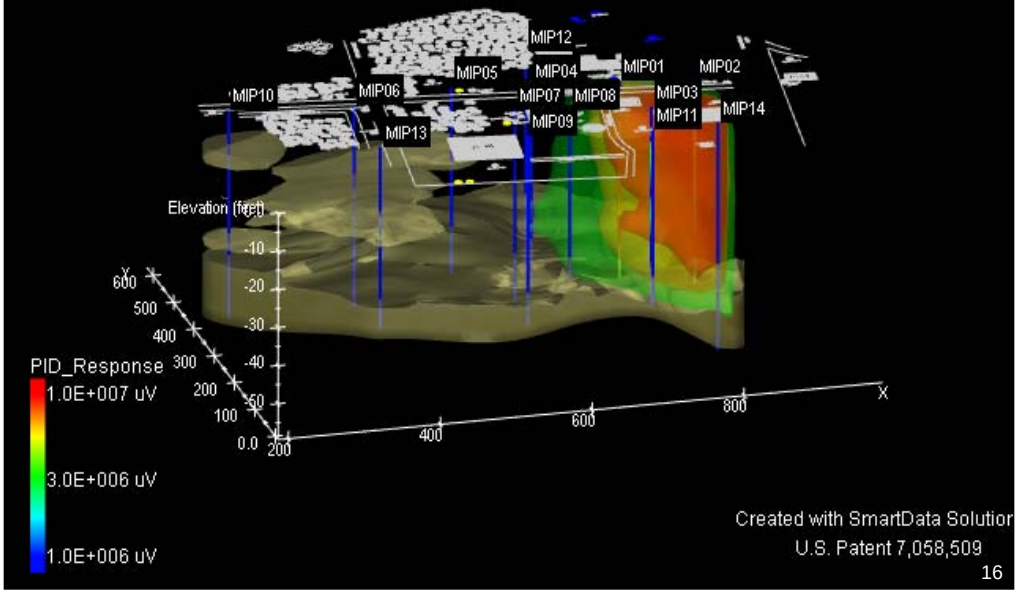
How do we deal with:

Complex geologies?
Non-representative samples?
Groundwater in lieu of soil samples?

The Inverted Data Pyramid



Former UST Site
State Petroleum Reimbursement Fund
What's Wrong With This Picture?



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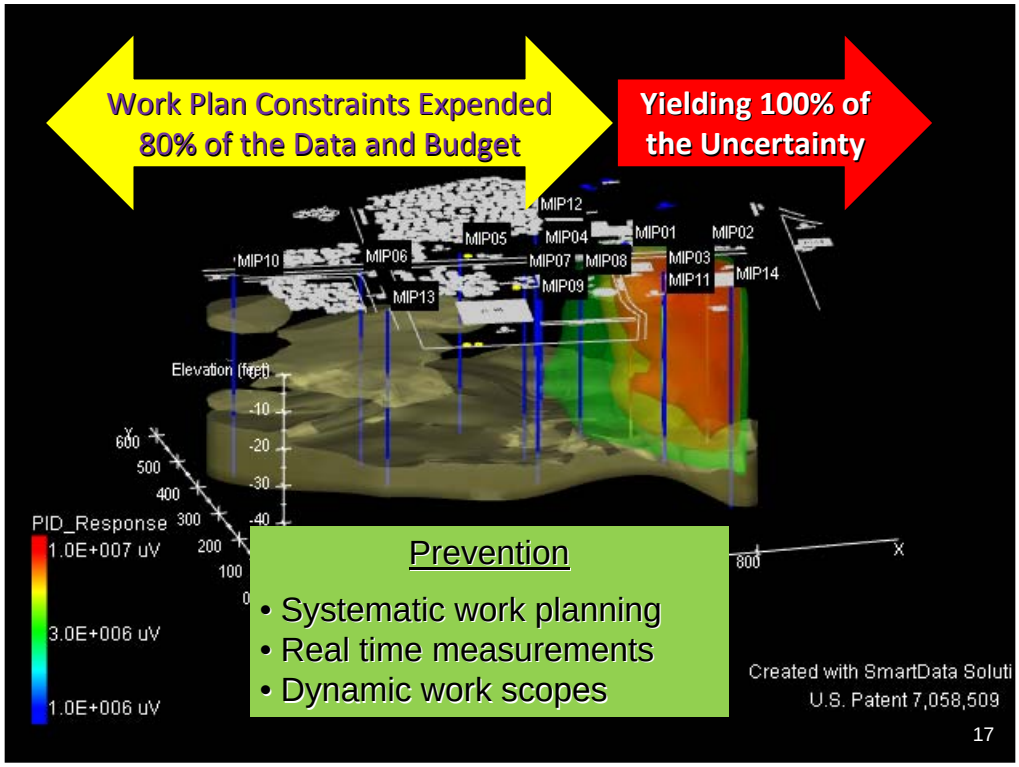
Work Plan Constraints Expended
80% of the Data and Budget
Yielding 100% of
the Uncertainty
MIP12
MIP01
MIP02
MIP05
MIP04
MIP10
MIP06
MIP07
MIP08
MIP03
MIP14
MIP11
MIP09
MIP13
Elevation (feet)
-10
-20
-30
-40
600
500
400
300
200
100
0
800
X
PID_Response
1.0E+007 uV
3.0E+006 uV
1.0E+006 uV
Prevention
• Systematic work planning
• Real time measurements
• Dynamic work scopes
Created with SmartData Soluti
U.S. Patent 7,058,509
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Triad - A Smarter Alternative

