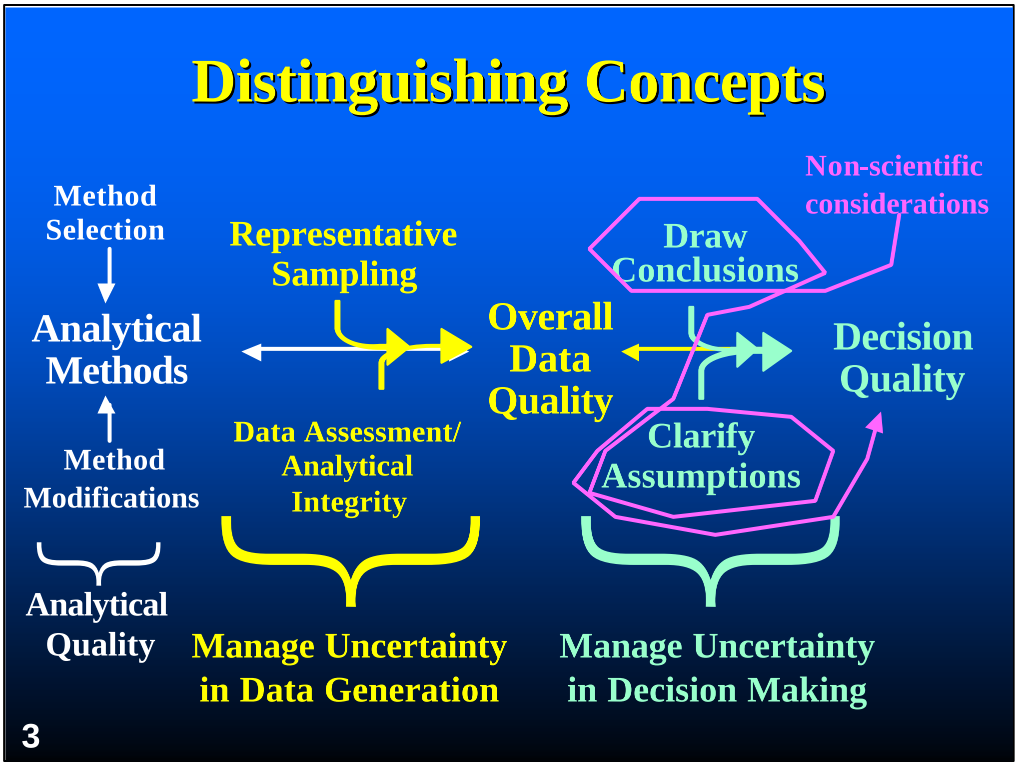
Modernizing Site Cleanup: Managing Decision Uncertainties Using the Triad Approach

