ALLOCATING FINANCIAL RESPONSIBILITY UNDER CERCLA: AN EMPIRICAL MODEL

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ALLOCATING FINANCIAL RESPONSIBILITY

UNDER CERCLA: AN EMPIRICAL MODEL

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NOMENCLATURE

AOC	Administrative Order on Consent
CERCLA	Comprehensive Environmental Compensation and Liability Act
EPA	Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
CBO	Congressional Budget Office
DOJ	Department of Justice
HRS	Hazard Ranking System or Score
HSC	Hardage Steering Committee
MCRS	Minimum Costs, Remaining Savings
NAPL	Nonaqueous Phase Liquid
NBAR	Nonbinding Allocations of Responsibility
NCP	National Contingency Plan
NPL	National Priority List
NSC	Nonseparable Costs
O&M	Operations and Maintenance
OTA	Office of Technology Assessment
PA/SI	Preliminary Assessment/Site Investigation
PRP	Potentially Responsible Party
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RI/FS	Remedial Investigation/Feasibility Study

ROD	Record of Decision
RSE	Removal Site Evaluation
SAC	Stand Alone Costs
SARA	Superfund Amendments and Reauthorization Act
UAO	Unilateral Administrative Order

CHAPTER I

INTRODUCTION

The Comprehensive Environmental Response and Compensation Liability Act (CERCLA), better known as Superfund, was enacted in 1980 in the wake of widely publicized concerns over toxic spills and hazardous waste problems at Love Canal, Valley of the Drums, and other sites throughout the country. In order to facilitate the cleanup of hazardous waste sites considered to be a threat to human health and the environment, Congress authorized the Environmental Protection Agency (EPA) to develop a "national priorities list" (NPL) of the nation's worst hazardous waste sites. The EPA initially received $1.6 billion to respond to and administer the cleanup of 400 such sites.[1] In 1986, Congress amended CERCLA by enacting the Superfund Amendments and Reauthorization Act (SARA), which reauthorized CERCLA and increased the Superfund to $8.5 billion to deal with an enlarged NPL (Mason 1991).

The problem facing Congress in 1980 was how to ensure the cleanup of contaminated sites without placing a strain on the general revenues or raising taxes. During the floor debate over CERCLA's passage in 1980, a strong notion emerged that past polluters should be required to pay for the cleanup of such hazardous waste sites, either directly or by reimbursing the government for any response actions that may have occurred (Greve and Smith 1992). As a result

CERCLA promoted two basic goals: (1) that the polluter pay for site cleanups; and (2) that cleanup be completed in a timely fashion. Congress hoped that forcing potentially responsible parties (PRPs) to internalize the costs of haphazard waste disposal would be an effective method of penalizing PRPs as well as deterring such behavior (Mason 1991 and Mullins 1991). The Act authorized the EPA to utilize CERCLA's comprehensive liability standard in order to compel voluntary or involuntary private party cleanups.[2] In instances where there was an immediate threat to the human health and environment, the agency was authorized to use Superfund monies for cleanup, after which the EPA may pursue private parties for contribution costs using the liability standard established by CERCLA.[3]

Superfund Progress to Date

Between 1980 and 1991, PRPs financed 52 percent of the cleanups started and 46 percent of the cleanups completed. Over $6 billion in cleanup costs or contributions have been paid or committed by responsible parties. As of 1992, the agency had been involved in 459 cost recovery cases worth an estimated $798 million, achieved 1,113 settlements to recover $592 million, and returned $359 million to the general fund (EPA 1992:12). In addition to private party expenditures, approximately $10 billion have been generated by special taxes on industry and expended through the Superfund for agency overhead, contractor and administrative costs, and cleanup costs associated with orphan sites (Barnett 1994:20).

In 1991 a University of Tennessee study put the average cleanup cost for a NPL site at $50 million (Russell et. al. 1991:65). A more recent study estimates the average cleanup costs to be $29.1 million for each site. The study took into account higher site study costs and the present value of operation and maintenance activities that would be incurred in the thirty year post-closure-care period following the site cleanup (Probst et. al. 1995:20). In 1994 a report by the Congressional Budget Office (CBO) estimated the total cost of cleaning up the current and future NPL to be between $106 and $463 billion (Probst et. al. 1995:18).[4]

Since 1980, the EPA and the states have investigated almost 38,000 potential sites to assess what, if any, cleanup is needed. In 1989 the EPA estimated that it would take 13 years to begin construction on the then 1,200 NPL sites, and that between 75 and 100 sites would be added to the list annually (Hedeman et. al. 1994:10423). Today about 1,320 sites have been placed on the NPL and are considered to be the worst in the country (Probst et. al. 1995). At the end of the 1993 fiscal year, of the 1,320 sites on the NPL, 617 (47 percent) were in the site study or design phase. Therefore, no cleanup activity has been taken at these sites. Half of all NPL sites had not yet been the subject of long-term cleanup, however, more than 40 percent had been the subject of removal actions. At the end of September 1993, only 52 sites (4 percent) had been deleted from the list. Remedies had been completed at another 166 sites (13 percent), many of which may require long-term post-closure operation and maintenance. At 393 sites (30 percent) cleanup activities were under way (Probst et. al. 1995:18).

Purpose of the Study

This study has two main objectives: (1) to describe and to evaluate the effect of CERCLA's liability standard on the allocation process; and (2) to develop an allocation method that is efficient, equitable, and logical. The study focuses on the use of CERCLA's comprehensive liability scheme and its impact on the allocation process. This study does not emphasize finding a unique set of conditions necessary for deriving a cost or set of costs to be allocated. However, the study does investigate the use of existing allocation methods and the basic principles of allocating costs. Additionally, the study focuses on allocating an identified cost or set of costs among a group of parties participating in a joint cleanup project.[5] The purpose of the study is to develop a cost allocation method that provides a streamlined approach to finding the least-cost allocation for each PRP coalition.

Significance of the Study

The liability standard under CERCLA has resulted in numerous law suits, adding to the excessive time and cost already associated with site remediation. Because liability under CERCLA is strict and joint and several, the courts have ruled that the government does not need to do the following: (1) prove a nexus between a PRP's waste disposed at a site and the subsequent release or threatened release that initiated the response action; or (2) join all the PRPs at a site. With so many parties attempting to limit their share of liability the costs of devising a cleanup strategy and deciding financial responsibility often threaten to exceed the actual cleanup costs (Hird 1993).

Due to the use of such a comprehensive liability scheme, a cleanup can be significantly delayed and overall cleanup costs can increase dramatically while the involved parties continue to debate their relative contributions. As a result some transaction costs are inevitable, especially when considering the number of parties and amount of time spent debating relative contributions.[6] Therefore, the process is generally considered to be an inefficient and inequitable attempt at allocating financial responsibility (Tietenberg 1989, Singer 1992, Hird 1993, Brazell and Gerardi 1994, Hall et. al. 1994, and Probst et. al. 1995).

Overview of the Study

This investigation requires a combination of information from four areas of related research. The relevant research areas include the following: (1) an extensive literature review of the Superfund liability standard and its implementation; (2) a review of CERCLA's economic efficiency; (3) a review of the decision criteria considered during the allocation process; and (4) a review of the principles used in the allocation of joint project costs. A review of these areas provide an understanding of why the program is considered to be an inefficient and inequitable attempt at allocating financial responsibility. The investigation focuses on the use of cooperative game theory methods used in allocating costs for water resource projects. Applying these principles of fairness aids in developing a cost allocation method that is an efficient and equitable alternative to traditional approaches.

The proposed allocation method relies on the formation of cooperative coalitions and the use of existing cooperative game theory methods in order to allocate Superfund cleanup costs.[7] In order to facilitate the implementation of the proposed method, the study will employ the use of data based loosely on PRP involvement at the Hardage Criner Superfund Site located near Criner, Oklahoma.[8] Conclusions and recommendations are offered in order to identify the required conditions for any allocation method to be successful and the purpose of future studies.

Chapter Notes

1. An excise tax on forty-two hazardous feedstock chemicals, as well as on crude oil and imported petroleum products, was the source of about 86% of the original Superfund. The remainder of the original Superfund monies came from general revenues. *See* Mason 1991:79.

2. A responding PRP will generally engage in the negotiation of a final settlement. A non-responding PRP will be the target of a government cost recovery action.

3. The comprehensive liability standard adopted by CERCLA is strict, joint and several, and retroactive. *See* Mullins 1991:36.

4. This has a current dollar value of between $42 and $120 billion. *See* Probst et. al. 1995:18.

5. Such an approach would presumedly minimize litigation among PRPs due to the fact that the participants would have agreed to the conditions prior to the final allocation.

6. Direct regulation under CERLCA is costly due to both public and private expenditures on administration, staff, and general overhead costs.

7. The proposed method is based on current methods used in the cost allocation of water resource projects. The minimum costs, remaining savings (MCRS) method is presented and implemented through a generalized case study.