- Less data gaps and less risk
- Accelerated decision making
- More cost-effective use of resources
- More cleanups “on target”

What's the Return on Your Triad Investment?

- Reduced cost of additional mobilizations and data collection
- Reduced impact of collecting inadequate or incorrect data on follow on work planning and remedial alternatives
- Too many or too few or incorrectly placed sample locations
- Too many or too few or incorrectly placed or screened expensive monitoring wells
- Too much, too little, or incorrectly targeted remedial hardware, approaches, or injection chemicals

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SmartData Solutions® is protected by U.S. Patent No. 7,058,509 and International PCT Application /US03/29812


Tools and Approaches for Managing Multi-Site, Multi-Year, Large Volume Datasets to Allow and Enhance Triad Implementation
45th Space Wing –
Cape Canaveral Air Force Station and Patrick Air Force Base, FL
Regina Dixon Butler, 45 CES/CEAN
Mark Kershner, 45 CES/CEAN
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Purpose
Illustrate application of Triad principles to streamline and accelerate management of a large environmental restoration program
– Conceptual applicability
– Case Study: Programmatic Triad implementation within 45th Space Wing Environmental Restoration Program
• History/Setting
• Challenges, issues, and constraints
• Tools and strategies
• Lessons learned
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CONCEPTUAL APPLICABILITY

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Programmatic Triad – Conceptual Applicability

- Equally effective for site and program management
- Streamline restoration process cradle to grave
- Establish programmatic framework to simplify Triad implementation at site/project-level

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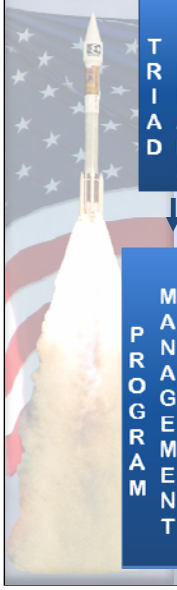
Translating Triad into the Program Management Paradigm



TRIAD PILLARS

- Dynamic Work Strategies
- Systematic Planning
- Real-Time Data Management and Analysis

PROGRAM MANAGEMENT PRINCIPLES

- Increase stakeholder involvement
- Establish common goals; shared constraints
- Facilitate information exchange
- Document approach, past decisions
- Streamline decision-making
- Optimize for long-term effectiveness

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Ingraining Triad Management

- Focus on outcome, not regimented process
  - Establish *flexible* framework for consistent decisions
  - Look toward long term goals and short term success
- Work as a team, not adversaries
  - Formal partnering = cooperation and teamwork
  - Identify constraints and craft effective, shared solutions
- Foster innovation throughout the management and implementation process
  - Applies to planning, data management, reporting, and decision-making, not just technological advancement
  - Even paper-pushers can innovate!