Internet Seminar

Supplemental Concept, Terminology and Resources Slides

Additional Clarifications of Quality-Related Concepts

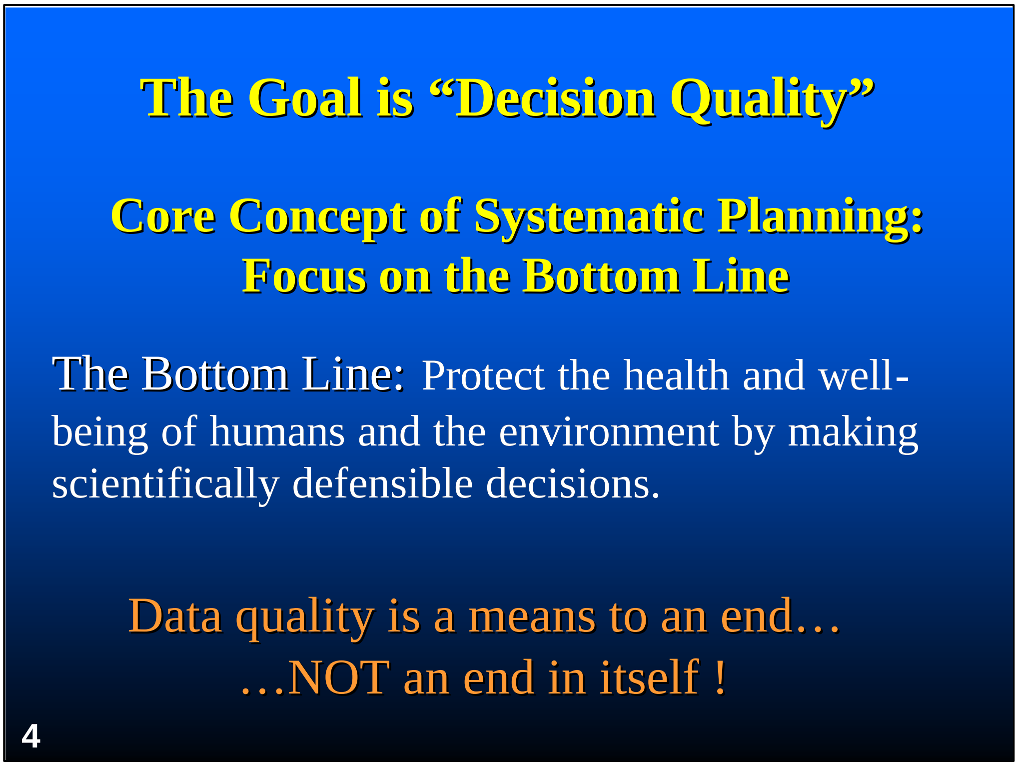


When planning and implementing contaminated site investigations and cleanups, data quality is not determined solely by the nature of the analytical method; and neither is decision quality determined solely by data quality. There are intervening factors that greatly influence the process of generating data, and the process of making decisions. If our "data quality" language acknowledges this, we could improve our ability to communicate throughout the project decision-making process. Improved communication would permit better project planning, faster and clearer negotiations, and more satisfaction in the outcome.

Method selection should be based on characteristics of the sample matrix and the desired data characteristics. The data to be produced must be representative of the decision to be made, therefore the intended use of the data is an important factor to consider when selecting the proper method. Method modification may be required to improve the analytical representativeness (i.e., improve the ability of the method to provide data that will be meaningful in the context of the decisions) when non-ideal or difficult samples matrices are involved.

Data assessment is the final check that establishes that actual data that were generated are suitable for their intended use. Both the sampling and analytical representativeness (e.g. the analytical integrity) of the data are assessed to verify that both are representative of the site conditions in the context of the decisions to be made. If there is a match is the data quality judged to be acceptable for use in decision making (i.e., judged to be "decision quality data" or "effective for decision-making"). The degree of "match" that is acceptable depends on how much decision uncertainty was determined to be tolerable.

Even if the project data are representative, there might not be enough information available to be able to interpret the *meaning* of the data in terms of the intended decision (i.e., "draw conclusions). Even if some data has a high degree of certainty associated with it, there may still be large amounts of uncertainty in the decision. For example, it might be established to a



Systematic planning focuses site activities toward a clear goal. Systematic project planning works, as shown by the successes of the USACE TPP initiative.

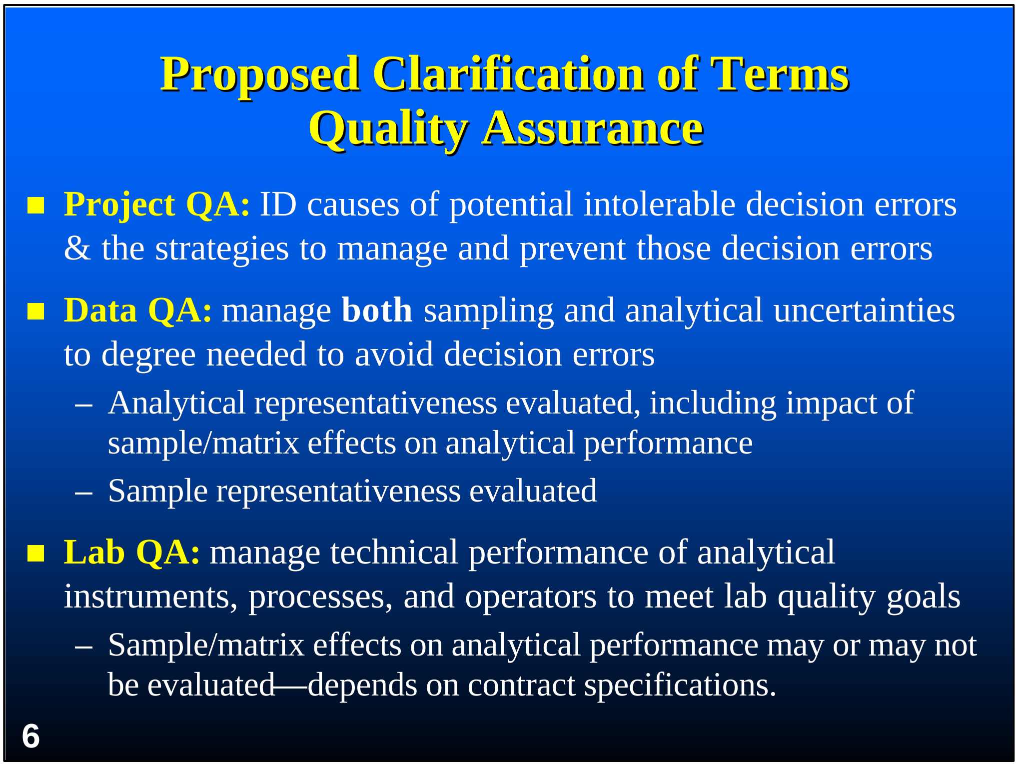
Systematic planning should focus on the bottom line, which is making correct decisions. Stakeholders want to know that they will not be exposed to hazardous chemicals. They want to know that the decisions being made will protect their health or their social and economic well-being. They want "decision quality."