8. In 1984, the EPA notified companies that had legally disposed of materials at the Hardage Site that they were potentially responsible for cleanup at the site under CERCLA. Following this notification, more than 100 PRPs formed the Hardage Steering Committee (HSC). *See* Costello 1995:1. The HSC independently identified and negotiated a settlement with a group of non-responding PRPs. The negotiations were based on data relative to the parties activities at the site.

CHAPTER II

LITERATURE REVIEW

This chapter investigates the Superfund process and the use of its comprehensive liability standard. The adopted liability standard was intended to facilitate the cleanup of hazardous waste sites. However, due to the litigious nature of such a strict liability standard, the Superfund process has been plagued by numerous delays and excessive transaction costs. Therefore, the purpose of this chapter is to investigate the implementation of the liability standard adopted by CERCLA and its effect on the allocation process. The relevant areas of the literature include a review of the following areas: (1) the statutory framework of CERCLA; (2) the judicial precedents; (3) the economic efficiency of CERCLA's comprehensive liability standard; and (4) the current allocation methods.

The Statutory Framework of CERCLA

CERCLA was intended to facilitate the cleanup of hazardous waste sites and, when possible, to impose strict, joint and several, and retroactive liability for response action costs. The comprehensive liability scheme for cleanup of hazardous waste sites enables the EPA to compel responsible parties to voluntarily cleanup sites or reimburse the agency for its cleanup expenses. Congress hoped that forcing PRPs to internalize the costs of haphazard waste disposal would be an effective method of both penalizing responsible parties as well as deterring such behavior in the future (Mason 1991 and Mullins 1991).

Summary of the Liability Scheme

Under section 104, the government is authorized to investigate and cleanup a release or threatened release of any hazardous substance, pollutant, or contaminant that may present an imminent and substantial danger to the human health or the environment. Under section 106, the government may seek an injunction directing a responsible party to initiate a response action. If the party does not respond the EPA may bring an action to enforce compliance. Finally, if the government undertakes a response action, it may initiate a cost recovery action under section 107 (42 U.S.C. 9604, 9606 and 9607 (1988) and Hall et. al. 1994).

The liability standard provides that certain "persons" be held responsible for response costs associated with cleanup activities. Section 107 of CERCLA defines certain "persons" to include the following: (1) present owners or operators of the facility; (2) any past owners or operators during whose tenure the substances were disposed; (3) generators who arranged to have their wastes deposited; and (4) any party involved in the transportation of the substances for treatment or disposal (42 U.S.C. 9607 (1988), Mank 1991, Mason 1991, and Hall et. al. 1994).

All four classes of PRPs may be held liable for response costs, damages to natural resources, and the cost of conducting studies on the health effects of the hazardous substances present at a site (Mason 1991). There are only three limited defenses available to the potentially responsible parties: (1) that the release or threatened release resulted from an act of God; (2) from an act of war or; (3) from the act of a third party not in any contractual relationship with the PRP (42 U.S.C. 9607 (1988), Mank 1991, and Mason 1991).[1]

The severity of the Superfund liability scheme may be understood from the following: (1) it is imposed without any showing of fault or knowledge; (2) it is retroactive for actions and practices that were legal, normal, and considered proper at the time; (3) it is not related to whether the wastes treated or disposed of caused the conditions requiring the cleanup; and (4) the standard is joint and several, which means that any one PRP can be required to pay the total cost of cleanup at a site regardless of the number of existing PRPs (Mullins 1991:36). Such an expansive liability scheme only reiterates the Congressional intent regarding who should pay for the site cleanups.

The Role Of SARA

When Congress reauthorized the Superfund program in 1986, it provided some settlement alternatives designed to ease the burden of strict and joint and several liability. SARA provided various mechanisms designed to expedite response actions, eliminate excessive litigation, promote voluntary cleanups, use Superfund monies more effectively, and treat PRPs more fairly. The legislative history of SARA indicates that Congress sought to ease the burden of joint and several liability by allowing a cause of action for contribution. The amendments also provide various mechanisms for promoting and negotiating settlement agreements between the government and PRPs.

The Right of Contribution

Because liability is joint and several, the courts have ruled that the government need not join all PRPs at a site. The legislative history of SARA indicates that Congress sought to ease the burden of joint and several liability by allowing a cause of action for contribution. Congress hoped that this new provision would stimulate quicker cleanups by encouraging PRPs to undertake voluntary actions (Hedeman et. al. 1991 and Hall et. al. 1994). Therefore, section 113(f)(1) of SARA allows a party who has incurred response costs to seek contribution from any person who is liable or potentially liable under section 107. The right of contribution enables a joined party(s) to sue fellow parties in order to recover the amount it paid in excess of its fair share (42 U.S.C. 9613 (1988) and Hall et. al. 1994).

However, according to the definition of unjust enrichment, a joined party seeking contribution may seek only the amount it paid in excess of its fair share, and may not coax other liable parties to pay in excess of their fair share of the total costs (Restatement (Second) of Torts 886A (1979)).[2] The courts have ruled that a PRPs' liability for contribution is several, not joint and several (*United States v. Conservation Chem. Co.*, 619 F. Supp. (W.D. Mo. 1985)). In cases where an original PRP seeks a claim for contribution from a fellow PRP, the third-party PRP is liable only for its "fair share" of the harm (Mason 1991). Therefore, PRPs found jointly and severally liable at the outset are prevented from discharging the full liability to a third-party PRP through the contribution process.

A suit for contribution may arise as a result of one of the following circumstances: (1) the government may sue multiple parties to force cleanup under section 106 or to recover cleanup costs under section 107 of CERCLA; (2) the EPA has sued fewer than all the PRPs at a site under section 106 or 107 and the responding PRPs bring suit against the non-responding PRPs; (3) a party that has settled with the government for more than its fair share of the cleanup costs may seek contribution from other PRPs; and (4) a non-responding party may bring counterclaim for contribution in a cost-recovery suit brought by a responding party who intends to or who has cleaned up a site (Garber 1987, 42 U.S.C. 9606 and 9607 (1988), Mason 1991, and Barnhizer 1994).

Settlement Alternatives

CERCLA failed to provide the agency or PRPs with any explicit guidelines for negotiating a settlement agreement (Mason 1991:86-87). Therefore, the SARA amendments explicitly authorized the use of the following mechanisms: (1) the preparation of nonbinding allocations of responsibility (NBARs), in which the EPA could proactively make an initial allocation of financial responsibility among the parties; (2) the use of mixed funding settlements, which enable PRPs to perform various cleanup activities with the help of Superfund monies and the EPA; (3) the use of *de minimis* buyouts, which allows an eligible party to buyout its financial obligation (contribution constitutes less than 1 percent of the expected cost); and (4) the issuance of covenants not to sue, providing a waiver from future liability (42 U.S.C. 9622 (1988), Hedeman et. al. 1991, Acton and Dixon 1992, and Hall et. al. 1994). Appendix A provides a complete definition of each settlement alternative. Whenever a negotiation would facilitate a settlement with PRPs the government must notify all such parties. Section 122 requires that the notice must contain the following information: the names and addresses of PRPs, the volume and nature of the waste contributed by each PRP, and a ranking by volume of the waste found at the site (42 U.S.C. 9622 (1988) and Cross 1988). Such a notice is intended to facilitate prompt and informed settlement offers from PRPs. When and if the EPA receives a settlement proposal, negotiations should begin immediately (Cross 1988).

These devices offered a departure from pure joint and several liability toward some notion of distributive justice and fairness during the allocation process. The alternatives were intended to expedite response actions, eliminate excessive litigation, promote voluntary cleanups, use Superfund monies more efficiently, and accommodate settlement negotiations (42 U.S.C. 9622 (1988) and Mason 1991). Although the intent of these settlement alternatives is to promote prompt cleanups and utilize Superfund monies more effectively, delays and high transaction costs continue to plague the Superfund process.

Overall, the limited success of these settlement alternatives can generally be attributed to the EPA's failure to utilize them on an active and consistent basis. Many of the alternatives are at odds with CERCLA's joint and several liability scheme as well as the agency's traditional approach to negotiations with PRPs. Furthermore, each EPA region implements these alternatives with a different management strategy, as a result their overall use lacks consistency. In other cases the alternatives are simply a severe strain on the EPA's resources. For example, when performing an NBAR the agency must initiate an extensive information gathering process that is both time consuming and costly (Hedeman et. al. 1991).

Of about 1,300 sites on the NPL, the EPA has entered into only 125 *de minimis* settlements at 75 locations (Shanoff 1994:12). As of September, 1993, the EPA (under the mixed fund alternative) had negotiated only four mixed work agreements, twelve preathorizations, and an uncertain number of cashouts (Hall et. al. 1994:1503). Furthermore, there is little evidence that NBARs are being implemented at all (Acton and Dixon 1992 and Hall et. al. 1994).