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CASE STUDY

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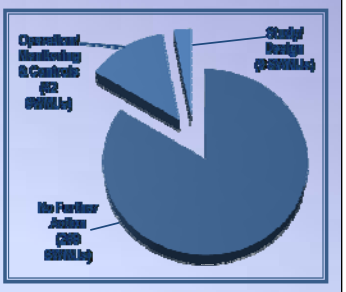
45th Space Wing Environmental Restoration Program

- Patrick Air Force Base (PAFB), Cape Canaveral Air Force Station (CCAFS), and down range facilities
- 320 Solid Waste Management Units (165 IRP "Sites")
- Past expenditures: $169M (1991-2007)
- Remaining requirements: $135M (2008-2040)



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History

- "*World's Premier Gateway to Space*"
- Proving ground for U.S. space program since 1950s; over 3,120 launches to date
- Tenants include NASA, Army, Navy, foreign entities, commercial launch vendors

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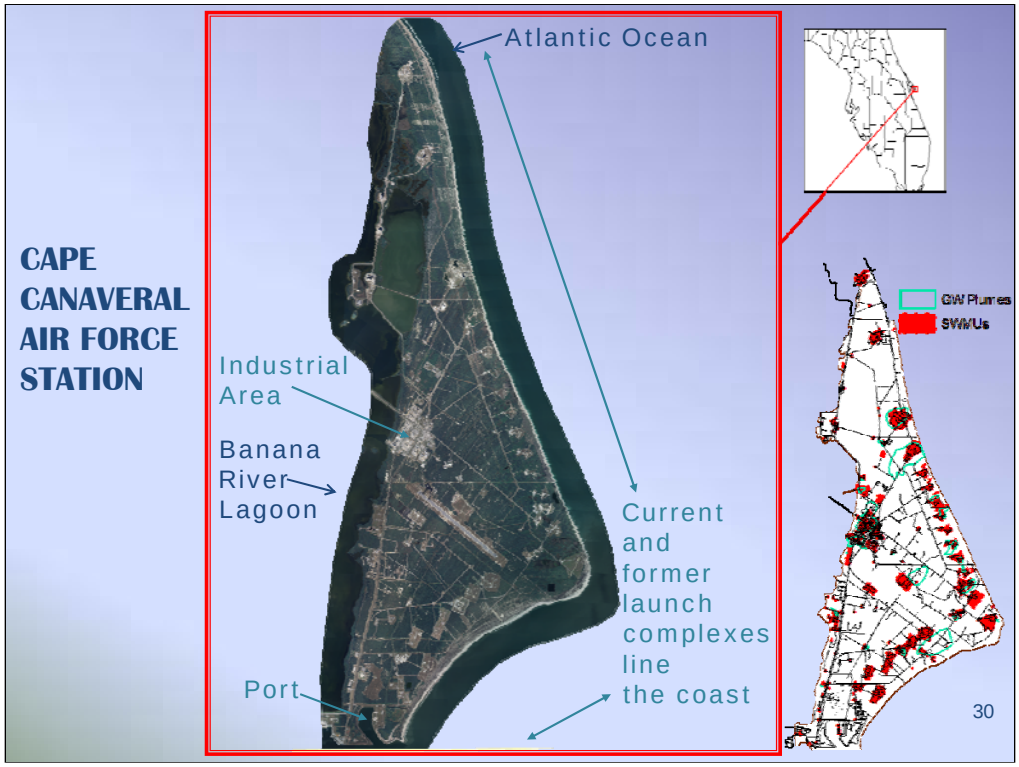
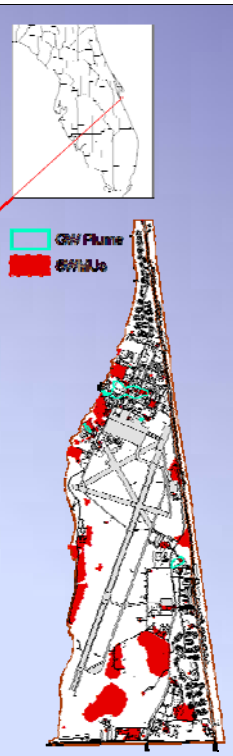

