CONTRACT ADMINISTRATION OF DEPARTMENT OF DEFENSE ENVIRONMENTAL RESTORATION CONTRACTS

by

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ABSTRACT

As the United States is attempting to strengthen its domestic economy and shrink its military forces, the military is being confronted with the results of ignorant or abusive policies toward the environment that have wreaked havoc at many installations. This thesis examines the contracting process which the Department of Defense uses to remediate, or cleanup, hazardous waste sites.

Many situations encountered in the environmental restoration process require flexibility and innovation, yet DoD's most common system for contracting for remediation work does not always meet those requirements. In addition, the exorbitant costs the nation and DoD face in cleaning up hazardous waste sites are partially driven by two factors: a misallocation of risk in the contracting process and poor technologies.

Since the military weapons acquisition process must treat similar conditions of uncertainty and has managed to do so while successfully developing new technologies, DoD should attempt to capture the benefits of its experience. The study found nineteen lessons learned from the defense industry that are applicable to environmental restoration. One environmental contracting combination which would recognize uncertainty and also encourage innovation is a cost-plus-award-fee contract for the completion of the study portions of the project, followed by a separate design-build contract for the execution of the project. This design-build contract would be a cost-plus-fixed-fee contract which would be converted to a fixed-price incentive (firm target) contract. Both procurements would be negotiated, not bid. The study also found that no single contracting method could address every situation that might be encountered during environmental restoration, and that there will always be a number of obstacles which will hinder the process.

Thesis Supervisor: Dr. Fred Moavenzadeh
Title: Director, Center for Construction Research and Education

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- To my late parents, who instilled in me my love of learning and the desire to seek great things.

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ABOUT THE AUTHOR

John H. Edwards is a Lieutenant in the United States Navy. During his seven-year career with the Civil Engineer Corps, he has served in public works and staff duties in the United States, and also completed two overseas deployments while serving with the U. S. Navy Seabees. He is a registered Professional Engineer in the Commonwealth of Virginia.

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GLOSSARY

acquisition - purchase of supplies or services

allowable costs - expenses incurred by a contractor which can be reimbursed because they fall within the terms of a particular contract

alternative (or innovative) contracting - a procurement other than by traditional contracting

ARARs - applicable or relevant and appropriate requirements: *applicable* requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under Federal or state law that specifically address a hazardous substance remedial action, or other circumstance at a CERCLA site; *relevant and appropriate* requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under Federal or state law that are <u>not</u> applicable to a CERCLA site but are sufficiently similar to those encountered at the CERCLA site and thus their use is well suited at the site. In effect, ARARs are "the letter of the law and the spirit of the law."

available technologies - those cleanup methods fully proven and in routine commercial use so that sufficient cost and performance data exists

CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980

contract administration - the process of planning and then executing a formal written agreement between two parties

cost-plus (or cost-type) contract - an agreement in which all allowable costs are reimbursed

cost-plus-award-fee contract - a cost-type contract that provides for a fee consisting of a base amount fixed at the inception of the contract and an award amount that the contractor can earn in whole or in part based on his quality, timeliness, technical ingenuity, and/or cost-effective management

cost-plus-fixed-fee contract - a cost-type contract that provides for payment to the contractor of a negotiated fee that is fixed at the inception of the contract and does not vary with the actual costs; the fee may be adjusted only as a result of changes in the work to be performed under the contract

DERA - Defense Environmental Restoration Account: a special DoD account which is fenced for DERP expenditures only

DERP - Defense Environmental Restoration Program: DoD's program to identify and remediate hazardous waste sites and to reduce the production of future hazardous wastes

design-build - a procurement in which a single contractor is responsible for the detailed design of a product or facility as well as for the manufacture or construction of his designed item

DoD - U. S. Department of Defense

DoE - U. S. Department of Energy

DPM - Defense Priority Model: an automated system used by DoD to help prioritize the use of DERP funds

EFD - Engineering Field Division, one of the regional contracting organizations under NAVFACENGCOM

environmental restoration - the process of identifying a hazardous waste site and returning it to its former condition

EPA - U. S. Environmental Protection Agency

FAR - Federal Acquisition Regulations: the laws and rules by which the U. S. government must contract

FFA - Federal Facility Agreement: an interagency agreement (between DoD, EPA, and the state agencies as applicable) on the cleanup action selected for a hazardous waste site, the alternatives that could have been taken, the action selected, the schedule for completion of each cleanup action, and long-term operation and maintenance plans for the site

fixed-price contract - an agreement in which the firm price, ceiling price, or target price (as applicable) is set at the inception of the contract and is subject to change only under contract clauses providing for equitable adjustment

fixed-price incentive (firm target) contract - a fixed-price contract which specifies at the outset a target cost, target profit, a price ceiling (but not a profit ceiling or floor), and a profit adjustment formula;

when the contractor completes performance, the parties negotiate the final cost and the final price is established by applying the formula (up to the ceiling price)

FS - Feasibility Study: the development of cleanup alternatives for a hazardous waste site, screening of those alternatives for their effectiveness, implementability and cost, followed by a detailed analysis of those alternatives which pass the initial screening

hazardous waste site - an area in which contaminants are uncontrolled and which may present a danger to human health or the environment

incentive-type contract - an agreement in which the contractor's profit or fee is related to his performance

innovative technologies - those cleanup methods for which performance information is incomplete

interim response - the immediate extraction of contaminants from a hazardous waste site, before the completion of the study, because of the danger presented by the substances

IR Program - Installation Restoration Program: the portion of DERP which addresses the cleanup of hazardous waste sites

IRTCC - Installation Restoration Technology Coordinating Committee: a DoD working group which coordinates environmental technology research, development, and implementation programs among the individual services

NAVFACENGCOM (or NAVFAC) - the Naval Facilities Engineering Command: the Navy organization with primary responsibility for facility planning, acquisition and management for the Navy and Marine Corps

negotiated contract - any agreement which is awarded by methods other than competitive bidding based on lowest price

NFRAP - no further response action planned: a site that EPA or the Navy has determined that does not warrant moving further in the site evaluation process

NPL - National Priorities List: the listing of sites that qualify for the Superfund program

PA - Preliminary Assessment: a desktop review of existing data about a hazardous waste site to determine if any releases may have occurred

PRP - Potentially Responsible Party: an individual or organization with some connection to a hazardous waste site who thus might be financially liable for all or part of the cleanup costs

RA - Remedial Action: construction and/or operation of a cleanup system at a hazardous waste site

RD - Remedial Design: production of plans and specifications which show remediation methods and construction materials for a particular hazardous waste site

remediation - the process of cleaning up and returning a site to its pre-polluted condition

removal action - the immediate extraction of contaminants from a hazardous waste site, before the completion of the study, because of the danger presented by the substances

responsible bidder (or offerer) - a contractor who, according to guidelines in the FAR and the contract solicitation, meets the government's criteria for entering into a contract with the government

responsive bid (or offer) - a bid which meets all requirements stated in the advertisement for the potential contract

RI - Remedial Investigation: a more intense study of a hazardous waste site which attempts to determine the nature and extent of contamination and to characterize the public health and environmental risks

risk - uncertainty, or the variability of possible outcomes

ROD - Record of Decision: selection (by EPA) of the preferred cleanup method for a hazardous waste site, considering both technical analysis and the public's input through local hearings, and documentation of the rationale for the selected remedy.

ROICC - Resident Officer in Charge of Construction: the Navy official responsible for administering construction contracts at Navy and Marine Corps installations

RPM - Remedial Project Manager

SARA - Superfund Amendments and Reauthorization Act of 1986

service (or military service) - one of the individual components under DoD (Army, Air Force, Navy or Marine Corps)

SI - Site Investigation: a combined visual and sampling inspection of a hazardous waste site to determine if releases have in fact occurred and to verify the need for any immediate corrective measures

strict liability - responsibility for damages subsequent to some event, even though there is no direct proof of cause and effect between the event and any injury or damage

Superfund - the account established to fund activities under CERCLA/SARA; more commonly, the Acts themselves

third party liability - responsibility for damages, resulting from performance under a contract, to someone who was not a party to the contract

traditional contracting - an agreement in which all plans and specifications are drafted, advertised for bid, and awarded to the lowest bidder based solely on his price

weapons system - military hardware, including all subsystems, training devices, computer resources and support items, which is designed to perform a particular military mission

weapons system development - the design, engineering and testing of a weapon system in an effort to reach the final configuration of the system

weapons system production - manufacturing of multiple units of a weapons system based on its final design

1

INTRODUCTION

1.1 General

> *Burgeoning world populations and the quest for industrial/economic development have begun seriously to erode the capability of the earth's environment to sustain itself...Environmental degradation is a physical manifestation created by man, but it impacts on man not only physically, but socially, politically and economically. The national security implications of environmental degradation derive, therefore, from this social, political and economic impact...National security, therefore, must be viewed in a context outside the traditional concept of military capability.*[1]

As the United States approaches the twenty-first century, the nation is facing staggering changes in the world's political, social and economic order. Communism has failed, nationalism is sparking both peaceful and revolutionary changes in governments, nations are attempting to assess the Earth's environmental health and are meeting to debate global responsibilities for the planet's survival, and world economies are consolidating and restructuring in an effort to promote growth.

Amidst this unsettling picture, the United States is striving to assert its status as a world leader. Part and parcel with this effort comes an attempt to strengthen the

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[1]John D. Schlegel, *Environmental Degradation: Implications for National Security.* Carlisle Barracks, Pennsylvania: Army War College, March 1990, pp. ii and 3.

domestic economy, which includes (among other challenges) the downsizing of American military forces. Installations in the continental United States (CONUS) and overseas are being closed and realigned as troop reassignments and force restructuring dictates.

At both the bases that are closing and at those that will remain part of the U. S. defense structure, the military is being confronted with a new enemy - itself. Past decades of ignorant, ill-informed and even outright abusive policies toward the environment have wreaked havoc at many installations.

Since a country's military and its practices reflect the norms and values of the nation it serves, it is only natural that the U. S. Department of Defense (DoD) has adopted a new environmental ethic. As the nation has become more environmentally conscious, so too has the military. DoD is firmly committed to conducting its operations in ways that are environmentally sound and to cleaning up the problems of the past. What good is national defense if the nation which is being defended is a dumpsite?

The objective of this thesis is to examine the process which DoD uses to remediate, or cleanup, hazardous waste sites. In particular, the focus is on the aspects of the remediation process which relate to contracting. Since the majority of the steps in the remediation process are performed by private sector contractors under DoD supervision, it is prudent to continually seek improvements in the contracting process in an effort to realize more value for the taxpayers' dollar. In addition to providing higher quality in the basic services which are being bought by contract, certain changes to the contracting process can also stimulate innovation in the private sector remediation markets; this aspect of the DoD remediation process is a key sidelight to the basic study of the contracting process.

This thesis follows a basic *problem-discussion-recommendation* format. Chapter 2 lays the foundation for a study of the environmental restoration contracting process by describing DoD's environmental restoration program and its relation to other national environmental programs. The chapter also reveals the scope of the DoD cleanup challenge. Chapter 3 analyzes the advantages and disadvantages of the current DoD environmental restoration contracting process by examining the nature of the work, the market which executes the work, and the particular ways in which risk is allocated and contracts are implemented. Chapter 4 analyzes similar characteristics for another area of DoD contracting expertise: weapons contracting. Chapter 5 provides recommendations for improvements to the environmental restoration contracting process by applying some of the lessons learned from weapons contracting; in addition, the chapter addresses some of the barriers to changing the existing methods and also comments on some aspects of the contract administration process which are relevant to those "in the trenches" trying to get the job of remediation done. Chapter 6 closes the thesis with some brief conclusions and recommendations for further research.

In an effort to maintain some semblance of focus, the thesis does not attempt to layout all the ills of the Superfund program or DoD's parallel program, but reviews them only to provide the framework in which the remediation contracting process takes place. This thesis also does not examine the role of DoD as a possible linchpin for changing the entire Superfund process, especially in the area of innovation, as this topic has been studied in some detail by other writers;[2] rather, innovation in remediation technology is treated as a corollary benefit of changes made while trying to improve the basic contracting methodology.

Finally, it should be noted that the majority of the procedures examined are those of the United States Navy, because that is the organization with which I am intimately familiar. However, my research leads me to believe that the procedures and practices in other elements of the Department of Defense are sufficiently similar that the analysis performed and recommendations made could be translated to the other services with relative ease.

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[2]See the MIT theses by Dornstauder and Rossi (referenced in the bibliography of this thesis).

2

BACKGROUND

2.1 General

> *Defense and the environment is not an either/or proposition. To choose between these is impossible in this real world of serious defense threats and genuine environmental concerns.*
> *Secretary of Defense Richard Cheney3*

One of the Department of Defense's genuine environmental concerns is cleaning up its "sins of the past." The focus of this thesis is on the remediation activities under the military's Installation Restoration (IR) Program because it is DoD's program for cleaning up that toxic contamination at its installations.

To provide a framework for this study, Chapter 2 lays the foundation of the environmental restoration contracting process by describing the legislation and policies which guide the nation's efforts to cleanup its civilian hazardous waste sites, and then relates DoD's environmental restoration programs to these other national environmental programs. The chapter also reveals the scope of the DoD cleanup challenge in terms of number of sites and expected costs.

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[3] *Defense Environmental Restoration Program, Annual Report to Congress for Fiscal Year 1990.* U. S. Department of Defense, February 1991, Introduction.

2.2 CERCLA/SARA Overview

2.2.1 The CERCLA/SARA Cleanup Process

In order to understand the military's methodology for cleaning up hazardous wastes sites, one should look first to the methods employed in the civilian sector under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), collectively referred to as "Superfund."

CERCLA became law in December 1980 primarily as a result of public outcry over well-publicized incidents involving hazardous materials and wastes at places like Love Canal, New York, and Times Beach, Missouri. The initial "Superfund" of $1.6 billion was created to fund investigations and cleanups of abandoned or disputed sites where no 'potential responsible party' (PRP) could be found to foot the cleanup bill. SARA reauthorized the provisions of the expiring CERCLA, enacted amendments to the original legislation based on lessons learned from the first five years, and provided a second dose of $8.5 billion into Superfund to cure the nation's hazardous waste ills.[4]

The methodology to be followed when cleaning up a hazardous waste site is described in CERCLA/SARA and various

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[4]Andrew Hoffman. *The Hazardous Waste Remediation Market: Innovative Technological Development and the Growing Involvement of the Construction Industry.* Cambridge, Massachusetts: Thesis submitted to the Department of Civil Engineering, Massachusetts Institute of Technology, September, 1991, pp. 20-23.

publications of the U. S. Environmental Protection Agency (EPA). Figure 2.1 outlines the complete environmental restoration process flow. An explanation of the major components of each step follows.

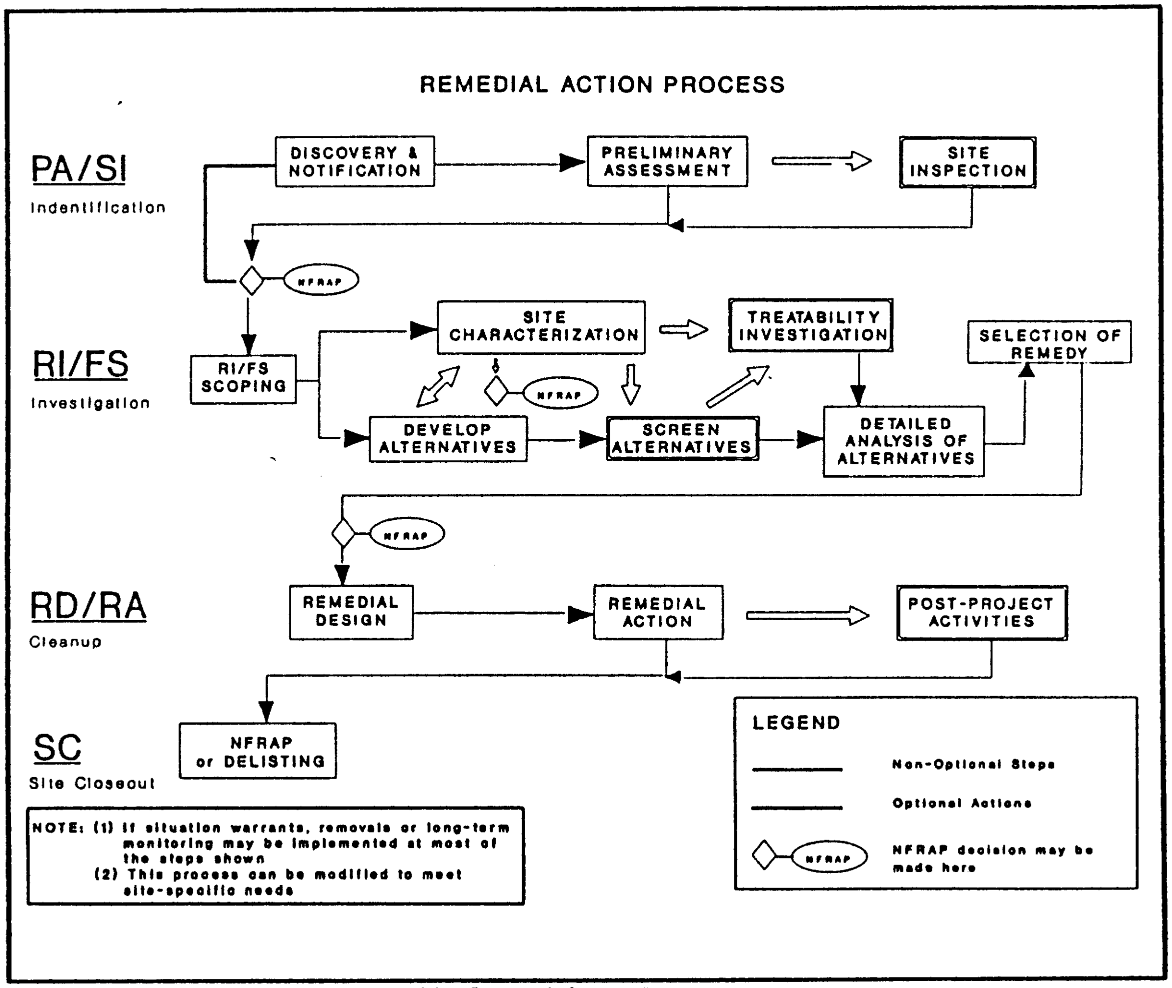

Figure 2.1 - The Remedial Action Process

(From the *Navy/Marine Corps IR Manual*)

The major tasks in each step are:[5]

1. **Preliminary Assessment (PA)** - a desktop review of existing data about the site (such as EPA files, property records, etc.) to determine if any releases may have occurred, to predict the need for any immediate corrective measures ("removal actions"), and to establish the priority and focus of the SI.

