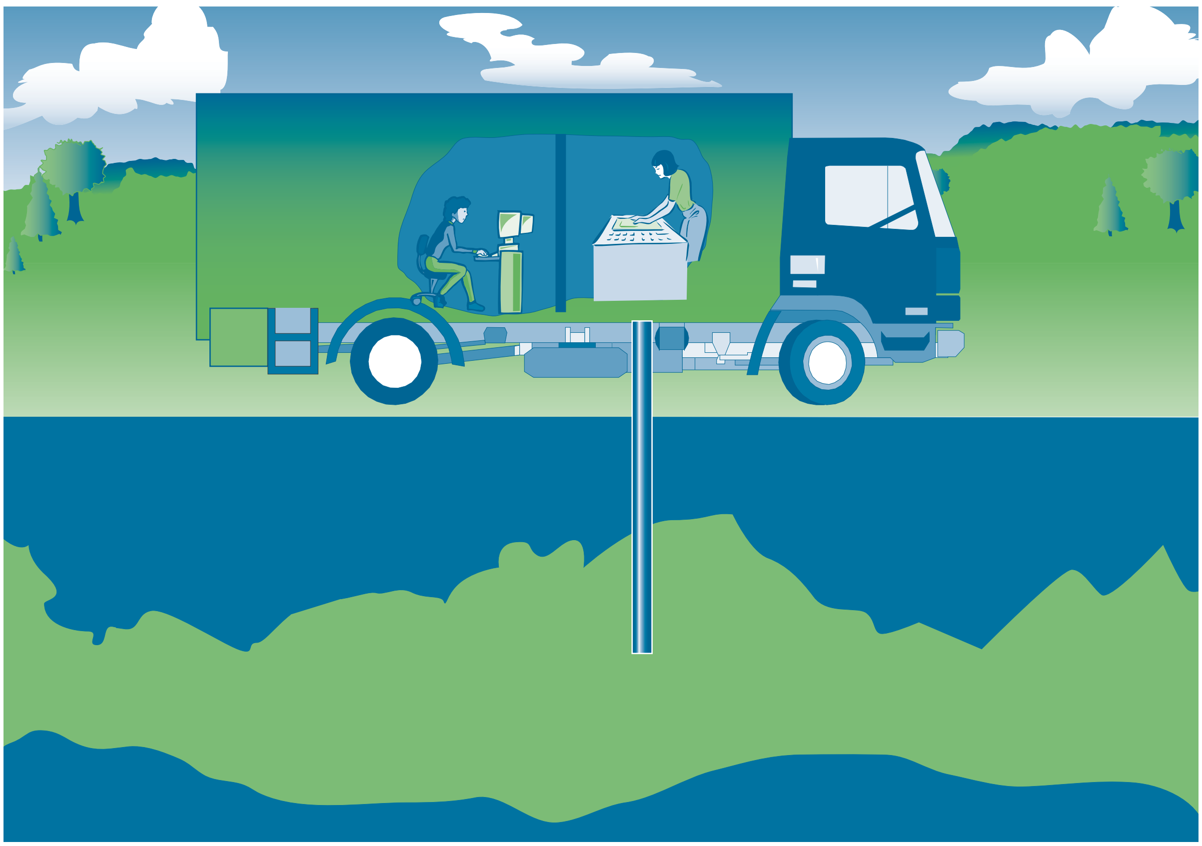
Overview Document

Triad Implementation Guide



May 2007

Prepared by
The Interstate Technology & Regulatory Council
Sampling, Characterization, and Monitoring Team

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EXECUTIVE SUMMARY

This document provides guidance for environmental organizations that want to implement the U.S. Environmental Protection Agency Triad process into their business practices. This document is intended to complement the first Sampling, Characterization, and Monitoring Team document, *Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management* (ITRC 2003). Although this document is written to specifically address issues that may be encountered by a state agency, it should also be helpful to those in other segments of government and in the private sector.

Reasons for implementing Triad are discussed, as are myths, potential obstacles, and lessons learned. Challenges and solutions to anticipated issues are discussed. The appendices include an example of an organization attempting to establish Triad as an internal policy. Other appendices include information on legal defensibility, budget and procurement issues, and acceptability of data generated via field methods and considerations dealing with risk assessment.

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TRIAD IMPLEMENTATION GUIDE

1. INTRODUCTION

The purpose of this document is to provide state regulatory agency policy setters with a tool to develop the Triad approach within their organizations as a standard business practice for remediation activities. This document is intended to provide key Triad information, outline an approach for obtaining consensus within the organization and formalizing the acceptance of Triad as the project management process, and provide additional documentation to allow for informed discussions of Triad. The document sections are intended to accomplish the following:

- explain why an agency would want to implement Triad, including a brief description of Triad and typical programmatic benefits of using Triad

- serve as a "How-To" guide based on the New Jersey Department of Environmental Protection's (NJDEP) program-level implementation of Triad

- provide in-depth discussions on how to address organizational, cost, and technical challenges related to changing business practices from traditional approaches to Triad

- provide additional supporting information in the appendices, such as sample implementation documents (meeting agendas, memoranda), acceptability and legal defensibility of data gathered using Triad practices, budgeting and procurement considerations, and the relationship of Triad principles to risk assessment and management

This document is the second related to Triad prepared by the Interstate Technology & Regulatory Council (ITRC) Sampling, Characterization, and Monitoring (SCM) Team. It is written assuming that the reader already possesses a basic understanding of Triad—it is not a guide on how to implement Triad on a specific project. Project-level Triad implementation was documented in the *Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management* (ITRC 2003). That document provides a complete how-to guide for use of Triad on environmental cleanup projects. For purposes of differentiating that first Triad document from the current document, the first document is referred to as "Triad I" throughout the remainder of this document.

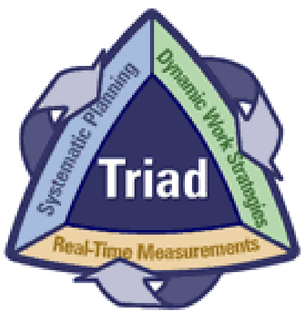
> **Triad I Link**
> Find the Triad I document, *Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management*, on the ITRC Web site at www.itrcweb.org/gd_SCM.asp
>
> Boxes like this direct readers to associated sections in Triad I.

Additionally, while this document has been written specifically for agency policy makers, the authors hope that this guide will be useful to others in the environmental field who are interested in program-level, organizational changes toward best management practices like Triad.

2. HOW TRIAD CAN HELP

This chapter is a brief introduction for policy makers unfamiliar with Triad. It provides an overview of Triad, context for implementing Triad at the program level, benefits of Triad implementation, and Triad application areas. As mentioned in the Introduction, a comprehensive ITRC document on Triad implementation at the project-level has been published previously (ITRC 2003). This document provides references to the first Triad document in boxes referencing “Triad I” so that concepts can be clarified for those needing further information. Details on free Internet-based training for Triad offered by ITRC can be found at www.itrcweb.org.

2.1 What Is Triad?



Triad is a best management practice developed from experience in the environmental field to provide the tools for making better cleanup decisions at contamination sites. The Triad approach is built on an accurate conceptual site model (CSM) that supports project decisions about exposure to contaminants, site cleanup and reuse, and long-term monitoring. The Triad approach also incorporates application of successful work strategies and the use of technology options that can lower project costs while ensuring that the desired levels of environmental protection are achieved.

The three components of Triad are as follows:

- **Systematic planning** involves the gathering of any and all information related to the goal of the remedial activity. Any unknowns (i.e., uncertainties) that could cause erroneous decisions are identified, and a process to communicate, document, and coordinate all project activities is clearly defined. Most importantly, the goal of the remedial effort is quantified in consultation with all parties involved in the project, which can include the site owner, potential buyer, insurer, regulator, and community spokespeople.

> **Triad I Link**
> See Triad I, Section 2.5 for a discussion of systematic planning and project uncertainties.

- **Dynamic work strategies** are designed around consensus-derived decision logic so that real-time decision making can quickly refine field work as new information becomes available. A highly trained and experienced team is established and empowered with the flexibility to make quick decisions in the field based on evaluation of new data as they are obtained.

> **Triad I Link**
> See Triad I, Section 2.6 for a discussion of dynamic work strategies.

- **Real-time measurement technologies** include geophysics and other imaging techniques, in situ analytical detection techniques, and expedited turnaround from mobile and fixed labs, all used collaboratively to quickly provide data that can be used to refine the CSM while the project team is still in the field. Innovations in

> **Triad I Link**
> See Triad I, Section 2.7 for a discussion of real-time measurements.

processing, displaying, and sharing these data help to determine whether the project goals have been met.

> **Triad I Link**
> Conceptual site model discussion: Triad I, Section 2.4.3

Triad focuses on establishing clear project goals and a common understanding of the site in the form of a CSM. Consequently, systematic project planning is the single most important element in Triad. Once project goals are understood, uncertainties that stand in the way of achieving those goals can be addressed by the team and stakeholders. Usually, environmental data will be collected as one means to manage decision uncertainty. When data are used to make decisions, the sampling and analytical uncertainties inherent to environmental data generation must be managed to a level commensurate with project decision needs.

2.2 Why Implement Triad?

> **Triad I Link**
> Triad approach summary: Triad I, Section 2.9

A state regulatory agency would choose to implement Triad to improve the quality of decisions it must make as a part of protecting the public from the dangers of environmental contamination. By consciously identifying acceptable levels of uncertainty for an individual project and then planning and implementing the data collection to achieve the necessary level of certainty, the regulatory agency, regulated facility, and stakeholders are all in a position to make better decisions. In addition, Triad has been shown to reduce overall project cost and reduce the overall time it takes to reach a final decision.

> *Why Implement Triad?*
> - Reduce uncertainty
> - Save time
> - Save money

The Triad approach can be compared and contrasted with the traditional approach for site characterization and cleanup. The traditional approach normally involved multiple investigations in which data were collected and interpreted in discrete phases, with the ultimate goal of achieving sufficient understanding of the site for effective remedies to be implemented. The up-front planning for these traditional investigations did not always define the project goals before sampling crews were dispatched to the field. Acceptable levels of uncertainty regarding such topics as contamination delineation, understanding of site hydrogeology, or rates of contaminant transport were not discussed and agreed upon during initial planning, and therefore it was difficult to determine when sufficient sampling had been accomplished. In addition, new advances in site characterization and data management were not being used to their full potential. Triad was developed to overcome these challenges and to improve the overall effectiveness of environmental restoration and protection of the public. The abbreviated narrative of the following case study is an example of how a project benefited from the Triad approach.

Triad Case Study: New Jersey Department of Environmental Protection Project

Type of Facility:	School Construction Project
Constituents of Concern:	Polychlorinated biphenyls, metals, polyaromatic hydrocarbons
Project Team Lead:	New Jersey Schools Construction Corporation and New Jersey Institute of Technology
Technologies Used:	X-ray fluorescence, conductivity probe
Triad Advantages:	Facilitated an environment of trust with the stakeholders and preserved $5,000,000 in capital expended for the project
Point of Contact:	Jim Mack, New Jersey Institute of Technology, James.Mack@NJIT.edu

This case study shows how the Triad approach was successfully applied to minimize construction delays, preserve the capital invested in this school project under construction, and restore the confidence of stakeholders in the community in support of the new Early Childhood Development Center (Pre-School). The New Jersey Schools Construction Corporation (NJSCC) is managing the project, which involves the demolition of an aged school structure and construction of a new early childhood development center on a 4.5-acre site owned by the Board of Education (BOE).