CAPE CANAVERAL AIR FORCE STATION
Atlantic Ocean
Industrial Area
Banana River Lagoon
Port
Current and former launch complexes line the coast
GW Plumes
SWMUs
30

PATRICK AIR FORCE BASE



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Cleanup Issues

- 1,200+ acres of contaminated groundwater
  - Major issue: past use of chlorinated solvents
    - 9 Sites with DNAPL/high concentration dissolved solvents
    - Other sites with more dilute daughter products
- 2003-2008: 7 Major cleanup actions ($36M+)
- Two major additional actions planned ($25M+)
- 180,000 tons contaminated soil removed to date in over 141 separate actions
  - Major issue: polychlorinated biphenyl (PCB) and lead contamination due to historical paint coatings

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Program Management Challenges
• Mission requirements/facility re-use
• Lengthy review and coordination
• Changing stakeholders/Evolving Process
• Goals and Expectations
• Process inconsistency
• Remedy Selection/Formalization/Implementation
• Long term planning/maintaining schedules
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Triad Strategies and Tools:
Stakeholder Involvement
General Public
Air Force and DOD Management
Regulatory Community
45th Space Wing Installation Restoration Program
Support Contractors
Other Wing Operations
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Stakeholder Involvement (Con't)

- AF project managers, regulators, contractors
  - Formal partnering relationship established -1995
  - Tiered structure within management levels
  - Team includes AF, regulatory agencies, contractors, service agencies
- Other Installation personnel
  - Align restoration activities with mission
  - Proactive mission planning, not reactive
  - Facilitate dig waivers/exemptions to reduce delays

Stakeholder Involvement (Con't)

- AF Management
  - Buy-in through formal partnering process
  - Advocates for funding; defends requirements/goals
- Restoration Advisory Board (public)
  - Past challenges overcome through communication
  - Advocates for program
  - Sounding board for new ideas/innovations
  - Encourages cross-feed

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Triad Strategies and Tools: Programmatic Documents

- Provide direction/consistency
- Continuity; How/why things are done
- Establish lines of communication
- Define common goals
- Eliminate redundant planning documents
- Programmatic documents include:

–Decision Process Document
–Field Sampling Procedures
–Land Use Management Plan
–Quality Assurance Program Plan
–Program Orientation/Status Manual
–Operating Procedures

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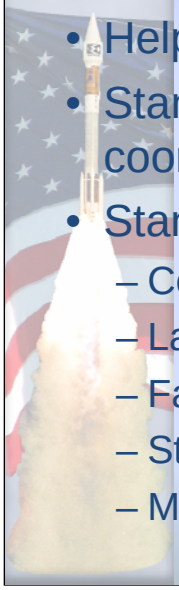
Triad Strategies and Tools: Templates



- Help stakeholders track and find information
- Standardization = faster review, coordination
- Standard templates include:
  - Corrective Action Management Plan
  - Land Use Control Implementation Plans
  - Fact Sheets
  - Statements of Basis
  - Minimum requirements for workplans/reports

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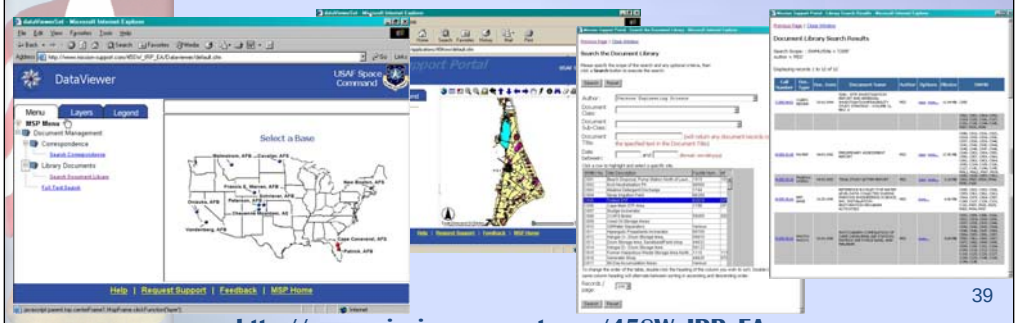
Triad Strategies and Tools: Electronic Data