2. **Site Investigation (SI)** - a combined visual and sampling inspection of the site to determine if releases have in fact occurred, to verify the need for any immediate corrective measures ("removal actions"), and to establish the priority and focus of the RI (should one be necessary). If the initial screening of the site shows contamination, a second phase "listing" site inspection occurs where additional data is gathered about the site.

3. **Hazard Ranking System (HRS) Scoring** - an evaluation of the information from the PA/SI and a comparison of the hazards discovered at the site to established standards. If the site scores higher than a certain "cutoff" score, it makes the National Priorities List (NPL) and becomes subject to CERCLA/SARA (i.e., it is now in the Superfund arena). Those sites that have contamination but are below the Superfund threshold are referred to the states and then come

[5]Condensed from Camp, Dresser, & McKee. *Course Notes: MIT Course 1.972 "Environmental Restoration Engineering."* (Lecture 2.0). Cambridge, Massachusetts: Department of Civil Engineering, Massachusetts Institute of Technology, Spring 1991.

under their jurisdiction.

4. **Remedial Investigation (RI)** - a more intense study of the site which attempts to determine the nature and extent of contamination, to characterize the public health and environmental risks through a preliminary risk assessment, and to refine the site data needs to ensure sufficient data quality for the analysis of alternatives during the FS.

5. **Feasibility Study (FS)** - the development of cleanup alternatives, screening of those alternatives for their effectiveness, implementability and cost, followed by a detailed analysis of those alternatives which pass the initial screening. The FS is often performed in an iterative manner with the RI step (rather than in a sequential fashion).

6. **Remedy Selection and Record of Decision (ROD)** - selection (by EPA) of the preferred cleanup method, considering both the technical analysis performed to date and the public's input through local hearings, and documentation of the rationale for the selected remedy.

7. **Remedial Design (RD)** - production of plans and specifications which show particular remediation methods and construction materials for a site.

8. **Remedial Action (RA)** - construction and/or operation of a cleanup system at a site.

9. **Site Closeout (SC)** - removal of the site from the

NPL upon satisfactory completion of the restoration.

For a particular site, the process may differ slightly because some wastes present an imminent public danger and require an immediate removal action. Some areas may be split into "operable units," where various pieces of the site are separated and tracked independently throughout the remediation process. Still other sites may require no further response action based on the results of previous steps. Figure 2.2 illustrates the process for these situations.

For the purposes of this thesis, the entire remedial action process will be examined in light of the contracting aspects involved at each step.

2.2.2 CERCLA/SARA Impacts on DoD

Although Superfund is written for private sector hazardous waste sites, the passage of SARA made the program mandatory for Federal facilities. Since DoD must comply with the same procedures, the above analysis of the Superfund remediation process serves as an important tool in understanding the philosophy used by DoD to contract for these services.

SARA also impacts DoD because it imposes strict

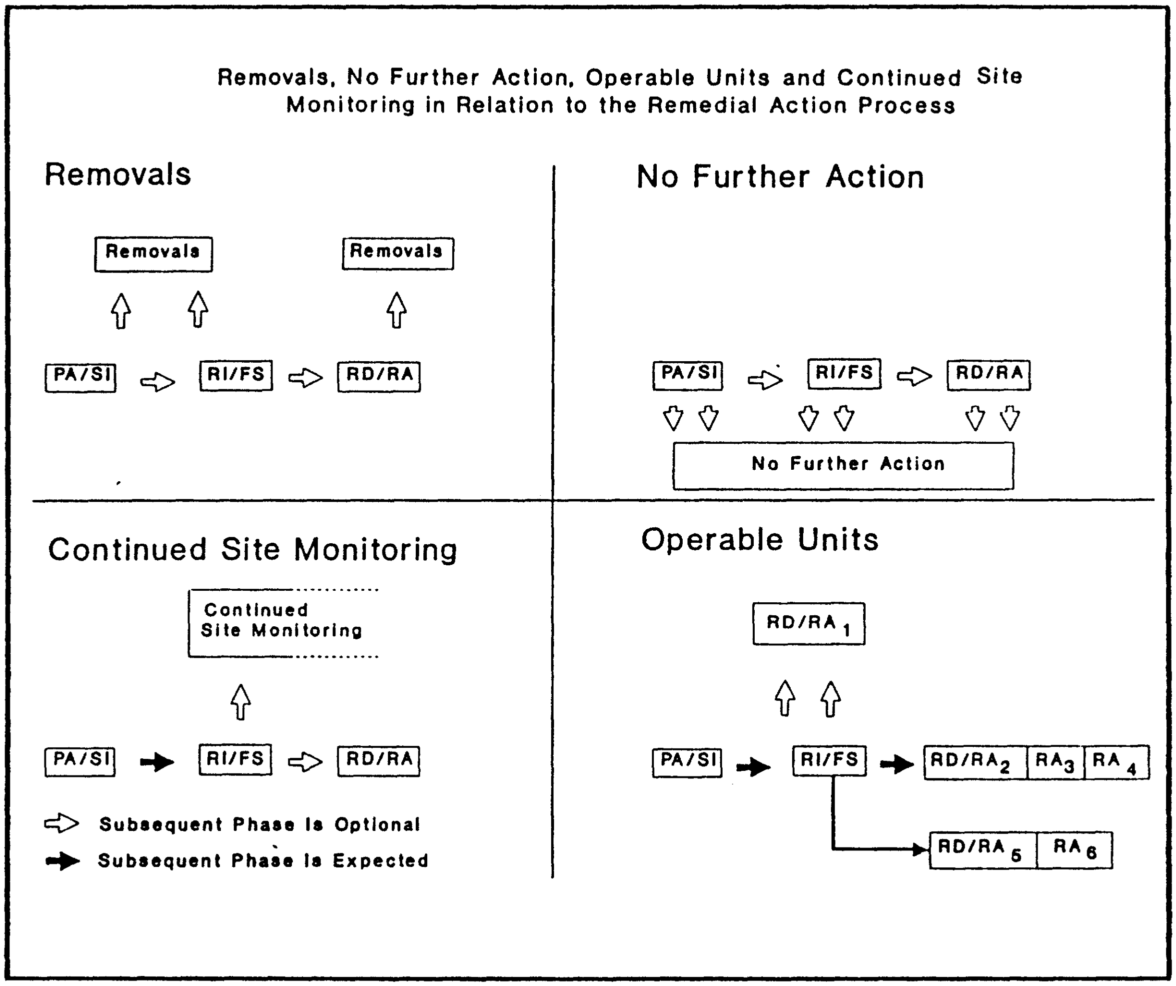

Figure 2.2 - Variations on the Remediation Process

(From the *Navy/Marine Corps IR Manual*)

timetables and schedules for compliance, including:[6]

- Federal facilities have no more than 6 months to commence an RI/FS once a site has been placed on the NPL.

- The Federal agency involved has no more than 180 days after the EPA has reviewed the RI/FS to enter into an interagency agreement with EPA for the "expeditious

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[6]Excerpted from *Navy/Marine Corps Installation Restoration (IR) Manual*. Washington, D. C.: Office of the Chief of Naval Operations, February 1992, pp. 1-2.

completion" of all necessary remedial action on the Federal NPL site.

- At Federal facilities subject to interagency agreements, remedial actions shall be completed as expeditiously as practicable.

- Other reporting and disclosure requirements.

2.3 The DERP/IR Cleanup Process

2.3.1 The Defense Environmental Restoration Program (DERP)

Executive Order 12580 delegated the President's authority under CERCLA and SARA to the various Federal agencies, including DoD. As stated earlier, the Department of Defense follows the same basic steps (as listed in Section 2.2.1) for restoration of their hazardous waste sites. However, funds for the remediation of DoD sites are not provided by the Superfund account but rather by the Defense Environmental Restoration Account, a special DoD account which is part of the annual Defense Appropriations Act. In any event, the same broad strategy of identifying possible sites, studying the sites in detail, then designing and implementing a solution to the problems is used by DoD and other federal agencies.

This cleanup strategy was implemented and became DoD policy under the Defense Environmental Restoration Program, established in 1984 to "promote and coordinate efforts for the evaluation and cleanup of contamination at Department of Defense (DoD) installations."[7] DERP consists of two main components, the Installation Restoration (IR) Program for investigating and cleaning up hazardous waste sites, and the Other Hazardous Waste (OHW) Operations Program for reducing the production of hazardous wastes through research, development and implementation of generation reduction programs.[8] DoD has made strides in the OHW program and views it as a preventative measure to keep from creating more contaminated sites for future generations. Nevertheless, the lion's share of the DERP appropriation each year is spent on the IR portion of DERP.

2.3.2 The Installation Restoration (IR) Program

Each individual service (Army, Air Force, and Navy/Marine Corps) has its own Installation Restoration Program for investigating and cleaning up its own contaminated sites. IR addresses past (not on-going) activities, and considers all potential hazardous waste sites on DoD installations in the U. S. and its territorial possessions. (Installations on foreign soils are subject to the relevant Status of Forces Agreement (SOFA) and are not subject to the IR Program requirements.[9]) One key difference for DoD is that DERP/IR apply to all potential

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[7]DERP Annual Report, p. 1.

[8]*Ibid.*, p. 1.

[9]*Navy/Marine Corps IR Manual*, p. x.

contamination sites on DoD property, while for the civilian communities CERCLA/SARA only apply to sites on the NPL.

DoD prioritizes its IR activities on a "worst-first" basis and thus concentrates its most intense investigation and cleanup activities on the removal of imminent threats from hazardous substances or unexploded ordnance, on stabilization measures to prevent site deterioration and achieve overall site cleanup savings, and on RI/FSs at sites either listed or proposed for the NPL and RD/RAs necessary to comply with SARA.[10]

At those "worst" sites that have made the NPL, EPA must approve the cleanup plans for the sites. All others must be approved by the host state in which the DoD installation is located.[11] Note, however, that as a balancing measure CERCLA Section 120 requires that in order for the state laws to apply to the Federal facility the state laws:

- must be consistent with CERCLA and must include a comprehensive scheme for remedial enforcement
- must use health-based standards based on ARARs
- must include cost effectiveness as an element
- and must be free of discriminatory application to Federal facilities.[12]

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[10]DERP Annual Report, p.3.

[11]Marc Zolton. "Toxic Waste: Poison in the Navy's Backyard." *Navy Times*. 41st Year, No. 15, January 20, 1992, p. 12.

[12]*Navy/Marine Corps IR Manual*, pp. 1-8.

2.3.3 Federal Facility Agreements (FFAs)

Because EPA and DoD are both executive branch agencies, SARA provides measures to ensure that both parties fulfill their obligations and that the public's interest is served. Federal Facility Agreements (FFAs) involving DoD, EPA, and the state agencies satisfy the requirements under SARA that federal facilities must comply with SARA, must have interagency agreement on the cleanup action selected, and must demonstrate to Congress and the public that progress is being made. FFAs must include the alternatives that could be taken, the action selected, the schedule for completion of each cleanup action, and long-term operation and maintenance plans for the sites. The final FFA is a legal document which binds the parties to their deadlines and which allows assessment of monetary penalties for failure to comply or meet deadlines. The real goal is to enhance coordination between the various players and jurisdictions and to provide a framework for resolution of conflicts so that the sites might be cleaned up quickly and effectively.[13] To ensure that the FFAs accomplish these goals, the Navy has established a policy that they will enter into the agreements only if "the provisions are realistically attainable and structured to avoid excessive reporting, duplication of effort, and other administrative

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[13]William Judkins. "Federal Facility Agreements at Naval Installations." *Navy Civil Engineer*. Vol. XXX, Issue 1, Spring 1991, pp. 10-11.

practices that reduce the efficiency of the overall remedial response."[14] In the end, FFAs ensure that the main parties who have different frames of reference (EPA = CERCLA/SARA; DoD = DERP/IR; states = state environmental laws) meet and agree to common goals.

2.3.4 DERP Summary

Although the DoD environmental restoration process, much like the Superfund cleanup process, has been subject to criticism from all corners, "[t]he Congress continues to provide strong support for the Installation Restoration Program via the Defense Environmental Restoration Account."[15] With the number of cleanups that DoD faces and with mounting public pressure for action, one can expect this Congressional support to continue.

The bottom line is that the job has to get done.

2.4 Scope of the DoD Cleanup Challenge

DoD is somewhat fortunate in that its hazardous waste cleanup problems are only a part of a bigger national problem; therefore, the military is not trying to solve these dilemmas in a vacuum. Figure 2.3 gives an overview of the cleanups that the U. S. must eventually address.

The military's peacetime and wartime operations over

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[14] *Navy/Marine Corps IR Manual*, p. 5-1.

[15] David E. Bottorff, Rear Admiral, CEC, USN. "Navy Engineering in Action." *The Military Engineer*. Vol.84, No. 547, January/February 1992, p. 32.

Hazardous Waste Site Clean-up Market
1,200 - 2,000 Superfund Sites
4,700 RCRA facilities with 60,000 units
28,000 State non-Superfund Sites
660,000 site with 1.8 million undergound storage tanks (90% petroleum)
638 DoD installations with 7,400 sites
76 DoE facilities with up to 1,500 contaminated areas/facility

Figure 2.3 - The National Cleanup Challenge

(From Kovalick, p. 6)

the past decades have taken their toll on the environment. Before environmental awareness was a national concern or anyone ever dreamed of "CERCLA," the military routinely disposed of their hazardous materials in base landfills or directly into the environment, dumped tons of unused aviation fuel before landing their aircraft, and regularly trained their firefighting crews by burning aircraft and vehicles on the ground and letting the fuel and firefighting liquids spill out to the surrounding areas.[16] These were not activities carried out under the cloak of national secrecy; rather, these practices of the military, just like those polluting activities of their counterparts on the civilian side of the fence, were the normal activities of the day. As the citizens of the United States as a whole have recognized the folly of their actions and begun to correct them, the military has reflected this national priority and also begun to tackle its problems.

2.4.1 Number and Types of Sites

As of the end of FY90, DoD had identified 17,482 total IR sites on 1855 installations, but 6361 required no further action. Table 2.1 summarizes the service component figures.

Table 2.1 - Installation Restoration Program Summary of Installations and Sites

Service	Number of Installations	Number of Sites	Sites Requiring No Further Action
Army	1,266	10,459	5,036
Navy	242	2,253	775
Air Force	315	4,513	448
DLA	32	257	102
Total	**1,855**	**17,482**	**6,361**

Source: DERP Annual Report to Congress[17]

Of those 17,000-plus sites, 95 were on NPL as of the

[16] Zolton, p. 11.

[17] DERP Annual Report, p. 6.

end of 1990.[18] In terms of pending base closures, 69 total installations have been slated to be closed by 1996, 15 of which have sites on the Superfund list.[19] One can imagine that it will take decades to complete all of these sites.

The types of sites to be cleaned run the gamut from small leaking underground fuel tanks to highly contaminated areas near storage areas for obsolete weapons and machinery.[20]

> Each branch of the military has its own characteristic environmental quagmires: The Army has horribly polluted ammunition plants; the Air Force continues to struggle with the devastating consequences of its historically indiscriminate use of solvents; and the Navy remains mired in environmental problems from, among other things, its careless disposal of paints and paint strippers into the ground at shipyards and into the nation's coastal waters.[21]

2.4.2 Potential Dollar Value

The guess-timates of the money needed to fix just the DoD's problems vary widely and are subject to just as much debate as similar figures for the estimated final costs of the Superfund efforts. A DoD IG report on the military's 17,000-plus sites estimates the cleanup cost between $100-

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[18]Zolton, pp. 10-11.