The Superfund Process

The process begins when the EPA becomes aware of a site. The agency will then perform a series of preliminary assessments and inspections in order to determine if a threat exists. There are two different actions that can take place at a Superfund site: (1) a removal action, and (2) a remedial action (Lawrence 1993:2962).[3] The EPA must perform any response action within the existing framework of CERCLA and the National Contingency Plan (NCP) (Pusch 1991 and Lawrence 1993).[4] Figures 1 and 2 describe the relevant steps of each action. The agency will then begin the formal process of assigning a hazard-ranking score (HRS) to the site. The site will be included on the NPL if it's score is greater than 28.5 (Mazmanian and Morell 1992 and Lawrence 1993).[5] Once a site has been included on the NPL, a formal study of the site conditions is conducted in order to determine the possible remedial actions.

To simplify the remaining steps of the process, the EPA then issues a record of decision (ROD) documenting the agency's chosen remedial action, the remedial design is then performed, and finally, the actual remedial action is conducted and the site is deleted from the NPL (Hedeman et. al. 1991 and Lawrence 1993). Appendix B provides a complete definition of each Superfund stage. The EPA conducts enforcement and public participation activities throughout the process. With the exception of the ROD, any of these steps may be performed by either the EPA or the identified PRPs at the site (Lawrence 1993). Figure 3 summarizes the process from site identification to the beginning of the actual cleanup.

The Enforcement Process

The enforcement process begins after a site is proposed for listing on the NPL. Following such a proposal, the EPA begins searching for PRPs who may be potentially liable for the contamination at the given site. Identified PRPs are given a general notice letter and involved in an information exchange with the EPA. The information includes site conditions, PRP connections to the site, and identification of other PRPs (Hedeman et. al. 1991 and Lawrence 1993). Figure 4 summarizes the basic enforcement process.

The EPA examines the information gathered and makes a determination of which PRPs to pursue. The EPA may then proceed with either a fund-lead or an enforcement-lead cleanup action.[6] Under a fund-lead cleanup action the EPA spends Superfund monies on remediation at the outset and then may enter into a cost recovery action against PRPs at the later stage of the cleanup action. Whereas, under an enforcement-lead cleanup action, the agency attempts to compel PRPs to take voluntary action and finance the cleanup from the outset (Hedeman et. al. 1991 and Acton and Dixon 1992).

The agency uses considerable discretion when determining the number of PRPs named at a Superfund site. The EPA typically names several responsible parties but, in general, fewer than the total number involved (Acton and Dixon 1992). The EPA's failure to identify all or at least a majority of the PRPs at a site may ultimately delay the cleanup of the site. The potential effect is to force a PRP to pay for the full cleanup costs of a site, despite the presence of other parties.[7] Aside from being potentially unfair to small contributors, such costs provide an incentive for PRPs to delay cleanup through litigation (Hird 1993). The named PRPs will not want to agree to a settlement until they are confident of the number of parties that should contribute to the final cleanup costs. In contrast, non-responding PRPs have a strong incentive to avoid being named as PRPs at the site. As a result, the named PRPs are often burdened with substantial transaction costs due to the costly process of gathering information relevant to identifying other potential responsible parties for contribution (Hedeman et. al. 1991).

The EPA's enforcement policy reflects an "all or nothing" approach and there is generally little room for negotiation (despite reform attempts). The threat of strict and joint and several liability enables the agency to compel PRPs to voluntarily settle rather than litigate. Underlying this policy is the EPA's belief that most PRPs would choose to negotiate an agreement with the government that allowed for the total or substantial cleanup of a site in exchange for a favorable settlement. The process is commonly characterized as a "carrot and stick" approach. PRPs who settle or otherwise quickly discharge their liability are offered a "carrot" in the form of protection from suits for contribution by other PRPs, and can recover response costs for which they are not directly liable. PRPs who choose not to settle are given the "stick" in the form of joint and several liability (Barnhizer 1994:566).

A Review of the Judicial Precedents

Although CERCLA did not establish an explicit liability standard, section 101 of the Act states that the "standard of liability" shall be the same as that of section 311 of the Clean Water Act (42 U.S.C. 9601 (1988) and Mason 1991). According to CERCLA's legislative history Congress chose to defer the exact definition of the liability standard, rather than asking the courts to enforce a potentially inequitable rule (Mullins 1991). Therefore, due to the difficulty of determining who dumped what and how much decades ago, CERCLA has been favorably interpreted by the courts to maintain a powerful standard of liability (Hird 1993). The EPA and the Department of Justice (DOJ) have sought favorable constructions of the statute in several areas. For example, the DOJ sought to establish a standard of strict and joint and several liability without a need to prove a nexus between a generator's waste disposed at a site and the subsequent release or threatened release that initiated the response action (Light 1990).

In *United States v. Chem-Dyne Corp*, the court concluded that the deletion of the term "joint and several" from section 107 of CERCLA did not mean that the doctrine could never be imposed under the statute. The court stated that the standard of joint and several liability was possible if the harm was caused by two or more parties and if their respective contributions were indivisible, therefore difficult or impossible to apportion responsibility (Restatement (Second) of Torts 886A (1979), *United States v. Chem-Dyne Corp.*, 572 F. Supp. (S.D. Ohio 1983), Prager 1986-1987, and Light 1990).[8] Moreover, in *United States v. Wade* the court interpreted section 107 not to require the government to prove any nexus between a generator's waste sent to a site and the spill or "release" that required the response action (*United States v. Wade,* 577 F. Supp. (E.D. Pa. 1983) and Light 1990). These rulings significantly eased the plaintiff's burden of proof in Superfund cases.

Divisibility of the Harm

With the enactment of SARA, in 1986, the government asserted that small contributors could also be held jointly and severally liable for the full costs incurred during the response action. The government believed that SARA confirmed that factors such as the volume of waste sent to a site are relevant only in contribution actions, and should not be used to undercut joint and several liability in the initial allocation process (Light 1990). Therefore, the courts have routinely held PRPs jointly and severally liable unless one or more can establish the "divisibility" of its contribution (Hall et. al. 1994). However, in cases involving very small contributors, even when the harm is not easily divisible, some courts have found that apportionment is needed in order to ease the harshness of joint and several liability (*United States v. A&F Materials Co.,* 578 F. Supp. (S.D. Ill. 1984), *Idaho v. Bunker Hill Co.,* 635 F. Supp. (D. Idaho 1986), *United States v. Alcan Aluminum Corp.,* 964 F.2d (1992), Garber 1987, and Harris and Milan 1992).

Some courts have held that apportionment may be appropriate only when there is a "reasonable basis" for division of the harm (Restatement (Second) of Torts 886A (1979), *United States v. A&F Materials Co.,* 578 F. Supp. (S.D. Ill. 1984), *United States* v. *Alcan Aluminum Corp.,* 964 F.2d (1992), and Garber 1987). The *A&F Materials* court stated that in cases where "equitable factors" exist, such as volume, joint and several liability should not be implemented (*United States v. A&F Materials Co.,* 578 F. Supp. (S.D. Ill. 1984), Prager 1986-1987, and Light 1990). The *Alcan* court recognized that proving "divisibility" might also require an inventory of "the relative toxicity, migratory potential, and synergistic capacity of the hazardous waste at issue." (*United States* v. *Alcan Aluminum Corp.,* 964 F.2d (1992) and Harris and Milan 1992).

In such cases the defendant carries the burden of demonstrating the divisibility of the harm (*United States v. Chem-Dyne Corp.,* 572 F. Supp. (S.D. Ohio 1983), *United States v. Wade,* 577 F. Supp. (E.D. Pa. 1983), *O'Neil* v. *Picillo,* 833 F.2d (1990), *United States* v. *Alcan Aluminum Corp.,* 964 F.2d (1992), Prager 1986-1987, Garber 1987, and Harris and Milan 1992). In instances where "divisibility" is proven the party would be held liable only for its contribution to the total harm caused (Garber 1987).

The Economic Efficiency of CERCLA Liability

Public policy towards accidental external diseconomies such as pollution-engendered injuries have two basic objectives: (1) efficient deterrence and (2) just compensation or equity (Calabresi 1968). Using the status quo as a baseline the efficiency criterion weighs the expected marginal cost of pollution against the marginal cost of pollution control. Where the marginal costs are equal, the cost of pollution-engendered accidents plus the cost of accident prevention is minimized (Coase 1960 and Katzman 1988). The equity criterion is expressed as "the polluter pays principle" (Katzman 1988). Under the polluter pays principle, responsible parties are required to arrange for site cleanup as well as provide compensation to those who suffered from their actions. However, because victims of pollution are not in a market relationship with the polluter, payment by the polluter will occur only if the tort system compels it, or if a government entity (the EPA for example) imposes liability through direct regulation (Greve and Smith 1992). The idea is that injuries caused by such activities should not be allowed to fall uncompensated upon an innocent victim.