- Electronic Archive (EA) website – on-line access to documents/correspondence
  - –Searchable (by map or text)
  - –Cross-referenced by SWMU
  - –Accessible to all stakeholders
  - –Complete index data
  - –Portable document format
  - –Downloadable files



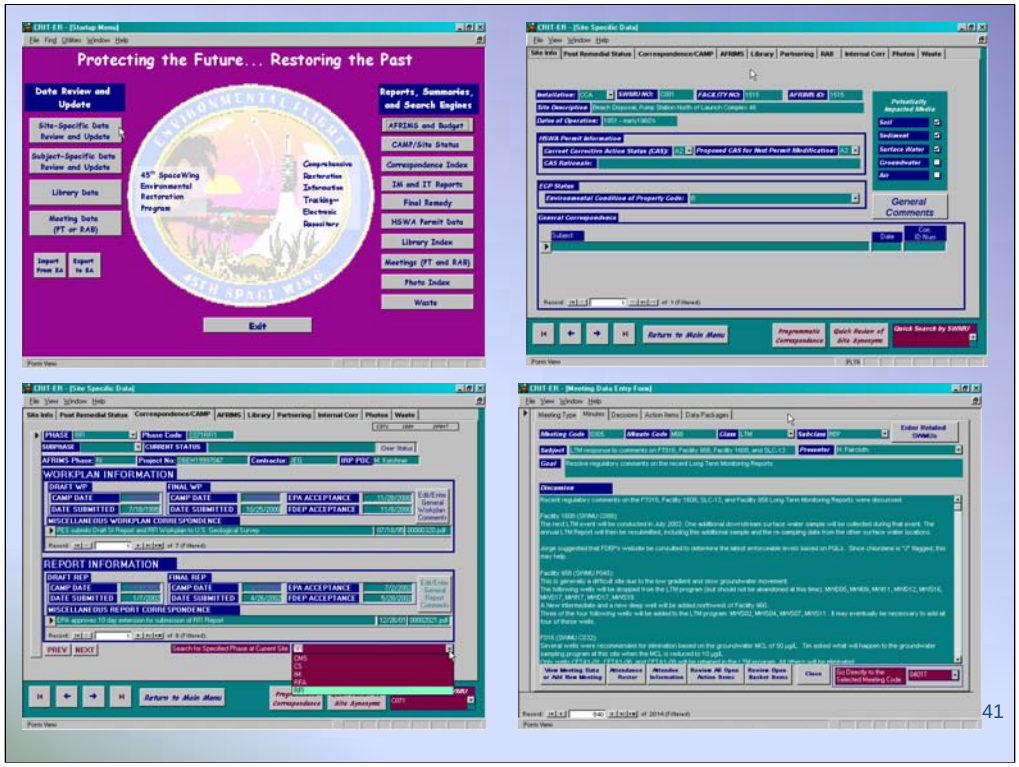
http://www.mission-support.com/45SW_IRP_EA

Electronic Data (Con't)

- CRIT-ER Database (Comprehensive Restoration Information Tracking – Electronic Repository)
  - Custom desktop database; automated tools, graphical user-interface
  - Facilitates day-to-day management decisions
  - Memorializes past decisions
  - Components include (all cross-referenced by SWMU):

- Meeting Minutes/Decisions
- Site-Specific Work Phases
- Site/Regulatory Schedules
- Photo Index
- Status Information
- Monitoring Program Details
- Interface w/ other data sources
- Land Use Controls

40


Protecting the Future... Restoring the Past
Data Review and Update
Site-Specific Data Review and Update
Subject-Specific Data Review and Update
Library Data
Meeting Data (FT or RAB)
Import From EA
Export to EA
45th SpaceWing Environmental Restoration Program
Comprehensive Restoration Information Tracking-Electronic Repository
Reports, Summaries, and Search Engines
AFRIMS and Budget
CAMP/Site Status
Correspondence Index
IM and IT Reports
Final Remedy
HSWA Permit Data
Library Index
Meetings (FT and RAB)
Photo Index
Waste
Exit
General Comments
Return to Main Menu
WORKPLAN INFORMATION
REPORT INFORMATION