During the NJSCC's installation of the foundation for the new school, historic fill was encountered, in an extant larger than originally suspected. The contractor stopped work as a health and safety precaution due to the presence of arsenic concentrations in soil above the New Jersey Department of Environmental Protection (NJDEP) residential direct contact soil cleanup criteria. At this stage, approximately $5,000,000 in construction costs had been incurred.

To minimize construction delays, the Triad approach was proposed. To obtain stakeholder approval for the proposed investigation and remedial strategy, a meeting was held to explain Triad benefits. A conceptual site model (CSM) was discussed at the meeting, and a draft CSM was developed shortly afterwards.

A sampling plan using field analytical methods (FAMs) was approved during the stakeholder meeting. Large amounts of FAM data were produced (including over 250 samples for arsenic) through the use of x-ray diffraction and conductivity probe instrumentation. During the time the sampling was being conducted, the CSM was refined by a historical records review, which revealed that a former stream channel existed on the site in the early part of the 20th century. The channel had been filled with soil and/or waste by a nearby a manufacturer prior to the 1930s.

The FAM results and the laboratory analytical results showed that the highest concentrations of arsenic were in the former stream channel. The wealth of data collected provided greater certainty with respect to the CSM, confirming the extent of the arsenic-impacted fill material as well as the determination that the extent of impact had reached a "steady-state equilibrium" and was not likely to migrate.

To make this project a success, an environment of mutual trust had to be established between the BOE, NJSCC, NJDEP, and the various experts working on the project before progress could be made. To establish this environment of mutual trust, the stakeholders were involved in the decision-making process. Incorporating stakeholder involvement as part of the systematic project planning is one of keys to implementing the Triad approach. The BOE's facilities coordinator was involved each step of the way. Collaborative meetings were held with the BOE's Facilities Committee to provide updates and to get stakeholder approval as needed. This process culminated in a meeting with the full BOE passing a resolution approving the proposed remedial strategy, which involved excavation and construction of an engineered cap for the remainder of the historic fill. Finally, the remediation plan was presented directly to the community.

> The success of the project was directly related to **systematic project planning**, **dynamic work strategies**, and **real-time measurement technologies.** The abundance of data generated and resultant certainty developed using the Triad approach reassured the stakeholders that the extent of the impacted soil and groundwater was well understood and that the proposed remedial action was protective of human health and environment. The involvement of the NJDEP and the BOE in the decision-making process, and the use of a **dynamic work plan**, as well as the use of FAMs, led to expedited reviews and the rapid approval of the remedial strategy by the property owner, the community, and the NJDEP. Without the up-front and diligent involvement of the key stakeholders, it is likely that the remedial strategy would not have been approved, which may have led to the abandonment of the project.

2.3 Typical Triad Benefits

Triad offers many benefits to regulatory agencies, both direct and indirect, as discussed below.

Triad I Link
Triad advantages and disadvantages: Triad I, Section 4

- **Greater Decision Confidence**

Triad offers a process to manage project decision uncertainty, allowing the project team to better focus data collection for the decisions to be made. Decisions can range from a more complete understanding of the nature and extent of contamination at a site to the performance of a constructed remedy. This improvement in decision quality is achieved through up-front planning that addresses acceptable levels of uncertainty, and data collection and interpretation culminating in a CSM tailored for the specific decisions to be made at the site. When possible and appropriate, use is made of field analytical technologies in combination with tried and true analytical methods. This approach allows for higher data density and more representative data sets.

- **More Effective Cleanups**

One benefit of the consensus-driven focus on uncertainty management that Triad promotes is that project teams often employ multiple technologies to gather data. Some of these technologies, especially "real-time" methods like membrane interface probes, x-ray fluorescence, and electrical conductivity, offer significant cost efficiencies while achieving a higher data density and, thus, lower uncertainty. The use of these field methods is normally done in conjunction with other techniques, such as laboratory analysis of samples and physical logging of boreholes, to create the collaborative data set and to ensure quality. Figure 1 shows conceptually how higher data density improves decision certainty through a better understanding of the site. This schematic helps to illustrate the benefits of low-cost, high-data-density investigations over the traditional methods. However, it is important to note that a field team consisting of multidisciplined, experienced project team members combined with systematic planning is required to execute the project successfully.

Triad I Link
Better investigation quality: Triad I, Section 4.1.1

Triad I Link
More effective cleanups: Triad I, Section 4.1.5

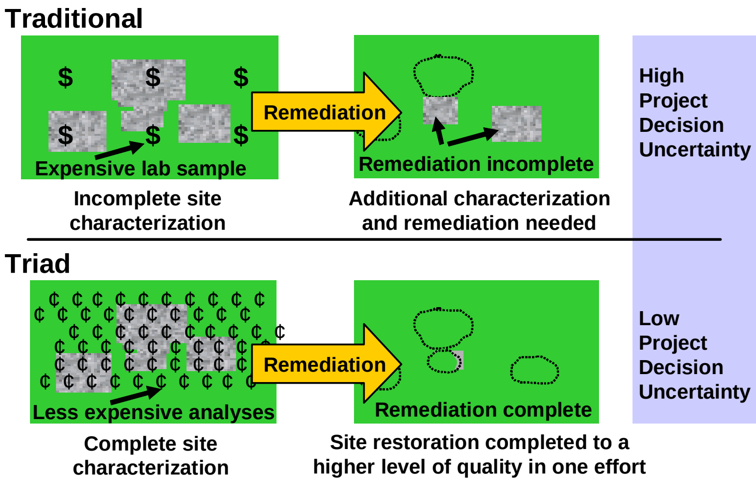


Figure 1. Triad approach focuses project resources on managing decision uncertainty.

- **More Efficient Investigations**

Using the Triad approach for investigations will result in better focused projects. There will normally be fewer mobilizations and rounds of data collection/evaluation. Projects will be completed faster, with fewer periods of inactivity, thus allowing regulatory personnel to spend less time in becoming reacquainted with issues and more time in guiding the project to a successful conclusion.

> **Triad I Link**
> Faster investigation, restorations, and redevelopment: Triad I, Section 4.1.2

- **Lower Life-Cycle Costs**

The procedures described above all lead to improved planning, fewer field mobilizations, fewer work plans and reports, better resolution of data gaps, and most importantly, faster project completion. These all results in lower life-cycle costs, and in most cases, significant savings of time and money. Other, less-direct benefits to regulatory agencies implementing a Triad program are less obvious, but potentially as rewarding. The following indirect benefits are more broadly realized when Triad has been implemented throughout a regulatory agency.

> **Triad I Link**
> Lower life-cycle costs: Triad I, Section 4.1.3

- **Better Communication of Information**

The foundation of the Triad approach is transparency regarding desired outcomes and motivations between stakeholders when discussing potential exit strategies and project decision uncertainty. With stakeholders as a part of the systematic planning rather than waiting to comment on documented decisions after a work plan or remedial design has been written, the regulatory perspectives are brought into the data collection and evaluation strategy as soon as possible. This process allows

> **Shortening Project Timelines with Triad**
> Triad can reduce project life-times by engaging decision makers and stakeholders early in the process. Social capital earned during systematic planning typically returns its investment with facilitation of the regulatory process.

the overall design of the project to reflect the data requirements of regulatory team members (and, of course, other stakeholders). Consequently, regulators participate directly (rather than in review mode) in shaping the project objectives and closure strategy, identifying data gaps, outlining the decision logic that the team will use to close the data gap, and determining acceptable decision uncertainty.

Caveat: The transparent communication model inherent to Triad may require more time for the planning phase as the most difficult issues are addressed up front. However, overall project efficiency will occur by working through these issues during the up-front decision making.

- **Improved Public Relations**

Triad I Link
Communication:
Triad I. Section 4.1.4

The public's appreciation of the regulatory agency will increase as they become aware of the overall improvement in environmental restoration efficiency. The public will benefit from reduced exposure to contamination as sites are brought to closure faster and with more confidence. Contaminated properties can be returned to productive reuse in a timelier manner. The regulatory agency will enjoy enhanced public approval through effective use of resources and greater stakeholder support for project decisions.

- **Improved Morale**

Within an agency, technical and management staff will experience the satisfaction of achieving project completion sooner and with a higher degree of decision confidence. The operational efficiency of the agency will also increase due to the involvement of agency personnel from different units and sections multidisciplinary teams. The agency further benefits as the professional expertise of staff members is enhanced from the completion of more projects.

- **Use of the Best Available Technologies**

One of the key components in Triad is the application of new technologies, brought to the project through the combined experience of a multidisciplinary team. More frequent interaction with other disciplines helps a regulatory agency identify implement new technologies as well as broaden technical resources.

2.4 Where Can Triad Be Applied?

Triad has been implemented successfully as part of characterization and remediation activities, addressing a broad range of contaminants at federal, state, and private sites. Successful implementation is defined as meeting the project goals laid out during the systematic planning phase for that phase or project closeout. Inherently, this process includes the agreement of regulators with the results.

Is My Organization Already Using Triad?
As described by its name, Triad consists of three components. If your organization uses all three elements in an articulated manner, then, yes, it's Triad. However, if your organization does not explicitly use three elements: systematic planning, dynamic work strategies, and real-time measurements, then the project cannot be described as a "Triad" project.

> **Traditional vs. Triad**
> Using the Triad approach can help save time and money by avoiding repetitive field mobilizations.

Application of the Triad framework is not limited to any particular type of site and is not dependent on the size or numbers of contaminants present on site. However, as complexity grows, so does the need for personnel expertise and support to ensure project or phase success. Additionally, the Triad principles can be applied at the beginning of a project, midstream, or during the post-construction phase. The principles are exportable to all projects in one form or another. One of the key features of successful application of Triad is experience, and while the project lead does not need to be an expert, appropriate expertise needs to be available and used throughout the project life cycle.

The Triad approach can be applied at most any facility or project under most regulatory programs. Though most projects that use the Triad approach are complex and require multiple team members, the approach can also be used for smaller facilities. Among the hazardous waste regulatory programs, Triad has been successfully implemented in Comprehensive Environmental Response, Compensation, and Liability Act; Resource Conservation and Recovery Act corrective actions; Voluntary Cleanup Programs; and property transactions. A new initiative that is strongly encouraging the use of the Triad approach is brownfields facilities. The Triad approach is also applicable to activities conducted under the Toxic Substance Control Act, Formerly Used Defense Sites, Federal Insecticide Fungicide and Rodenticide Act, Clean Water Act, Underground Injection Control, lead and indoor air programs, and other state or federal cleanup programs.

3. TRIAD IMPLEMENTATION PROGRAM

3.1 Getting Started: Lessons Learned from the New Jersey Experience

> **Triad I Link**
> Introduction to NJDEP implementation: Triad I, Chapter 6

As with any comparison of organizations, there is never one clear road for implementing change. Each organization has its own style and management strategy, but certain basics can be gleaned from experience in promoting the use of Triad in an organization where it may be new or where certain resistances exist. Understanding what information to have in hand to bring about a shift in thinking regarding project execution is as important as the process itself. This section provides a basic "how-to" guide for getting an agency up to speed with Triad. The implementation process described is based on the experience of the NJDEP.

> **Achieve Support for Triad**
> - Educate staff, consultants, and stakeholders
> - Develop relationships = social capital
> - Communicate successes and lessons learned

The general approach to develop a Triad program involves a few key steps. First, identify a staff member willing to lead the charge for change. This person's main focus is to achieve management support along with acceptance of Triad by at least a few project managers. Second, communicate with other Triad participants such as facility representatives, consultants, banking/insurance companies, private citizens, and other external stakeholders.

Third, using the comments and ideas generated through outreach sessions, create a training program to ensure Triad is consistently implemented. Finally, publicize successful completions of Triad projects to encourage support of the program. The remainder of this section will expand on each of these steps.