The polluter pays principle is generally effective in environmental regulation because it allows externality costs to be "internalized" by the individual firm, thereby leading to socially responsible decisions (Tietenberg 1989). The polluter pays principle can be interpreted as an attempt to invoke the benefits-received principle, whereby the cost of remediation should be paid by those who benefitted from the less restrictive waste disposal practices of the past (Hird 1993). However, the method of allocating direct cleanup costs to responsible parties through the imposition of joint and several liability may be difficult to support under a benefits-received criterion for allocating costs.

Generally, the polluter pays principle works closely with the goal of economic efficiency. In order for economic efficiency to occur, firms and consumers must be forced to bear all the costs associated with the products that they produce or consume (Tietenberg 1989 and Probst et. al. 1995). Therefore, the societal welfare is maximized when the price of a good accurately reflects its true cost as well as the degree of consumer demand for the product.

Pollution engendered torts may possess several unique characteristics that undercut the use of conventional liability rules, such as multiple parties, multiple wastes, and high transaction costs (Coase 1960, Calabresi 1968, and Katzman 1988). Therefore, the use of direct regulation under CERCLA requires that the government promote a site remediation program based on a broad liability standard, enforce the liability standard, and arrange for the cleanup of the site in cases where responsible parties are unwilling to initiate the cleanup (Barnett 1994). Because the courts have interpreted CERCLA to maintain such a powerful standard of liability, it is very difficult to achieve economic efficiency. Such an enforcement approach results in significant delays, high transaction costs, and the allocation of substantial cleanup costs.

Delays

An Office of Technology Assessment (OTA) report notes that an average of 39 months pass between the site identification and the time a site reaches the NPL (OTA 1988). Table I reflects the average time between the main steps in the Superfund process. These delays can be attributed to various factors, including the time spent negotiating and allocating liability under CERCLA. In most cases the process is impeded by the frequent difficulty of coordinating negotiations with multiple PRPs, each of which must agree on a remedial plan and allocation process (Hird 1993). As a result, significant delays occur at each phase of the process. These delays are often a direct result of litigation, or negotiation to avoid litigation, all of which are necessitated by the statutory framework (Hedeman et. al. 1991).

Transaction Costs

Transaction costs can be characterized as being a major expenditure that occurs throughout the Superfund process.[9] The costs are measurable in terms of dollars spent and cleanup delays. Virtually all transaction costs relate to the search for parties that may contribute to site cleanup costs, debating relative contributions, agreeing to a remediation plan, and developing a suitable allocation process (Hedeman et. al. 1991).[10] As a result, transaction costs typically increase in proportion to the time spent in negotiating these issues.

The number of PRPs at a site has a direct impact on transaction costs, even when other factors are constant. Due to the number of parties involved in the process the costs of devising a cleanup strategy and deciding financial responsibility for a cleanup often threaten to exceed the actual cleanup costs (Hird 1993). The transaction cost share is 34 percentage points lower at a single PRP site than at a multiple PRP site with the same characteristics. This suggests that transaction costs are significantly higher at multiple party sites than at single party sites. Therefore, the costs of communication and negotiation are expected to rise as the number of PRPs grows (Acton and Dixon 1992).

Direct regulation under CERCLA is costly in terms of public expenditures on administration, staff, and general overhead costs. However, using joint and several liability the government can deal with a smaller number of parties than if it had to recover cost contributions in proportion to waste contributions (Acton and Dixon 1992). The agency often focuses on only "deep pocket" PRPs in order to shift their overhead costs onto private parties. Therefore, public costs are often replaced by private party costs

(Acton and Dixon 1992, Church and Nakamura 1993, and Barnett 1994). Transaction costs for private industry are generally higher than the EPA's because PRPs typically engage in both intra-PRP litigation, litigation with their insurers, and also litigation with state agencies and the DOJ (Hedeman et. al. 1991).

Recent studies suggest that EPA's enforcement action costs account for an estimated 10 percent of total trust fund expenditures to date (Probst et. al. 1995:23). In contrast, transaction costs have been estimated to account for between 24 and 44 percent of the total expenditures incurred by private parties at a typical site (Butler 1985:120). A recent Office of Technology Assessment (OTA) report estimated that 20 to 40 percent of total spending for the Superfund program is inefficient because of prolonged negotiations and litigations between the EPA and PRPs (OTA 1989).

The Issue and Its Background

Apportioning liability at a Superfund site can be characterized as a difficult, controversial, costly, and time consuming process. The allocation of cleanup costs is an inherently litigious issue because the relationship between responsibility and liability is often absent or, at best unclear. It is the doctrine of joint and several liability that ensures that a PRP's actual contribution to a site will most likely not play a significant role in the allocation of their financial responsibilities (Hird 1993). The inability or failure to determine the waste contributions made by each party often results in the inequitable distribution of cleanup costs.

Compounding the problem is the fact that CERCLA did not establish any explicit method for allocating financial responsibility in a given case. In fact, the Act provided very little guidance for parties looking for a way to structure an allocation proposal for settlement negotiations or judicial proceedings (Butler et. al. 1993). Therefore, both the courts and the agency have developed methods for allocating financial responsibility among PRPs.

There are four basic cost allocation methods used in Superfund situations. These methods allocate costs on the basis of volume, relative toxicity, a combination of volume or toxicity and other equitable factors, or stand-alone costs (Butler et. al. 1993). In most cases volume is the primary factor taken into consideration by the courts, the EPA, and private negotiators in apportioning liability.[11] However, in cases involving multiple parties various quantities and types of waste will have been contributed. Therefore, the courts have recognized that where a purely volume-based allocation would be inequitable, because one party's waste is significantly different than another party's, other factors must be considered. As a result, allocations methods are increasingly focusing on whose waste stream is responsible for which associated costs (Hall et.

al. 1994).

Allocations Based on Relative Volume

This approach is simple, understandable, and cost effective given the right circumstances. Volumetric apportionment requires the use of "waste-in-lists". The waste-in-lists are comprised of information relative to the quantity and type of waste present at a site. This information is normally gathered during the general information search under Section 104(e), therefore collected regardless of whether or not a waste-in-list is performed (Hall et. al. 1994:1497). The information is obtained from records maintained by site operators, transporters, generators, state records, and on-site inventories. Apportionment is made on the basis of relative volumes shipped by each PRP, or on the proportionate volume disposed of at the site by each PRP (Hedeman et. al. 1991, Butler et. al. 1993, and Hall et. al. 1994).

One major factor that complicates allocations using the volumetric approach is incomplete or missing data. Many Superfund sites are abandoned ones, therefore, companies will have little or no data on the amount of waste shipped to or disposed of at the site. These circumstances often result in the need for arbitrary decisions to be made due to the lack of sufficient data required to complete the waste-in-list (Hedeman et. al. 1991). Furthermore, using volume as the primary decision factor, many assumptions may need to be made in relation to the specific conditions of a site (Butler et. al. 1993).

Even if a reliable waste-in-list can be prepared the use of the volumetric approach is plagued by other inherent problems. The approach violates the cost causation principle by allocating volumes without regard to directly attributable costs.[12] Furthermore, some key assumptions must be made in order to implement the volumetric approach. Wastes must be considered to be homogenous, therefore, the approach does not distinguish between hazardous and non hazardous wastes or the different cleanup costs associated with each. Also, depending on what units volume is measured in (gallons, cubic yards, number of drums, etc.) may directly affect the cost allocation (Butler et. al. 1993:10139).

Allocations Based on Relative Toxicity

Use of the relative toxicity approach generally requires that wastes to be cleaned up or treated be placed into groups of wastes with similar toxicity. A toxicity score is then developed for each group. The volume of each waste group is then multiplied by its toxicity score in order to obtain a toxic equivalent volume. Finally, the ratio of each PRP's toxic equivalent volume to the total toxic equivalent volume of all the representative wastes at the site constitutes its cost allocation share. Therefore, this approach does account for the higher cost shares associated with highly toxic wastes and the lower cost shares associated with less-toxic wastes, all things remaining equal (Butler et. al. 1993).

Once again this is a process that requires a substantial amount of information and data, therefore, an arbitrary decision(s) may need to be made in order to facilitate the final allocation. Due to the heterogeneity of the wastes contributed by each party (specifically generators), individual parties may need to provide detailed information on the composition and quantity of wastes sent to the site (Butler et. al. 1993). Therefore, the inherent lack of valid information common to many Superfund sites remains a logistical problem. Moreover, due to the detailed information required to perform such an allocation, PRPs may be unwilling (especially at early negotiation stages) to share such data with government agencies or other parties (Hedeman et. al. 1991). Furthermore, this allocation method is typically more costly than the volumetric approach (Butler et. al. 1993).

