DRAFT

Best Management Practices Inventory for Triad Elements

Cover Page

The goal for Triad projects is to produce project decisions that are protective, transparent, defensible, and confident, while also being as cost-effective and efficient as possible. A wide variety of tasks go into achieving these goals. Collectively, the high and low level details of these tasks can be termed the "**management of decision uncertainty**." This concept is the basis of the Triad framework. All other Triad concepts and activities are built around this goal.

This **inventory is intended to aid practitioners to operationalize** Triad concepts. It can be used as a checklist of current best practices that are integral to successful Triad projects. Although a few entries are optional depending on the specifics of the project, a good Triad project will demonstrate nearly every aspect of this inventory. The structure of this framework ensures that planning considers best practice options, that implementers will have clear goals and performance measures, and that practitioner education includes best practices.

Do not be intimidated by the **length of this inventor**y. Many items (but not all) simply spell out formally activities that are already frequently done by most practitioners. The list serves to "put meat on the bones" of the Triad framework. A simple check-the-box table is used to ensure that all aspects of a Triad project have been considered during project planning, implementation, or post-implementation review.

"Managing uncertainty" requires that both well-known and cutting-edge best practices be incorporated into Triad projects whenever they are appropriate. **Additional best practices** will undoubtedly emerge as science and technology advance, and as collective practitioner experience expands and deepens. As is the very nature of uncertainty management, emerging best practices are automatically incorporated "by reference" into the Triad framework

At the start of each major section, 4 to 5 general concepts or tasks are listed. Below that, the general listings are broken down into more specific individual tasks which, when put into operation by an experienced team, create the integrated approach that constitutes a successful Triad project.

Best Management Practices Inventory for Triad Elements
DRAFT

Triad Project Planning Features	Absent	Present, but unclear	Clearly written
GENERAL PLANNING ITEMS GP1) Consideration of **end-goals/preferred reuse** of the site given site owner, stakeholder, and regulatory interests.			
GP2) **Collaboration** among all interested parties (including financial institutions, contracting & legal staff) throughout the planning & implementation lifecycle. Representation of **all relevant science & engineering disciplines** during planning.			
GP3) Discovering & articulating **decision uncertainties** that will need to be managed to have a successful project			
GP4) Creating a **detailed CSM** & updating it over the entire life of the site.			
DETAILED PLANNING ITEMS DP1) **SOCIAL CAPITAL** (trust, open communication, cooperation, respect for other parties' interests)			
DP2) **OUTREACH** to all appropriate parties/stakeholders			
DP3) **EXPERIENCED STAFF** with the required expertise have been identified and accessed			
DP4) Clear consensus on the desired project **OUTCOME**			
DP5) Preliminary **CSM** developed from existing information & updated as more information obtained			
DP6) Clear articulation of regulatory, scientific, social & engineering **DECISIONS** supporting desired outcome(s), which include life-cycle site planning			
DP7) Articulate the **UNKNOWNS** (uncertainties) that inhibit confident decision-making			
DP8) General & (later) detailed descriptions of **STRATEGIES** to manage those decision unknowns/uncertainties			

Triad Project Planning Features (cont'd)	Absent	Present, but unclear	Clearly written
DP9) Describe **INFORMATION** gathering/generation techniques (e.g., records reviews, interviews, GW flux testing, photo analysis, chemical data generation, geophysical tests, etc.) to manage unacceptable uncertainties to an acceptable level.			
DP10) Develop a **WEIGHT OF EVIDENCE** approach that explains how which information will manage which decision uncertainties			
DP11) Acknowledgement of potential & actual sources of **INFORMATION UNCERTAINTY** & relevance to decision confidence			
DP12) Information acquiring technique selection is guided by evaluation of the **COST-BENEFIT** value of the information.			
DP13) Identification of **REGULATORY** authorities/ARARs			
DP14) Project **FUNDING** & **CONTRACTING** mechanisms; monitor budget status			
DP15) Known & potential **RPs** & legal considerations			
DP16) Include the costs of environmental **INSURANCE** & redeveloper risk (and how decision uncertainty affects both) on the site's lifecycle costs			
DP17) Assess whether the project (or parts of the project) can benefit from **REAL-TIME DYNAMIC/ADAPTIVE** work strategies			
DP18) Ensure planning process is well-documented in acceptable **WORK PLAN** or **QAPP** formats			
DP19) Outline the communication & documentation process for recording & justifying when there are substantial implementation **DEVIATIONS** from that written & approved in the planning documents.			
DP20) Plan for on-going documentation of the information materials that would be included in a structured **CASE STUDY** write-up.			