[19]"Pentagon Update: Base Cleanups." *The Military Engineer*. Vol.84, No. 547, January/February 1992, p. 23.

[20]Zolton, p. 10.

[21]Seth Shulman. "Toxic Time Bomb." *The Boston Globe Magazine*. Sunday, April 5, 1992, p. 23.

200 billion.[22] (To put this in perspective, however, "[t]he estimated cost of cleaning up military bases is about one-tenth that of similar efforts at Department of Energy installations."[23]) In current terms, DoD is moving from the study phase to cleanup steps on many projects. DoD will spend about $1.1 billion in FY92 and estimates it will spend about $1.3 billion next year on environmental cleanups.[24]

Some argue that this "strong support" from Congress, representing only about 0.4% of the total DoD budget, is inadequate. The National Toxic Campaign Fund, a Boston-based environmental group, is quoted in a January 1991 report on the military's cleanup efforts:

> The failure to provide adequate funds is by far the greatest obstacle to the timely, proper cleanup of military hazardous wastes...Funding by itself will not solve the myriad of Pentagon contamination problems, but without it the Defense Environmental Restoration Program cannot even approach its stated goals."[25]

Despite this criticism, the services press on. About one of every six dollars spent at domestic Navy bases for FY91 was for environmental related projects.[26]

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[22]Zolton, p. 10.

[23]"Pentagon Update...", p. 23.

[24]*Ibid.*, p. 23.

[25]Zolton, p. 12.

[26]Keith Schneider. "Military's New Strategic Goal is Cleanup of Vast Toxic Waste." *The New York Times*. Monday, August 5, 1991, p. D3.

2.4.3 Status of the IR Program

PA/SIs are either underway or complete at nearly every DoD installation. Table 2.2 provides a snapshot of DoD's progress in IR.

Table 2.2 - DoD Environmental Restoration Program IRP Status Summary as of 30 Sep 1990

Phase	Number of Sites: Completed	Underway	In Future	No Further Action Required
PA	16,776	658	48	5,000
SI	9,625	1,263	935	1,111
RI/FS	916	4,511	1,540	250
RD	261	1,066	2,559	
RA	296	1,191	2,572	

Source: DERP Annual Report to Congress[27]

Obviously, there is a slug of remedial designs and actions coming down the pipeline. The Navy alone has some 1000 sites under investigation, and is currently working on or has completed over 150 sites.[28]

With the large number of sites expected to simultaneously reach the costly cleanup phase, and knowing that funds made available for IR activities by the annual Defense Appropriations Act are limited, DoD has developed the Defense Priority Model (DPM) to help refine the priorities for IR moneys. The DPM uses RI data to provide a relative risk scoring based on the contaminant hazard, the

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[27]DERP Annual Report, p. C-101.

[28]Bottorff, p. 32.

pathways, and the potential receptors. The model has been automated and refined in the past few years based on input from the EPA, the states, environmental organizations and the public.[29]

2.5 Chapter Summary

Both the nation as a whole and DoD in particular have aggressive environmental restoration programs to cleanup hazardous waste sites. With the large amounts of taxpayer money being used to execute these programs, it is wise to understand the structure of these programs and to analyze the contracting process that will serve as the interface between those who want a cleanup done and those who will get paid to do it.

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[29]DERP Annual Report, pp. 1 & 3.

3

DOD ENVIRONMENTAL RESTORATION CONTRACTING

3.1 General

> *Concern for the quality of the environment has brought about fundamental and far reaching changes in the construction markets. Enormous investments are being made to build treatment facilities and for hazardous waste site clean-up.*[30]

With all the environmental restoration work needed by DoD, it is important to take a look at how that work is done. Chapter 3 analyzes the current DoD environmental restoration contracting process by examining the nature of the work, the market which executes the work, and the particular ways in which risk is allocated and contracts are implemented. This chapter also gives some of the advantages and disadvantages of the existing methods and sets the stage for a comparison to other contracting methods in DoD.

3.2 Analysis of the Nature of Restoration Work

Environmental restoration work is much like traditional construction work in that it has an owner who wants something done, a designer who provides a map of how to meet the owners needs, and a contractor who executes the

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[30] Ravi Jain. *Opportunities and Challenges Related to the Environment: A Government Perspective*. Speech delivered at the Symposium on Global Environment and the Construction Industry, Massachusetts Institute of Technology, Cambridge, Massachusetts, October 22, 1991, p. 16.

designer's plan; contractual agreements between the various parties to define duties and liabilities and to state the compensation for providing those services; a body of laws, regulations and traditions (outside of the defined contracts) which also controls the process; and a finished product which rarely fulfills 100% of the owner's original expectations.

Even the steps in the remedial action process (as described in Section 2.2.1) parallel the building construction process. The owner begins with a study (the Preliminary Assessment/Site Investigation and the Remedial Investigation/Feasibility Study), commits to a design (the Remedial Design) and then has the design constructed (the Remedial Action). It is easy to understand why traditional construction contracting methods might be used by an owner who feels comfortable with those procedures and who does not consider environmental work to be any different than other building projects for which he has contracted in the past.

However, there are a number of characteristics of environmental restoration work that distinguish it from a mundane construction project. For example, environmental work is unlike traditional construction in that the desired result or performance level is known, but how to get there is often up for grabs because many alternatives could provide that same result. With a traditional constructed facility, there are a very limited number of construction methods that will result in the exact facility called for in the plans and specifications.

Another difference is that each remediation project is a "one-off" design and construction effort, with no "off-the-shelf" answers available; rarely will one find two remediation projects so similar that one might be able to duplicate major portions of the design. The particular cleanup levels for a site are determined by site specific risk assessments[31] which are based on the particular sources of contamination, the specific potential receptors of that contamination, the expected routes of exposure between the two, and the acceptable level of exposure to the contaminant should it occur. Although one might argue that every building is unique as to its location, design, etc., building types and facility designs are much more readily adapted from one project to the next than environmental designs. Also, restoration work incorporates a wide variety of skills that aren't usually found in one firm, such as hydrogeology, biology, construction management, regulatory expertise, industrial hygiene, chemical engineering and so on.[32]

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[31]Walter W. Kovalick. *Innovative Site Remediation Technologies: Barriers and Opportunities.* Speech delivered at the Symposium on Global Environment and the Construction Industry, Massachusetts Institute of Technology, Cambridge, Massachusetts, October 21, 1991, p. 3.

[32]Donald T. Goldberg. *Market Trends in Environmental.* Presentation at the Symposium on The Construction Industry in the Northeast: Opportunities for the 21st Century, Massachusetts

Another difference between environmental construction and traditional construction is that ALL environmental jobs are high cost efforts, easily in the millions. Under Superfund, the remediation costs have averaged between $20-30 million.[33] There are certainly some facility projects that well exceed this cost, but the *average* building construction cost for a facility erected using traditional contracting methods (especially in the DoD sector) is much lower.

The high potential for change in an environmental restoration project makes it stand out from typical construction. Because almost all contaminants of concern in a restoration project are underground, there is a high degree of uncertainty about the quantity of and location of contamination. At the same time, the contaminants are usually mobile (albeit a slow movement) so one who is trying to scope, design and construct a restoration job is trying to hit a moving target. Many routine construction jobs face major changes as they develop, but in most cases the major decisions about the construction are known well before the design and construction commence. The potential for change does exist in standard construction, but that potential is far greater in environmental work.

Finally, the biggest difference between environmental

Institute of Technology, Cambridge, Massachusetts, May 13, 1992.

[33]Hoffman, *The Hazardous...*, p. 44.

construction and traditional building construction is in the area of liability. Both types of projects involve liabilities for the adequacy of design, for accidents during construction, for damages to third parties, and so on, but (as will be pointed out in more detail in Section 3.5) the liabilities for performing environmental restoration work are almost mind boggling when compared to a routine construction project.

In summary, there are several key differences between environmental projects and typical building projects. Although some of these unusual traits are found in facility construction situations, when those unusual situations are present in a building project they often lead the owner to treat the project differently from his other projects. Either way, the argument can be made that environmental restoration work is much different than an ordinary building project and thus by its very nature should not be handled in a "business as usual" manner.

3.3 Overview of the Players in the Market

The environmental restoration market as a whole is growing rapidly, so the military should benefit in that it is not trying to solve an internal problem but is part of a bigger picture. Other organizations, especially EPA, DoE, the states and private companies, are all contracting for remediation or other environmental related services on a more frequent basis. The players who make up the main contractors in this market come from a variety of origins.

3.3.1 Existing Environmental Companies

Solid waste disposal firms were the early and obvious entrants to the environmental market as it emerged. Environmental consultants who traditionally have the skills necessary to study soil and groundwater have also captured part of the market. Some of these "green" consultants have also begun offering cleanup services to their customers.[34]

3.3.2 Defense Industry Firms

One of the more recent entrants to the market is the defense industry. With the downsizing of the U. S. military-industrial complex, these defense contractors are making less military hardware. "Spending on military-environmental projects is causing private companies, some of them among the largest contractors for the military industry, to establish new divisions to compete for government contracts, many of them worth $100 million to $1 billion."[35]

3.3.3 Construction Contractors

Considering the nature of the field work in environmental cleanups and the contracting techniques often used to obtain these efforts, traditional construction contractors are becoming more interested in the

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[34] *Ibid.*, pp. 40-42.

[35] Schneider, p. D3.

environmental arena because they see it as a natural fit with the rest of their business. "Waste remediation may be a solid shot in the arm for construction firms who have been hit hard by the current recession and it offers to provide substantial payoffs for years to come."[36] Among those constructors that have done well are those whose original business was environmentally related, such as in waste and wastewater facility construction. Others have vertically integrated or established strategic alliances with other firms having the skills they need to offer a complete package of services.[37]

One should not assume, however, that just any construction firm can jump right in to the environmental ring and be successful. "Although the project management and construction/earth moving skills that construction companies possess are precisely the skills necessary for the action phases of remediation, waste remediation is completely unfamiliar territory for contractors."[38]

The unfamiliarity with the interdisciplinary and complex world of environmental restoration has been characteristic of all the major players in the market. As a

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[36]Andrew Hoffman. "Strategic Alliances for the Hazardous Waste Remediation Market." *Construction Business Review*. Vol. x, No. x, January/February 1992, p. 56.

[37]*Ibid.*, pp. 59-61.

[38]*Ibid.*, p. 57.

result, there have been a number of growing pains in Superfund, DERP/IR and other remedial action programs:

> As has been discovered over time, Superfund cleanups often require special expertise that was not and is still not readily available in the private sector. For instance, large numbers of inexperienced civil engineers, geologists and hydrogeologists have no expertise or experience with toxic chemicals...To a large extent, the billions of dollars rapidly spent on Superfund have provided an opportunity for many contractors to start new businesses and to learn the business of toxic waste cleanup. To some extent this was inevitable and has precedents in other fields. The point here is that the rapid increase in spending on contractors was based on incorrect assumptions and that the efficiency of the program has suffered as a result.[39]

Even among the industries listed above, there are a number of firms who are NOT playing because of the current climate. Those companies which fear strict liability judgements from environmental related work (no proof of cause and effect between an event and the subsequent damages, yet the award is still made), those who fear unlimited and unspecified future claims by allegedly damaged parties, and those corporations which do not want to test the theory of the 'corporate veil' on their particular institution have shied away from the environmental market.[40] As succinctly stated by James Janis, chairman of the Hazardous Waste Action Coalition (HWAC) Federal

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[39]U. S. Congress, Office of Technology Assessment. *Assessing Contractor Use in Superfund: A Background Paper of OTA's Assessment on Superfund Implementation.* Washington, D. C.: U. S. Government Printing Office, January 1989, p. 40.

[40]Hoffman, *The Hazardous...*, pp. 60-65.

Action Committee, in his testimony to the Environmental Restoration Panel of the House Armed Services Committee,

> "Without a reliable system in place to share third-party liability risk equitably with the government, our members tell us that entering into a DoD cleanup contract becomes a virtual 'bet the company' situation."[41]

Still others in the private sector who, for example, do not want to deal with government bureaucracy or do not want to wait out the permitting process for a hazardous waste remediation facility also steer clear.[42]

Nevertheless, with the large amounts of cash just waiting to be had, the competition between the environmental "greenies," the defense industry and the construction industry will remain intense.

3.4 Overview of the DoD Remediation Contracting Process

In trying to restore a hazardous waste site to a safe condition, DoD has to balance a number of often conflicting factors. On the one hand, there is the need for quick, effective and high quality action to protect the public and the environment. On the other, the Federal Acquisition Regulations (FAR) which dictate how the government contracts for goods and services call for full and open competition in the procurement process, demand sealed bid procedures in

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[41]Sally Keene. "Washington Update - HWAC Testifies on DoD Contracting Terms." *The Military Engineer*. Vol. 84, No. 549, May-June 1992, p. 27.

[42]Kovalick, p. 3.

almost every circumstance and generally restrict how DoD can enter into contracts.[43] Intertwined with all of these elements is a limited pool of manpower and financial resources trying to put it all together. In this atmosphere of conflicting demands, DoD has come up with a relatively effective way to complete an environmental restoration project.

Although throughout the decentralized DoD there are countless variations on how each service and local office contracts for environmental restoration services, the general scheme is as follows.[44] DoD typically awards, by negotiation, a cost-plus-award-fee contract to an environmental consultant to conduct the Preliminary Assessment and Site Investigation (the award portion is based on the contractor's cost efficiency, schedule and quality). If conditions dictate that the remediation process continue, the same engineering consultant is retained to conduct the Remedial Investigation, the Feasibility Study and to write the Record of Decision. (In the early years of hazardous waste site remediation, DoD often hired multiple consultants to conduct various steps up to the point of the ROD. However, the lack of continuity in the work and the inefficiencies of having to reclimb the learning curve with each new consultant has led DoD to

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[43]See FAR 6.1, 36.103 and 36.209, for example.

[44]Summary of Interviews with Wironen, Harber and Hicks.

follow private sector practices and hire one consultant for all the study phases). The firm which studies the site is normally a well established environmental consulting firm which has been hired on its merits (not on its price proposal) using Brooks Act procedures. For the Navy, these contracts are usually awarded and administered at the engineering field division (regional) level, not at the local installation level. Once the Record of Decision is published by the EPA, DoD will hire an engineering firm to perform the remedial design for the site. In most cases, the firm which performed the first part of the study continues with the RD; in other cases a separate company does the design. In either case, this contract is also a cost-plus-award-fee negotiated contract managed, in the case of the Navy, at the EFD level. The engineering firm doing the RD is paid to produce a set of biddable plans and specifications, a construction cost estimate, a draft Operations and Maintenance Plan, a draft Monitoring Plan, and a final Quality Assurance Program Plan. Figure 3.1 illustrates the RD steps.

The plans and specifications are then advertised by DoD through an Invitation for Bid, and award of the remedial action contract (the "construction" contract) is made to the

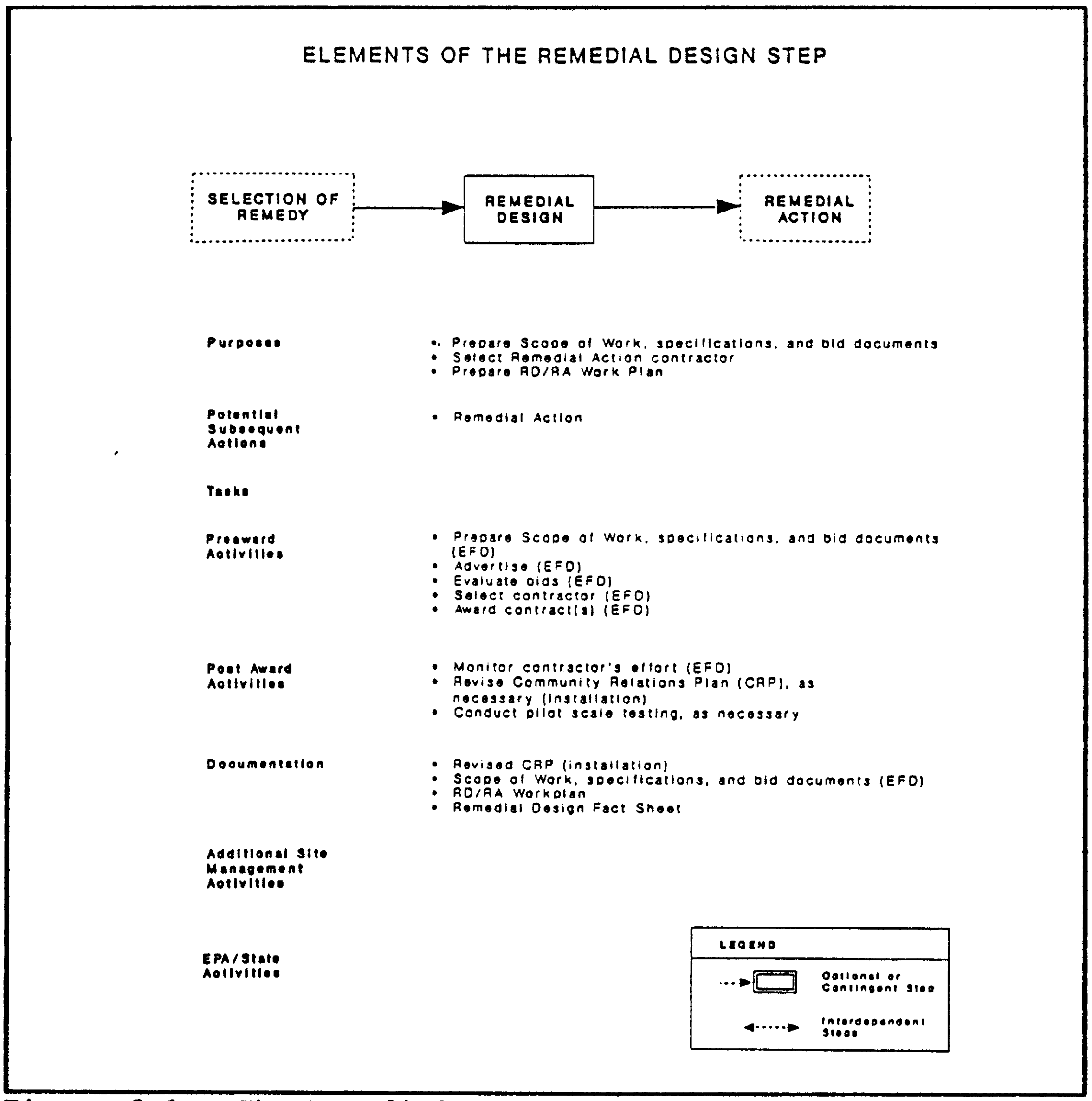

Figure 3.1 - The Remedial Design Step

(From the *Navy/Marine Corps IR Manual*)

lowest responsive, responsible bidder. The remedial action contract is administered by the local DoD construction contracting office for the activity on which the hazardous waste site is located. Figure 3.2 shows the elements in this step of the process.