Allocations Based on Stand-Alone Costs (SAC)

The SAC method is an approach that has historically been used in the distribution of costs for water resource projects. The method is based on the idea that fairness requires the members of a multi-purpose project to pay in proportion to the benefits they receive (Butler et. al. 1993:10141). The stand-alone cost (SAC) method begins by allocating any identifiable direct cleanup costs to the responsible parties. Following this initial allocation, the common costs would be allocated according to the relative costs of cleaning up each PRPs contribution as if it was the only waste at the site.

This approach can be mathematically expressed by the following:

$$\sum_{i=1}^{N} SAC_i \qquad (1)$$

Where:

SAC_i =the stand-alone cost for PRP_i (or PRP group *i*)

N =the total number of PRPs (or PRP groups)

Σ =the sum of all SAC_i terms

This calculated share of the common costs is multiplied by the total common costs associated with the cleanup effort to arrive at the share of common costs allocated to each PRP or PRP group (Butler et. al. 1993:10141).

Allocating Superfund remediation costs based on the SAC method derives from the concept of economies of scope.[13] The economies of scope at a Superfund site occur when the cost per cubic yard to treat a large volume of waste is less than the cost per cubic yard to treat a small volume of waste (Butler et. al. 1993:10142).[14] Theoretically a party would realize significant savings by participating in a joint cleanup effort, rather than acting alone. One disadvantage of the SAC method is that the cost of implementing the approach increases as the number of PRP groups increase due to the additional number of SAC options that must be calculated (Butler et. al. 1993:10143).

Judicial Guidance on Allocating Responsibility

Detailing the contribution of each PRP would be a lengthy, expensive, and an almost impossible task. Often it is difficult to determine who dumped what and how much. In many cases generator and transporter records of the types and quantities of wastes sent to a given site are many times incomplete or completely missing, making it difficult to apportion liability on anything but an arbitrary basis (Light 1990 and Mason 1991). Therefore, the courts are more likely to impose joint and several liability on PRPs rather than to attempt to divide response costs among multiple PRPs for various reasons (Mason 1991 and Hird 1993).

The allocation issue typically arises at two stages under CERCLA: the initial response stage and the contribution stage.[15] In the initial allocation stage a court must determine a party's responsibility according to the principles of joint and several liability. In contrast, the contribution stage involves the use of various "equitable factors" to be considered by the courts (Mason 1991). The problem faced by the courts is that Congress failed to suggest how they were to apportion liability in a given case (Garber 1987). Therefore, the courts have traditionally applied the strict and joint and several liability standard on a case-by-case basis. As a result, two methods of application have evolved: (1) the majority, strict "restatement" approach; and (2) the minority, "moderate" approach (Restatement (Second) of Torts 886A (1979), *United States v. Chem-Dyne Corp.,* 572 F. Supp. (S.D. Ohio 1983), *United States v. A&F Materials Co.,* 578 F. Supp. (S.D. Ill. 1984), Light 1990, and Mason 1991).

The Restatement Approach

Under the Restatement approach (using sections 433A, 875, and 881 of the Second Restatement of Torts), once a group of PRPs is found liable under CERCLA, the court may choose to impose joint and several liability, holding each PRP individually liable for the total costs of the response action (Mason 1991, Light 1990, and *United States v. Chem-Dyne Corp.,* 572 F. Supp. (S.D. Ohio 1983). Therefore, a court will impose joint and several liability when faced with joined parties that have created a single and indivisible harm (*United States v. Chem-Dyne Corp.,* 572 F. Supp. (S.D. Ohio 1983), *United States v. Bliss,* 667 F. Supp. (E.D. Mo. 1987), Mason 1991, and Restatement (Second) of Torts (1979)).

However, under sections 433A and 881 of the Restatement, a court may choose to apportion liability where joined parties acting independently have combined to create a single harm. Under such a situation each party is liable only for its part of the harm (*United States v. Chem-Dyne Corp.,* 572 F. Supp. (S.D. Ohio 1983), *United States v.*

Monsanto, 858 F.2d (4th Circuit 1988), and Mason 1991). Such an apportionment is appropriate only when the court can distinguish the causes from one another or find some other reasonable basis for determining how much harm each party contributed to the total harm (Restatement (Second) of Torts (1979), and Mason 1991).

The Moderate Approach

Once a court has established the initial divisibility or indivisibility of the harm, then any of the identified PRPs may try to limit its costs by seeking contribution from fellow PRPs. Section 113(f)(1) of SARA provides that a court may allocate response costs among liable parties using such "equitable factors as the court determines are appropriate" (42 U.S.C. 9613(f)(1) 1988 and Mason 1991). However, Section 113(f)(1) of SARA fails to suggest what "equitable factors" may be used in addressing the apportionment issue (Garber 1987, Mason 1991, and Hall et al. 1994). Moreover, the equitable factors' standard offers little guidance as to the proper distribution of liability among the responsible parties (Burt and Sanoff 1990:204).

The moderate approach follows a set of important "equitable factors" taken from a proposed amendment (the Gore amendment) to CERCLA that was eventually dismissed (Mason 1991). Therefore, when a court is confronted with a contribution case, it may choose to apportion liability according to the following equitable factors: (1) the PRPs ability to prove that it's contribution was distinguishable from that of other PRPs; (2) the amount of hazardous waste attributable to the PRP; (3) the toxicity of that waste; (4) the PRPs involvement in the generation, transportation, treatment, storage, or disposal of the waste; (5) the degree of care that the PRP exercised in those activities; and (6) the extent to which the PRP cooperated with government officials in preventing further harm (*United States v. A&F Materials Co.,* 578 F. Supp. (S.D. Ill. 1984), *Amoco Oil Company v. Borden, Inc.,* 889 F.2d (5th Circuit 1989), Mason 1991, Prager 1986-1987, and Hall et. al. 1994).

Apparently Congress did not want to limit the factors the courts could consider. Therefore, the equitable factors' standard has given the courts a wide base for making decisions concerning what constitutes a fair allocation. The courts have adopted other equitable factors. They include: (1) existing contracts between the parties on the subject of liability; (2) the owner's involvement in the operator's activities and operations; (3) benefit received by the owner from the operator's activities; and (4) benefit of the owner if after the cleanup the land is cleaner than at the outset of the operation that caused the harm (Burt and Sanoff 1990 and Hall et. al. 1994).

EPA Guidance on Allocating Responsibility

The broad CERCLA settlement policy provided little guidance on allocating responsibility and as a result, the EPA has had little experience in the area (Butler et. al. 1993). Generally, the agency has left the PRPs to resolve the allocation issue on their own.[16] However, the agency does provide a few alternatives for allocating responsibility among the PRPs: (1) the tiered approach; (2) the preparation of NBARs; and (3) the formal organization of PRPs.

The Preparation of NBARs

The reauthorization of Superfund, in 1986, provided the agency with some guidance in the area of allocating response costs among PRPs. Section 122(e)(3) of SARA authorizes the agency to develop guidelines for preparing nonbinding allocations of responsibility (NBARs) and waste-in-lists (42 U.S.C. 9622(e)(3) (1988)). However, the EPA has utilized these settlement alternatives offered by SARA in only a limited number of cases.

To prepare an NBAR, the agency must divide one-hundred percent of the liability at a site among the waste generator PRPs (according to volume) (42 U.S.C. 9622(e)(3) (1988), Mason 1991, and Hall et. al. 1994). The EPA uses the volume of waste that each PRP contributed to a site as the threshold criterion for apportioning liability under an NBAR. However, the EPA has acknowledged that factors such as volume, toxicity, mobility, ability to pay, litigative risks in trying the case, and evidence tracing wastes at a site to a specific PRP(s) may be used in order to allocate cleanup costs (Hall et. al. 1994). Section 104(e) allows the EPA to obtain information from a PRP on: (1) the nature and quantity of hazardous waste generated, treated, stored or disposed of at a site; (2) nature or extent of a release; and (3) ability to pay (42 U.S.C. 9604(e) (1988) and Hall et. al. 1994).

The EPA may then adjust the allocations using the following criteria: (1) the evidence linking wastes at the site to specific PRPs; (2) ability to pay; (3) the risks of litigation; (4) public interest considerations; (5) the precedential value of the case if it were to go to court; (5) the value of getting a fixed monetary settlement; (6) inequities and aggravating factors; and (7) the nature of the case that will remain after settlement. The agency must allocate shares of liability to the nongenerator PRPs based primarily on the degree of culpability, and transporters according to volume, packaging, and placement of the wastes at the site (42 U.S.C. 9622(e)(3) (1988), Mason 1991, and Hall et. al. 1994).