NJDEP Triad Implementation Briefing Outcomes

- Triad supports New Jersey's brownfields initiative as it is particularly applicable at brownfields sites and other sites requiring rapid assessment.
- Triad can eliminate the need for multiple mobilizations and lengthy time frames for site characterization and remediation.
- Triad minimizes decision uncertainty that leads to decision errors, including contamination being overlooked on a site and inflated cleanup costs.
- NJDEP has a "war on caseload" as a result of over 15,000 sites in the program. Triad has the potential to dramatically reduce the life-cycle time of cases.

3.1.1 Management Stayed Informed and Involved

U.S. Environmental Protection Agency (EPA) was very interested in promoting Triad nationally and approached NJDEP in 2003 to develop interest and expertise in the Triad approach in New Jersey. Although there was some initial resistance to the idea due to the additional staff resources needed for the up-front planning, the Triad approach was overwhelmingly supported by upper management after the benefits were understood. Through the ITRC Point of Contact in New Jersey, a Triad briefing was set up for the Assistant Commissioner and Division Directors in the NJDEP's Site Remediation and Waste Management Programs.

Triad I Link
NJDEP policy in support of Triad: Triad I, Section 6.1

Triad Implementation Note
A high-level official should sign the Policy Implementation Memo.

One outcome of this meeting was that the Division Director drafted a memorandum (Appendix A) affirming the department's commitment to promoting the use of Triad, encouraged staff members and managers to support the use of Triad, encouraged staff members to volunteer for Triad projects, and provided the Web link for the department's Triad resource Web page (www.state.nj.us/dep/srp/triad). Also, the Commissioner issued a policy statement in support of the Triad approach (www.nj.gov/dep/srp/triad/policy.htm). Once the upper-level management support was in place, resistance at the mid-management and staff levels was diminished.

3.1.2. Identify a Triad "Champion"

Find someone in the agency to take the lead by conducting a series of briefings, then ask for volunteers to head an effort to encourage the use of Triad. Find that person who is excited about Triad, is technically competent, and has the time to devote to making Triad a success. This person does not necessarily need to be a high-ranking staff member or manager. In New Jersey, a Triad Committee was formed so members from the public and the agency could discuss how to implement Triad. It was clear from these meetings that there were several individuals within the organization who were

Triad Program Implementation Needs

- Training for staff and consultants
- Development of a Triad guidance document
- Program for prequalification of Triad practitioners

passionate about implementing Triad. If the Triad champion is not a high-ranking staff member or manager, the next step is to recruit a management liaison to take the lead and initiate action and form a Triad Resource Team.

3.1.3 Develop Relationships with Those Outside Your Agency

As acceptance grows in your organization, it is important to focus not only on your agency but also on your relationships to the regulated community, stakeholders, and other key constituencies (insurance companies, laboratories, and engineers/consultants). These relationships not only improve your project outcomes, but also provide cross-feed input into how Triad is being implemented and the impacts of the projects.

3.1.4. Listen to Stakeholders

An important step in the NJDEP's Triad implementation was holding a "listening session" for consultants, laboratories, site owners, and others active in New Jersey remedial activities to assess readiness of firms for Triad and other Triad implementation issues. A mixture of small, medium, and large businesses was invited to provide a cross section of potential Triad users. In April 2003, the "Interactive Workshop for Site Assessment Practitioners: Using the Triad Approach for Brownfields Site Assessment in New Jersey" was attended by 35 participants (EPA, NJDEP, environmental consultants, academics, and vendors) who explored the use of the Triad approach as a process for managing site characterization uncertainty. Comments received by the NJDEP via outreach sessions with Triad stakeholders are listed below.

Triad I Link
Stakeholder concerns regarding Triad: Triad I, Chapter 7

NJDEP Triad Implementation Stakeholder Comments

- A contact person should be designated within NJDEP to champion the Triad approach.
- NJDEP needs a group to facilitate Triad implementation and work with Triad practitioners.
- Distribute a list of Triad experts/contacts to staff.
- Schedule peer review sessions to assist staff with review of Triad proposals.
- An internal peer review panel could serve as a review mechanism for Triad approach proposals.
- Post a list of Triad cases with case team contact information to the intranet or Internet.
- Set up regular sessions with staff (approximately 1 hour per month) on Triad-related news to maintain interest and momentum and continue to build in-house expertise.
- Triad proposals should always include a brief conceptual site model.
- Submittal of a Triad proposal should automatically trigger a meeting to discuss Triad.
- Certification of field analytical methods is good but should be optional.
- Determine up-front agreements on end goals and how data will be used for decision making, and establish a pathway toward an end point such as a no-further-action (NFA) determination.

3.1.5. Educate/Train Agency Staff

Next, a training program was developed and held for NJDEP staff members who were individually selected to work on Triad projects. Ten key Triad user bureaus within the department were identified, and two staff members and one supervisor from each bureau attended. The intent was for these staff to provide support for Triad projects currently in-house and those received in the future. The agenda for that training session is included in Appendix A.

Eventually, all Triad practitioners (project managers, contractors, stakeholders, and industry representatives) need to learn the procedures, guidelines, and expectations for Triad projects.

Triad Resources

- Triad program implementation resource: www.nj.gov/dep/srp/triad
- NJDEP Certification Program for Field Analytical Methods: www.nj.gov/dep/oqa/bboard.html#new
- ITRC Triad Training: www.itrcweb.org/ibt.asp#TriadApproach
- Triad Resource Site: www.triadcentral.org/

Triad training must provide certain fundamental information to be effective and to gain the support of important key players. To ensure the success of Triad, all individuals involved in the process must be represented in training. A good training program will include the following key elements:

- How to write a comprehensive CSM
- How to develop a "workable" flexible work plan
- How to select the appropriate real-time measurement methods

3.1.6. Form an Internal Triad Implementation Team

After internal training was conducted, a committee was formed to integrate Triad with departmental regulations and guidelines and to develop an implementation plan for promoting the Triad approach in New Jersey. The committee was chaired by an NJDEP "Triad champion" and included representatives from key Triad user groups in NJDEP, EPA, New Jersey Institute of Technology, consultants, and private-sector laboratory managers. The committee met monthly to network, develop guidance materials, and track implementation progress and obstacles.

Converting Current Projects to Triad Projects

The Triad approach, particularly systematic planning, can be implemented at any phase of a project. Implementation consists of creating or updating the CSM, ensuring stakeholder involvement, and evaluating the closure strategy. The levels of effort for these steps are determined by project complexity and current phase of work (remedial investigation, remedial action, etc).

Written policy and procedures for NJDEP case managers was prepared with EPA and other federal agency input. The guidance documents provide a general description of the Triad approach; describes how Triad can mesh with the technical rules; provides quality assurance/quality control (QA/QC) guidelines for the use of field analytical methods (FAMs), including method deliverables; and includes many references and links to Triad resources and training.

3.1.7. Discuss Successes and Lessons Learned

NJDEP Triad Successes

NJDEP calculated that using Triad on 11 projects saved $4,430,000 in New Jersey.

Continuous internal communication regarding Triad is essential to long-term success. Publicizing Triad success stories as positive examples is another key aspect of developing and sustaining a Triad program. While anyone can do this, it is an essential function of a Triad champion. In New Jersey, success stories were mined and documented during the Triad Committee meetings. The Triad champion tracked successes in a spreadsheet format, summarized the stories, and ensured that they were highlighted in mid- and high-level meetings.

Develop yearly commitments to Triad implementation in your agency. For the NJDEP, a major committee activity for 2006 was to facilitate the use and acceptance of Triad by incorporating the approach into NJDEP regulations for site remediation (N.J.A.C. 7:26E), a strategy to institutionalize the Triad approach in New Jersey. It is important to note that the regulations are not prescriptive with respect to Triad because rigid, inflexible regulatory oversight is not consistent with the intent of Triad. Rather, the rules describe Triad as an alternative approach and discuss concepts such as the strategic planning process, how workflow differs for Triad, and the required active participation of NJDEP case managers throughout a Triad project. The rule summary includes a discussion of Triad and document major life-cycle cost savings for Triad projects despite possible higher up-front costs.

3.2 Triad Implementation Checklist

The checklist at right was used to implement Triad in New Jersey. While the identified steps are useful, other steps may be necessary to implement Triad elsewhere.

Triad Program Implementation Checklist

- ❑ Identify a Triad champion
- ❑ Identify a management liaison
- ❑ Conduct management briefings
- ❑ Identify high-priority programs/sites that would benefit from Triad (developer sites, brownfields, imminent threat sites, sites with sensitive receptor, e.g., schools, residential developments)
- ❑ Triad briefing to management by experienced and qualified team such as EPA Triad program managers or internal managers or staff with Triad experience—include Triad success stories
- ❑ Get upper-level management to issue Triad endorsements and a “Statement of Support” for the implementation of Triad
- ❑ Hold public information session(s); address concerns raised
- ❑ Form a Triad Committee
- ❑ Develop a field analytical methods laboratory certification program
- ❑ Develop a Triad guidance document
- ❑ Develop and implement a Triad Training program for staff
- ❑ Develop and implement training for consultants and responsible parties
- ❑ Publicize successes
- ❑ Set goals and continue to promote the use of Triad

Suggested Training Protocols:

1. Training for state agency staff:
    a. Training for both state agency staff and contractors is critical.
    b. Focused two-day workshop on Triad for selected agency staff, including representatives from priority programs identified (brownfields, imminent threat, and sensitive receptor sites). Identify one manager and two staff from each high-priority program. These staff will be able to provide support for Triad projects currently in house and those received in the near future.
2. Conduct focused training for additional staff at subsequent workshops, based on the frequency and quality of Triad submittals.
3. Conduct two-hour overview of Triad for all staff.
    a. Consultants
        i. A “listening session” for consultants active in your state to assess readiness of firms for Triad concerns. Include mix of small, medium, and large firms to provide a cross section of potential Triad users. Expand this section to include notes from NJ “listening session”?
        ii. Full-day Triad workshop.
    b. Involving your regulated community
        i. Publish policy statement in support of Triad on agency Web site.
        ii. Conduct outreach to key potential Triad users.
        iii. Present at brownfields/developer conferences.
        iv. Invite representatives to participate on agency Triad committees.

3.3 Differences in Project Management with Triad

Triad I Link
Programmatic needs: Triad I, Section 3.3

The Triad approach is a new philosophy for environmental project management. Rather than one organization taking the responsibility for accomplishing work and then reporting it to others for review and critique, all concerned stakeholders are invited to assume a partnership role and determine the steps needed to facilitate satisfactory project decisions. Thus, project planning becomes a collaborative effort between all concerned parties. All stakeholders collaborate to develop a dynamic work plan that can be implemented by the field personnel. Rather than defining a strict plan with no allowance for field changes, Triad uses a flexible plan, with changes implemented by the field personnel as necessary. This is a significant change in philosophy from traditional project management and requires that the field personnel have the authority to implement the flexible plan.

Triad Implementation Ideas

- Set yearly goals for Triad implementation
- Incorporate Triad into state regulations

Also, because of Triad's focus on systematic planning, programmatic budgeting should take into account the different budgeting that Triad projects require. Typically, cases using the Triad approach initially increase regulator workload and project budget during the planning phases of a project. However, from a total-project perspective, the time investment up front will pay dividends later on in the project. Early participation in defining the project objectives and subsequent data identification and data collection methods reduces the time necessary to evaluate project results and documentation. Additionally, projects benefit from investment in systematic project planning with fewer planning, field, and data management phases. The hard work up front results in projects that will travel through the system faster with fewer iterations of deliverables, thereby reducing overall case loads and freeing up resources.