<u>CSM</u> Features (systematic planning activity)	Absent	Present, but unclear	Clearly written
CSM MATERIALS clearly describe:			
CSM1) known & suspected contaminant sources, release mechanisms, and amount released;			
CSM2) fate (including degradation products) & transport/migration mechanisms;			

CSM Feature cont'd	**Absent**	**Present, but unclear**	**Clearly written**
CSM3) known or suspected contaminated media (waste, soil, GW, SW, sediment), spatial/temporal boundaries, and define at least 2 (and probably more) separate contaminant populations in the context of the project's intended decisions;			
CSM4) likely interactions between contaminants and matrix constituents;			
CSM5) degree of contaminant heterogeneity (contaminant distribution) at long-, short, and within-sample spatial scales;			
CSM6) evaluate degree of mismatch between matrix variability, decision support & the sample support of anticipated sampling & analysis techniques;			
CSM7) known or potential reuse options, prioritize according to stakeholder wishes, expected site conditions, & the projected cost to achieve 1st choice, 2nd choice, etc.			
CSM8) known & potential exposure pathways & receptors;			
CSM9) probable remedial, redevelopment or IC options to achieve site reuse & reduce/eliminate receptor exposures.			
CSM10) determine decision support for each characterization, exposure, remedial or compliance decision			
CSM11) determine proper sample design, collection & handling techniques to tailor sample support to be representative of the various decision supports			
CSM12) consider what graphical or mapping techniques may be used to display chemical data & other information comprising the CSM in a form that is easily understood			
CSM13) continually re-evaluate what information is needed to guide selection, design & operation of effective remedial techniques			
CSM14) predict what information the CSM will provide when it is mature enough to support each decision			
CSM15) **CSM UPDATES** are recorded regularly in project documentation, and the information passed onto future teams involved with the site.			

Continued…

Reducing Uncertainty through Information *Note: "Information" includes both measurement (chemical & non-chemical) & non-measurement information*	**Absent**	**Present, but unclear**	**Clearly written**
<u>G</u>ENERAL <u>I</u>NFORMATION ITEMS GI1) Shows understanding of **Triad principle** that decision uncertainty is managed by using/gathering the best available information as efficiently & economically as feasible.			
GI2) Clear articulation of **what information is needed** to reduce the risk of making the wrong decision(s) (i.e., manage decision uncertainties).			
GI3) Match decision uncertainty management to various management strategies: 1) better utilize existing information; 2) gather new non-measurement information; 3) gather new measurement information. (See below)			
GI4) Evaluate all sources of **information uncertainties** (for both measurements & non-measurements. For measurements, consider the effect of heterogeneity & the appropriately uses & limitations of statistical analyses & other descriptive & predictive models.			
GI5) Employ **collaborative data set**s (when analyzing the same analytes by different analytical chemical methods) and **weight-of-evidence** approaches (to blend different types of information into the CSM) to manage various kinds of information uncertainties and data interpretation.			
<u>D</u>ETAILED <u>I</u>NFORMATION ITEMS DI1) Articulate decisions to be made to achieve **site reuse** or other long-term goals for site (not just for this project) & what general information is needed to achieve site goals.			
DI2) Use long-term goals as an anchor for defining what contribution **this project** will make for achieving long-range site goals. Determine what **general information** is needed to make project decisions that achieve project goals.			
DI3) Over the course of project planning, break general information needs down into the **specific information** needed to address specific project decisions.			
DI4) For each type of information, consider whether the project team is unsure about the reliability of that information (i.e., are there **uncertainties in the information**?).			
DI5) Evaluate whether some decision uncertainties can be managed by accessing **existing, but under-utilized, information** (i.e., non-measurement & measurement data).			
DI6) Evaluate whether some decision uncertainties can be managed by **gathering <u>new non-measurement</u> information**, e.g., Find out what stakeholders' interests are regarding site reuse. Are there new budget priorities? Will legal, regulatory, insurance & lender negotiations affect project goals & decisions, decision transparency & confidence level?			

Managing Information Uncertainties cont'd	**Absent**	**Present, but unclear**	**Clearly written**
DI7) Evaluate whether some decision uncertainties can be managed by designing efficient strategies to generate & interpret **new measurement information** (both chemical & non-chemical, e.g., contaminant concentrations, DO, hardness, GPS, geophysical, geotechnical, ecological, …), while avoiding duplication & non-informative data.			
DETAILED DATA ITEMS DD1) Consider the **RANGE OF DATA** generation & management options available & applicable for a weight-of-evidence approach that includes field analytics, *in situ* sensing systems, geophysical & geotechnical tools , traditional laboratories, locational, etc., & computer systems/GIS that assist project planning & data storage, display, mapping, statistics & sharing/transfer.			
DD2) Each kind of data to be collected should be matched to the data needs identified to support **INTENDED PROJECT DECISION(S)**			
DD3) Include all potential **DATA USERS** (such as risk assessors, statisticians, legal staff, etc,) when planning data collection			
DD4) Design analytical **INSTRUMENT** usage consistent with instrumental strengths & limitations			
DD5) Estimate the amount & kind of QC required to meet various data quality requirements on a decision-by-decision basis & be prepared to modify QC based on increased or decreased QA needs to accommodate matrix, method & decision situations **(ADAPTIVE FOCUSED QC PROTOCOLS)**			
DD6) List analytical QC checks & the **CORRECTIVE ACTIONS** to take when a QC check fails			
DD7) Continually assess whether real-time data is **CONSISTENT WITH THE DEVELOPING CSM**; if not, increased QC, data replication and/or data density may be needed to ensure data & CSM confidence			
DD8) A demonstration of methods applicability (**DMA**) (attached to or detached from the main field work mobilization) is performed where performance of sampling & analysis tools is in doubt. Use **DMAs** to optimize field tools, their implementation, data management, and work flow. Also use DMA results to evaluate and optimize strategies for data generation, QC, information sharing & info management for their ability to **support real-time decisions.**			
DD9) **CONTINGENCIES/**back-up plans for sampling, analytical & software equipment failures			

