Triad’s Systematic Planning Process

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Systematic Planning is Not Unique to the Triad

- Systematic planning is essential for any environmental project.
- EPA expects systematic planning whether the Triad is used or not: *Policy and Program Requirements for the Mandatory Agency-wide Quality System, Order 360.1, CHG 1, 1998.*
- Process goes by various names depending on organization [e.g. Data Quality Objectives Planning Process (DQO), Technical Project Planning (TPP)].

Why Bother with Systematic Planning?

- Systematic planning is the most important and universally applicable element of the Triad approach.
- Systematic planning ensures that there is a clear understanding of the information needed to make the required decisions (ties data collection to decisions)
- Systematic planning requires up-front investments. The rewards include increasing the likelihood of project success, reducing overall project costs, and shortening project life-cycles.
- Systematic Planning is key for the implementation of a defensible approach and the generation of scientifically sound data.

How is the Systematic Planning Process Different for the Triad?

- The Triad explicitly focuses the systematic planning process on cost-effectively managing decision uncertainty.
- The Conceptual Site Model (CSM) is at the core of the systematic planning process.
- Systematic planning for the Triad is a process-driven strategy. It sets the stage for responding and adjusting to a more accurate understanding of the CSM.
- Reliance on dynamic work strategies and real-time measurement systems

Triad Systematic Planning Has Three Critical Components

- **Multi-Disciplinary Technical Support Team**: bringing the right expertise to project decision-making needs.
- **Conceptual Site Model**: providing the technical foundation for decisions that need to be made.
- **Triad Core Team**: ensuring stakeholder participation, regulatory concurrence, and timely decision-making.

Systematic Planning Set-Up: Forming the A Team

Multi-disciplinary technical teams are essential with Triad-specific expertise in:

- CSM development
- GIS/data management support
- Field decision support
- Contracting support
- Analytical chemistry support (field deployable/real time methods)

Systematic Planning Set-Up: Forming the A Team

A Triad core team can be an effective means of engaging stakeholders in the Triad process. Requirements include:

- Non-adversarial approach to problem solving
- Available and engaged on an as-needed basis
- Team membership continuity over the project life cycle
- Ability of team members to speak for their respective organizations
- Bringing consensus on decisions that need to be made and how to effectively manage intolerable uncertainty.

Systematic Planning Set-Up: Building Social Capital

- Term used by social scientists, acknowledges that "people" can be as critical to project success as the science and technology
- Includes trust, reciprocity, and connectedness
- Triad relies on social capital for effectiveness, directly affects effectiveness of core team
- Triad systematic planning builds social capital by encouraging an atmosphere where knowledge and insights can be shared; assumptions, beliefs, and personal perspectives can be tested, and legal, budgetary, and technical constraints evaluated.

Communication is Key for Team Success

- Face-to-face meetings builds social capital, but….
- Team members are often physically distant
- Decision-making requirements often have short "fuses"
- Secure project Web sites can be extremely effective for disseminating information

Triad Systematic Planning Has Three Principal Steps

- Problem Set-Up: What are the project objectives, constraints, stakeholders, regulatory framework, and primary/secondary decisions to be made?
- Uncertainty Identification: What prevents decisions from being made confidently?
- Uncertainty Management: What can be done to raise decision-making confidence to acceptable levels?

Systematic Planning Set-Up: Project Objectives, Constraints, and the Regulatory Framework

- What is the desired overall project outcome?
- What are the specific objectives for the current stage of the process?
- What constrains possible actions that could be taken to reach those objectives?
- What regulatory framework is in place that will guide the project?

Systematic Planning Set-Up: Specifying Decision Statements

- Decision statements capture decision-making requirements.
- Decision statements can include primary decisions, and secondary decisions that flow from primary decisions.
- Decision statements define alternative actions that could result from resolving the primary decisions.

Cleanup Requirement Definitions Are Critical for Decision Statements

- Incomplete cleanup definitions complicate systematic planning, confuse decision-making, and make technically-defensible sampling program design difficult.
- Complete cleanup requirements include the spatial scale over which the cleanup requirement applies, and may also include a time scale.
- Complete cleanup requirements generally come in two flavors: a wide area average requirement and/or an elevated requirement ("hot spot") applied to much smaller areas.

Decision Error Consequences Can be Significant

- "Closure" achieved for sites, with subsequent contamination discovered that requires the site to be reopened.
- Expensive groundwater treatment systems operated for many years, yet cleanup does not appear to be making progress.
- Characterization programs that do not resolve fundamental site questions, requiring remobilization for additional data collection.
- Inaccurate contaminated volume estimates, leading to additional remedial activities with significant cost and schedule overruns.
- Brownfield redevelopment hobbled by the uncertainty associated with potential environmental liabilities and their associated financial risks.