It is important for the Triad implementer to communicate the shift from traditional staffing needs. Figure 2 is a schematic of the level of effort required from the different approaches to project management. It helps to articulate the change in staffing requirements to match project time lines of a traditional phased approach in comparison with a Triad project with more systematic planning at the beginning of the project. The orange-colored curve represents a project using the Triad approach; the blue curve represents the traditional approach. The orange curve illustrates the significant increase in level of effort at the initiation of the Triad approach. Traditional projects typically do not to put in the same initial effort as a Triad project using systematic planning, creating the need for additional later phases of work because of unaddressed data gaps and no stakeholder involvement. Figure 2 also demonstrates that traditional projects tend to run beyond projected time frames because of the iterative nature of phased work. When using the Triad approach and initially focusing on the most difficult issues (project uncertainties), the project team is more likely to obtain the critical information with a reduced number of field efforts.

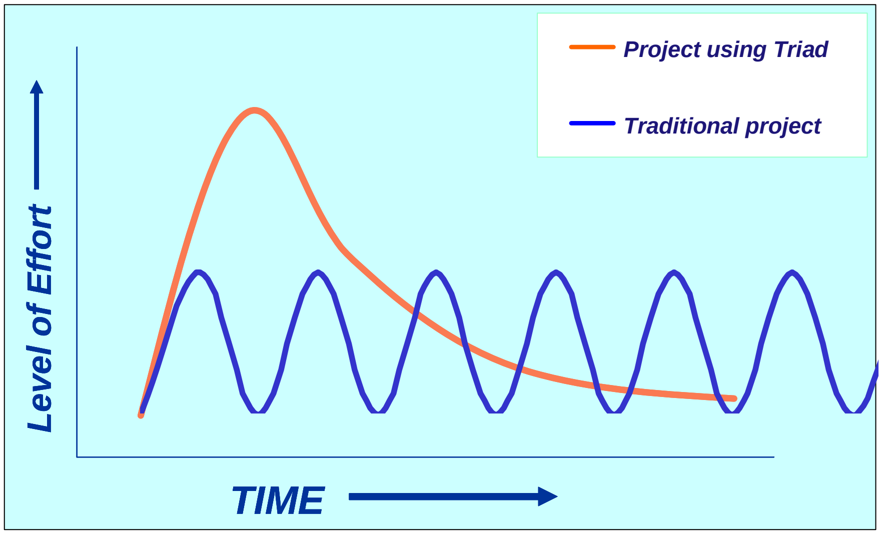


Figure 2. Comparison of level of effort vs. time between Triad and traditional projects.

4. CHALLENGES AND SOLUTIONS

This section helps identify key obstacles to implementing Triad in an organization so they can be more easily overcome. Key institutional barriers to implementing Triad in state and federal regulatory agencies typically fall into three general categories: cost, use of field analytical data, and project management considerations. Typical challenges from each of these categories are provided below, followed by potential solutions.

4.1 Cost Challenges

> **Triad Approach and Possible Cost Savings**
> Many case studies show the Triad approach saving money.

Triad projects often cost less *in the long term* than those performed with conventional remedial strategies. However, identifying and engaging stakeholders during systematic planning, developing an effective CSM, and using the most effective on-site analytical methods can increase the up-front costs. During the "learning curve" for project managers, Triad projects may cost more. As practitioners become more experienced, Triad projects may become more cost-effective than traditional projects.

4.1.1 CSM Costs

> **Triad I Link**
> CSM components: Triad I, Section 2.4.3

Challenge: Development of CSM and dynamic (flexible) work plans are more time-consuming than traditional remedial procedures.

Solution: Making decisions based on an inadequate CSM is a common error in site management. This crucial and often costly mistake can result in improper site characterization, a poorly designed monitoring system, or even an inefficient remedial system. Overall, the development of CSMs and dynamic work plans becomes easier as a Triad practitioner gains experience. Also, the project benefits far outweigh the costs of up-front planning and analysis. In traditional projects it is highly unusual that work plans are implemented as initially designed because field conditions often require modifications. Triad simply anticipates areas where flexibility will be needed and builds that flexibility into the work plan instead of requiring special permission and change orders for unscheduled modifications.

4.1.2 Data Generation

Challenge: Triad projects often require the collection and on-site analysis of significantly more data than the traditional phased approach. This data collection approach may increase the cost of data review and management.

Triad I Link
Details on data: Triad I, Section 2.4.3

Solution: For the most part, review of data occurs concurrently with, and is part of, the field effort. Some additional review time is required to understand the collaborative data sets to ensure that all specified data needs have been met, but because there are fewer mobilizations, less data review time is required overall.

4.1.3 Demand on Senior Staff

Challenge: Triad projects require more up-front planning, experienced personnel in the field, and involvement from senior staff.

Triad I Link
Personnel in the field: Triad I, Section 2.8

Solution: Expertise and experience are necessary on Triad projects. However, mentoring is the best way to maximize junior staff development and project cost balance with senior staff.

4.1.4 Budget Management

Challenge: The phased approach to project management generates the most predictable budgets. Costs associated with dynamic work plans can be difficult to estimate and may lead to budget overruns.

Solution: Actually, projects with dynamic work plans enable experienced Triad practitioners to stay within prescribed budget guidelines. Projects involving an unknown number of multiple mobilizations are more difficult to budget. To help alleviate this concern, cost savings can be demonstrated by compiling cost data from prior Triad projects.

4.1.5 Technology-Related Costs

Challenge: Triad projects require new instrumentation, certification, and training, which increase overhead costs.

Triad I Link
Real-time measurement technologies: Triad I, Section 2.7

Solution: The biggest cost is the purchase or rental of field equipment. In some situations, an agency may already own equipment that can be used on Triad projects, thereby reducing the overall expenses for program implementation. If site remediation using Triad is a long-term agency objective, amortization of new equipment costs over many projects and years is much less of a concern. Likewise, costs for certification and training, assuming skilled professionals are employed, should not be entirely different from traditional business practices.

4.2 Data Challenges

The use of on-site measurements to assist with site decisions makes many regulators nervous. Much of these data are of equivalent quality to those generated in fixed laboratories by SW-846 analytical methods. More importantly, on-site measurements, taken in real or near-real time, can provide greater data density, leading to more certain site decisions. Good science, however obtained, has been supported at many levels of government, including the U.S. Supreme Court.

4.2.1. Field Analytical Methods

Challenge: Regulatory acceptance of field-generated data depends on knowledge of field analytical methods.

Solution: Most field analytical methods are minor modifications of techniques commonly in use at fixed laboratories.

> **Triad I Link**
> Data challenges related to real-time measurement technologies: Triad I, Section 2.7

4.2.2. Analytical Method Approval

Challenge: A list of approved field analytical methods is needed from regulatory agencies.

Solution: State agencies with laboratory certification programs can add field analytical methods to their "approved methods list." See the NJDEP example below.

4.2.3. Method Complications

Challenge: Interferences for field analytical methods must be defined.

Solution: Interferences are defined and/or can be evaluated for specific site applications via standard operating procedures (SOPs) provided by the Triad field team.

4.2.4. Field QA/QC

Challenge: Field analytical methods do not have QA/QC and/or defined limits of precision and accuracy.

Solution: Field analytical methods do have QA/QC. These quality parameters are defined and/or can be evaluated for specific site applications and are always specific in a project-specific SOP.

> **Triad I Link**
> QA/QC challenges: Triad I, Section 2.8.2

4.2.5. Legal Defensibility

Challenge: Data generated by field analytical methods are not legally defensible.

> **Triad I Link**
> Legal defensibility: Triad I, Section 5.2.3

Solution: This is a common misconception. In fact, any method that can be defended by sound science is acceptable, including field methods and the data generated from such. See Appendix B for further detail.

4.2.6. Decisions

Challenge: Triad-based data cannot support no-further-action (NFA) decision making.

Triad I Link
Decision making using Triad: Triad I, Section 4.2.4

Solution: Actually, it can. The NJDEP Site Remediation Program has done so.

4.2.7. False Positives

Challenge: Field analytical methods tend to generate many false positives.

Solution: Field analytical measurements may generate more false positives than traditional EPA methodologies. What must be considered is the impact of any of these "false positives" on the decision making regarding the site. For example, if a false positive is still below the action level for a given analyte, there is no problem. If there is a consistency or pattern to the false positives, an assignable cause for this systematic bias can often be found, or perhaps a correction factor can be applied. Understanding the reason for a pattern to any data set gives the field and project team greater confidence in the use of such data.

4.2.8. Quality Control

Challenge: How many laboratory-based confirmatory samples are needed to verify field measurements?

Solution: Arbitrary percentages of QC samples, such as "10% split sample confirmation" by certified laboratory techniques nearly always fail to provide convincing evidence to "confirm" that field data are reliable. Split samples are not a substitute for in-field method QC to demonstrate the method is working properly. Split samples should be selected on the basis of the analytical information these samples provide to enable interpretation of nonspecific analyses and to provide the low reporting limits and analyte-specific data needed for risk assessment or to demonstrate regulatory closure compliance.

4.2.9. Trained Personnel

Challenge: Trained personnel are needed to employ field analytical methods.

Triad I Link
Decision making using Triad: Triad I, Section 4.2.3

Solution: Trained personnel are needed to employ any analytical method. NJDEP experience suggests that the training and expertise of those performing laboratory measurements in the field is greater than those who perform similar tests in a fixed laboratory.

4.3 Project Management Challenges

For Triad to succeed, individuals at all levels of management must be convinced that Triad is an efficient way to complete many types of remedial investigations. Like all professionals, regulators are measured by certain benchmarks. Pushing the bureaucracy forward will likely have real effects on individuals. Even regulators who encourage change will meet resistance. It is important to recognize the constraints and drivers for all stakeholders.

> *Triad Paradigm*
> Working in the new Triad paradigm requires team feedback and addressing challenges directly.

The regulator holds a central spot in the process because he or she has the authority granted by the populace to make final decisions. For example, the regulator is often driven by the greatest good for the greatest number, while the individual land owner is likely driven by protecting the health of his/her family as well as the value of the individual property.

4.3.1. Cautious Approach

Challenge: The regulatory review process is slow and resistant to new approaches.

> **Triad I Link**
> Changing the existing paradigm: Triad I, Section 1.2

Solution: By the nature of their position, regulators are forced into a critical and conservative mind-set. At times, whether intentional or in error, regulators are presented documents that do not accurately represent details of the facility. These documents cause the regulator to question the information and intentions of the facility, resulting in a more detailed time-consuming review. Open communication, developed through the systematic planning process of Triad, will build more trust and understanding between the project team members.

4.3.2. Management Support

Challenge: Skepticism toward Triad exists within the agency. Some agency leadership supports a Triad program, while others refuse to consider it.

> **Triad I Link**
> Triad approach to project management: Triad I, Section 2.2

Solution: All levels of management must eventually embrace Triad before a Triad program can be successful. In some situations, project managers and other middle-management staff may not be willing to devote the time necessary to learn how to conduct a Triad project, while in other situations senior management may present an obstacle. Many of these objections can be overcome through the implementation of a pilot Triad program with selected staff. To get the ball rolling, Triad projects should be assigned only to those staff members who are motivated and willing. Although Triad projects will require more up-front time, these projects will ultimately travel through the system faster.

4.3.3. Management Style

Challenge: Through training and experience, some regulators have developed a control style of project management. These regulators may demand to be involved in most or all aspects of the project.

> **Triad I Link**
> Triad approach to project management: Triad I, Section 2.4

Solution: Even though Triad assumes the project team will make many decisions in the field, the ultimate decision-making authority still resides with the regulator. Using Triad, the regulator, as part of the team, will be involved in these decisions as the project advances. This change in management style may be difficult for some agency staff, which is the primary reason why Triad is not recommended for all project managers. Care should be exercised when selecting the Triad team.