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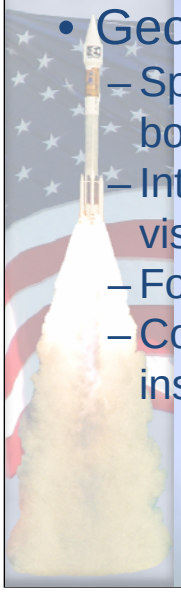
Electronic Data (Con't)



- Geographic Information System (GIS)
  - Spatial representation of data (SWMU boundaries, plumes, sampling locations, etc.)
  - Integration with existing databases as visualization/problem solving tool
  - Foundation for custom automation
  - Core layers on "geobase," with visibility to installation stakeholders

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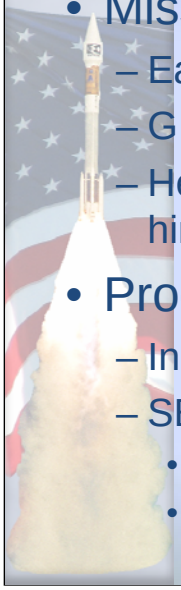
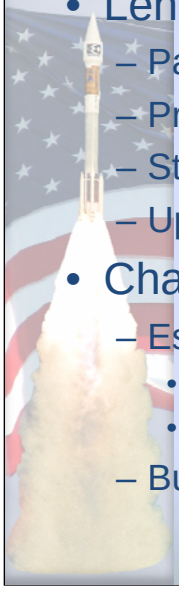
Overcoming Programmatic Management Challenges (Con't)



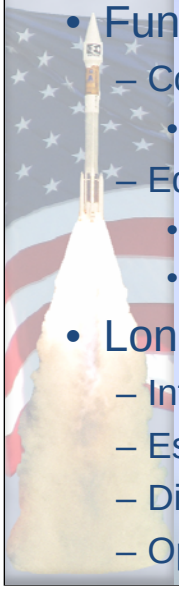
- Mission requirements/re-use
  - Early communication with planning personnel
  - GIS to help visualize constraints
  - Help site new launch programs, rather than hinder siting process on back-end
- Process Inconsistency
  - Inconsistencies breed future problems
  - SB templates resolved 2+ year conflict
    - 30+ SBs completed/formalized since 2002
    - Currently establishing process for SB modification

Overcoming Programmatic Management Challenges (Con't)



- Lengthy review and coordination
  - Partnering Team = on-board reviews, prioritization
  - Programmatic documents = decision framework
  - Streamlined review through templates
  - Up-front planning facilitates back-end approval
- Changing Stakeholders/Evolving Process
  - Establish clear documentation for all decisions
    - Eases personnel transitions
    - Provides justification
  - Build confidence through information exchange

Overcoming Programmatic Management Challenges (Con't)



- Funding/Program Expectations and Goals
  - Communication sets realistic expectations
    - Leave your hats at the door; Put cards on the table
  - Educate stakeholders about constraints/goals
    - Share agency goals; understand significance
    - Agency-specific constraints influence planning
- Long term planning/maintaining schedules
  - Information tools = automated schedules
  - Establish guidelines for phasing and schedules
  - Discuss scheduling constraints
  - Optimization/Five Year Review/Exit Strategies

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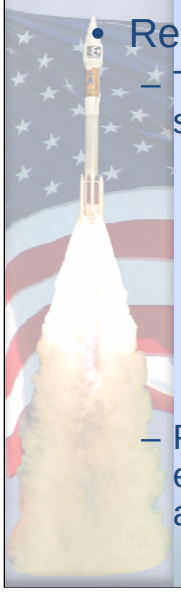
Overcoming Programmatic Management Challenges (con't)



- Remedy Formalization/Implementation
  - Triad buy-in at programmatic level facilitates project-specific triad implementation
    - Executed 3 innovative soil mixing remediation projects
      - Addressed deeper contamination than planned
      - Added/deleted cells based on real-time data
      - Increased treatment time based on real time data
    - Testing, proving, full-scale implementation of numerous innovative technologies

      Vegetable oil injection, emulsifed zero valent iron injection, in-canal ozone treatment, horizontal sparge system, soil washing, etc.
  - Programmatic decision framework and information exchange streamlines real time data management and decision-making in the field