“Uncertainty” is a Key Triad Concept

“Uncertainty” refers to a state of knowledge that prevents decision-making from proceeding with the desired level of confidence.

“Does information support an NFA determination for the site?”

“Is the 95% UCL of the mean less than the cleanup level?”

“Does the real-time result indicate a concentration that is above or below the cleanup requirement?”

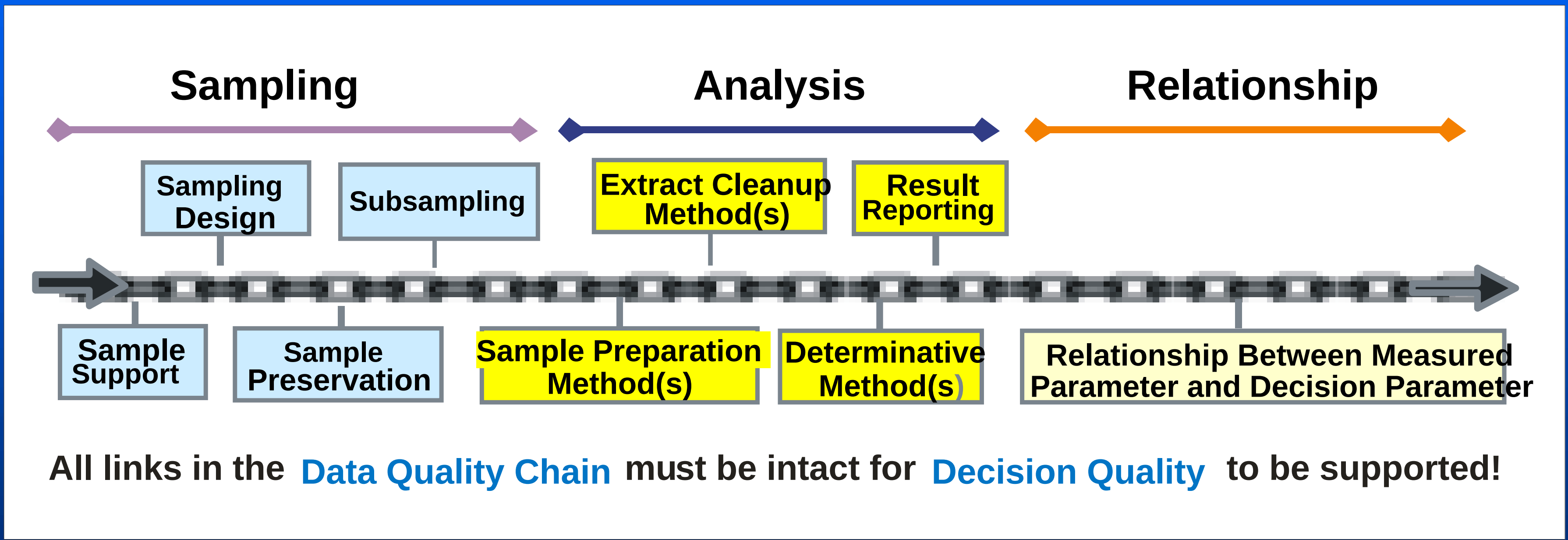
Identifying Decision Uncertainty and Its Sources

- What prevents a decision from being made confidently?
  - The ability to answer this depends on the clarity of the decision statement
  - The answer to this should flow from the CSM
- Potential sources of decision uncertainty:
  - Political, economic, organizational, and social uncertainty (outside the Triad scope, although a Triad approach may provide ways to mitigate impacts).
  - Model uncertainty (also outside the Triad scope, although a Triad approach may provide mechanisms for addressing this).
  - Data uncertainty. A primary focus of the Triad. Includes
    - » Analytical data uncertainty
    - » Sampling "uncertainty"
    - » Relational uncertainty

The Triad Targets Data Uncertainty

- **Analytical Uncertainty**: Uncertainty introduced by limitations of analytical preparation and determination methods (bias, lack of precision, detection limits, interferences, etc.)
- **Sampling Uncertainty**: Uncertainty introduced by the sample collection and handling process (lack of sample representativeness, limited sample numbers, contaminant loss, etc.)
- **Relational Uncertainty**: Uncertainty associated with the relationship between a parameter being measured and the true parameter of interest from a decision-making perspective.