4.3.4. Regulatory Restrictions

Challenge: Some federal and state laws and regulations may specifically prohibit or limit the use of dynamic (flexible) work plans.

> **Triad I Link**
> Regulatory challenges: Triad I, Chapter 5

Solution: This issue is usually the consequence of internal policy and organizational structure rather than the effect of regulations. An explanation of Triad to management and/or legal staff can reduce the resistance to Triad and help initiate the changes within the organization to develop a Triad program. The best way to ensure flexibility is to build it into the rules and regulations.

4.3.5. Program Funding

Challenge: How can the agency fund both a Triad program and the traditional project management approach?

> **Triad I Link**
> Budgeting challenges: Triad I, Section 5.1

Solution: This issue is closely related to management support and cost considerations. Management, being responsible for the allocation of agency funds, must be supportive of the Triad approach. The degree of support will determine the level of the Triad program—full support of a complete Triad program or partial funding of a pilot Triad project. Once the benefits are understood, the funding objection will diminish. Also, resistance will be reduced with the realization that implementing Triad is largely dependent on reallocating some of the existing agency resources. Simple changes can demonstrate how the current phased approach to characterization and remediation obstructs creative approaches like Triad.

4.3.6 Education and Training

Challenge: How can you communicate a complicated technical concept like Triad to stakeholders such as the public, site owners, and insurers?

> **Triad I Link**
> Budgeting challenges: Triad I, Section 5.1.2

Solution: The most important component of Triad is clear and open communication. While traditional data generators have held cards close to the vest during the field effort, Triad is built on transparency. Getting used to this shift requires trust between responsible parties, technical teams, and stakeholders. The most difficult situation for a Triad project is when any of the above players do not accept the Triad approach. Work toward trust and transparency throughout the project.

4.3.7 Intensive Planning

Challenge: Development of a CSM will cost too much to justify its usefulness.

Triad I Link
Budgeting challenges: Triad I, Section 5.1.3

Solution: A common mistake of facility owners is the lack of understanding of the geologic setting of a site before remediation decisions are made. A key component of Triad is the development of a CSM during the systematic planning process. This tool will enhance the understanding of all team members and will aid communication. Overall, the development of the CSM takes less of the regulator's time than reviewing multiple work plans and data-gathering exercises performed over many years. If a Triad case team is formed with the client as part of the team, trust is developed, and suspicions are minimized.

4.3.8. Case Management

Challenge: Triad success depends on the capability and knowledge of each case manager. Triad will occupy the time of the best staff. Triad requires greater knowledge of chemistry, geology, and statistics than the conventional site remediation approach.

Solution: Triad does seem intimidating at first and does require the involvement of experienced staff members. Most project managers already have the skills necessary to manage a Triad project. In general, the more experience employees have using Triad, the less time they will spend on each individual case. Eventually, these skills can be taught to junior staff through a mentoring program.

4.4 Public and Tribal Stakeholder Challenges

4.4.1 Communication

Challenge: Communicating technical information to nontechnical stakeholders.

Triad I Link
Stakeholder communication: Triad I, Chapter 7

Solution: As stated earlier, clear and open communication is the most important component of Triad. Opportunity to interact with the regulator and technical experts provides a forum to address technical questions in a nonadversarial manner and establishes a foundation upon which trust, understanding, and transparency are built.

4.4.2 Decision Making

Challenge: How can the affected public and tribes participate in the decision-making process?

Solution: During the systematic planning stage representatives from the affected public and tribes are engaged as part of the decision team. In many Triad projects, a communication plan is written delineating how information will be disseminated to members of the decision team. The process of open and ongoing communication provides a mechanism for the public and tribal representatives to take part in project decision making.

5. SUMMARY

Triad, a new environmental project management approach, focuses on managing project decision uncertainties. The primary product of the Triad approach is an accurate CSM that can support decisions about exposure to contaminants, site cleanup and reuse, and long-term monitoring. Triad encourages strategy and the use of technology options that can lower project costs, while ensuring that the desired levels of environmental protection are achieved.

Changing a Paradigm

Changing the manner in which an organization does business is never easy.

The three components of Triad—systematic planning, dynamic work strategies, and real-time measurement technologies—are incorporated into one process to manage project uncertainties. Systematic planning involves the identification of unknowns (i.e., uncertainties) that could cause erroneous decisions and development of a process to communicate, document, and coordinate all project activities. Dynamic work strategies are designed around consensus-derived decision logic so that an experienced team, empowered with the flexibility to make quick decisions in the field, can quickly refine field activities as new information becomes available. Real-time measurement technologies involve the use of analysis and imaging tools to provide data that can be used to refine the CSM as field activities occur. These analysis, imaging, and data processing tools help ensure that the project goals are met.

The Triad approach offers many direct and indirect benefits to state agencies that implement it. These benefits create positive outcomes for the regulatory agency, regulated facility, and stakeholders. The most common direct benefits involve expedited completion of the field investigation and cleanup activities that are based on confident decisions generated from more reliable data. In short, the Triad approach creates better results than traditional environmental project management.

By implementing a Triad program, the project team and agency can expect more reliable data, generated in real or near-real time. With this information, the agency will be equipped to make better decisions with more confidence. The increased rate of data acquisition will reduce the overall time a facility is under investigation and will result in more efficient remediation with lower management costs. In addition, once a Triad program has been implemented, the agency can expect better communication within the organization due to the necessity for multidisciplined interactions to complete Triad projects.

The indirect benefits to an agency implementing Triad are less obvious, but potentially more rewarding. These benefits can be realized only after Triad has been implemented within an agency. Most notable is the enhanced communication and teamwork that occurs between the regulatory agency, regulated facility, and stakeholders as a result of the formation of a cohesive, multidisciplined team of professionals during the strategic planning stage of a Triad project. With a team approach, a better CSM and a more complete set of options and scenarios can be developed to guide project management decisions. The close working relationship between the regulator, facility, and stakeholder helps foster trust for future interactions.

The operational efficiency of the agency will also increase due to the involvement of various agency personnel from different units and sections within the agency with the multidisciplined team. The agency benefits further from the professional expertise of staff members developed from the completion of more projects. Finally, Triad will help the agency identify and implement new technologies in the environmental field. From an external perspective, the agency can enjoy enhanced public approval through the effective use of resources.

The Triad approach can be applied at almost any facility or project under most regulatory programs. Though most projects that use the Triad approach are complex and require multiple active team members, the same approach can also be utilized for smaller facilities.

This Document

This document is designed to help those who wish to implement Triad into their organization's regular business practice by providing what is needed to—

- Get ready
- Get started
- Do the job
- Follow up

Once a decision to implement Triad is made, an agency or organization must develop a strategy to facilitate the necessary changes within the agency. Before work on this program is started, those involved in its implementation must consider various aspects of the program. Some of these elements include whom to involve in the process, what the goals of the project are, the procedures that will be used to obtain and analyze the data, and communication of successful project completion with members of the staff and the public. Some suggested steps for implementation are discussed below.

Getting Ready

Identify the current inventory of remedial sites in your state that would best benefit from application of Triad and develop a clearly defined agency entry process for consultants wanting to use Triad on specific cases. Identify key analytical data collection techniques that are used in your state; if possible, incorporate them into your state's laboratory certification program. Develop data review and acceptance criteria to ensure that Triad results will be acceptable for site decisions.

Getting Started

The first step in the process of implementing a Triad program in an organization is to achieve management support. One avenue to accomplish this task is to write a cover letter to accompany ITRC's Triad I and Triad II documents and forward these to senior agency management for their concurrence. Follow up with a briefing of senior agency management and seek their oral and written endorsement of Triad. A Triad "champion" will need to be identified along with other staff within the agency who are willing to implement Triad. EPA and U.S. Geological Survey resources can be used to train staff on Triad principles. Conduct outreach programs for consultants and industry about Triad.

Doing the Job

Having completed the background stages of implementing a Triad program, the next stage is to physically complete the planning and field activities. To successfully accomplish these tasks, apportion Triad cases to only Triad-trained case managers. Develop a contact list for Triad case managers to provide a ready response if/when questions arise. Manage an internal "peer group" of Triad case managers so they can share experiences. Perform document project management activities; have Triad case managers document time and cost factors for Triad cases. This can be easily accomplished by following documentation procedures similar to traditional remedial projects.

Following Up

A key aspect of a successfully implemented Triad program is communication. Therefore, hold frequent internal and external meetings and presentations to discuss progress on Triad cases and promote Triad success stories. Encourage Triad staff to participate in national Triad activities such as EPA and U.S. Geological Survey working groups; Triad Community of Practice; and ITRC's Sampling, Characterization, and Monitoring Team. Follow up with continual updates to senior agency management on Triad progress. Also, identify additional staff that might be interested in becoming involved with Triad.

6. REFERENCES

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Walsh, J. T. 1997. "The Evolving Standards of Admissibility of Scientific Evidence," *Judges Journal* **36(**3): 33.

Online Resources

http://clu-in.org

http://triadcentral.org

APPENDIX A

Example Agendas, Memos, and Justifications for Triad Implementation

EXAMPLE AGENDA
Two-Day Triad Orientation for Internal Staff
May 13–14, 2003

Location:

Tuesday, May 13, 2003

8:00–8:30 am	**Registration and Continental Breakfast**
8:30–8:45 am	**Welcome and Introductions** • Assistant Commissioner • Director, Division of Remediation • Remediation Technology Manager
8:45–9:15 am	EPA Speaker: **Triad as a Framework to Manage Decision Uncertainty**
9:15–0:00 am	Corps of Engineers Speaker: **Overview of Triad Mechanics**
10:00–10:15 am	Break
10:15–11:00 am	EPA Speaker: **Updating the Data Quality Model**
11:00–11:30 am	Video Tape: **Hanscom Air Force Base Dynamic Work Plan**
11:30–12:30 pm	Lunch (provided)
12:30–1:15 pm	EPA Speaker: **Systematic Planning: Prerequisite for Dynamic Work** University Speaker: **Plan Strategies and Data Collection**
1:15–2:00 pm	State Agency Speaker: **Regulatory Oversight Issues and Guidance Manual**
2:00–2:15 pm	Break
2:15–4:00 pm	Consultant and Lab Representative Speakers: **Case Study—Applying the Triad Approach at the Assunpink Creek Greenways Project**

Wednesday, May 14, 2003

8:00–8:30 am	Continental Breakfast
8:30–8:45 am	EPA Speaker: **Review Questions from Day 1**
8:45–9:45 am	EPA Speaker: **General Considerations When Using Field Methods**

9:45–10:00 am	Break
10:00–10:40 am	Consultant Speaker: **Use of Triad at Brownfield Sites—The Consultant's Perspective**
10:40–11:00 am	State Agency Speaker: **The State's Experience Using Field Analytical Methods**
11:00–11:20 am	State Agency Speaker: **Triad and ITRC—National Focus**
11:20–11:30 am	Question and Answer Period
11:30–12:30 pm	Lunch

FIELD ANALYTICAL METHODS—CASE STUDIES AND LESSONS LEARNED

12:30–12:45 pm	Corps of Engineers Speaker: **Introduction**
12:45–1:15 pm	Consultant: **Direct Sampling Ion-Trap Mass Spectrometry**
1:15–1:45 pm	Vendor Speaker: **Brownfields and Site Investigations with XRF Portable Analyzers**
1:45–2:00 pm	Break
2:00–2:30 pm	Vendor Speaker: **Direct Sensing Field Measurements and Data Management**
2:30–3:00 pm	Vendor Speakers: **The Power of Immunoassay**
3:00–4:00 pm	Panel of Hurley Case Manager and others as suggested by attendees: **Interactive Discussion of Potential Triad Sites**