The Tiered Approach

When there are a significant number of PRPs at a site, the EPA typically divides them into groups of defendants known as tiers. These tiers are based primarily on each PRP's site specific criteria and financial viability (Acton and Dixon 1992). Using the Tiered approach PRPs are divided into subgroups that represent specific site conditions. Tier I defendants generally consist of PRPs with the largest volumetric shares or largest assets. Tier II and Tier III PRPs usually constitute smaller volumetric shares or financial assets. The EPA typically focuses exclusively on the Tier I defendants, leaving it to the Tier I PRPs to pursue the PRPs in the lower tiers. However, in some instances the agency will enter into serious negotiations with Tier II and Tier III PRPs if negotiations become finalized with Tier I PRPs (Acton and Dixon 1992:10).

The Formal Organization of PRPs

When a substantial number of PRPs are identified, the EPA encourages the parties to form PRP organizations. These organizations or PRP groups often create a steering committee. This committee is usually responsible for directing all negotiation and settlement activities, directing the activities of hired consultants and common counsel, appointing members of other sub-committees, as well as recommending cost allocation methods (Hedeman et. al. 1991:10418).[17] Figure 5 summarizes the organizational structure and function of the steering committee. The creation and maintenance of a PRP organization often entails substantial costs. These costs are generally allocated through non-binding structures that consist of distinct tiers of contribution (Hall et. al. 1994:1492).

Additional committees are generally formed, including an allocation committee. The purpose of the allocation committee is to recommend a method for apportioning the response costs among the group (Hedeman et. al. 1991:10418). The cost allocations are most often based on volumetric contributions because this information is generally the most readily available. However, the actual allocation will vary significantly depending on the site conditions, relative facts, and the resources of various parties (Hall et. al. 1994:1492).

Chapter Summary

It would appear that the basic goals of Superfund are hindered by the interpretation and implementation of its own liability scheme. The use of such a comprehensive liability standard often prevents the timely cleanup of sites. Even when the EPA seeks settlements or cost recoveries from one or a few large PRPs, these parties often sue other PRPs in hopes of recovering their incurred costs. Therefore, although government transaction costs may be reduced by concentrating on larger PRPs, they are frequently replaced by private transaction costs. The process is further hindered by the frequent difficulty of coordinating negotiations with multiple PRPs, each of which must agree on a remedial plan and a cost allocation method (Hird 1993).

The CERCLA liability scheme creates complex and practical problems for parties attempting to allocate financial responsibility. Many of the cost allocation methods commonly used lack logical foundations. The lack of techniques based on accepted principles inevitably leads to continued debating among PRPs, ultimately resulting in significant delays and excessive costs.

Chapter Notes

1. The third defense is only available if a PRP can prove that it exercised due care and took reasonable precautions against foreseeable acts or omissions of any such third party. *See* Mason 1991:82.

2. No joined party may bring a contribution claim if it is found that the party intentionally caused the harm for which it is liable. *See* Restatement (Second) of Torts 886A (1979).

3. Removal actions are typically short-term actions taken to address an immediate threat to the human health and the environment. Remedial actions are generally long-term actions that are intended to provide a permanent remedy to the threatened release or release.

4. The National Contingency Plan (NCP) establishes standards for the assessment of cleanup actions. Any response action taken by either a public or private entity must be consistent with the NCP. *See* Pusch 1991:217.

5. This number apparently has no intrinsic value and was initially chosen simply to ensure that at least 400 sites nationwide made the NPL.

6. In a "fund-lead" cleanup, the EPA will hire contractors to evaluate potential remedies. The agency will then perform the cleanup and bring suit against PRPs to recover response costs that were incurred. In an "enforcement-lead" cleanup, the EPA issues an order or sues the PRPs, forcing the PRPs to conduct the necessary response action, with the agency maintaining a supervisory role. *See* Hedeman et. al. 1991:10416.

7. Such PRPs are generally referred to as "deep pockets". They are usually characterized as parties with substantial financial assets.

8. The court took a common law approach in the case, stating that the term "joint and several" had been omitted from the final bill in order for the courts to determine the use of joint and several liability on a case by case basis. However, the court failed to adopt the blanket liability scheme of the Clean Water Act. *See United States* v. *Chem-Dyne Corp.,* 572 F. supp. (S.D. Ohio 1983).

9. Transaction costs are generally those overhead costs associated with consultant fees, legal, and administrative costs.

10. In identifying fewer than all the PRPs, the agency incurs substantial upfront costs. However, the responding PRPs generally incur more costs on attorney and consultant fees in order to identify other PRPs. *See* Hedeman et. al. 1991:10414.

11. Other factors to be considered could included toxicity, migratory potential, and ability to pay.

12. The volumetric approach fails to take into account directly attributable costs that may cause the cost of the cleanup to change significantly.

13. The stand-alone cost of a cleanup effort is similar to the cost of producing a single product or service separately from, rather than in combination with, other products or services. *See* Butler et. al. 1993:10142.

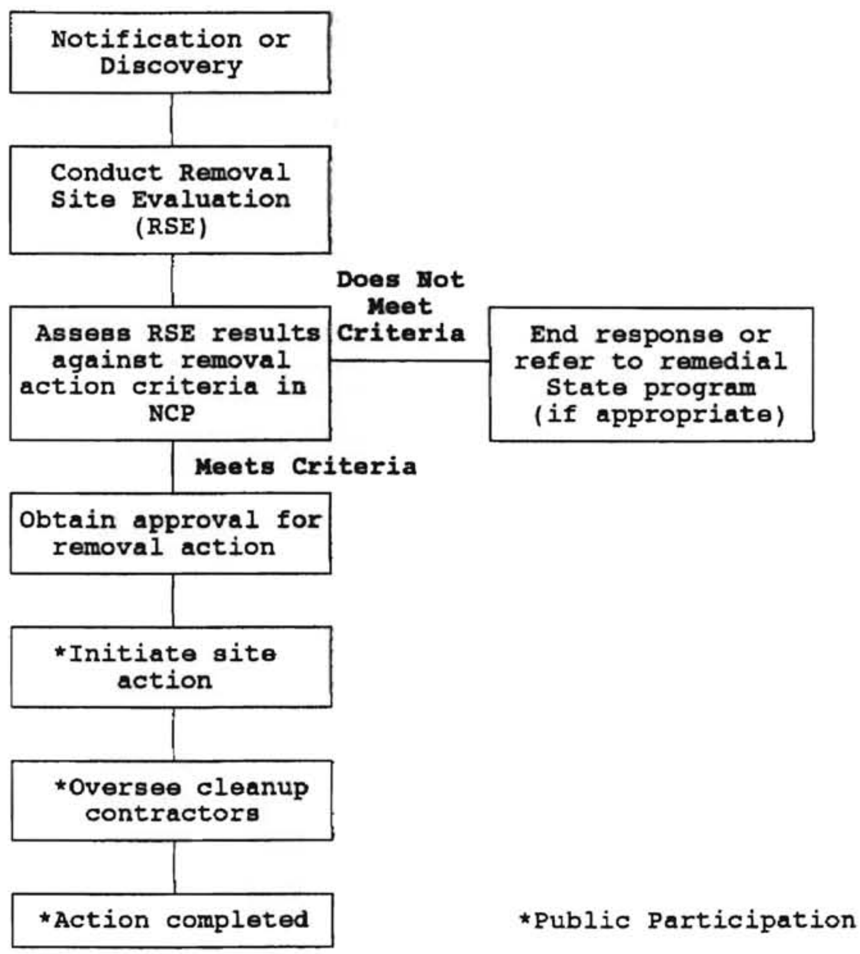
14. Such economies of scope would arise when the toxicity associated with the larger contribution is less than the toxicity associated with the smaller contribution. Therefore, the treatment of the smaller contribution would drive the remediation costs.

15. The allocation stage typically follows a government cost recovery action, while the contribution stage occurs when a PRP(s) brings a contribution claim against a fellow PRP(s). *See United States v. Western Processing Co.*, 734 F. Supp. (W.D. Wash. 1990).

16. The agency usually recommends that the PRPs resolve the allocation issue through the use of a PRP allocation committee (entity of the steering committee) or the assistance of an outside consultant. *See* Butler et. al. 1993:10134.

17. Numerous sub-committees are generally formed: an executive committee to handle administrative and financial matters; a technical committee to oversee technical consultants and negotiate technical issues with the government; an allocation committee to recommend a method for allocating costs among the parties; and a *de minimis* committee to recommend the terms of a *de minimis* settlement, if applicable. *See* Hedeman et. al. 1991:10418 and Figure 5.

FIGURE 1: Overview of the Removal Action Process.



Source: EPA 1991:6 (slightly modified).

Figure 2: Overview of the Remedial Action Process.