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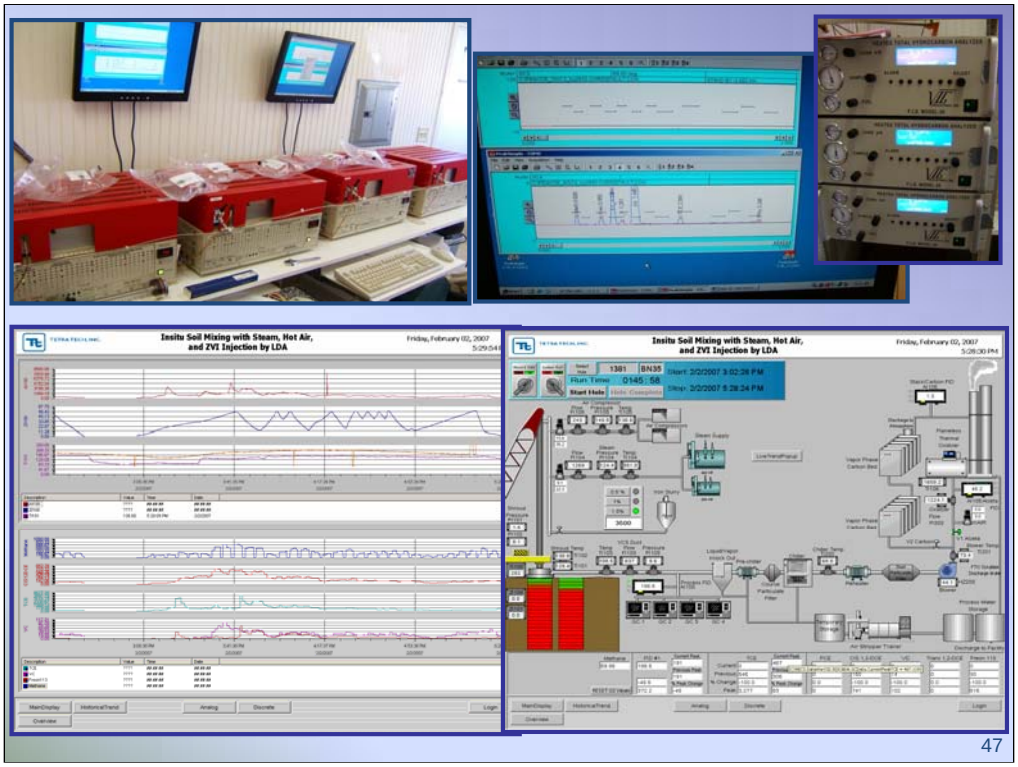
Insite Soil Mixing with Steam, Hot Air, and ZVI Injection by LDA
Friday, February 02, 2007
Insite Soil Mixing with Steam, Hot Air, and ZVI Injection by LDA
Friday, February 02, 2007

Lessons Learned

- Communication builds realistic expectations
- Prioritization is a key to project success
- Information resources should be accessible
- Maintain information resources locally
- Document, organize, document some more
- Process is important, but only if it's beneficial
  - Don't follow process just to "check the box"
  - Look for opportunities to innovate/streamline

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In the end, actions speak louder than words. But <u>successful</u> actions rely heavily on words in the form of past decisions, planning, information exchange!

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Acknowledgements

Thanks to Space Command, the 45th Space Wing Partnering Team and Support Staff:

John Armstrong (FDEP)	Mark Ashton (HQ AFSPC A4/7PC)
Stephen Ball (EPA)	Ron Bond (45 CES/CEAN)
Mike Bowers (45 CES/CEANR)	Anne Chrest (Portage Env)
Harlan Faircloth (CORE)	Teresa Fiorillo (45 CES/CEAN)
Joe Foran (Management Edge)	Patrick Giniewski (45 CES/CEA)
Paul Goldsmith (CORE)	Mike Higgins (Tetratech)
Deda Johansen (Jacobs Eng.)	Loren Lorenz (Portage Env)
Karen Mengden (Ageiss)	Eric Nuzie (FDEP)
Greg Simonson (HQ AFSPC A4/7PC)	Dennis Theoret (Apex Env)

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