EXAMPLE AGENDA
Short Triad Awareness Seminar for Internal Management
August 14, 2003

2:00–2:10 pm	**Welcome and Introduction** State Agency Personnel
2:10–3:00 pm	**Triad—Managing Decision Uncertainty** EPA Speaker
3:00–3:40 pm	**Technical Rules Issues and Overview of State Triad Guidance** State Agency Speaker
3:40–4:00 pm	**Overview of Real-Time Measurement Technologies** Consultant Speaker
4:00–4:30 pm	**Case Study—Local Project** University Speaker
4:30 pm	**Questions and Wrap-up** State Agency Speaker

EXAMPLE AGENDA
One-Day Triad Orientation for Consultants
May 26, 2004

8:30 am	**Registration** (and continental breakfast)
9:00 am	**Welcome and Introductions** Director, Division of Remediation Remediation Technology Manager
9:15 am	**Triad Overview** State Agency Speaker
9:45 am	**Strategic Planning for Complex Triad Projects** State Agency Speaker
10:15 am	Break
10:30 am	**Dynamic Work Strategy at the Milltown Site** University Speaker
11:10 am	**Technical Rules Issues** State Agency Speakers
11:45 am	Lunch (on your own)
1:00 pm	**Real-Time Measurement Methods Applicability** Mobile Laboratory Speaker
1:30 pm	**Field Analytical Methods Certification** State Agency Speaker
2:00 pm	**Portable GC/MS for Site Investigation** Vendor Speaker
2:45 pm	**Membrane Interface Probe Technology Demonstration** Vendor Speaker
3:30 pm	**Wrap-up** State Agency Speaker

EXAMPLE AGENDA
One-Day Introduction to Triad for Regulators, Consultants, Site Owners, Vendors, and Community Stakeholders
May 26, 2005

8:30 am	**Registration**
9:00 am	**Welcome and Introductions** *State Agency Speaker* *Executive Director, Professional Association* *Director, Division of Remediation*
9:15 am	**Triad Overview** *State Agency Speaker*
9:45 am	**Strategic Planning for Complex Triad Projects** *State Agency Speaker*
10:15 am	**Break**
10:30 am	**Dynamic Work Strategies for Triad** *University Speaker*
11:10 am	**Real-Time Measurement Methods Applicability** *Mobile Laboratory Speaker*
11:45 am	**Lunch**
1:00 pm	**Data Management Using Scribe** *EPA Speaker*
1:30 pm	**Field Analytical Methods Certification** *State Agency Speaker*
2:00 pm	**Portable GC/MS for Site Investigation** *Vendor Speaker*
2:30 pm	**Membrane Interface Probe Technology and Data Visualization** *Vendor Speaker*
3:15 pm	**Wrap-up**

EXAMPLE MEMO TO ENCOURAGE TRIAD ADOPTION INTERNALLY

From: Division Director
To: Subgroups
Date: 2/25/04 10:49 AM
Subject: Triad Approach

To All:

As most of you know, the Department has been promoting the use of Triad to increase the confidence in site characterization data and to expedite the remediation process at contaminated sites. We have conducted several training sessions on the Triad approach for staff and consultants, and we have set up a Triad resource page on the Web that contains our policy statement supporting Triad, our draft guidance document, and links to EPA resources.

Where applicable, please encourage the use of the Triad approach at your sites. We are seeking volunteers to participate on case teams that will handle Triad cases that come into the various programs. We already have case team members who are experienced in using Triad (see attached list) that may be available as a member of your team.

In addition, we are exploring adding language to NJDEP letters that accompany memorandum of understanding applications, initial notice letters, work plan review letters, etc. encouraging the use of the Triad approach. We are also considering offering Triad orientation sessions to responsible parties and developers who are interested in finding out more about Triad might work for their site.

If you need more information about Triad, please contact (local agency contact) who will assist you.

Division Director

EXAMPLE CERTIFICATION PROGRAM FOR FIELD ANALYTICAL METHODS

Addition of Field Analytical Methods to the New Jersey Environmental Laboratory Certification Program

The New Jersey Department of Environmental Protection (NJDEP) is committed to streamlining the site investigation and remediation process at contaminated properties without compromising data quality and reliability. The Triad approach integrates systematic planning, dynamic work plan strategies, and real-time measurement techniques. It recognizes and seeks to manage the uncertainties involved in generating representative analytical data obtained from heterogeneous environmental matrices. Field analytical methods are a subset of real-time measurement techniques. The use of the techniques can result in more time- and cost-effective site characterization and cleanup.

The NJDEP has evaluated the Technical Requirements for Site Remediation, N.J.A.C. 7:26E, and has determined that the concepts embodied in the Triad approach can be implemented within the framework of this rule. Furthermore, the NJDEP's Office of Quality Assurance (OQA) has the authority to certify real-time measurement techniques performed in the field using the authority granted at N.J.A.C 7:18, "Regulations Governing the Certification of Laboratories and Environmental Measurements."

Effective January 1, 2004, the NJDEP added the following analytical techniques to its Environmental Laboratory Certification Program to support real-time measurements being performed on behalf of the NJDEP:

- Field immunoassay
- Field gas chromatography
- Field gas chromatography–mass spectrometry
- Field x-ray fluorescence spectroscopy

Examples of each of these real-time measurement methods can be found in the U.S. Environmental Protection Agency's *Test Methods for Evaluating Solid Waste Physical/Chemical Methods* (also known as SW-846).

The NJDEP currently offers certification for the real-time measurement methods listed in USEPA SW846 for immunoassay, gas chromatography, gas chromatography–mass spectrometry or x-ray fluorescence, or for standard operating procedures (SOPs) for these types of real-time measurements that are specific to the practices of each business entity. Additionally, the NJDEP may add additional categories of real-time measurements to the laboratory certification program in the future.

These real-time measurement methods will support the use of the Triad process for sites undergoing investigation and remediation within the Site Remediation and Waste Management Program, as well as other remedial activities being conducted on behalf of the Department.

All business entities (i.e. corporation, engineering firm, environmental firm, laboratory) performing these real-time measurements must be granted New Jersey environmental laboratory certification using the rules at N.J.A.C. 7:18, “Regulations Governing the Certification of Laboratories and Environmental Measurements.” The NJDEP has initiated the following plan to implement the addition of these analytical methods.

1. Effective immediately, the OQA is accepting applications for certification.
2. By April 1, 2004, the NJDEP will inform all applicants of the requirements necessary for certification. These will include at least a detailed SOP containing information on method detection limits, dynamic range, precision, accuracy, calibration, quality assurance, and other operational procedures used by each business entity to generate these real time measurement data.
3. By July 1, 2004, only business entities that have submitted an application and SOP, approved in writing by the OQA, will be eligible for certification by January 1, 2005.
4. Effective January 1, 2005, only business entities that have received NJ environmental laboratory certification can use these real-time measurement methods for regulatory decision-making purposes

As part of the application approach, documentation is required to demonstrate that personnel performing real-time measurements have the same education and experience as those performing similar laboratory-based analyses (see N.J.A.C. 7:18-2.10). On-site audits to evaluate the use of real time measurements may also be conducted prior to the issuance of certification.

APPENDIX B

Additional Background on Legal Defensibility

ADDITIONAL BACKGROUND ON LEGAL DEFENSIBILITY

Note: The following article is available online at
http://www.hanford.gov/dqo/training/appendix/pdfs/UsingFieldMethods.pdf

Using Field Methods—Experiences and Lessons: Defensibility of Field Data

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Summary

One perceived obstacle to the use of field methods is the legal defensibility of field data. The standards which are used by the courts are quite different than the standards used in the environmental testing community. The rules on the acceptability of scientific evidence are different in federal courts than in some state courts. The federal rules were changed significantly by the *Daubert v. Merrell-Dow* decision handed down by the U.S. Supreme Court in 1993. In that decision, the Supreme Court gave judges considerable latitude to decide what evidence was relevant and reliable. California, on the other hand, still uses a standard based on "techniques that are generally accepted by the scientific community." Neither the federal nor California standards for admissibility distinguish between analysis done in a fixed laboratory and analysis done in the field. Nor do the standards require adherence to methods approved by U.S. EPA or other standard-setting organizations. In one California case, *People v. Hale,* there were major deviations from the relevant EPA method, but an appeals court found that the deviations were harmless and allowed the data to be used. In order for data to be accepted as evidence, whether the data come from a fixed laboratory or the field, the technique may need to generally be recognized in the scientific community (state standard), and must be shown to be relevant and reliable (federal standard). Once evidence has been accepted, the weight that is given to the evidence may depend on a variety of factors, including the training and experience of the personnel, the accuracy of the equipment, and the reliability of the method. The rules for the defensibility of field methods are no different than those for fixed laboratory methods.

Introduction

A real obstacle to the wider use of field methods is the perception that field data are legally less defensible than fixed laboratory data. To actually examine this perception, it is necessary to examine the actual legal standards which are used for scientific data. Although environmental scientists have their own standards for analysis, the actual standards for the legal defensibility of scientific data involves the interaction of science and law. The courts have made significant changes in recent years to the rules for scientific evidence, which reached a climax with the U.S. Supreme Court opinion in the case of *Daubert v. Merrell Dow Pharmaceuticals*.

Federal Rules for Scientific Data

First, we must realize that the rules for scientific data may be different in federal courts than in state courts. This, however, does not necessarily pose an insurmountable problem. The federal rules changed in 1993 when the U.S. Supreme Court issued an opinion in the case of *Daubert v. Merrell Dow Pharmaceuticals*. Although the case involved allegations that a drug, Bendectin, caused birth deformities, the ruling had a broad application because it abandoned an earlier standard, based on *Frye v. United States.* In its 1993 *Daubert* ruling, the court established a more flexible and liberal test of admissibility of scientific evidence. The Supreme Court received a considerable number of briefs from scientific organizations, and this is reflected in their opinion, which even dealt with the definition of science. "...under the Rules the trial judge must ensure that any and all scientific testimony or evidence admitted is not only relevant, but reliable" *(Daubert v. Merrell Dow Pharmaceuticals,* 4827). Readers who are interested in a thorough examination of the *Daubert* ruling may want to look at Foster and Huber's book, *Judging Science*. The question of what constitutes reliable scientific evidence is still subject to debate, but the impact of the Court's ruling was to give the judge considerable flexibility in deciding that question in a particular case.

State Rules for Scientific Data

Unlike the federal courts, California courts still maintain a standard based on "general acceptance" in the relevant scientific community (*People v. Kelly,* 1976). The three "prongs" of this standard are:

1) The scientific test's reliability must be established by its general acceptance in the relevant scientific community;
2) The testifying witness must be properly qualified; and
3) The proponent of the evidence must demonstrate that the correct scientific procedures were used.

Again, none of these standards would distinguish field methods from fixed laboratory methods. They also should not pose a significant barrier, with the exception of a "black box," which may operate using principles that have not been accepted in the scientific community.

Case Histories

People v. Hale, 1994*:* The first line of this California Appellate Court ruling reads: "SW-846 is not the name of some new gasoline additive marketed by an oil company. It is the title of a manual compiled by the United States Protection Agency (EPA) dealing with the collection and testing of hazardous waste." The case involved illegal dumping of 1,1,1-trichloroethane into waste dumpsters. The appeal focused on major deviations from SW-846: no sampling plan was used, the lab had used Method 8015 (using a flame-ionization detector) instead of the accepted methods 8010 or 8240; the samples were frozen instead of cooling to 4EC; and the 14-day holding time was exceeded. The court held that the deviations were harmless. "We discern no per se rule which does automatically precludes the introduction of evidence of disposal of hazardous waste just because the gathering of the sample does not follow every jot and tittle of the EPA manual."