"Decision quality" is ideally described as the degree to which the *actual* decisions coincide with the decisions that *would have been made* if complete and fully accurate information (i.e., the true state) were known (or if it were knowable). However, in the environmental field, including site restoration activities, it is often difficult or impossible to know the "true state" at the time of making the decision. Sometimes, errors in decision-making become obvious at some later time, but in general, our ability to fully measure, understand, and predict the behavior of contaminants in the biotic and abiotic "environment" is very limited, although constantly improving.

Assuming that decisions are made solely on the basis of an impartial weighing of the evidence (an assumption that also frequently does not hold in the environmental field), a more realistic and practical description of "decision quality" needs to include considerations of "uncertainty" and the impact that uncertainties may have on the correctness of decisions. Therefore, a more workable definition for our purposes might be: Decision Quality = The degree to which decisions are defensible based on available evidence, including the ability to estimate the amount of confidence that the decision is correct.

Defensible = Conclusions are derived logically with all underlying assumptions and uncertainties openly acknowledged. To the degree feasible, uncertainties are managed or

Additional Clarifications of Terminology to Focus on Decision Quality



Quality assurance (QA) activities should focus on the explicit identification and management of uncertainties:

1) Project QA - explicitly organized around identifying the potential causes of project decision errors that are judged intolerable by the project manager or project mgt team, and then identifying and designing the strategies to manage uncertainties that could lead to decision error.

2) Data QA – ensures that **both** the sampling and analytical uncertainties are explicitly managed to the degree needed to support the intended use of the data, and thus avoid making intolerable decision errors that could stem from inadequacy of the data sets.

3) Laboratory QA – Laboratory managers must ensure that the technical performance of analytical instruments, processes, and operators fall within acceptable limits to meet the quality goals of the laboratory. If the procedures used by the laboratory are designed to accommodate or correct for certain matrix interferences, or if the contract with the laboratory requires that sample-specific performance is guaranteed, then lab QA is relevant to the project data quality. If uniform, “routine” laboratory procedures are used that neither evaluate for, nor compensate for, sample matrix interferences, or if the data user requested that the wrong procedures be used, then lab QA is only partially relevant to project data quality. In those instances, good lab QA practice cannot be assumed to be equivalent to producing project-level data quality.

Proposed Clarification of Terms Data Quality

- Decision quality data* = Effective data* = data shown to be effective for decision-making
- Screening quality data* = some useful information provided; but too uncertain to support decision-making alone
- Collaborative data sets = distinct data sets used in concert with each other to co-manage sampling and/or analytical uncertainties to an acceptable level

* Includes sampling uncertainty. Nature of method irrelevant.