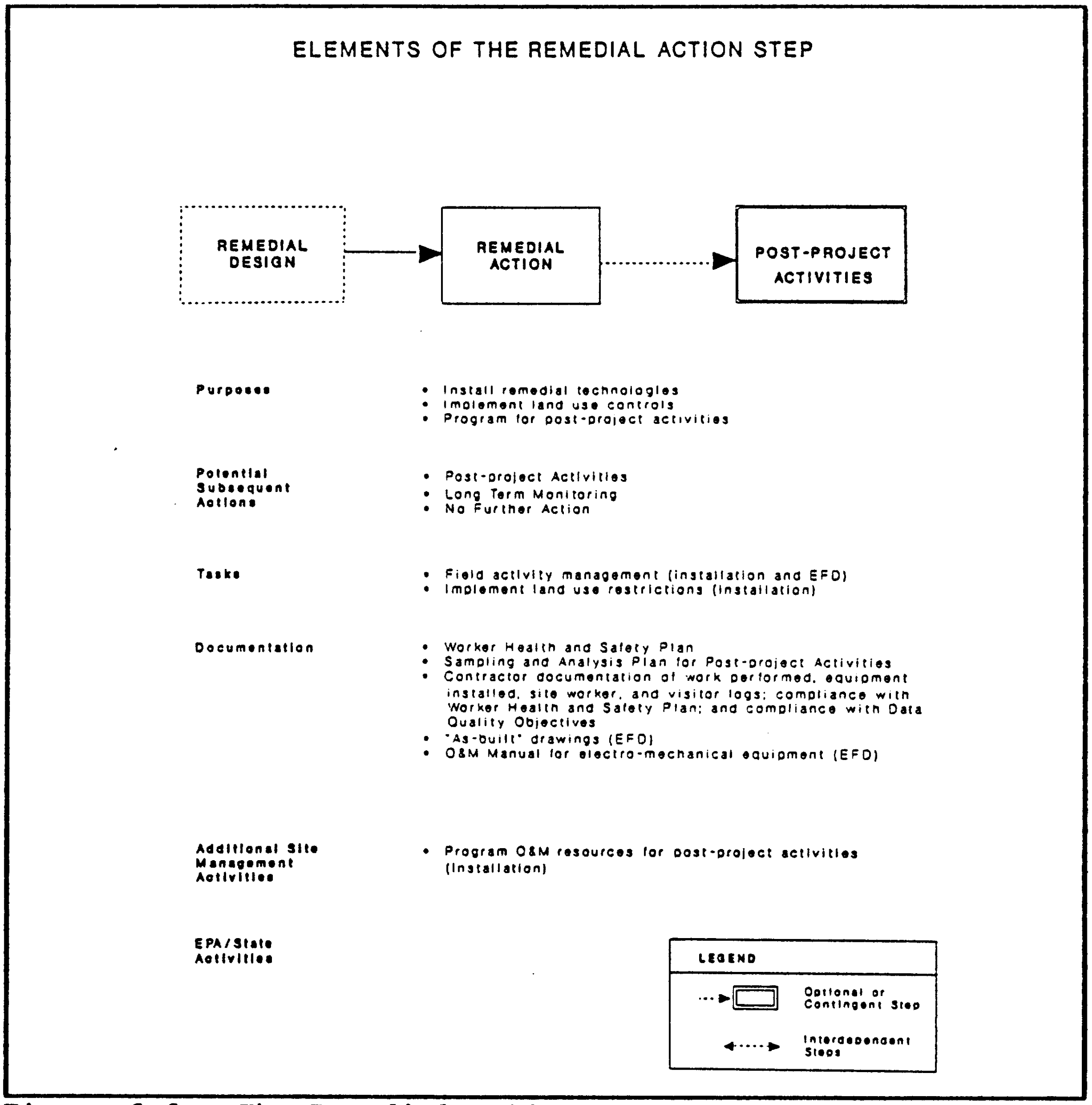

Figure 3.2 - The Remedial Action Step

(From the *Navy/Marine Corps IR Manual*)

In essence, DoD is using traditional building construction contracting procedures to execute its environmental restoration work. "[T]he idea of making field decisions, which would be useful in considering that no two hazardous wastes sites are the same, is dismissed because field decisions do not lend themselves to detailed documentation" which is required in a litigious and highly regulatory environment.[45] In addition, this method is being forced upon a group of players who have varying levels of expertise. You have:

- the traditional environmental "greenies," who understand the nature of environmental work very well, but who may not be very familiar with the construction contracting methods;

- the construction companies, some of whom know DoD construction rules inside-out but who may not be very experienced in environmental restoration; and

- the defense contractors, who in many cases are probably not familiar with either the type of work or the construction contracting methods.

The Navy somewhat recognizes this inconsistency in using building construction procedures to contract for environmental projects. In the *Navy/Marine Corps Installation Restoration Manual*, they point out:

> "The field implementation of remedial action project designs <u>differs</u> from standard facility construction designs. While a "facility" will not usually be the end product of remedial action work, the work effort uses construction methods to accomplish the goal."[46] (emphasis added)

As will be highlighted in Section 3.6, the existing

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[45] Dan Morse. "What's Wrong with Superfund?" *Civil Engineering*. Vol. 59, No. 4, April 1989, pp. 41-42.

[46] *Remedial Action Management Guide for Resident Officer in Charge of Construction (DRAFT, Version 2.0)*. Port Hueneme, California: Naval Energy and Environmental Support Activity, November 1991, p. 1-1.

contracting methods serve their purpose, but there are a number of weaknesses in the system which could be shored up.

3.5 Risk Allocation in the Current Contracting Process

Risk is most often viewed as "the likelihood of something bad happening." From a contracting standpoint, risk is better defined as "uncertainty." The more doubt about the future of some event (i.e., the variability of possible outcomes), the higher the risk.[47]

"The decision by an owner of what type of contract to use should revolve around risk allocation."[48] A properly conceived contract package allocates the various risks to the party which has the best ability to manage each risk, compensates that party for assuming that risk, and provides incentives for each party to properly manage the risks which they have been assigned. Thus when one is putting together an contract acquisition package, one should assess the risks, properly allocate them, and fairly compensate the assigned party.[49]

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[47]Richard A. Brealey and Stewart C. Myers. *Principles of Corporate Finance.* New York, New York: McGraw-Hill, Inc., 1991 pp. 132-139.

[48]Christopher M. Gordon. *Compatibility of Construction Contracting Methods with Projects and Owners.* Cambridge, Massachusetts: Thesis submitted to the Department of Civil Engineering, Massachusetts Institute of Technology, September, 1991, p. 112.

[49]Carl R. Beidleman, Donna Fletcher, and David Veshosky. "On Allocating Risk: The Essence of Project Finance." *Sloan Management Review.* Spring 1990, pp. 47-51.

3.5.1 Assessing the Risks

One convenient way to organize the risks is by when they occur in the remediation process. Some risks are present throughout the restoration process, others are predominant in only one step, and still others are questionable as to when they occur. This section lists and briefly describes the significant risks during each restoration phase. A discussion on the allocation of risks follows in Section 3.5.2.

Study Phases (PA/SI and RI/FS)

- Scope of work: quantity and location of contaminants, amount of sampling which will be required, manpower required to do the studies, etc. (this is a risk because of the unpredictable nature of environmental work)

- Performance of the environmental consultant: quality and timeliness of his work

- Performance of various remediation technologies: the FS encompasses an analysis of alternatives and choices about the technologies; both the decision maker and the technology itself are at risk

Design Phase (RD)

- Scope of work: amount of design effort required, additional sampling necessary to complete the design, and areas to be incorporated into the design; all depend somewhat on the study phases

- Performance of the designer: quality and timeliness of his work, adequacy of the design in terms of reaching the cleanup standard dictated by the ROD, completeness of the design in terms of capturing all conditions at the site and incorporating those conditions into the plans and specifications, and the associated latent liabilities for failing to perform in these areas

- Performance of the remediation technology <u>application</u>: the ROD may select 'incineration' but the designer must choose which incinerator, how high the temperatures must be, throughput, etc.; also carries the associated latent liability for failure of the application to perform

<u>Implementation Phase (RA)</u>

- Scope of Work: quantity and location of contaminants to be treated, other conditions at the site which the contractor will encounter

- Performance of the remedial action contractor: production rate of the labor force; actual material, labor and overhead expense costs incurred; quality and timeliness of work

- Safe execution of the work: protection of the site and surrounding areas from accidental releases during remediation; protection of the workers at the site

- Completion of the contract: financial stability and technical capability of the RA contractor

- Performance of the technology: RA contractor may be blamed for his performance when in fact the technology is failing

3.5.2 Allocation and Compensation

As stated earlier, an efficient contracting process allocates risk to the party that is best able to manage the risk and compensates that party in proportion to the risk. The risks listed in Section 3.5.1 are analyzed below in the following format:

" - Risk: who is best able to bear that risk (and why); who bears that risk in the current DoD environmental restoration contracting process."

Recommendations for improvements to the process in general and risk allocation in particular are reserved for Chapter 5.

Study Phases (PA/SI and RI/FS)

- Scope of work: DoD, because they have caused the problem which has generated the need for restoration work to begin with and because they dictate what they want done by the contractor; DoD, because of the cost-plus nature of the study contracts

- Performance of the environmental consultant: the consultant, because he has direct control over his personnel, the resources he commits to the task, the level of supervision and review, and so on; the consultant, because his performance determines the level of award fee he receives (assuming the award fee panel is unbiased)

- Performance of various remediation technologies: best shared between the consultant and DoD, because "the technology" is an abstract concept that no party can control while the evaluation/decision making about the technology is controlled by the consultant; the consultant, because if the technology fails DoD has no liability and can blame the contractor's decision making and require him to do more studying (at his expense) until the problem is resolved, while it may be difficult for the contractor to prove he is NOT at fault

Design Phase (RD)

- Scope of work: DoD, same reasoning as above; DoD, same reasoning as above

- Performance of the designer: the designer, same reasoning as above; the designer, same reasoning as above

- Performance of the remediation technology application: best shared between the designer and DoD, same reasoning as above; the designer, same reasoning as above

Implementation Phase (RA)

- Scope of Work: DoD, same reasoning as above; born mostly by DoD (because of the "Changes" and "Unforeseen Conditions" clauses included in DoD contracts), but shared somewhat by the designer, in that DoD can occasionally recoup from the designer if the plans and specs were faulty (and DoD didn't hamper the designer by its budget or actions during the design phase); and by the remedial action contractor because changes to the scope of work often result in increased costs which he is unable to adequately recover from the government

- Performance of the remedial action contractor: the remedial action contractor, same reasoning as for other contracted parties; the remedial action contractor, by the nature of the firm fixed-price contract

- Safe execution of the work: best shared between the contractor, because the contractor has direct control over the means and methods of construction and the actions of his workforce, and to a lesser degree DoD, because they caused the hazard in the first place and because it is often difficult to determine whether damages to a third party were caused by the original contamination or by some action during the cleanup; the contractor, because DoD assumes no liability and expects the contractor to be insured. The whole issue of liability is a major problem as discussed at the end of Section 3.3, but for now

> CERCLA allows the government to indemnify remedial action contractors. Presently, the Department of Defense (DoD) does **NOT** indemnify remedial action contractors while the Environmental Protection Agency (EPA) does.[30] (emphasis in the original).

- Completion of the contract: the contractor, because he has control over his firm and its backing; either the contractor, if he is bonded, or DoD, if the contractor is unbonded. There are a number of restoration contractors who

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[30]*Remedial Action...*, p. 5-10.

simply can't get or maintain bonding for environmental work.[51]

- Performance of the technology: DoD and the designer at this phase, because their actions led to the technology that is called for in the plans and specifications; the designer, because a technology failure can easily be termed a design failure as described earlier, and the RA contractor to a lesser extent because he might be held accountable for poor performance when in fact the technology is faulty and he cannot prove it to the government's satisfaction.

One of the key aspects of risk which permeates all three phases delineated above but which is muddled under the current process is the issue of liability. There is a distinct difference between liability stemming from third party accusations versus liability for performance of the engineering, technology, or construction means and methods. The first is really external to the process and to the contracts between DoD and the various firms, while the latter is internal to the process but more readily controlled. Most engineers/constructors are willing to take accountability for their own actions but are very leery about facing huge third party claims, perhaps even years after they've walked away from a successful restoration

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[51]Hoffman, *The Hazardous...*, p. 63.

project.[52] DoD should begin to take a more active role in assuming some of the liabilities if it wants to help keep the contracting community solvent.

In summary, the current methods seem to allocate risk properly in most areas, but not so in the areas of technology performance and liability.

3.6 Advantages and Disadvantages of the Current DoD Process

As mentioned earlier, the existing methods have worked reasonably well to date and there are times when they are appropriate. However, this "traditional" building construction process of *design-bid-build* brings certain advantages and disadvantages when applied to the environmental contracting process.

3.6.1 Advantages

From DoD's perspective as the owner, some of the advantages of the traditional method are:

- the contractor(s) for the highly technical engineering phase(s) is/are selected based on their qualifications, not their price proposal
- the independent design professional is available during the construction phase to advise DoD
- full and free competition for the remedial action or "construction" phase

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[52] *Ibid.*, pp. 58-60.

- an objective evaluation criteria for the remedial action contractor (price) that is not subject to fraud or abuse, along with the resulting public perception of incorruptibility of the process

- application of market forces to the process

3.6.2 Disadvantages

Some of the drawbacks of the existing procedures are:

- it is bureaucratic, time intensive, difficult to manage and expensive. "The Office of Technology Assessment (OTA) reports that it is not uncommon for the government to spend from 100%-500% more than a private client for the same study or cleanup."[53]

- by having the remedial action contractor commit to a firm fixed-price bid, adversarial relationships develop and teamwork between the owner, the designer and the constructor is hampered.

- with no prequalifications of remedial action contractors, contractors of questionable ability may be awarded work that is beyond their capabilities. In the DoD sector, it is extremely difficult to prove (prior to contract award) that a contractor is not capable of performing the work.

- there is a high potential for changed conditions

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[53]Michael A. Rossi. *The Department of Defense and the Construction Industry: Leadership Opportunities in Hazardous Waste Remediation Innovation.* Cambridge, Massachusetts: Thesis submitted to the Department of Civil Engineering, Massachusetts Institute of Technology, January, 1992, p. 15.

during construction, because the design is at 100% when advertised but by its very nature environmental work is constantly changing and hard to define prior to the commencement of remedial action.

- the remedial action contractor does not guarantee that the design will work or will achieve the desired results, only that he will construct whatever is shown in the bid documents. This can also lead to finger-pointing between the designer and the constructor if something fails to work.

- the remedial action contractor is brought in late in the acquisition process, which leads to a lack of innovation in available solutions. "A common complaint about bidding is that it stifles innovation and research in the industry because contractors cannot afford to invest in it, and are not rewarded for innovation unless it results in immediate cost savings."[54]

- technology innovation is stifled because the contractors must bear the risk of the technology itself rather than *their performance* of that technology

- there is no incentive for superior performance because there is no way to recognize the outstanding contractors (such as with the promise of repeat business). A good remedial action contractor has to compete for the next award just like everyone else.

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[54]Gordon, p. 135.