People v. K&L Plating, 1997*:* Although this is not a case published by an appellate court, this case involved the use of field methods. This was a manslaughter case, in which a worker died after rescuing another worker who was cleaning out sludge in a waste treatment tank. The prosecution used results from a Draeger tube testing of head space in a jar of sludge and a hydrogen cyanide monitor as evidence that hazardous levels of hydrogen cyanide were emitted from the waste. The defense challenged the reliability of all of the data. Review of validation of the Draeger tube showed that a lower estimate of HCN concentration could be calculated even though the tube changed color on one stroke instead of the required ten strokes. The HCN monitor, the prosecution argued, used an accepted principle and provided an expert witness to support the data. The defendant pled guilty.

People v. Sangani, 1994: This case involved illegal disposal of hazardous waste into a sewer system. The defendant was convicted, but appealed, in part, because the lab which did the analysis was not certified by the California Department of Toxic Substances Control. The Appellate Court found that even if the Hazardous Waste Control Law required the use of an accredited lab, the data would be admissible. "Failure to follow precise regulatory or statutory requirements for laboratory tests generally does not render the test results inadmissible, provided the foundational requirements for establishing the reliability of the tests are met. The necessary foundational requirements are:
1) the testing apparatus is in proper working order;
2) the test was properly administered; and
3) the operator was competent and qualified." (*People v. Sangani*, p. 1276)

People v. Adams: In what has been described as an explanation of the general rule of evidence in California, the court found: "Where a statute ...does not specifically provide that evidence shall be excluded for failure to comply with said statute...such evidence is not inadmissible. Statutory compliance or noncompliance goes to the weight of the evidence" (*People v. Adams*, 567).

The Application of Rules of Evidence

The legal cases which established rules of evidence were primarily created to deal with new scientific techniques, e.g., a crude predecessor to the lie detector, or to distinguish real science from "junk science." The examples of rules for admissibility of evidence given in the examples above should pose little problem for a validated technology which is operated correctly by a trained operator.

Conclusion

The rules on the legal defensibility of scientific data do not distinguish between measurements made in the field and measurements made in the laboratory. The rules used by the courts are very different than those established in regulation. In particular, courts have found that evidence may be reliable even if there were major deviations from methods specified in regulation, or if the analysis was done in a non-accredited laboratory, even if accreditation were required by regulation. As to the weight which is put to evidence, the validation of the method and the quality system documentation are certainly relevant.

Reference List

Foster, K. R., and P. W. Huber. 1997. *Judging Science: Scientific Knowledge and the Federal Courts.* MIT Press.

People v. Adams, 59 Cal. App. 3rd 567 (1976).

People v. Hale, 29 Cal. App. 4th 730 (1994).

People v. Kelley, 17 Cal. 3rd 14 (1976).

People v. Sangani, 94 C.D.O.S. 1273 (1994).

U.S. EPA Office of Solid Waste, *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*.

Appendix C

Budget and Procurement Considerations

BUDGET AND PROCUREMENT CONSIDERATIONS

C.1 Cost Estimation for Triad

Unknown factors abound for hazardous waste site cleanup programs. The complete list of contaminants of concern, volumes of affected media, effectiveness of a proposed remedial action, and/or duration of cleanup activities may be unknown. These unknowns complicate cost estimation and the procurement of characterization and remediation services.

Historically, the process for addressing these issues has been to keep individual project activities fixed and well defined. However, no limit is placed on the number of activities that would ultimately be required to bring about site closure. With this model, short-term costs and schedules are well understood, but life-cycle costs and time lines are unknown.

Triad flips this model around. Project uncertainties are identified by the systematic planning process and are often addressed during ongoing activities. The scope of activities reflects the changes in conditions as they are encountered, keeping work efficient and effective. Triad results in shortened project time lines and reduced life-cycle costs but also greater up-front costs and exposure of project uncertainties. Consequently, Triad-specific cost estimation and procurement needs must be addressed for successful deployment of a Triad project.

Cost estimation in support of Triad programs can produce best estimates of expected costs, just as a more traditional approach can. However, Triad cost estimation can also provide upper bounds on what the potential costs might be for proposed activities. The CSM is the foundation for “best estimate” cost numbers for all site-related characterization and remediation activities. Further, a cost estimate’s upper limits are based on the uncertainty analysis presented in the CSM. Any uncertainty in the CSM contributes to uncertainty in cost estimation. For example, an excavation at a site to address soil contamination estimates that 5,000 cubic yards of soil will require removal to meet cleanup objectives. However, an analysis of the uncertainty associated with those volume estimates might determine that the removal of as much as 30,000 cubic yards of soil could be required to complete the task.

Triad-based cost estimation is best done through a process called “unitized project costing,” which identifies costs for logical units of effort (e.g., the per foot cost of direct-push sample collection or the per acre cost of nonintrusive geophysical surveys). In addition, elemental unit cost estimates (e.g., per sample collection or analytical costs) can be aggregated. Costs may be unitized by time (costs for a mobile laboratory per day), by function (costs per sample), or by activity (costs per cubic yard of soil that is identified for remediation, excavated, shipped, and disposed).

Other factors important to consider for Triad cost estimation include calculating the costs associated with real-time measurement systems. Field-deployable, real-time measurement systems typically are cheaper on a per analysis basis than their standard, fixed-laboratory counterparts. However, care must be taken in the cost estimation process to obtain accurate unitized estimates. Factors to consider include the following:

- *QA/QC Requirements*: Field-deployable method expenditures are usually estimated on a time basis, with per sample costs dependent on output. The level of required analytical QA/QC should be identified and factored into the cost estimation process.

- *Demonstration of Method Capability*: Field analytical methods may need a demonstration of method applicability at a site. Such additional costs are more common with the Triad than with a traditional approach. These expenses need to be included in the cost estimation process when considering alternative real-time measurement techniques.

At times, the Triad approach can result in higher initial costs due to the systematic planning process and technology acceptance demonstrations. However, with application of this approach, hazardous waste site characterization and remediation is expected to result in significantly lower life-cycle project costs, compressed schedules, and improved decision making.

C.2 Hiring a Competent Triad Consultant

There are five basic steps to hiring a competent Triad consultant:

- Outline the scope of work.
- Contact several different companies to request proposals.
- Interview more than one company.
- Learn exactly who will work on a project.
- Review past performance (always check references)!

Each of these steps is explained in more detail below.

C.2.1 Outline the Scope of Work

Understanding the specific reasons why site work is needed is critical. Is investigation needed to gather information for a real estate transaction? Is a buyer concerned with liability or a seller preparing the property for sale? Does the nature and extent of a previously identified release of contamination need to be defined? In any event, understand the reasons why a level of effort is needed.

Next, the project team needs to outline the scope of work the consultant is to perform. Is the consultant to assist in the entire process from investigation through cleanup, or is the scope limited to a particular phase of the project? The project team should also recognize that some companies specialize in certain aspects of environmental work. For example, some firms specialize in underground storage tanks (USTs) site investigations. Others specialize in investigating releases from industrial operations, and still others specialize in cleanup with a particular technology. For these reasons, clearly stating the purpose of the project and establishing a functional scope of work is critical to selecting the appropriate contractor.

C.2.2 Contact Several Companies to Request Proposals

Once the needs of the site are identified, the proposal evaluators should contact several firms. Recommendations for firms to contact can come from various sources:

- trade organizations and/or professional associations
- other companies in the environmental industry
- legal counsel, insurance firms, or mortgage lenders

The process for submission of proposals to government agencies may be more involved. For example, the federal government request for proposal (RFP) format and composition are mandated by the Federal Acquisition Regulations. RFPs are typically broken down into sections that are identified by letter. The table in Section C.3 lists and describes typical RFP categories.

Essentially, request a <u>written</u> proposal from several companies. Be sure to obtain written proposals from at least three companies.

C.2.3 Interview More Than One Company

After the proposals are received (get at least three!), choose at least two companies to interview. They should be firms that have provided professional, competitively priced proposals, and presented a clear understanding of Triad, the project, and requirements. Before selecting a firm to contract with, the project manager or management team should conduct interviews. Discussing the following issues might be helpful:

- Approach—What they propose to do and why
- Cost—What is included in it and what is not and how additional work would be handled
- Personnel—Who will work on your project, and who is the project manager responsible for the work
- Experience—What is the project manager's experience with working on sites and also on sites with similar issues
- Reporting—How the company makes sure that reports are well written and organized and technically correct
- Legal—How the company keeps up with state and federal regulations, policy, and guidance
- Training—How the firm trains its junior staff
- Specialty—What services the firm offers that make it stand out from other consultants, why it should be hired rather than another

C.2.4 Know Who Will Work on Your Project

The skills and experience of the individuals assigned can greatly impact the success of the project. Before hiring the firm, identify the personnel that will work on the project (including who will review the reports generated by less experienced staff) and make sure that they are available to complete the project in a timely manner. Also—

- Look at the training and experience of each of the key people who will be involved. Make sure they have worked on similar sites and have a thorough knowledge of all regulatory requirements.
- Ask for resumes. Check for professional licenses such as Professional Engineer (P.E.) and Certified Professional Geologist (C.P.G.).
- Ask for references from former clients.

C.2.5 Review Past Performance—Always Check References!

Contact at least two former clients and ask about the scope and nature of the services provided and whether they were satisfied with the work performed. Questions to consider:

- Was the consultant timely in completing all elements of the work?
- Were the final project costs relatively consistent with the original estimate?
- Did the scope of work change a lot during the project? If so, why?
- Did the consultant work effectively with the client and the case manager?
- Were reports well written and technically correct?
- Were submitted documents initially approved by regulatory staff, or was it necessary to resubmit information? If they needed to resubmit, was it a little or a lot of information?
- How many times did the consultant have to mobilize to the site to gather additional information?
- Did the personnel that worked on the project change over time? If so, was the change handled satisfactorily?

C.3 Procurement and Triad

There is a strong connection between the RFP and the systematic planning process, dynamic work strategies, and communication of contingency plan requirements. Examples of details that may be important include QA/QC requirements and the qualifications of essential personnel. The following table lists and describes typical government RFP categories.

Typical RFP Categories
Section A. Information to Offerors or Quoters Identifies the title of the procurement, procurement number, point of contact, how to acknowledge amendments, and how to indicate "No Response." Section A often appears as a one-page form.
Section B. Supplies or Services and Price/Costs Defines the type of contract, identifies Contract Line Items, and Subcontract Line Items that identify billable items, describes the period of performance, identifies option periods, and provides cost and pricing guidelines. This section is often presented and responded to in tabular form.
Section C. Statement of Work Describes what the government wants done or supplied. Sometimes this section is contained in a separate appendix. Section C is frequently associated with other appendices that contain other details to enable the bidder to understand the nature and scope of the tasks requested.
Section D. Packages and Marking Defines how all contract deliverables such as reports and material will be packaged and shipped. This information is important as these instructions may effect costs and raise logistics issues.
Section E. Inspection and Acceptance Describes the process by which the government will officially accept deliverables and what to do if the work is not accepted. This can also affect costs and identifies tasks the bidder must be prepared to undertake.