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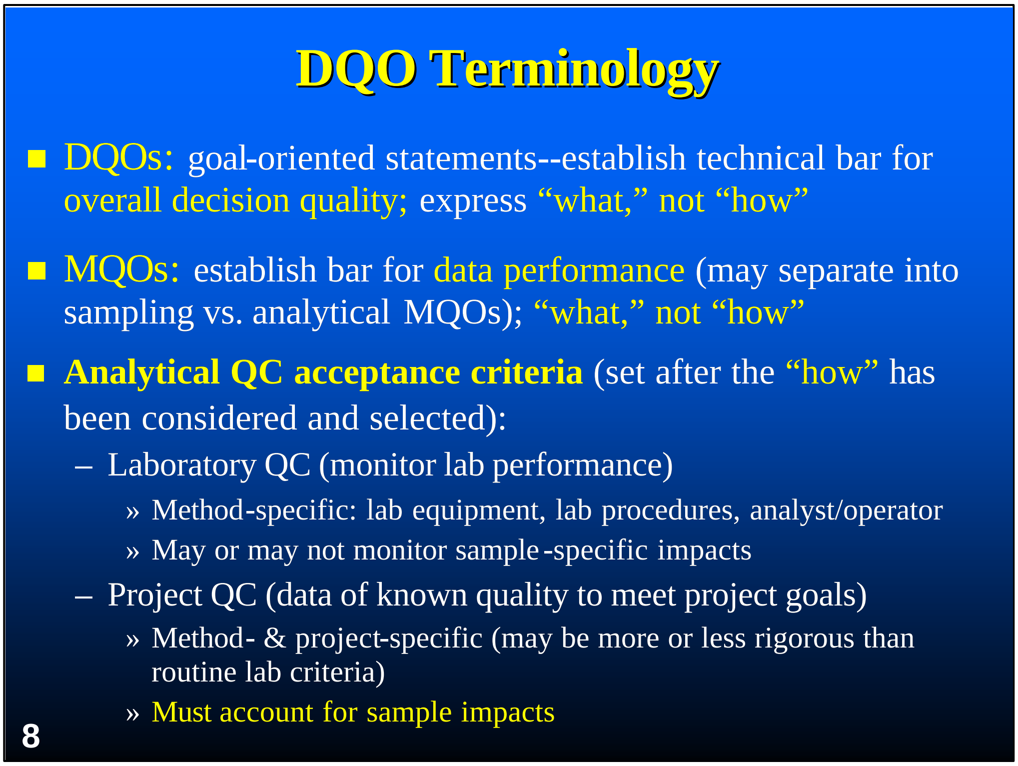
Terminology to express data quality concepts should focus on the ability of data to meet project decision-making activities, encouraging explicit identification and management of uncertainties in the data that could lead to decision errors:

1) Decision quality data = Effective data = data of known quality that can be logically shown to be effective for making defensible project decisions (because BOTH sampling and analytical uncertainties have been controlled to the degree necessary to meet clearly defined project goals). The nature of the analytical method (screening method vs. definitive method) is irrelevant.

2) Screening quality data = Data that provide some useful information, but sampling and/or analytical uncertainties about the data set limit the ability of those data to support defensible project decision-making on their own merits. Again, the nature of analytical method (screening vs. definitive) is irrelevant.

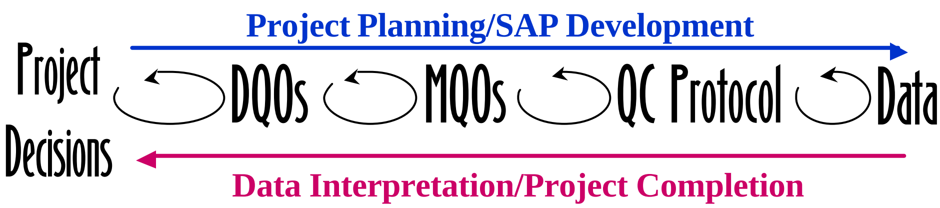
3) Collaborative data sets = It is possible that data sets (that by themselves would be considered screening quality) may become part of an effective data set if other data or information is available to manage residual uncertainty to the point where decision-making is defensible when this information is combined. This may sometimes be considered a type of "weight of evidence" approach. Using different techniques to manage various aspects of analytical or sampling uncertainty is often more cost-effectively than trying to manage all relevant data uncertainties using a single technique.



Refer also to the DQO Terminology paper (EPA 542-R-01-014) on webpage: http://cluin.org/tiopersp/issue.cfm

It is important to distinguish between analytical QC criteria that are used for different purposes. Laboratory QC is designed to monitor laboratory performance from the perspective of equipment maintenance and operator performance. Project QC criteria that are designed to establish that data of known and acceptable quality from the standpoint of the meeting project-specific goals. QC acceptance criteria established to meet project goals may be more or less stringent than routine laboratory QC criteria. Laboratory QC may or may not be designed to monitor for sample-specific matrix effects, however, project QC must monitor for sample-specific matrix effects to ensure that project data are representative of project decisions.

DQO Term Relationships



All data **generation activities** are **derived from** the
Project Decisions

so **data interpretation** will **lead back to** and directly support the
Project Decisions.

For more information, see the DQO Terminology paper (EPA 542-R-01-014)
on webpage: http://cluin.org/tiopersp/issue.cfm

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There is a linear <u>conceptual</u> flow from articulating a <u>non-technical</u> expression of project decisions to articulating DQOs (<u>technical</u> expression of desired decision quality to then articulating MQOs (technical expressions of overall <u>data</u> quality) that will guide method selection and design of a QA/QC protocol (performance criteria that are technology- and method-specific; e.g., criteria for analytical quality) that will produce the data needed to meet the DQOs and support a scientifically defensible project decision. Although the concept of progressing from lower to higher degrees of technical detail is linear, actual implementation usually is not linear. There is usually a good deal of feedback and iteration when progressing from through the planning process.