> Even though contractors in general are highly professional and want to do a first rate environmental job, how well the public interest is served depends on how well a program is managed by the government. If the government does not <u>demand</u>, measure and <u>reward *quality*</u> contractor work it will not get it (emphasis added).[55]

The disadvantages listed above show that the "traditional" process is probably not well suited for all situations encountered in the installation restoration process. In this situation where timeliness and quality of work should be far more important than cost, DoD currently applies a contracting method which is structured to take a long time (the designer must have complete confidence in his study before committing to 100% plans and specs, so he spends his time accordingly; the bidding process itself takes additional time; and the expectation of changes during the construction phase also means an expectation of delays and work stoppages) and which uses cost as the most important award criterion for the remedial action contract.

3.7 Chapter Summary

The analysis of the amount of work to be done, the nature of the work, the players who are standing by to do it and the potential for improving the existing process shows there are great opportunities ahead for both DoD and the contracting community, as well as some obstacles to overcome. The Army Corps of Engineers and the Navy Civil

[55] U. S. Congress, OTA, *Assessing Contractor Use...*, p. 2.

Engineer Corps have a history of working successfully with industry to meet the challenges of the nation's defense and infrastructure, albeit a "love-hate" relationship at times. These two groups are well situated to take on the next great mission of environmental cleanup.

> As we make the transition from the investigation of our sites to the more costly cleanup phase, we must ensure that our efforts are properly focused to obtain the greatest benefit possible for our cleanup dollars. Many challenges await us in the coming years. Although we have come a long way in the seven years that DERP has existed, we still have far to go. The course we have charted for the future is sound and will ensure the achievement of our environmental restoration goals.[56]

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[56] Deputy Assistant Secretary of Defense (Environment) Thomas Baca in DERP Annual Report, p. v.

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DOD WEAPONS ACQUISITION CONTRACTING

4.1 General

> *Before and during World War II, the defense industry was usually compared with a typical manufacturing industry, such as the auto industry. The emphasis was on simplicity, reliability and producibility. Since the late 1950s, however, the industry has been compared with a custom design and development industry, where contracting plays a major role.57*

A "custom design and development industry, where contracting plays a major role" not only describes the weapons industry but also rings of the construction industry and the environmental restoration process. The first part of this thesis has addressed the unique nature of environmental work and the methods currently employed to accomplish that high-risk work. However, when one thinks of high-tech, high-risk projects, the immediate industries which come to mind are the defense weapons industry and the aerospace industry. Since DoD has experience in the procurement of weapons systems, one can look to that method for some clues to improve the environmental contracting methodology. "Despite the significant problems plaguing the acquisition process, few would challenge the statement that

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[57] J. Ronald Fox. *The Defense Management Challenge: Weapons Acquisition*. Boston, Massachusetts: Harvard Business School Press, 1988, p. 11.

U. S. defense weapons and equipment are among the best in the world."[58]

This chapter follows a format similar to that of Chapter 3. The general nature of weapons acquisition is outlined, the industry and market that are providing that product/service are discussed, the process by which DoD accesses these industries is presented (including a discussion of risk allocation), and then some of the strengths and weaknesses of the weapons acquisition process are given. The intent is to provide enough information to extract some of the key aspects of the procedures without going into a complete analysis of the weapons acquisition process.

4.2 Analysis of the Nature of Weapons Development and Production

When analyzing the nature of weapons system development and production work (irrespective of the contracting process used), many of the characteristics that were descriptive of environmental restoration work apply as well to the weapons process.

Weapons development is driven by mission and performance oriented specifications, rather than by descriptions of a physical product that must result. When beginning the process to obtain a new weapon system, the

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[58] *Ibid.*, p. 11.

military services decide what job that system must perform and to what standards, but they do not initially attempt to define what type of product will result. This performance oriented development process generates many opportunities for creative thinking and innovative ideas.

The next characteristic of the weapons development process is that it deals with high technology products and services. In the choice between having a large number of cheap, low technology weapons complemented by a large fighting force, or having a fewer number of expensive, high technology weapons rounded out by a smaller fighting force, the United States has chosen the latter. Since many of the weapons programs are so complex and unique, there is little basis for cost, schedule and performance estimates at the beginning of the process.

High program costs are another characteristic of the weapons development process. Depending on the year in question or the source you read, the estimates of federal spending for defense research and development and for weapons production range from $100-140 billion per year. Considering that the U. S. typically has some 100 to 150 weapons systems in the development and production process at any given time, the average cost per program is obviously quite high.

The most important characteristic of weapons development is that it is highly risky work. As will be described in Section 4.5, there is a high degree of both technological and financial uncertainty. Since the emphasis of U. S. strategic policy traditionally has been on technological superiority, "the weapons acquisition process is defined by the inherent uncertainty that comes with pressing beyond the existing technological horizon."[59] There is enormous potential for change throughout the life of the process, caused by both the nature of the work itself and the length of the process (seven to twenty years depending on the program).[60]

In summary, as described by Leonard Sullivan, Jr., in his paper "Characterizing the Acquisition Process,"

> Major weapons system development and production programs are technologically advanced and complex. Indeed, they are often designed to achieve performance levels never before realized, using many components and some materials never before used in military applications. Production is characteristically low volume, with the final cost of a major system frequently running into billions of dollars. This substantial expenditure of time and money occurs in an environment of rapidly evolving technology and unexpected changes in priorities for individual programs. This predicament creates an environment of uncertainty and risk for buyer and seller alike, exacerbated by the unpredictability of technical performance, development time, and cost.[61]

4.3 Comparison of the Weapons Acquisition Industry

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[59]Thomas L. McNaugher. *New Weapons, Old Politics*. Washington, D.C.: The Brookings Institution, 1989, p. 3.

[60]Fox, p. 28-29.

[61]*Ibid.*, p. 10.

Unlike the environmental remediation industry, which is newly emerging and consists of players with backgrounds from a number of other businesses and industries, the weapons development industry (as a whole) is a mature industry. There are a number of segments, such aircraft production, shipbuilding and electronics manufacturing, but each segment is relatively consolidated when compared to the highly fragmented environmental restoration industry. Since the 1950s, the top 25 defense contractors have consistently captured more than 45% of the dollars awarded each year, with the top 100 being awarded more than 60% each year.[62]

Many of these leading aerospace, engine and electronics firms which dominate the scene have been in existence for years, and often times have relied almost solely on DoD weapons contracts for their business. As a result, these players understand the nature of the DoD procurement process quite well.

As mentioned earlier, estimates of federal spending for defense research and development and weapons production range from $100-140 billion per year. These figures are on the order of the total predicted environmental spending in the U. S. over the coming decades. However, defense weapons spending is expected to shrink as the U. S. military gets smaller, but environmental spending is on the rise.

The competition for the defense weapons acquisition

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[62] McNaugher, p. 150.

dollars takes place under somewhat unique circumstances. Most writers contend that the business of the defense industry is not a true commercial marketplace. In a competitive market, the business firm decides what it will produce, the methods of production, the quantity, the price, and so on, and then lets the pressures of the commercial marketplace validate its decisions about minimizing costs and maximizing profits. In the defense sector, the product and quantity are determined by governmental authority, price is normally not an overbearing concern, and competition normally focuses on the proposed design and its promise of performance rather than on the product itself and its actual performance.[63] (Hence, the attempts to reform government procurement and make it 'more business-like' have been doomed to failure.) "In the absence of market forces, the big defense firms respond mainly to signals, incentives, and regulations provided by the government."[64]

4.4 The DoD Weapons Acquisition Process

The development and production of sophisticated military hardware is a daunting challenge. Hundreds of DoD staffers in offices in the Pentagon and in the plants of the major defense firms must keep track of thousands of design details, component testing schedules, Congressional

[63]Fox, p. 16-17.

[64]McNaugher, p.151.

inquiries, contractor change proposals, budgeting constraints, ad nauseam. To condense the process into a few short pages oversimplifies what is a truly difficult management task that few in the public understand. However, a few generalizations and a survey of the methodology are sufficient to allow one to gain some insight into this complex acquisition system.

4.4.1 History[65]

Prior to World War I, the military departments developed and produced their required ammunition and equipment using their own government plants and workers, or by using rigid contracting procedures. The procurement bureaucracies "emphasized strict separation of R&D from production, elaborate test procedures, competitive bidding for production contracts, and quality control during production."[66] The organizations, the methods and the general mentality were all geared to the manufacturing of ordnance and equipment by mass production rather than to a focus on innovation and advancement.

DoD's use of the private sector as the primary agent for the development of new hardware had its origins in the 1920s. The shift in emphasis was driven mostly by advances in aviation and aircraft technology. While working to develop new aircraft engines, the arcane in-house methods

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[65]This section drawn from McNaugher, pp. 17-33.

[66]*Ibid.*, p. 21.

employed by the Navy and the Army Air Corps put them miserably behind commercial industry. The bureaucracies could not respond to the rapidly changing technological environment.

The impetus for using the private aircraft industry to design and develop new aircraft came primarily from entrepreneurs in the industry. These leaders lobbied Congress to get the development of military aircraft out of the government's inflexible system and into the hands of the experts. Speed and innovation were paramount, and the military's in-house capability could provide neither. Congress, being "fascinated not only with aircraft and the free-wheeling entrepreneurs who built them but also with the 'promise of air power',"[67] forced the change upon the services. Since the military's aviation community was still relatively new at this time and not as entrenched as, say, the Army Ordnance Bureau, opposition by the services to these changes was meager.

During the interwar period, this turn to the private sector became a highly politicized process. Congress, seeking to ensure competition so that all companies (especially those in their home districts) had a fair shot at the American dream, instituted provisions requiring fixed-price contracts and competition for development contracts. The services held a competition for each design,

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[67] *Ibid.*, p. 22.

bought the rights for the design, and then advertised the production contract for competitive bid. With enormously detailed contracts at each step and intense pressure on contractors to win low-bid contracts, innovation languished. In order to get the contract award, developers often under-bid their design contracts with the hope of making up their expenses by winning the production bid. However, this scenario rarely played out because competing contractors with no invested development costs usually submitted lower prices for the production contract.

Although the American taxpayer received the immediate financial benefit of having market forces driving down prices at every step, several damaging influences were also being felt. First, designers who lost the production bid had no incentive to improve their design; at the same time, winning bidders had no incentive to change the design because they were constrained by the terms of the contract. Therefore, the aircraft was stagnant while technology marched on. The second repercussion of this contracting situation was that aircraft designers, unable to recoup their true expenses of developing and experimenting with new ideas, often either abandoned the process or were driven to insolvency. Although designed to protect the public's interest, Congresses actions actually did a disservice to the industry and to the military research and development effort.

During the late 1930s, reforms to the process were being considered. However, the United States' entry into World War II put those plans on hold. Production was king for the war effort.

The final step in the evolution to the current weapons acquisition process came with the beginnings of the Cold War and an increased reliance on new technologies in electronics, radars, and communications systems.

> At that point the United States took up the challenge of accommodating a large, expensive, and risky technical and military undertaking into a political system inherently uncomfortable with what it takes to do a good job of developing technology.[68]

The nature of the hardware had changed again. Instead of being able to develop and produce individual components and piecing them together to make a missile or airplane, the military found that each part was so dependent on the others that they all had to be developed in concert. The modern "weapons system" acquisition process was born.

4.4.2 The Current Process

In reality, there are as many particular variations to the weapons acquisition process as there are weapons systems, but the overall process is similar. Many variations and reforms have been instituted in the past 40 years, yet the current weapons acquisition process can still be categorized into two broad areas: weapons development and

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[68] *Ibid.*, p. 3.

weapons production. Since production as currently practiced is primarily a manufacturing effort to produce multiple physical products, it bears only a slight relation to the environmental restoration process. Therefore, the focus of this section will be on the development of weapons and weapons technology. This process, filled with unique designs, engineering efforts, and one-of-a-kind results, has a higher probability of offering some insights applicable to the challenges of remediation contracting.

Figure 4.1 shows the basic process followed by DoD when developing a weapon system. A more detailed explanation of each steps follows.[69]

The initial step in the development of a new weapon is the recognition of a need. If one of the individual military services (Army, Air Force, Navy, or Marine Corps) identifies an operational mission which cannot be accomplished with the existing assets, a requirement is generated for something new. The service passes this information to the DoD staff level.

The first hurdle in the process, known as Milestone 0, is the validation of the operational requirement by DoD. A joint staff validates the necessity of the requirement and then determines which service can best meet the mission need. For example, the Marine Corps may identify a mission need for some new air defense capability, but it is the

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[69]Developed from Fox, pp. 22-27, and Celotto.

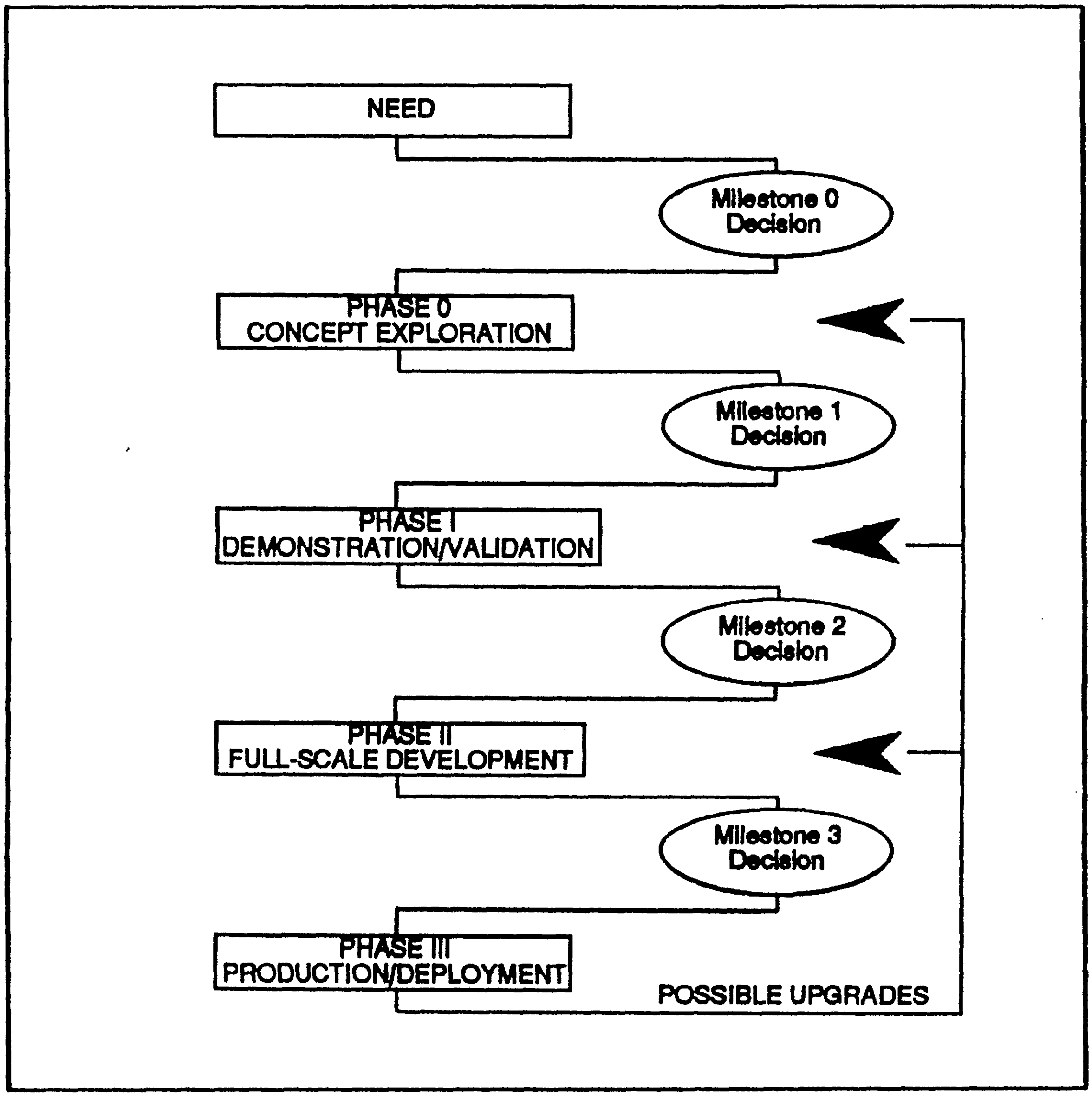

Figure 4.1 - The Weapons Acquisition Process

Pentagon staff which determines whether that requirement should be addressed by the Air Force, by naval aviation, by Army air defense, or by a Marine Corps element. DoD gives budget authority to the service which is slated to begin the development process.

Phase 0 of the process is known as concept exploration. The individual service which has been tasked to explore the need develops alternative system design concepts. These alternatives are initially very broad (an airplane? a missile? a laser?), and are often generated in consultation with several of the major defense contractors.

Contractors are willing to undertake these discussions for two reasons. First, they are at least partially reimbursed for certain "independent research and development costs" by a separate charge to other contracts they have with DoD;[70] in effect, each contract with DoD gives them an opportunity to recoup some of these costs in a pooling arrangement. Second, the contractors want to participate in the system design concept discussions because it provides them an opportunity to get their foot in the door early on what may eventually blossom into a lucrative development contract.