The Data Quality Chain



Adapted from: "Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management" ITRC, December, 2003

Relative Uncertainty Contributions

- Relative analytical variability often ranges around 30%.
- Spatial variability depends on sample support size, but for standard sample sizes (i.e., 200-400 g) can span several orders of magnitude.
- Under these conditions sampling uncertainty dwarfs analytical uncertainty when conclusions are being drawn for site areas.

Managing Uncertainty Recognizes Several Realities

- Decision uncertainty for hazardous waste site cleanup is a fact of life. It is unavoidable.
- Decision uncertainty can never be completely removed from the cleanup process.
- Inherit heterogeneity of environmental matrices
- Some types of uncertainty are "worse" than others (i.e., if a cleanup goal is 45 ppm, and an area is missed that is at 50 ppm, that's not as bad as missing an area that's 5,000 ppm).

Uncertainty Management: Changing the Paradigm

- **<u>Old Way of Doing Business</u>**:
  - – Cleanup uncertainty managed by multiple data collection. programs/project activities.
  - – Each activity well-defined at its outset.
  - – Uncertainty reflected in project schedules and the number of project activities that eventually required to reach the desired end state.

- **<u>Triad Way</u>**:
  - – Address uncertainty directly within project activities.
  - – Final scope of individual project activities uncertain at outset.
  - – Much less uncertainty about schedules and overall activities that need to be undertaken. Extreme example: characterization, remediation, and closure accomplished in one field mobilization.

Managing Uncertainty using the Triad

- What are the implications of getting a decision "wrong"?
  - Who suffers (residual risk versus cost)?
  - Can the decision be changed in response to new information?
- What level of confidence is required for decision-making to go forward?
  - DQOs, the gray region, and the 95% habit
  - Role of cost-benefit analysis
- How much uncertainty must be resolved before project work begins, and how much can be deferred and addressed while a project is underway?

Uncertainty Management Options

- "Common Sense"
  - Constrained solutions, obvious technical answers, insignificant implications for mistakes
- Weight of Evidence
  - Multiple data sources that cannot be merged quantitatively
  - Classic example: NFA early in CERCLA process
- Collaborative Data Sets
  - Use of multiple data sources to manage different uncertainty sources
- Dynamic Work Strategies and Real-Time Measurement Systems

Uncertainty Management Tools: Common Sense

- Are the implications of getting a decision "wrong" insignificant?
- Is there an obvious technical answer?
- Are there project factors that constrain the solution (e.g., state regulations that dictate sample numbers and analyses for site closure demonstration)?

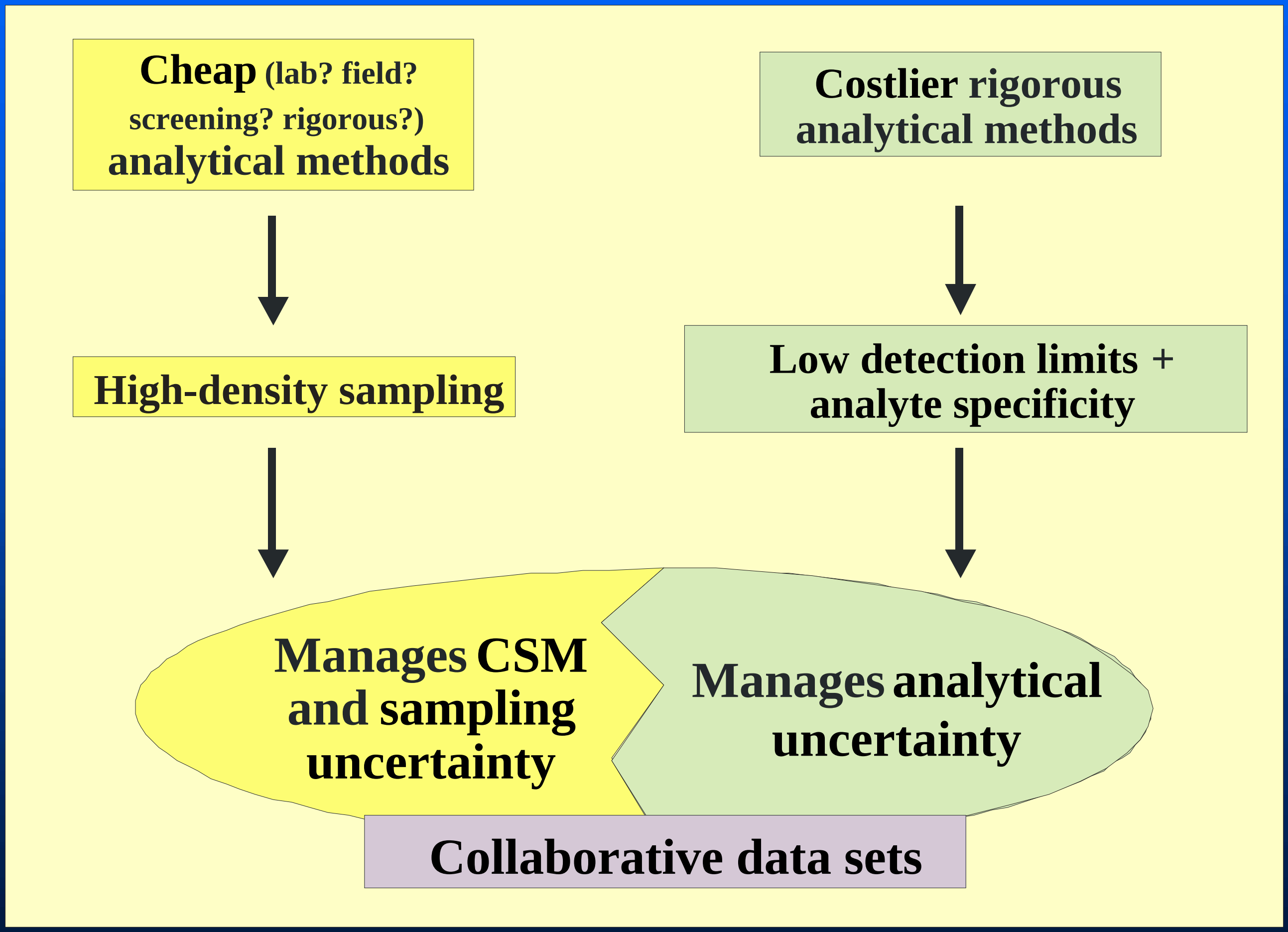
Beware of "obvious" technical solutions. Environmental conditions are often much more complex than they first appear.