Remedial Investigation (RI)

An assessment of the nature and extent of contamination and the associated risks

Feasibility Study (FS)

Development and analysis of the range of cleanup alternatives for the site

Selection of Remedy

Selection of the remedial alternative for the site includes:

Proposed Plan

Identifies the remedial alternative likely to be chosen and explains why and allows for public comment

Record of Decision (ROD)

The official report documenting background information on the site and describing the chosen remedy

Remedial Design (RD)

Preparation of technical plans and specifications for implementing the chosen remedial alternative

Remedial Action (RA)

Construction or other work necessary to implement the remedial alternative

Operation & Maintenance (O&M)

Activities conducted at a site after a response action occurs to ensure that the cleanup methods are working properly and to ensure site remediation is effective

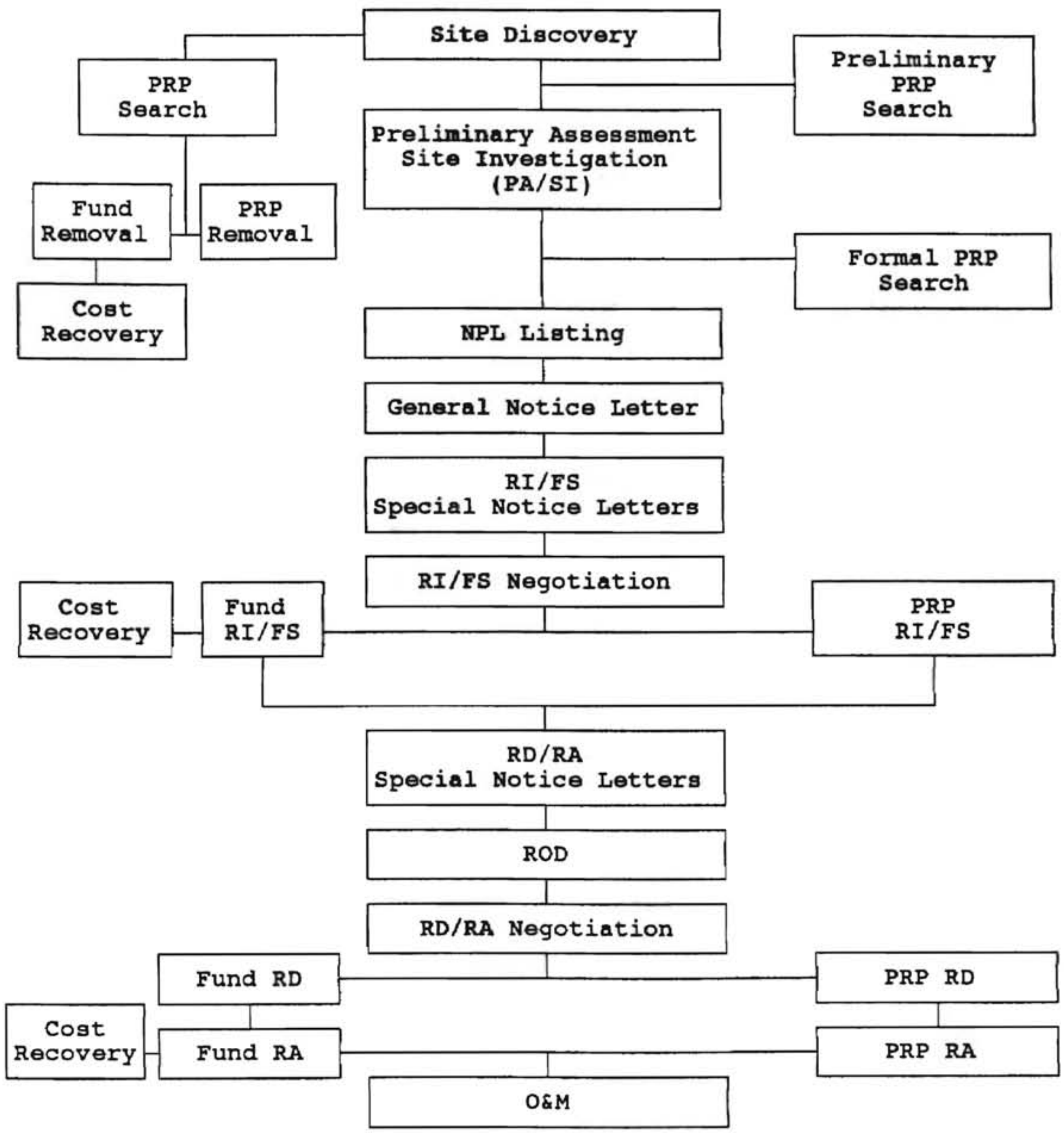
Source: EPA 1991:14 (slightly modified).

TABLE I: Times for Sites to Reach Points in the Superfund Process.

	Average	Range
From entry into Superfund until:		
PA completion	18 months	1-45
Site Inspection completion	21 months	1-44
Placement on NPL	36 months	4-75
Start of RI/FS	44 months	20-68
Completion of RI/FS	75 months	47-103
Signing of ROD	81 months	50-104
Completion of ROD remedy	10 years	6-20
Between PA completion until:		
Site Inspection	14 months	0-39
Placement on NPL	32 months	3-73
Start of RI/FS	42 months	13-68
Between placement on NPL and RI/FS	16 months	3-39
Duration of RI/FS:		
Studies	32 months	21-38
Total period (studies through ROD)	34 months	24-39
Signing of ROD and ROD estimated completion of RA	38 months	20-120
Duration of public comment period	33 days	24-44
Time between end of public comment period and signing of ROD	34 days	15-122

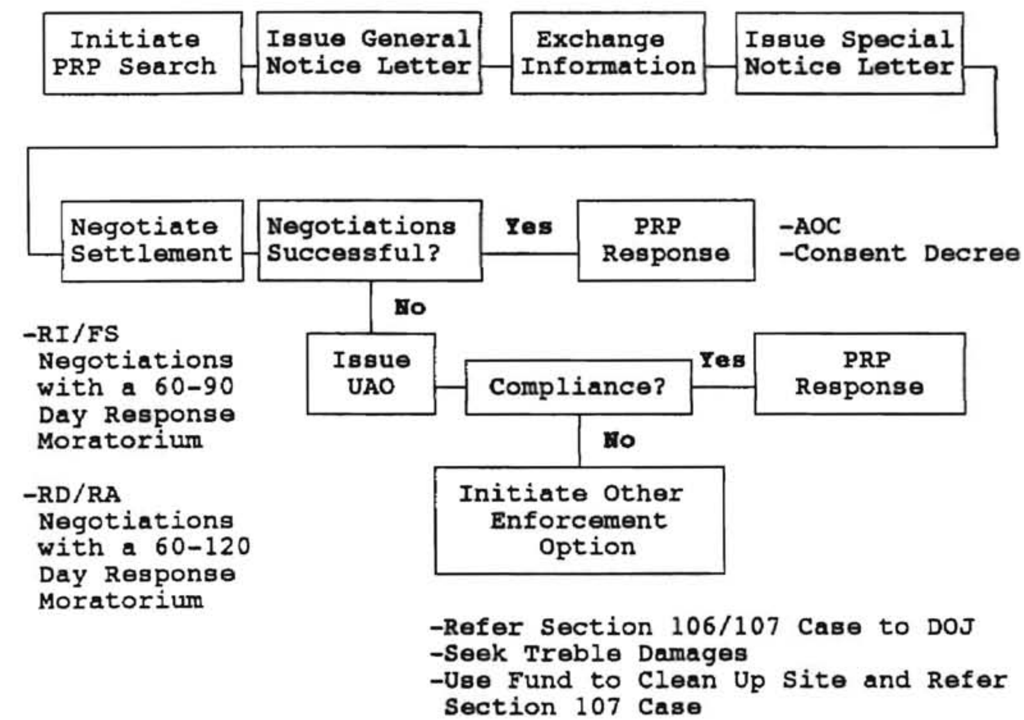
Source: OTA 1988:13 (slightly modified).

FIGURE 3: Overview of the Superfund Process.