By the end of Phase 0, DoD will have established a general idea as to the type of weapon it wants to pursue and will set broad cost, schedule and operational thresholds that must fall within set ranges by Milestone II. In theory, by this time DoD has identified the key areas of technical risk that must be reduced by research and development in the next phase. The service prepares a system concept paper for the DoD staff, who in turn makes the Milestone I decision to proceed into the concept

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[70] William H. Gregory. *The Defense Procurement Mess.* Lexington, Massachusetts: D. C. Heath & Company, 1989, p. 68.

demonstration/ validation phase.

Phase I, demonstration and validation, is when the rubber begins to meet the road. The services and interested contractors begin exploring detailed technical approaches to the program and performing analyses of the technical risks. If funding permits, hardware prototypes are often used to demonstrate the feasibility of the various alternatives. Contractors are usually reimbursed on a cost-plus basis for their efforts during the demonstration phase, provided they stay within reasonable bounds of the intent of the program.

The results from Phase I are again passed from the individual service to a joint DoD staff. In order to pass Milestone II, the program must meet six criteria:[71]

1. Demonstrable engineering, rather than experimental, effort.
2. Definition of the mission and performance requirements.
3. Selection of the best-perceived technical approaches.
4. A thorough trade-off analysis.
5. Comparison of the cost effectiveness for the proposed weapon system and competing systems within DoD, concluding that the proposal is feasible.
6. Credible and acceptable cost and schedule

[71]Fox, p. 26.

estimates.

Following the Secretary of Defense's authorization to proceed, and appropriation/allocation of project funding, the individual service issues a Request for Proposals (RFP). The RFP gives the managerial, technical and cost criteria against which the proposals will be evaluated. Although the RFPs normally request only a moderate amount of information that will be used to evaluate the offers, the responses are almost always huge, with "pound upon pound of annexes and appendices - their thickness measured in feet, not folios."[72] No one wants to take a chance on leaving anything out.

Preparing these proposals costs defense firms millions, but the costs are reimbursed in part as a "bid-and-proposal" line item charge against other contracts the company may have with the government (much in the same way as the independent research and development costs are reimbursed). The quandary for a contractor is that he is never fully reimbursed for his efforts. If the government is actively pursuing a contractor to submit a proposal, the vendor may not be sure whether the government is doing it because they expect him to be able to win the award or because they need to give an appearance of competition before they award to the contractor that they really want.[73] The contractor

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[72]Gregory, p. 66.

[73]*Ibid.*, p. 68.

must weigh the uncertainty of the award against the non-reimbursed portion of his "bid-and-proposal" expenses.

In the end, the evaluation process becomes increasingly difficult in direct proportion to the size and complexity of the proposals, often taking six months or more. The responsive proposals are evaluated by a panel, which varies in size and seniority of appointees depending on the value and complexity of the acquisition. This panel makes a recommendation to a Pentagon political-level appointee (often the service secretary himself) who can accept or reject the source selection panel's choice.[74] The source selection authority bases his decision on the comparative evaluations of the proposals, costs, risk assessment, past performance, contractual considerations, and surveys of contractor capabilities.[75]

The awarding of a contract signals the entry into Phase II, full-scale development. The system (including all training devices and support items) is fully developed, engineered, fabricated and tested at some low rate of production. The contract for this stage of the process is either a cost-plus contract or a fixed-price contract, depending on the particular acquisition. If a weapon is new and it is also being pushed through the process rapidly, it is likely to overlap with the earlier and later development

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[74] *Ibid.*, pp. 67-68.

[75] Fox, p. 30.

phases and thus will often be a cost-type contract. Even if the technology is relatively sure and the contract is fixed-price, the developer is still likely to negotiate several hundred changes to the original contract (changes that either party might initiate). It does not take too many of these changes before the contract begins to mimic a cost-type contract.

Provided that Phase II proceeds without too many major cost overruns, schedule problems, or too much attention from Congress or the media, the individual service secretary has the authority to approve entry of the system into full scale production. This approval is known as Milestone III.

Phase III of the weapons development and production process is full-scale production and initial deployment. The contract for this production is often competitively bid on a fixed-price basis, because by this time most of the major risks have been identified and contractors are expected to bear some of those risks. However, if the program is rushed and full-scale production overlaps with the development phase, the production contract can be negotiated on a sole-source basis with the development contractor.

Of course, by the time a new weapon system reaches full-scale production, twelve years have passed, the threat has shifted, and the operational requirement has changed, so the plans for the updated model begin...

4.5 Risk Allocation in the Weapons Contracting Process

As mentioned earlier, the key to properly managing the uncertainty in a contracting situation is to assess the risks, allocate them to the party best able to manage or control the uncertainty, and compensate the party appropriately.

4.5.1 Assessing the Risks

As with Section 3.5.1, one convenient way to organize the risks is by when they occur in the process. Some risks are present throughout the acquisition process, others are predominant in only one step, and still others are questionable as to when they occur. Some risks, such as business risk, are present regardless of what business one is in so those categories are ignored here. This section lists and briefly describes the significant risks during each development phase. A discussion on the allocation of risks follows in Section 4.5.2.

Phase 0

At this stage, the risks are minimal because very little commitment has been made by either party.

- Financial risks: uncertainty as to whether contractor can recover the costs of his independent efforts; uncertainty as to whether the project can be completed within the given budget.

- Technological risks: uncertainty as to whether the selected technologies are even appropriate to meet the mission need (risk of the <u>decision</u> about the application of technologies, not the risk of the performance of the technologies per se); uncertainty as to whether DoD has identified all the "unknowns" which must be tackled as the program progresses (the "known unknowns" versus the "unknown unknowns").

<u>Phase I</u>

The risks increase during the demonstration and validation phase.

- Scope of work: amount of effort which will be required of the contractor in order to obtain the level of information needed for decision-making; number of "unknown unknowns" which will surface.

- Performance of the contractors: their ability to achieve what they claim they can in terms of technological advancement or innovative ideas.

- Financial risks: costs required to perform an undefinitized level of work on what is often a technology application that is unproven at this stage; uncertainty as to the reliability of cost estimates for future phases of the development based on the work to date; risk of not recovering all expenses required to prepare the proposal for Phase II.

- Technology: ability of the particular technology to function in a field application and at the levels of performance necessary; risk in the selection of the particular technology to pursue in Phase II.

Phase II

At this stage, all major risks are expected to have been identified and should be more of an engineering nature than an experimental nature. As will be shown, however, this is not always the case.

- Scope of work: uncertainty as to the level of effort required to manufacture a working product; uncertainty as to what that final product will actually look like and how it will be manufactured.

- Performance of the developer: ability to meet schedule and cost estimates; ability to manage the work as required by contract; ability to identify the source of any problems which cause cost overruns or delays.

- Financial risks: uncertainty as to whether the actual costs for items that were foreseen at the time of proposal preparation fall within estimates; uncertainty in the costs for any "unknown unknowns" which surface and whether or not the added costs can be recovered by the contractor.

- Technology: uncertainty in the conversion of the technology from the prototype/theoretical stage into a fully engineered application of that technology; uncertainty that even if the transition is successful that the technology will perform well enough to meet the mission need.

Phase III

The risks of Phase III usually encompass more typical business, market or manufacturing risks than the earlier developmental phases.

- Scope of work: level of effort required to manufacture each product.

- Performance of contractor: quality and timeliness of his work.

- Financial risk: costs to produce each product, including tooling, labor, etc.

- Technology: performance of the technology in deployment situations and in the hands of the everyday user (as opposed to the performance in a test/lab situation at the hands of a military test specialist or engineer).

4.5.2 Allocation and Compensation

The weapons development and production process has evolved over the past 40 years to the point where risks seem to be allocated logically. Although the system does have flaws in the way it is carried out, the methodology is appropriately structured to handle uncertainty.

This section examines how the risks identified in Section 4.5.1 are allocated. Since the financial compensation in most cases is one way (from the government to the contractor), the appropriateness of the compensation is discussed only when the contractor is bearing a risk. Each risk is listed as written earlier, followed by a discussion of who appears to be bearing that risk and some of the important considerations that govern the allocation and compensation.

Phase 0

- Financial risks: the uncertainty is shared as to whether the contractor can recover the costs of his independent research efforts; he will only be partially compensated by the "independent research and development" charge if he has other contracts (which most major firms in this business do have). Nevertheless, the level of effort the contractor chooses to devote to this phase is purely voluntary and under his control, so the compensation appears fair. The uncertainty as to whether the project can be completed within the given budget is born by the government, since they make the decision as to whether or not to proceed with the program.

- Technological risks: the risk of the appropriateness of the technologies belongs to the government, since they choose which avenues to pursue further. The uncertainty as to whether DoD has identified all the "unknowns" which must be tackled as the program progresses is also carried by DoD because they suffer the financial consequences of higher payments in later stages if they haven't analyzed the situation correctly. Again, these are tasks under DoD control so they should carry the risk.

Phase I

- Scope of work: the government bears the risk because they contract for this work on a cost-plus basis; since the government has control over how much work they request and how much information they need to make their next Milestone decision, it is appropriate for them to manage this risk.

- Performance of the contractors: born by the contractors, as it should be. If their performance is satisfactory, they are compensated for their costs plus overhead and profit; if they stray too far from the intent of the program and their agreement with the government, the government can disallow the recover of the unnecessary expenses.

- Financial risks: The financial risk of the undefinitized scope of work is shouldered by the government with the cost-plus contract. The uncertainty as to the reliability of the government's cost estimates for future phases of the development is born by DoD because they suffer the consequences of inadequate estimates. The risk of not recovering all expenses required to prepare the proposal for Phase II is appropriately carried by the contractor, since he determines how much effort he puts into preparing the proposal. This risk is carried by any contractor in any industry which competes for work by bidding or competitive proposals.

- Technology: again, DoD has control over the decision and subsequently carries the risk for that decision by the amount it must pay in later phases.

<u>Phase II</u>

- Scope of work: since the level of effort required to transition from experimentation to engineering is so unpredictable and since DoD determines in the end whether the developed product is what they want, the government should and does carry most of this risk through the contracting arrangement (be it cost-plus or a de facto cost-plus contract disguised as a 'fixed-price' contract).

- Performance of the developer: because of the government's ability to disallow reimbursement for certain costs that are not within the standards of the contract, this is a risk carried by the contractor. The allocation is proper because it is the developer who determines his company's management attention, cost control procedures, etc., and he has the ability to control whether or not he is meeting the standards to gain the cost-plus reimbursement.

- Financial risks: as with the scope of work, carried mostly by the government through the contracting arrangement. Since the development contractor cannot count on getting the production contract, he has no way to ensure he can later recover the developmental costs as part of the overhead charge on each manufactured product. "His risk, then, is prohibitive - unless the government agrees to underwrite the bulk of the costs."[76] Thus the government pays for the developmental cost as it occurs rather than trying to spread these expenses over the costs of each

[76]Gregory, p. 70.

finished product.

- Technology: carried by the government through the cost-plus (or pseudo-cost-plus) contracts. This is appropriate, even though some might argue that by this point in time the contractor should be carrying more risk to develop his particular weapon technology. The problem is that the level of effort required at this stage is often influenced by the government's actions at the previous stages.

> At Milestone II [the decision which allowed the program to proceed into full-scale development], all significant risks are expected to have been resolved, the technology is in hand, and only engineering (as opposed to experimental) efforts remain...In practice, paper studies and analyses often substitute for essential system development and testing. As a result, uncertainties that could be eliminated or reduced in the research and exploratory development phases are often carried into advanced engineering development or operational systems development, where unresolved technical problems are significantly more expensive and troublesome to correct.[77]

Therefore, a de facto cost-plus arrangement in the full-scale development phase may still be suitable in order that DoD still bear the risk.

Phase III

- Scope of work: the uncertainty of the level of effort required to manufacture each product is born by the contractor by his fixed-price bid; this allotment is correct since most of the engineering and technical uncertainties

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[77]Fox, pp. 25-26.

have been resolved by this point and thus it is the contractor who can control how he manufactures the product.

- Performance of contractor: also born by the contractor by his fixed-price bid, and rightfully so since he has the best ability to manage the quality and timeliness of his work.

- Financial risk: the costs to produce each product are carried by the contractor in his bid, along the same lines as the scope of work.

- Technology: even though the contract is normally a fixed-price contract, it is the government which actually bears the uncertainty that the technology it has chosen will perform as desired in deployment situations and in the hands of the everyday user (as opposed to the performance in a test/lab situation at the hands of a military test specialist or engineer). If the product it receives meets the specifications of the contract, the government must pay for the product even if it doesn't do what DoD thought it would. Even if the contract is eventually terminated, the vendor receives compensation for the costs he has incurred.

In summary, the weapons development business is a very risky business, and the government recognizes those uncertainties with the contracts it uses.

4.6 Some Positive and Negative Aspects of the Weapons

Acquisition Process

Since the focus of this thesis is the environmental restoration contracting process, it is not necessary to perform a complete analysis of the weapons acquisition process and all of its advantages and disadvantages. Therefore, this section presents only the key aspects of the weapons development and production system that could be relevant to environmental remediation contracting methods.

4.6.1 Positive Aspects

There are several positive aspects of the weapons acquisition process which are worth noting. First, the results achieved by the industry are a reflection of the ingenuity and adaptability of the private sector. Historically, DoD turned to the marketplace when speed and flexibility were needed to keep pace with technology, and industry more than met the challenge.

Another beneficial facet of the weapons contracting process is that it clearly recognizes technical uncertainty. Although the notion of cost-plus contracts conjures up images of contractors sucking the government dry, in reality the contracts play a necessary role in the acquisition process.

> ...cost-plus contracts - or, more broadly, cost-type contracts - continue to survive, because they provide an incentive to producers in what would otherwise be too risky a situation - the quest for advanced technology equipment that has never been built before in this particular form for a narrow market (perhaps a single customer) that can, and does, change its mind. Thus cost-plus contracts

allow for financing of programs that a private contractor would not otherwise take on.[78]

During the history of DoD reforms to the acquisition system, one of the attempts to break free of open-ended cost-type contracts was the use of incentive-type contracts. The format for these is much like a guaranteed maximum price contract in construction, where the contractor gives an estimated price and a ceiling price, with provisions for sharing the savings until the ceiling price is reached (at which time the contractor bears all costs). The contract for the development of the F-111 fighter aircraft was an incentive contract, and it was fraught with both technical problems and cost overruns.[79]

In short, DoD tried to overcome the inherent technical uncertainties in aircraft development (and resulting cost-plus contracts) by writing an extremely detailed project definition package and turning it over to industry on an incentive contract basis. The downfall for this method was that the project definition package, despite its thoroughness, did not predict the inevitable technical problems.

> Given the project's technological risk, writing such an accurate contract would have required more perspicacity than anyone possessed...(Defense Secretary) McNamara and his staff were arguably

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[78]Gregory, p. 69.

[79]For a complete discussion on this case, the reader is referred to McNaugher pp. 60-62.

insensitive to the unpredictability of technology.[80]

The contract between DoD and General Dynamics was confounded by engineering change proposals, claims and counterclaims. The result was that technical and design issues became legal issues which had to be resolved by bureaucrats and lawyers instead of the technical managers. "The resulting environment hardly favored the development of sophisticated weaponry."[81]

In the final analysis, the current cost-plus system recognizes and treats technology risks much more effectively than incentive or fixed-price contracting systems.

A third positive point about the method used by DoD to develop its weapons is that it shows the value of prototype testing during the early stages of development when trying to predict the likelihood that a new technology will work. One keen example of this benefit in solving technical uncertainty was the Pentagon's lightweight fighter fly-off competition during the 1970s. In a nutshell, instead of trying to use a specific aircraft program to push defense contractors into developing the next generation fighter aircraft (while two multi-billion dollar programs, the F-14 and F-15, were still in full production and nowhere near obsolete), DoD decided to hold a prototype competition for

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[80]McNaugher, p. 60.

[81]*Ibid.*, p. 61.

the sake of the technology only. The aircraft which eventually resulted from this "fly-before-buy" competition in ideas (the F-16 and F/A-18) were then incorporated into the more traditional development process and "set the mold for fighter design all over the world for decades to follow."[82]

> What fly-before-buy does for program management is to knock off the nonsense of paper-cost estimates, of paper-performance estimates, and get real hardware into the sky to get hard data. Fly-before-buy gives some real indications of manufacturing costs. A prototype injects hard-nosed experience and realism into a system filled with computer runs and marketing optimism. Flight testing demonstrates how accurate fuel-consumption projections are; it gives a preliminary idea of reliability, of maintenance manhours; it shows whether the prototype will deliver on maneuverability, speed, and the rest of the performance its designers promised.[83]

Keeping innovative contractors interested and involved in the development of new weapons is the fourth benefit of the DoD acquisition system. By having contractors participate in the conceptual phases of a new program, and by reimbursing part of their upfront bid-and-proposal and independent research and development costs, DoD gives incentives for contractors to work with the Pentagon and promote their ideas.

Finally, the weapons acquisition process allows for the selection of the most qualified contractors. Since the

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[82]Gregory, pp. 135-136.