Uncertainty Management Tools: Weight of Evidence

- Appropriate when multiple information sources are available to support decision-making, and those data sources cannot be "merged" quantitatively.

- Classic example: determining no further action for areas where there is little expectation of contamination potential. Decision-making here might be supported by:
  - Historical aerial photographs
  - Site reconnaissance
  - Judgmental sampling
  - Non-intrusive geophysical work
  - Interviews with key individuals familiar with site history

Collaborative Data Sets Play an Important Role in the Triad



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Dynamic Work Strategy Captured as a Decision Tree

"Each subsurface 15 cm (6 in.) interval beginning with the 15 - 30 cm (6 - 12 in.) interval will be measured with an XRF for total uranium concentration. Depending on XRF results, the following generic actions will be taken:

•If no interval yields an XRF U-238 result above the lower investigation level, then a surface sample and subsurface sample homogenized over the 1 m (3 ft) core depth will be collected and submitted for analysis.

•If one or more intervals yield an XRF U-238 result greater than the upper investigation level, the interval with the highest XRF value will be submitted for laboratory analysis. No additional samples will be collected in this case.

•If the highest XRF result falls between the lower and upper investigation level, then three samples will be collected and submitted for analysis. One will be from the interval with the highest XRF value, one will be a surface sample, and one will be a subsurface sample homogenized over the 1 m (3 ft) core depth."

- Can be simple or complex.
- Specify actions to be taken in response to potential outcomes.
- Complete decision trees include stopping criteria.
- Used to guide field activities in response to data.

Triad Systematic Planning Products

- Living Conceptual Site Models
- Dynamic work strategies for managing uncertainty
- Demonstrations of methods applicability as necessary
- Standard project planning documents (QAPP, FSAP, ES&H documentation, SOPs, etc.)

Triad Systematic Planning Peculiarities

- Logistics (primarily driven by dynamic work strategy needs)
  - Scheduling: Choreographing field work
  - Load balancing: Efficient use of resources
  - Decision support: Effective decision-making
  - Information management: Supporting timely decisions
  - Readiness reviews: Chaos avoidance
- Budgeting
  - Cost estimation: Dealing with cost uncertainties
- Procurement
  - Facilitating flexible contracting mechanisms

Example Systematic Planning Frameworks: EPA DQO Process

1. State the Problem
2. Identify the Decision
3. Identify Inputs to Decision
4. Define Study Boundaries
5. Develop Decision Rule
6. Specify Error Limits
7. Optimize Data Collection

- DQO process is an example of a systematic planning process applied to data collection design.
- Typically associated with classical statistical sampling program design, but the process works for other situations as well.
- Triad systematic planning is broader, looking at uncertainty management across project activities.