Method Quality Assurance

- Demonstration of method applicability
  - Shows that a particular method, project-specific SOP, and selected QC acceptance criteria are appropriate for a project-specific application or site-specific matrix
  - Matrix-specific samples required
- Demonstration of proficiency
  - Shows that a particular operator or lab can perform a method properly
  - Lab control samples or PE samples often used

“Demonstration of method applicability” and “demonstration of proficiency” are terms used by the Office of Solid Waste’s Methods Team, which is responsible for developing and maintaining the SW-846 methods manual.

Additional Resource Information

Tree Fruit Case Study Resources

- **EPA Tree Fruit Case Study + work plans:** http://cluin.org/char1_edu.cfm#site_char
- **USACE TPP Manual:** http://www.usace.army.mil/inet/usace-docs/eng-manuals/em.htm
- **"A Guideline for Dynamic Workplans and Field Analytics":** http://cluin.org/char1_edu.cfm#dyna_work
- **TIO Issue papers:** http://cluin.org/tiopersp/issue.cfm
  – Triad, decision uncertainty vs. data quality, SW-846, DQOs

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USACE Cost and Performance Report: *Expedited Characterization and Soil Remediation at the Test Plot Area, Wenatchee Tree Fruit Research Center, Wenatchee, Washington.* Final May 2000

EPA Case Study: *Innovations in Site Characterization Case Study: Site Cleanup of the Wenatchee Tree Fruit Test Plot Using a Dynamic Work Plan.* EPA-542-R-00-009 August 2000. The Case study report is available through the Clu-In website at http://cluin.org/char1_edu.cfm#site_char. Associated USACE work plans used for the actual Tree Fruit project are also available for download.

More EPA Site Characterization Case Studies are available at the same site. The availability of new reports is announced through TechDirect (see http://cluin.org, under the TechDirect menu of the Homepage).

The USACE has called their emphasis on systematic planning for hazardous waste projects the "Technical Project Planning" (TPP) approach. Thus far, about 12 of 15 Hazardous, Toxic, and Radioactive Waste (HTRW) USACE design districts have been trained in the TPP approach. The use of TPP greatly enhances the cost-effectiveness of projects under a more "traditional" approach (i.e., not using DWPs or onsite measurements). Although the TPP approach is not specific guidance for using dynamic work plans or onsite analysis, TPP principles are vital to their implementation.

•TPP Manual downloadable from: http://www.usace.army.mil/inet/usace-docs/eng-manuals/em.htm

An ASTM guide for using the Expedited Site Characterization (ESC) approach can be located through http://www.astm.org/

TIO Efforts to Create Support

- Public outreach (See Clu-In)
  - ET&A article (Jan 2001): http://cluin.org./download/char/etasaparticle.pdf
  - ES&T feature article (Oct 2001): http://cluin.org./download/char/oct01est.pdf
- Triad Handbook for Project Managers (in development)
  - Hyper-linked Internet-based (also CD-ROM) "how-to" road map to existing EPA and technical guidance to support Triad approach
- Partnering with other organizations' efforts:
  - US Army Corps of Engineers (including TQRS effort)
  - EPA/Superfund guidance on Dynamic Field Activities
  - Argonne National Lab: Adaptive Sampling & Analysis Programs

Published references:

1) ET&A article: Lesnik, B. and D. Crumbling. 2001. Guidelines for preparing SAPs using systematic planning and PBMS. *Environmental Testing & Analysis Vol.10*, No.1. January/February. pp. 26-40. Electronic reprint available at http://cluin.org/download/char/etasaparticle.pdf

2) ES&T feature article: Crumbling, D. M. et al. Managing Uncertainty in Environmental Decisions. *Environmental Science & Technology*, Vol. 35, No. 19. October 1, 2001, pp. 405A-409A. Electronic reprint available through Clu-In at http://cluin.org./download/char/oct01est.pdf

Education Resources

- Field Analytical Technologies Encyclopedia (FATE): http://fate.clu-in.org
- Case Studies: http://cluin.org/char1_edu.cfm#site_char
- Triad Approach Procurement Guide (in development)
- Training opportunities
  - 5-day Field-Based Site Characterization Technologies and Strategies course (EPA TIO): http://trainex.org/
  - Web-based seminars (EPA TIO): http://cluin.org/studio/
  - Managing Uncertainty for Environmental Decision Making (offered by DOE/PNNL): http://www.hanford.gov/dqo/training/cover.html