Planning for Data Collection cont'd	**Absent**	**Present, but unclear**	**Clearly written**
DD10) **SOURCES OF UNCERTAINTY** in data are explicitly discussed and the partitioning between sampling vs. analytical variability/uncertainty is predicted & re-evaluated during refinement of the data collection process			
DD11) CSM features are used to help sampling design & handling & choice/combination of analytical options (constructing **COLLABORATIVE DATA SETS**)			
DD12) Mechanisms are developed to evaluate **DATA COMPARABILITY** for using collaborative data sets			
DD13) DATA QUALITY TERMS ("screening data quality" and "definitive data quality") are used consistent with the language of managing decision uncertainty			
DD14) DATA REPRESENTATIVENESS articulated in terms of "representative of <what matrix> in the context of <what decision>"			
DD15) Include data-related **EXPERTS** (labs, field analysts, instrument vendors, field-samplers, GPS, software users) in up-front project planning			
DD16) Consider the **THROUGHPUT** of sampling & analytical techniques when predicting field time required & on-site analysis costs			
DD17) Evaluate sampling/analysis costs on a lifecycle basis rather than just a **PER-SAMPLE COST** basis			

Real-time Dynamic/Adaptive Work Strategies	**Absent**	**Present, but unclear**	**Clearly written**
GENERAL ADAPTIVE ITEMS GA1) Evaluate whether a dynamic/real-time field decision strategy can improve the **quality of the project, while saving time & money.** Evaluate whether the needed **expertise & equipment** are available.			
GA2) Lay out the adaptive work strategy & logic in **decision trees (or similar mechanism)** that also address contingencies, and obtain stakeholder/regulator buy-in.			
GA3) Structure the work plan to **accept real-time information/input** from regulators & stakeholders in response to further refinement of the CSM & project progress.			
GA4) Use real-time strategies to efficiently **ground-truth & evaluate the performance of predictive models** before accepting model predictions.			

Real-time Dynamic/Adaptive Work Strategies cont'd	**Absent**	**Present, but unclear**	**Clearly written**
<u>D</u>ETAILED <u>A</u>DAPTIVE ITEMS **DA1) CAN A DYNAMIC STRATEGY OFFER BENEFITS?** For this project consider whether moving some decision-making to the field improves decision confidence, speed site resolution & reuse, and reduce site lifecycle costs			
DA2) The **INTENDED OUTCOMES** & goals desired from the dynamic activities are clearly described			
DA3) The real-time decision-making strategy is **CLEARLY DESCRIBED** in flow charts, decision trees, tables or text.			
DA4) The dynamic decision strategy (e.g., the decision tree) is **APPROVED** by regulators in writing			
DA5) Must have property access to make a DWS work. Need physical access to offsite properties (ie access agreements) if plan to search for sources or define extent. Define the spatial boundaries of field work.			
DA6) A mechanism is provided to easily access **OFF-SITE EXPERTISE** when needed			
DA7) The dynamic strategy includes descriptions for **HANDLING LOW PROBABILITY EVENTS OR "SURPRISES"** outside the scope of the approved decision trees; for example, when to stop work to consult with regulators & stakeholders about future direction			
DA8) Real-time compilation of data & incorporation of new information into the **EVOLVING CSM**			
DA9) Website or other mechanisms to facilitate **REAL-TIME DATA SHARING** & activity updates with regulators & other stakeholders so they can closely follow field progress			
DA10) Develop an adaptive strategy for data management, i.e., what will be done if data transfer, storage or mapping tools do not function as intended. Ensuring the performance of data handling tools should be considered when designing the DMA.			
DA11) Make preliminary or unpolished information available to stakeholders wishing to see it; trust built thru **TRANSPARENCY**			
DA12) Accommodate **REAL-TIME STAKEHOLDER INPUT** into field implementation to build confidence/comfort with the process or address new concerns as they arise			
DA13) Extend dynamic strategy to include **REMEDY-RELATED DECISION-MAKING** to degree feasible			
DA14) Consider whether a dynamic strategy can test and refine 1) fate & transport, and 2) exposure pathway **MODEL** assumptions in real-time & improve the model's predictive performance			
DA14) Consider whether a dynamic strategy can improve **CLEANUP PERFORMANCE** of on-going remedial systems while reducing O&M costs			

DA15) Consider whether a dynamic strategy can **MONITOR FOR FUGITIVE EMISSIONS** from remedial systems to ensure stakeholder comfort with process safety			