[83]*Ibid.*, p. 141.

selection criteria include factors other than price, DoD can consider the firm's past performance and other important concerns when trying to create a new weapon system.

In summary, the DoD weapons acquisition process has achieved remarkable success in terms of allocating risk and in the products and technologies it has created. Since the linchpin of U. S. strategy has been superior technology, the process has succeeded in its mission.

4.6.2 Negative Aspects

The extent of the problems in the weapons acquisition process are too lengthy and detailed to be expressed in full here. Some of the negative aspects are capsulized below so that they can be drawn upon in later sections.[84]

Because of the size of the programs and the number of organizations involved in the decision making, the process is highly centralized and consensus building is the only way anything gets accomplished. One has to satisfy the interests and concerns of Congress, the Office of Management and Budget (OMB), the DoD senior staff, the particular service staff, the program management team, the user commands, and industry itself before any issue is resolved

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[84]For a more comprehensive view of the DoD weapons acquisition process and its associated ills, the reader is referred to the books by Fox, Gregory and McNaugher listed in the bibliography.

and the process can move.[85] As a result, programs lumber along no matter how urgent the priority.

A second negative aspect of the weapons acquisition process is that it is highly politicized. The risk assessment of the perceived national threat and the defense capabilities needed to respond to that threat is not always rational. "To be sure, the nation as a whole does not collectively make risk assessments in some rational sense. Rather, the political system makes these calculations implicitly in the context of formulating defense budgets each year."[86] The ramification is that money may be allocated on a partisan or emotional basis rather than where it is most needed or where it can be used most effectively.

One of the biggest criticisms of the DoD weapons development process is that costs are seemingly uncontrolled, with overruns being the rule rather than the exception. The spiralling costs are caused by a number of factors, some of which are justifiable.

One of the biggest contributors to the ever increasing costs is the nature of the work and the technical uncertainty involved. "Technology is not a sure thing. Old fashion cut-and-try will always be with us, something engineers understand - but taxpayers do not. A turkey may

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[85]Fox, p. 18.

[86]McNaugher, p. 12.

be necessary the first time to produce an eagle the second."[87] Sometimes it takes a few failures and a chunk of money in order to crack a technology barrier.

Another item which adds to the cost problems is the instability in the funding of the various programs. In both the development and the production phases, Congress has the prerogative of terminating funding, reducing the number of units bought, or delaying the program for a year or more. An Air Force study found "funding instability at the top of the list of reasons why development programs take longer and cost more - surprisingly ahead of technical problems."[88] With the uncertainty in funding or contract renewal for the next year, the contractor must consider higher contingencies in his budgeting and there is no real incentive for the contractor to invest in any long-term cost saving measures.

Costs also escalate because many of the DoD program managers are not acquisition professionals and do not have the industrial or management background to properly run their projects. Most are military officers who rotate through the Pentagon after having completed operational tours throughout their careers.[89] Lower level managers also lack in their experience and training. It has been reported that during the proposal evaluation process,

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[87]Gregory, p. 130.

[88]*Ibid.*, p. 146.

[89]Fox, pp. 151-156.

government personnel have been known to reveal to a proposer, by offering suggestions for improvements to his particular proposal, the technical and design approaches of a competitor. Industry considers this technical leveling process as unethical.[90] Acquisition personnel at all levels contribute to the cost problems.

One way Congress has tried to cap the expanding costs and exert more control over the process is through detailed legislation. This "solution" has actually become another negative aspect of the DoD weapons procurement process. Instead of providing guidelines, balancing national priorities, and allocating funds, Congress has injected itself into the process by writing laws which detail particular actions that must occur in specific weapons contracts, which redirect programs from one district to another, and which require voluminous reports back to Congress.

> Good regulation helps good managers, but weapons acquisition regulation has been pursuing an impossible dream: legislating perfection. Driven essentially by Congress, regulation and reform in the Pentagon have pushed paperwork and procedure to prevent every possible mistake. But this has not worked. It could not. No regulation can create good management or top-notch people.[91]

Program managers, unable to freely exercise their authority or judgement (and fearful of making an error while under the

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[90] *Ibid.*, p. 30.

[91] Gregory, p. xii.

magnifying glass of Congress), have been more likely to defer action and take the safest path in order to comply with the law, regardless of the results achieved.[92]

In the cases where fixed-price contracts have been used, there is an additional conflict with this excessive amount of procurement legislation and regulation. The customer, DoD, can direct, approve or disapprove particular contractor actions and exercise detailed management over a program, yet DoD does not share in the financial success or failure of the contractor's performance because it expects the contractor to bear all the risks inherent in a fixed-price contract.[93] There is a natural tension created when the government wants the contractor to commit to a fixed price and then also wants to control how he executes the contract. You can't have it both ways.

One final negative aspect of the weapons development process is that it has fostered the consolidation of the defense industry. The large program dollar values, the management systems and engineering expertise required by the government's contracts, and the convoluted regulation schemes all contribute to the formation of large, specialized contractors who deal almost exclusively with DoD. As a result, obtaining competition for particular projects becomes more difficult because only a few firms

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[92]Fox, p. 84.

[93]Gregory, p. 76.

have the ability to survive in this environment.

4.7 Chapter Summary

The design and manufacture of military weapon systems is a complex, expensive process that only the most technologically advanced firms can master. The current "weapons system" approach to the procurement of military hardware from the private sector evolved from its origins in the 1920s, and changes to the process have almost always been driven by advancements in technology and changes in the nature of the weapons themselves. Although the process is far from perfect, some good does come from this flawed process. In particular, the DoD weapons development and production system delivers a high quality product that has done its job.

> ...in a world where everyone's weapons are growing more complex and expensive, U. S. weapons often stand out as top performers. The acquisition process seems to do tolerably well what it was established to do, namely, arm the nation's forces with weapons technologically superior to those of its chief adversary, the Soviet Union.[94]

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[94] McNaugher, p. 1.

5

RECOMMENDATIONS FOR THE ENVIRONMENTAL CONTRACTING PROCESS

5.1 General

> *If one purchases standard items - cars, trucks, or other commercial products - a fixed-price contract is usually an appropriate substitute for day-to-day management of the project. If one purchases a large custom-made R&D or production program, however, where changes in schedules, cost and specifications occur as frequently as once a week (or, more likely, once a day), a fixed-price contract is inappropriate and therefore no substitute for day-to-day evaluations and negotiations between the buyer and the seller.*[95] (emphasis added)

Many situations encountered in the environmental restoration process require flexibility, innovation, and the capacity to create a custom-made solution. As argued in Chapter 3, the military's most common system for contracting for environmental remediation work does not meet these requirements as well as it could. In addition, the exorbitant costs the nation as a whole and DoD in particular face in cleaning up hazardous waste sites are partially driven by two factors: a misallocation of risk in the contracting process and poor (i.e., inefficient) technologies.

What, then, can the military do to improve on its contracting practices in an effort to more effectively

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[95] Fox, pp. 2-3.

attack the environmental problems of the coming decades?

One possible solution is to improve the contracting process so that risk is more effectively allocated. This shift would not only be more efficient in terms of risk management and pricing, it should also encourage the development of innovative technologies. Both of these improvements would lead to lower overall costs for the hazardous waste cleanup effort.

Since the weapons acquisition process must treat similar conditions of uncertainty and has managed to do so while successfully developing new technologies, DoD should attempt to capture the benefits of its experience. This does not imply that the weapons acquisition process should serve as a *model*. One normally associates military weapons procurement with terms like gold-plated, scandal, corruption, or porkbarrel.

> In the minds of much of the citizenry, the Pentagon procurement system is manned by fast-buck artists, incompetents, or deranged Dr. Strangelove's who, when they lack weapons of mass destruction to tinker with, design $600 hammers or $5,000 coffeepots.[96]

Although this perception is not truly indicative of the situation in Washington, it hints that there are as many lessons to be learned about what NOT to do as there are what TO do when structuring a procurement system. Those who are responsible for managing DoD's environmental restoration

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[96]Gregory, p. 1.

programs should try to glean from the weapons procurement methodology the basic principles which might solve some of the deficiencies in the environmental restoration contracting process.

This chapter highlights some of those lessons, then applies them by describing one possible contracting structure. The hindrances to applying the lessons learned are also presented. The chapter concludes with a brief consideration of the challenges facing DoD personnel at the local installation level who are trying to get the environmental restoration work done.

5.2 Lessons from Weapons Contracting to be Applied to Remediation Contracting

This section states, in a generic sense, the lessons to be learned from the weapons contracting process. Those who are involved with the environmental contracting process might use some of these principles to solve the particular problems they confront.

5.2.1 What to Do

- DoD should recall that in the weapons industry innovation outpaced the contracting changes and <u>forced</u> a reaction. The prudent manager should foresee the need for change and help to shape the outcome.

- DoD should continue to contract with the private sector for environmental restoration services in order to take advantage of industry's ability to respond to change and to innovate. There is no need to establish a government agency to create the new technologies or to perform the site remediations. Government's role should be to establish and monitor a system that uses the private sector.

- DoD must be willing to use flexible contracts where uncertainty is high with regards to the scope of work or the performance of the technology. This may include contracts in which the government absorbs some of the financial and technical risks.

- As an owner who must rely on multiple contractors to get a restoration completed, DoD should make every effort to foster teamwork and reduce disputes. The structuring of the contracts and the general attitude of the owner both play a big part in reducing the costs of disputes or litigation, and DoD has control over these factors.

- DoD must recognize how to develop new remediation technologies. It is unreasonable to expect the current contracting system or any alternative procurement method for a *particular* project to be the font of new technologies. Contractors can't afford the risk and the results are too narrow. Instead, DoD should develop a system that allows vendors to test their ideas under full-scale, real-world conditions (not just a bench scale test on selected contaminants at a controlled site), and partially reimburses them for their efforts. The lightweight fighter competition of the 1970s was an example of a competition for the sake of the technology alone, outside the window of a particular development program. The results of this fly-off were captured and matured into two very successful aircraft.

> While independent research and development has been attacked in Congress as a gift to contractors, and by antidefense groups as a system whereby the government finances contractors to develop hardware that they then sell to the military at fat prices, defenders can point to this case [the F-16 and F/A-18].[97]

- As new technologies emerge, DoD must pay attention to how to apply the technologies on particular projects. The government should use performance and mission oriented specs to encourage adaptation. DoD must structure its contracts to allow for change on individual projects. In addition, the contracting environment must be one which allows multiple advanced technologies to come together, much like a situation where a firm such as General Dynamics draws subsystems from the most creative and advanced vendors and then interfaces those components with its own work.

- In the quest for innovation in either the general sense or for a particular project, DoD must absolutely recognize that technical uncertainty is high and treat the situation accordingly. If DoD wants modernization, it must be willing to assume some of the risks inherent in breaking technical barriers.

- On a more mundane contracting level, DoD should

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[97] *Ibid.*, p. 136.

consider factors other than price when choosing a contractor for any step in the restoration process. When evaluating contractor proposals, government personnel must keep proposals confidential or DoD will lose credibility with the industry. For those contractors who are selected and who perform well, DoD should find a way to recognize outstanding contractors and keep them interested in doing more work. This requires that the good contractors remain involved in the decision making processes and that they remain solvent while sharing in this risky business with DoD.

- The government must make every effort to fund projects fully and stably, including reserves for contingencies which thus allow prudent management.

- Since DoD cannot control the total funds Congress appropriates for environmental restoration each year, DoD must work to allocate the funds it gets in a rational manner. The Defense Priority Model mentioned in Chapter 2 should help DoD do this.

- DoD and the nation as a whole must try to keep the environmental restoration process rational, not political or emotional. The fact that each individual project is essentially a "local" project and that the environmental restoration industry is still fragmented works to diminish the political lobbying effects. Only education and trust can diminish the emotional facet.

- Finally, to make any of these ideas work well, DoD needs to ensure it has created a working environment which attracts high quality people and rewards them for their excellence in government service.

5.2.2 What Not to Do

- DoD should not attempt to use any particular contracting method or choose any restoration technology "just because it's the way we've always done these things." Judgement and consideration of the individual circumstances are the most important roles of the manager.

- The government must not create a contracting environment full of waste in overpriced/gold-plated specifications. One should not create a system where higher costs mean higher profits for the contractor unless there is a tight but fair control mechanism for evaluating the validity of costs.

- If DoD seeks value for its money and also seeks innovative ideas, then it should not use sole-source solicitations which prevent any remnant of competition.

- The government should not make a contractor bear the risk of technology itself, but just his performance of that technology.

- DoD must not seek to overregulate the restoration process or they will stifle it:

> For years, acquisition managers have asked the customer to give industry a performance specification, to tell industry in broad terms what it wants, and then let competitors vie to see who can do the best design and manufacturing job. But instead, government exerts more and more

> control over more and more detail of how industry does a technical job, through incessant reviews, regulations, and paperwork.[98]

In situations were DoD is using fixed-price contracts, the problem of regulation is further exacerbated because it is counterproductive to used fixed-price contracts when the customer (DoD) has so much control over the contractor's means and methods.

- To take advantage on the knowledge of the people in the field and closest to the individual projects and problems, DoD should not allow the environmental restoration process to become overly centralized.

- Finally, DoD must not create a "defense-environmental complex" of a few megacontractors. Most of the negative aspects of the weapons acquisition process stem from power, greed and politics.

5.3 Defining the "Ideal" Remediation Contracting Package

This section attempts to apply some of the lessons learned by outlining one possible contracting situation. Since some of the same players under weapons contracting are now getting into the environmental business, some of the changes to the process lend themselves nicely to the market which is being called upon to contract with DoD.

By no means should this application be considered 'the definitive answer.' No single "ideal" procurement package

[98] *Ibid.*, pp. 200-201.

could ever hope to incorporate every one of the principles of Section 5.2 or pretend to apply to every situation encountered in the field. To make matters worse, one still has to consider the real world when outlining an alternative method. (Section 5.4 injects some of this realism). What senior DoD environmental managers can do is create a system that helps foster a corporate mentality of innovation and willingness to change.

5.3.1 Individual Projects

One contracting combination which would recognize when uncertainty is high and also encourage innovation is a cost-plus-award-fee contract for the completion of the "study" portions of the project (the PA/SI, RI/FS and writing of the ROD), followed by a design-build contract with a new contractor for the execution of the project (RD/RA). This design-build contract would be a cost-plus-fixed-fee contract which would be converted to a fixed-price incentive (firm target) contract. The procurements with both of the firms would be negotiated, not bid.

The contract for the study should be awarded and administered by one of the service's regional level engineering offices in consultation with the local activity where the project occurs. This would ensure that the government has adequate expertise to evaluate the firm's proposal, experience with or access to cost information that would allow them review and audit the contractor's progress, and sufficient technical expertise to make decisions with respect to the RI/FS and ROD. This cost-plus-award-fee contract would offer the following advantages:

- the cost reimbursement nature of the contract counters the uncertainty about the level of effort required to collect data, to characterize the site or to evaluate the alternative technologies during the FS

- the award-fee (in which the government evaluates the contractor with respect to cost, schedule and quality of work) can be weighted to emphasize the most important aspect of the project and offers an incentive to the engineering firm to control costs without cutting corners on the work necessary to perform a proper study

- because the contract is a negotiated procurement, DoD can consider factors other than price when awarding the contract

- the analysis performed by the contractor when evaluating alternatives and preparing the ROD is not biased by the firm's own design capabilities because the contractor would not be allowed to compete for the follow-on design-build contract (i.e., he is free to recommend any alternative)

The design-build contract for the remedial design and remedial action steps should be awarded and administered by the local activity's construction office with the assistance of the regional level engineering office. This too would be a negotiated procurement, where competing design-build teams' proposals would be evaluated and ranked considering experience on previous work as a team, qualifications of the individual members of the design-build team, financial stability of the firms, bonding capacity, experience (either separately or together) on other DoD work, proposed methods of design/project management, adherence of proposed technologies to the Record of Decision, Work Plan for the remedial design, proposed subcontractors, and so on.

Negotiations would begin with the most advantageous offerer in an attempt to execute a bilateral cost-plus-fixed-fee agreement. Included in that agreement would be a provision to convert to a fixed-price incentive (firm target) contract when most of the technical and scope uncertainties are resolved. At that point, the design-build team would be reimbursed for its allowable costs and paid its flat fee for the work to date, and then the target cost, target price, and price ceiling would be set for the remainder of the contract. This point of conversion could vary from project to project, but because of the design-build nature of the work would probably be after the early stages of "construction" but while some design details remained.

If for some reason the two parties could not reach a CPFF agreement, negotiations would begin with the second-ranked proposer. Upon award of a design-build contract, the successful team would begin the remedial design and remedial action.

This contracting arrangement would offer the following advantages:

- the cost reimbursement nature of the initial contract counters the uncertainty about the level of effort required to design an acceptable solution and the uncertainty in testing particular technologies under the actual site conditions. It also reduces the risk to the RD designer if the data gathered by the study engineering firm turns out to be inadequate or flawed.