Section F. Deliveries or Performance Defines how the Government Contracting Officer will control the work performed and how certain contract items will be delivered.
Section G. Contract Administrative Data Describes how the Government Contracting Officer and the firm will interact and how information will be exchanged in administration of the contract to ensure both performance and prompt payment.
Section H. Special Contract Requirements Contains a range of special contract requirements important to this particular procurement, such as procedures for managing changes to the original terms of the contract, government-furnished equipment requirements, and government-furnished property requirements.
Section I. Contract Clauses/General Provisions Identifies the contract clauses incorporated by reference in the RFP. These clauses will be incorporated into the contract. While it doesn't require a separate response, its terms will be binding.
Section J. Attachments, Exhibits Lists the appendices to the RFP. These attachments can cover a wide range of subjects ranging from technical specifications through lists of government-furnished equipment. It generally is used to provide data needed to respond to the statement of work.
Section K. Representations/Certifications and Statements of Offerors Contains things that the bidder must certify to bid on this contract. These can include things such as certification that the firm has acted according to procurement integrity regulations, taxpayer identification, the status of personnel, ownership of the firm, type of business organization, authorized negotiators, that the firm complies with affirmative action guidelines, whether the firm qualifies as a small business, disadvantaged business, and/or women owned business, etc.
Section L. Proposal Preparation Instructions and Other Provides instructions for preparing the proposal. These include any formatting requirements; how the material should be organized/outlined; how to submit questions regarding the RFP or procurement; how the proposal is to be delivered; and sometimes notices, conditions, or other instructions.
Section M. Evaluation Criteria Defines the factor, subfactors, and elements used to "grade" the proposal. Proposals are graded, and then cost is considered to determine who wins the award and gets the contract.

A prequalification process can be used to establish unitized costs, simplify site-specific RFP development, and still guarantee a sufficient level of competition in the RFP process. The Florida Department of Environmental Protection's dry cleaning program (www.dep.state.fl.us/waste/categories/drycleaning/default.htm) is an excellent example of the use of basic ordering agreements, unitized cost estimation, and fixed-price contracting mechanisms for implementing Triad-based cleanup activities.

When evaluating proposal responses for Triad-related work, remember the following:

- An RFP may specify performance characteristics desired but not specific technologies. Care must be taken when comparing costs for different analytical techniques in this setting since technical performance characteristics (e.g., turnaround time, analytical quality, etc.) will not be identical.

- Particular attention must be paid to the level of QA/QC proposed and its relationship to analytical performance and cost estimates. This is especially true if QA/QC requirements are not spelled out in detail in the RFP statement of work but are left open for the respondent to propose.

- Successful Triad activities require appropriate expertise. Proposal evaluators should also look carefully for evidence of prior experience with the proposed technologies. Many innovative analytical technologies are not commodity products and require proper expertise for successful implementation.

C.4 Insurance and Funding/Reimbursement Considerations

Federal and state governments have instituted environmental liability regulations in response to public demand. Consequently, many industries have become exposed to increased environmental liability and potential financial losses. Today, some industries realize they must protect themselves with environmental liability insurance. A limited number of environmental liability insurance policies exist. Some policies cover the following:

- Site owners and operators—Provides coverage for third-party claims as a result of a pollution event on, at, under, or coming from a covered location

- Lenders—Provides collateral environmental liability protection for lenders of real estate, leaseholds, or fixed assets

- Borrowers—Provides commercial real estate borrowers with an environmental liability policy for transferring risk to a financially secure company

- Contractors—Provides environmental liability coverage for acts, errors, or omissions committed during the rendering of professional services

Greater data density equals more accurate contaminant information, possibly translating to an environmental insurance cost savings. As stated by AIG Environmental, "Placement of cost overrun coverage is based upon a site that has been well-characterized, remedial objectives that have been determined, and a remedial action plan that has been developed and approved by the appropriate regulatory agencies." (www.environews.com/Features/managing_risk.htm)

Before starting a Triad project, research should be conducted on the Triad's affect on reimbursement from funding sources. Some UST, brownfields, or dry cleaner reimbursement programs may not oblige the Triad's condensed work schedule. Additionally, some state reimbursement regulations may not allow the use of new technology. Barring these obstacles, Triad is expected to reduce life-cycle project costs and reduce environmental liability.

APPENDIX D

Data Acceptability Considerations

DATA ACCEPTABILITY CONSIDERATIONS

Many individuals and regulatory officials believe that good, defensible, reliable data are data generated by certified laboratories. One strategy to gain credibility for real-time measurements is to include them in state laboratory certification programs. Those analytical methods that are in greatest use in your state and that have the longest history of application should be selected for certification.

One successful program for the certification of real-time measurements has been implemented by the New Jersey Department of Environmental Protection. A memorandum used by the NJDEP to authorize certification of real-time analytical measurements is included in Appendix A.

The Triad Implementation Team must emphasize repeatedly to everyone concerned that all measurements taken as part of a Triad investigation must have "appropriate" QA/QC measures associated with them. While the amount and extent of QA/QC data collected in the field may not be the same as in traditional SW-846 methods, the level of QA/QC must always be commensurate with ensuring the successful achievement of predetermined data quality objectives.

An additional component to gain acceptance of data generated by real-time measurements is to require laboratory certification for such measurements in three important areas:

- Quality Assurance Project Plans and other work plans that precede the development of a Triad project CSM
- Regulations or policies that govern the use of environmental data
- Regulations or policies that describe procedures for remedial activities

Mobile Laboratories vs. Data Collected in the Field

With smaller, more rugged, and therefore more portable analytical instrumentation, mobile laboratories today are considered equivalent to fixed facilities with respect to the quality of analytical data they can provide. Many laboratory organizations, including NJDEP's Office of Quality Assurance, certify mobile laboratories to conduct regulatory methods, including those specified in SW-846 for inorganic and organic parameters. In this context, mobile and fixed laboratories can be considered to equivalent.

What mobile facilities can offer that fixed laboratories cannot is the additional capability of performing in situ analyses using test kits or instrumentation that may or may not parallel published analytical methodologies. These data, often referred to as "field" or "real-time" measurements, are used to make quick decisions regarding site conditions, do not need certification by a regulatory agency, and cannot be used as stand-alone information to support a final site decision. Real-time measurements are discussed in Section 4.2 of this document.

Laboratory Certification Issues

Many regulators believe that the only good data are those generated by certified laboratories. One effective strategy to gaining credibility for real-time measurements is to include them in state laboratory certification programs. Select for certification those analytical methods that are in greatest use in your state and have the longest history of application.

A successful program for certification of real-time measurements has been implemented by the NJDEP. A memorandum used by the NJDEP to authorize certification of real-time analytical measurements is included in Appendix A.

The Triad Implementation Team must emphasize over and over again to everyone concerned that all measurements taken as part of a Triad investigation will have “appropriate” QA/QC associated with them. While the amount and extent of QA/QC for field analytical methods may not be the same as in traditional SW-846 methods, the level of QA/QC must always be commensurate with ensuring the successful achievement of the predetermined data quality objectives.

QA/QC

The extent of QA/QC performed must match the data quality objectives.

Real-Time Data Measurement Issues

An additional component to gain acceptance of data generated by real-time measurements is to require certification for such measurements in three important areas:

- Quality Assurance Project Plans and other work plans that precede the development of a Triad project CSM
- Regulations or policies that govern the use of environmental data
- Regulations or policies that describe procedures for remedial activities

Federal and state environmental agencies have regulatory infrastructures that accept only data obtained from the analysis of discrete samples performed by regulatorily approved analytical methods in certified laboratories.

The nature of the Triad paradigm (collection of data in the field in real or near-real time, often by measurement systems that provide a continuous, voluminous stream of data) challenges existing policies and regulations, especially with regard to the quality assurance of such information streams. One cannot apply the same QA practices to data obtained from a membrane interface probe (MIP) probe from a direct-push well installation that generates thousands of data points per day in the same way that one does with a traditional well installation, where samples are obtained on a regular schedule for transport to a laboratory that may take weeks to report individual results.

For Triad to work effectively, federal and state environmental agencies must realize that the data collection process for a Triad project is different from that for a conventional project and must be dealt with differently. Based on the model provided by the NJDEP, the following changes regarding data management must be made:

- Certify Triad data generators.

- Provide instrument- and project-specific guidance on assessments of data quality.
- Agree during CSM development on what are and what are not data that will be used for definitive site decisions.
- Codify Triad decision making in federal and state remedial regulations.

As with other aspects of Triad implementation, a key factor is educating staff and management that a different approach to data management and quality assurance is needed.

Another aspect of the management of Triad data is the issue of data storage and visualization. Federal and state regulatory agencies must ensure that their data management systems, including geographic information systems, can accommodate the large amounts of information inherent in a Triad project.

Appendix E

Risk Assessment Considerations

RISK ASSESSMENT CONSIDERATIONS

The three components of Triad—systematic planning, dynamic work strategies, and real-time measurement technologies—are ideally suited for the risk assessment and management process. Risk assessors are an important part of the project team, particularly during the systematic planning phase, when the data needs and requirements are being selected. The information that risk assessors use in risk management is the same information as that used in the development of the CSM, site characterization and sampling plans, and the selection of real-time measurement technologies for site characterization, even through site remediation.

The Triad process for managing uncertainty and the risk assessment process for risk management are not significantly different. The following list demonstrates the similar components of Triad and risk management in environmental decision making:

- multidisciplinary decision-making teams
- sampling plans designed for specific project outcomes
- site characterization
- legal and technical defensibility
- socioeconomic considerations
- data collection designed to a known analytical and sampling confidence
- minimizing and managing uncertainty
- public and tribal acceptance
- accurate and iterative CSMs
- regulator partnering
- more correct data producing methods

Risk Management vs. Risk Assessment

Risk assessments evaluate the hazardous properties of environmental agents, the dose-response relationship, and the extent of human exposure to those agents. A risk assessment results in a statement regarding the probability that populations or individuals so exposed will be harmed and to what degree. Risk management uses risk assessments (risk measurement) to develop strategies to address (manage) the identified risk. Risk management is a decision-making process that accounts for political, social, economic, and engineering implications together with risk-specific information to develop, analyze, and compare management options and select the appropriate managerial response to a potential chronic health hazard (*Glossary of IRIS Terms, Integrated Risk Information System*, U. S. Environmental Protection Agency, December 2005).

The most common basic definition of risk assessment used within EPA is paraphrased from the 1983 report *Risk Assessment in the Federal Government: Managing the Process* by the National Academy of Sciences' National Research Council:

> Risk Assessment is a process in which information is analyzed to determine if an environmental hazard might cause harm to exposed persons and ecosystems.

This process is highly interdisciplinary in that it draws from such diverse fields as biology, toxicology, ecology, engineering, geology, statistics, and the social sciences to create a national framework for evaluating environmental hazards. EPA uses risk assessment as the tool to integrate exposure and health effects or ecological effects information into a characterization of the potential for health hazards in humans or other hazards to our environment (EPA/100/B-04-001, March 2004).

Triad draws on the same principles as risk management, including risk assessments, to define and address project uncertainties.

Risk Assessment in Environmental Decision Making

Risk assessments are built on credible science to make and support risk management decisions, but it is not the only factor that the risk manager considers, and it is not just the numbers that are important to consider. Other important factors are as follows:

- costs
- regulations
- social
- technological
- political

These important risk management factors are also crucial on a Triad project. Although the scientific and technological factors are necessary in the development of the CSM, it is these human factors that must be considered in achieving the primary objective in any Triad project, that is, minimizing the uncertainty of a particular site to a level acceptable by all stakeholders.

Appendix F

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Appendix G

Acronyms

ACRONYMS

CSM	conceptual site model
EPA	U.S. Environmental Protection Agency
FAM	field analytical method
GC/MS	gas chromatograph/mass spectrometer
ITRC	Interstate Technology & Regulatory Council
NFA	no further action
NJDEP	New Jersey Department of Environmental Protection
QA/QC	quality assurance/quality control
RFP	request for proposal
SCM	Sampling, Characterization, and Monitoring (Team)
SOP	standard operating procedure
UST	underground storage tank