- the fixed-fee and conversion features diminish the possibility of gold-plating because increased costs do not result in increased profits (note that unlike many cost-type contracts in the private sector, cost-plus contracts under the FAR do not permit the fee to be a fixed percentage of costs; the fee is negotiated and fixed at the inception of the contract, but may be adjusted as a result of changes in the work to be performed under the contract[99])

- because of the fixed-price incentive contract, the final price of the project is somewhat constrained but still offers some flexibility for contingencies. Also, the targets are set after meaningful work at the site has begun (whereas incentive-type contracts which are applied when

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[99]FAR 16.306

uncertainty is high result in massively detailed contracts that stifle technology and limit flexibility in handling changes in a fluid environment).

- because the contract is a negotiated procurement, DoD can consider factors other than price when awarding the contract

To traditional DoD construction experts, the notion of combining the design and construction phases of a project makes them nervous.

> Design-build contracting is often dismissed out of hand due to perceived "conflict of interest" between the designers and builders (fear of "gold-plating"). However, there are times when design-build is the most cost-effective method of procurement. For example, when recompeting between phases, the RA (construction) contractor may not have a proprietary technology available to the RD (design) contractor. This almost assures an adverse cost/schedule impact.[100]

However, design-build has begun to appear in the typical building construction setting, even for somewhat complex facilities such as industrial, power and process related facilities[101]. Thus, conversion to the use of this method may be easier for DoD than it initially seems. Some of the positive aspects of facility design-build would also be beneficial in the environmental restoration process. For

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[100]Grant S. Bowers. *A Contract Management Guide for Air Force Environmental Restoration.* Wright-Patterson Air Force Base, Ohio: Thesis submitted to the Air Force Institute of Technology Air University, September 1991, p. 141.

[101]Jacques R. Courtillet. "Have You Considered Design/Build?" *Navy Civil Engineer.* Vol. XXX, Issue 3, Fall 1991/Winter 1992, p. 18.

example:

- "Use of design/build maximizes the use of 'constructability' principles, which, as defined by the Construction Industry Institute, are the 'optimum use of construction knowledge and experience in planning, design/engineering, procurement and field operations to achieve overall project objectives.'"[102]

- "Application of these (constructability) principles in a design/build environment leads to the use of innovative building products, systems and methods of fabrication and construction..."[103] (emphasis added)

- an atmosphere of teamwork is fostered among the designer, the constructor and the owner

- "...major advantages that can benefit the Navy include the reduction in management time (especially at the construction office) and the ability to capitalize on the construction industry's working knowledge of state, local and other building codes and standards. Field changes from errors, omissions and inconsistencies in the design are essentially eliminated."[104]

In summary, there may be situations where flexibility and innovation are required to complete an environmental restoration project, and alternative contracting methods may

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[102]*Ibid.*, p. 18.

[103]*Ibid.*, p. 18.

[104]*Ibid.*, p. 19.

be more suitable than traditional methods.

5.3.2 Research and Development

In addition to participation in centralized research and development programs such as the Superfund Innovative Technology Evaluation (SITE) Program and its own Installation Restoration Technology Coordinating Committee (IRTCC), DoD could stimulate innovative technologies through its contracting procedures. By allowing certain reasonable "independent research and development" costs to be allowable costs under the cost-plus contracts, technology developers would have a risk-free incentive to experiment with ideas that may not turn out to be applicable to the particular project they are working on but which might eventually show promise.

Such reimbursements would decentralize a portion of the R&D effort and allow a broader span of ideas to be tested. Hopefully, this would lead to an increase in the nation's environmental restoration technology base.

5.4 Real-World Barriers and Pitfalls

Every suggestion to change an existing system comes with certain caveats. The recommendations of Sections 5.2 and 5.3 deserve a "sanity check" to make sure that one understands the barriers to implementation of, and the potential pitfalls of, a more liberal environmental contracting process.

The first barrier to implementation faced by DoD is in defining its strategic goal in the environmental restoration contracting process. Is the goal to create a system which will, over the long haul, most effectively cleanup its own sites by allowing the private sector to innovate and function as a key member of the remediation team, or is the goal of the contracting system to drive down costs for each particular restoration project? It can be argued that DoD does partially recognize the importance of innovation, for the *Navy/Marine Corps IR Manual* states:

> This guidance should not be taken as a replacement for well-informed judgement or innovative solutions and approaches to adapt the IR Program to the novel characteristics of a particular site, the needs of the local populace, or the overall mission of the Department of the Navy.[105]

However, the current contracting process still seems to be geared to a low-bid construction mentality.

Another indicator that promoting innovation may still not be hot on the minds of DoD remediation managers is in its priorities for its IR funds. The *Navy/Marine Corps IR Manual* lists the categories of work for various IR activities and classifies them in importance as Priority 1, 2 or 3. Among the activities with the lowest priority is "research, development and demonstration (RD&D) which has broad applicability and high potential to reduce costs or

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[105]*Navy/Marine Corps IR Manual*, p. xi.

improve the pace or quality of work."[106] With the vast majority of the remediation work being in Priority 1 activities such as 'projects on the NPL,' it is doubtful that R&D will carry much weight.

In the end it is easy to see that changing the current contracting structure would require an increased emphasis on innovation over cost and a slight shift in the corporate mentality of DoD restoration leaders.

A second barrier to implementation of an alternative procurement system is that the "naysayers" who are used to their tried and true methods are quick to point out the mistakes that happen under any new process.

> ...in implementing these new and innovative procurement methods we must always maintain a level playing field for all participants, use good judgement, pay prudent attention to monetary considerations and always be cognizant of the perception of the taxpayer. We must never forget that we are stewards of the public trust and any experience which is bad, or even less than good, will cause the critics to rise up and cause retrenchment of the old ways.[107]

Along these same lines is a pitfall that some will view the development of new technologies as a waste of time, effort and money. The desire to "make something happen" might lead to the selection of an expedient solution instead

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[106] *Ibid.*, p. 8-3.

[107] Henry J. Hatch, Lieutenant General, USA. *Which Procurement and Contracting Methods Reduce Disputes?* Speech delivered at the Construction Disputes Resolution Conference, Hyatt Regency Capital Hill, Washington, D. C., November 7, 1991, p. 11.

of a more effective, but unproven, technology. One should not be too anxious to eliminate a technology option before it has a chance to prove itself.

> The appearance of waste is unavoidable in a process so rife with uncertainty. Wrong turns will be taken, to be exposed only by testing and further development. Yet to see this occurrence as waste is to take a short-term view of a process that can only be properly evaluated over the long haul. The danger that haunts R&D, especially in early stages, is that in trying to save money early in a project developers will make bad choices based on misleading early data. Having eliminated interesting new ideas prematurely, they will wind up wasting more money later on. The conundrum of R&D, it might be said, is that unless one is willing to waste money early, one is likely to waste much more money later. Good R&D can survive only in an environment that tolerates a certain amount of messiness and error early in order to avoid it later.[108]

In a demanding military environment where perfection is expected and mistakes are not tolerated, the previous quote should be taken to heart by every DoD environmental restoration project manager (and should be posted in their bosses' offices!). Obviously, there comes a point where one is pouring good money after bad. With the federal government spending some $1.5 billion annually on environmental research and development,[109] there is a

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[108]McNaugher, p. 5.

[109]*National Technology Initiative: Protecting-and Investing in-the Environment.* Unnumbered handout produced jointly by the U. S. Departments of Commerce, Energy, and Transportation and the National Aeronautics and Space Administration and distributed at the National Technology Initiative Conference, Massachusetts Institute of Technology, Cambridge, Massachusetts, February 12, 1992.

potential for abuse or mismanagement. However, the decisions about the development of technology should be made in a rational manner. Also, one cannot forget that the contracting system must be structured such that those innovative choices can emerge in the first place.

The broad issues of cost and the limitations on resources available for environmental restoration work present several intertwined challenges which serve as yet another barrier to a contracting methodology which is based on anything other than low price. The contract vehicles must not reward increasing costs with increasing profits. DoD project managers must appreciate that they have to complete their projects with a finite pot of money. If cost-type contracts, which are founded in trust and teamwork between the contracting parties, are employed, there is a danger of DoD remediation project managers getting too familiar and "going native" to the contractor's way of thinking. At the same time, the possibility exists that an unsuspecting or unknowledgeable government employee will be taken advantage of by a dubious contractor.

The way to avoid these pitfalls is to train the people who are responsible for monitoring the contractor's costs and provide those managers with enough oversight to ensure that they are using their resources wisely. The balance comes in avoiding the "overregulation" syndrome. The other way to deter any less than honest practices by a contractor is to reward contractors who do a fair, honest and proper job by giving them more work. Market mechanisms can quickly weed out those who do not perform in an open and above-board manner.

Another barrier to the implementation of an alternative strategy is the number of codes, regulations and laws which must be considered when contracting for environmental services in the government sector. Any remediation program, public or private, is subject to the ever-changing laws under CERCLA and RCRA. DoD contracting officers must also abide by the Federal Acquisition Regulations (FAR), which on one hand state that designers are not allowed to construct the projects they design, but on the other hand state that deviations to the FAR may be granted

> ...when necessary to meet the specific needs and requirements of each agency. The development and testing of new techniques and methods of acquisition should not be stifled simply because such action would require a FAR deviation.[110]

Properly classifying the nature of environmental work as 'design,' 'construction,' or 'service' also makes application of the FAR difficult. Still other laws, such as those covering minority or small disadvantaged business quotas, local resident hiring quotas, or prevailing wages, show that the government uses contracting with the private sector as part of a larger socio-economic program. Hence, for the sake of these other goals DoD must often do things

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[110]FAR 1.402

in a contracting situation that are not necessarily the most efficient. This is not to argue that the socio-economic goals are flawed; rather, one must realize that these and all other regulations, rules and laws serve as a barrier to enacting an "ideal" process.

One final caveat: any argument for changing the DoD contracting system is moot if DoD does not address the long-term and latent liability issues that environmental firms face. These issues not only distort the normal risk allotments and tendencies in the contracting arena, they also constrain the market and the number of eligible players. DoD should consider changing its stance on indemnification of contractors and provide some rational but limited amount of indemnification so that the reforms to the contracting process described in this thesis, or any other proposed reforms, can flourish.

5.5 Administration of Remediation Contracts at the Local Installation Level

Because the majority of the effort expended in the remediation of DoD sites takes place in and around the installation that contains the hazardous waste site, government personnel at the local level (not the Pentagon level) are the key figures in the institution of a solid contracting system. "Government managers are needed to play major roles in shaping the effectiveness and efficiency of the acquisition process."[111] These on-scene leaders must set the standards for the quality of the program, decide on the contracting methods, inspect the work, and so on. It is incumbent upon them to be efficient and effective and not to abdicate that responsibility to a fixed-price contract.

To be proficient in an acquisition position, one must be trained and experienced. A number of the problems with the weapons acquisition process have been traced back to the quality of the personnel charged with running the programs. Unfortunately, just as the environmental restoration industry has found itself lacking in the number of people with the necessary skills to execute this new style of work, so too has DoD.

The government must make certain that its local personnel are properly trained in the principles of contracting and that they understand the precepts behind an effective procurement. To carry out the kind of contracting arrangement described earlier, DoD personnel must have the savvy to recognize good contractor performance; they also have to have the tools to reward that performance as an incentive to the environmental contracting community.

To survive in the environmental restoration contracting domain, local personnel also must have a solid foundation in the legal aspects of their business.

As in other construction work, the ROICC needs to

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[111]Fox, p. 3.

ensure that the contractor performs the work in accordance with the plans and specifications. It must be remembered that the plans, specifications and, in some cases, the construction schedule, have specific legally binding measures which must be followed.[112]

Finally, each local office should have a cadre of talent with respect to the technical and engineering aspects of the work. Not everyone needs to be an expert, but a corps of people need to be wise enough to communicate effectively with the environmental industry and to evaluate the performance of those paid professionals.

How can DoD attract such high caliber acquisition personnel? As with any organization, DoD has to offer career paths which provide challenging assignments, recognition for dedicated performance, and opportunities for promotion and advancement.

Creating a team of environmental contracting specialists at each DoD installation would be both impractical and impossible. Fortunately, the services seem to have chosen a tack which will allow them to meet the needs of most installations and hopefully avoid the charges of mismanagement that have been leveled against other agencies (such as EPA) and their contracting abilities.[113] By using base engineers and construction

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[112]*Remedial Action...*, p. 2-4.

[113] As detailed in *Implementation of the Superfund Alternative Remedial Contracting Strategy (ARCS): Report of the Administrator's Task Force.* Washington, D.C.: U. S. Environmental Protection Agency, November 1991.

offices to contract for environmental work (as opposed to using the purchasing offices of the base logistics department), DoD has tapped a resource which already has experience in contracting, law and engineering, albeit in more traditional building construction. As time progresses, these personnel can refine their skills to include those necessary to manage an environmental construction job. Part of that refinement is, of course, the recognition that environmental restoration jobs are truly different from typical construction projects.

5.6 Chapter Summary

Through its proven results in contracting out for high technology weapons, DoD has served the nation's interests and carried out its strategy. DoD's next great challenge is to try to learn from their successes and failures and capture the best ideas for use in environmental contracting.

No single contracting method can address every situation that might be encountered during environmental restoration. Each situation requires educated thought and seasoned judgement, and there will always be a number of obstacles which will hinder the process. In the end, the burden for improving the environmental restoration contracting process falls on the government personnel at the local installations.

6

CLOSING

6.1 Conclusions

> *Through these and other activities, we have made significant headway in building an environmental ethic within DoD. The perseverance and commitment of our personnel, from the installation level up to this Headquarters, have enabled us to lead the way among Federal agencies in the investigation and cleanup of our facilities. This continuing dedication to duty, both in the defense of our national security and in the protection of our environment, will enable us to meet the challenges ahead.*
>
> *Deputy Asst. Sec. of Def. (Environment) Thomas Bacal*[114]

Why try to improve the environmental contracting process? Won't the existing procurement methods and restoration technologies eventually get the job done?

The answer is yes, maybe, but more efficient contracting leads to a better allocation of resources. Altering the process can also result in the development of new technologies which in turn will lead to faster, more effective, and cheaper projects; thus, more cleanups can be completed with less drain on the nation's resources.

Doesn't the country run the risk of "wasting" a lot of money while searching for improved contracting mechanisms and innovative technologies?

Call it an investment in the future. DoD "wasted" a

[114]DERP Annual Report, p. v.

lot of defense dollars while researching and developing its weapons, but look what it got in return. The U. S. undoubtedly has produced the most advanced technology weapons in the world, which in turn has furthered many of this nation's goals, saved lives, made for smaller fighting forces and brought an end to the longest conflict in the nation's history: the Cold War. If the U. S. seeks to be a world leader in solving environmental problems, then it must be willing to pay a premium for the advancement of remediation technology.

Why should DoD be so concerned with solving a problem that is being tackled by private sector industries in this country, by multiple U. S. government agencies, and by countries around the world?

Because of the military's national security mission. DoD is still the instrument of the nation's policy makers and the defender of the nation's well-being. With its mission-oriented mentality, the military can take charge in experimenting with these improvements (and some argue that the Army Corps of Engineers is ideally suited for this mission and should be tasked to do so[115]). The engineering nature of the problem makes DoD the most capable U. S. agency at this time to take the lead in promoting technology for the public good. The government would be

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[115]The reader is referred in particular to the MIT theses by Rossi and Dornstauder.

wise to use the military's traditional strength in contracting to set the pace for the nation.

The Department of Defense has had some success using the traditional method for contracting for environmental restoration services. However, since this type of work is still relatively new and expected to grow dramatically in the coming years, it would be prudent for DoD to consider alternative contracting methods such as design-build in order to obtain the highest quality and the most value for its contracting dollars. The changes DoD must undertake include both its particular contracting procedures and its corporate mentality.

> Returning to industry the job that is industry's - innovative design and quality manufacturing - and returning to the program manager the job that is the program manager's - sound decision making and accountability - are complementary sides of the same structure. These are matters of style rather than regulation.[116]

There won't ever be a perfect solution. People are involved. Priorities change. The level of knowledge is changing. Funds are limited. Engineering solutions always carry a range of uncertainty.

There will be obstacles to overcome. Critics will be quick to point out any increases in contract prices, and in reality there is no way to respond to them by showing them a rapid payback; the benefits of progressive technology will be spread over many separate projects and will be reaped

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[116]Gregory, p. 202.

gradually over time. In addition, it will be difficult to measure the internal effectiveness of any changes made because DoD is a bureaucracy which does not operate on a clear-cut or measurable basis such as profit.

The key is a willingness to undertake constant self-examination and improvement. Call it total quality management (TQM) or any other buzzword which fits.

6.2 Areas for Further Research

- A survey and analysis of completed DoD restoration projects, including location, remediation technologies employed, contract types used, competition and award procedures, original project estimates versus actual costs, claims encountered, etc.

- Drafting of a complete "model" restoration contracting package utilizing some of the principles outlined in this thesis, but also including all required FAR clauses, variations to the FAR that must be generated, proposed fee schedules, profit rates, negotiation or bid procedures to be employed, etc.

- A comparative analysis of using cost-type contracts for environmental restoration projects versus using firm fixed-price contracts in conjunction with "partnering" concepts for contract execution and dispute resolution.

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