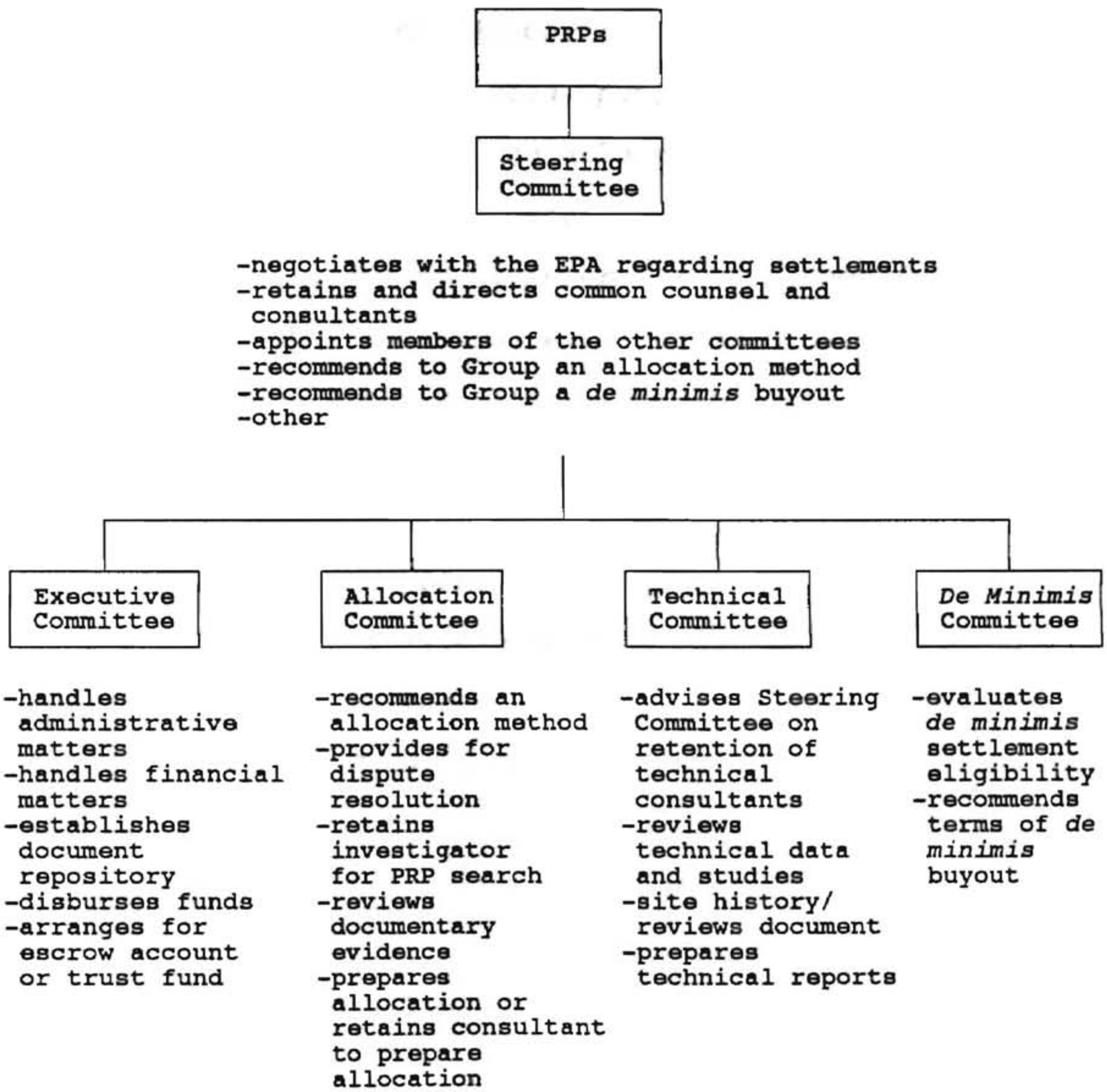
Source: Hedeman et. al. 1991:10416.

FIGURE 4: The Basic Superfund Enforcement Process.



Source: EPA 1991:23 (slightly modified).

FIGURE 5: The Steering Committee Structure.



Source: Hedeman et. al. 1991:10418.

CHAPTER III

COST ALLOCATION PRINCIPLES: DEVELOPING A MODEL

A successful cost allocation generally involves identifying a total cost to be allocated, followed by implementation of a cost allocation method. Once the relevant information is agreed upon, a cost allocation method must be selected. The allocation method must be consistent and reflect the nature of the costs that are to be allocated (Biddle and Steinberg 1984). Therefore, the usefulness of the allocation will depend upon the nature of the cost being allocated, the allocation method chosen, and the decisions to be based on the allocated costs (Biddle and Steinberg 1984).

In general, an apportionment problem arises whenever a set of similar, indivisible objects must be distributed among a group of claimants in proportion to their claims (Young 1994:43). Traditionally, joint cost allocations have been based on information regarding either (1) physical proxies for benefits received from joint factors; or (2) the ability to pay. These physical proxies may include units of production, volumes, lengths, weights and heat contents (Biddle and Steinberg 1984:11). Historically, joint cost settings occur when production costs are a nonseparable function of the outputs of two or more products. In some instances, physical proxies such as volume and toxicity may be an inadequate basis for allocating financial responsibility under CERCLA. Disputes often arise between parties concerning their relative contributions and their associated cleanup costs. As a result of these pitfalls, there has been some discussion on the appropriate rules for allocating joint costs under Superfund.

Discussions on the appropriate rules for allocating cleanup costs under Superfund have lead to several conclusions. First, a party or class of parties should bear only those costs that can be directly attributed to them. In Superfund cost allocations it is viewed as equitable and economically efficient that costs that can be directly traced to the actions of specific party should be paid by that party (Butler et. al. 1993:10138).[1] Secondly, any costs that cannot be directly traced to a party or class of parties should not be borne by that party or class based on cost causation (cause and effect) (Butler et. al. 1993:10138).[2] These costs are considered to be a nonseparable function of the outputs of two or more products or, in the case of Superfund, two or more parties. Such costs cannot be logically apportioned to any single party (Biddle and Steinberg 1984 and Butler et. al. 1993).

The nonseparability of the cost function and the joint production of the products reflect cost savings or economies of scope. Economies of scope arise when it is less costly to jointly produce a set of products.[3] The costs associated with jointly producing a product are known as common costs. Common costs apply to a setting in which the production costs are based on a single service which is used by two or more users (Biddle and Steinberg 1984:4-5).[4] In the context of Superfund, common costs are the nonseparable costs that cannot be allocated to any single party on the basis of cost causation (cause and effect).[5]

Generally, joint cost allocations emphasize output decision incentives, whereas common cost allocations emphasize incentives to potential users to participate in the common provision of a product or service (Biddle and Steinberg 1984:5). It follows that common production is undertaken in order to realize the cost savings related to economies of scope. However, these cost savings will not be realized unless parties agree to voluntarily participate in a coalition (Biddle and Steinberg 1984:16). Therefore, a party must choose between acting independently and participating in a joint project, such a decision should be made by comparing the cost of each.[6]

The Formation of Cooperative Coalitions

The decision to participate in a coalition will be made only if a party's cost as a member of the coalition is lower than the cost of acting independently (Faulhaber 1975:966). The decision to participate can be "systematically analyzed by applying cooperative game theory" principles (Lejano and Davos 1995:1387). When allocating costs among a group of parties, some sense of fairness must exist in order for there to be agreement among the project members. Concepts from cooperative game theory are often used to apportion costs among project participants in a fair manner (Loehman and Whinston 1975:87). Cooperative game theory analyzes a joint cost project as a game with *N* players, each of which can choose among the following: (1) acting independently; (2) joining the grand coalition of all *N* players; or (3) forming a coalition with only a sub-set (*S*) of the *N* players (Lejano and Davos 1995:1387).

Games in which a coalition seeks to minimize costs are known as cost games. Cost games can be converted to savings games by measuring savings relative to the costs of not participating in a coalition (Heaney and Dickinson 1982). Cost games are subadditive; that is:

$$c(s) + c(T) \geq c(S \cup T) \text{ for } S \cap T = \Phi \quad S, T \subset N \quad (2)$$

Where Φ is the empty set and (*S*) and (*T*) are any two subsets of *N*. Satisfaction of subadditivity is a requirement for voluntary cooperation. If it is not met, then at least one coalition exists for which costs would be lower if the members did not form the coalition. However, this is not possible if the least-cost solution has been found for each coalition. At worst, no lower cost would occur when the coalition forms, such a condition is said to be inessential (Heaney and Dickinson 1982:477).

Game theorists have established three general axioms, which a fair solution to a cost game should satisfy. First, the cost assigned to the i^{th} group, x(i), should be less than or equal to its cost of acting independently;

$$x(i) \leq c(i) \qquad \forall i \in N \qquad (3)$$

Second, the total cost, c(N), must be allocated among the groups;

$$\sum_{i \in N} x(i) = c(N) \qquad (4)$$

Finally, the cost allocated to the members of any sub-group (*S*) should be less than, or equal to the costs that the sub-group will incur by acting independently from the other members of the grand coalition *N*;

$$\sum_{i \in N} x(i) \leq c(S) \qquad \forall S \subset N \qquad (5)$$

(Heaney and Dickinson 1982:478 and Lejano and Dickinson 1995:1388). Any solution(s) satisfying the first two criteria are referred to as imputations. Any solution(s) satisfying all three criteria will constitute the core of the game.[7] A cost game has a convex core if:

$$c(S) + c(T) \geq c(S \cup T) + c(S \cap T) \quad S \cap T \neq \Phi \quad S, T \subset N \qquad (6)$$

Therefore, an allocation is in the core of the cost-sharing game if no participant, or group of participants, pays more than its cost of acting alone (Young 1994:85). As a result, the more attractive (less costly) the game, the more likely that the core is convex. On the other hand, the less attractive (more costly) the game, the more likely the core is empty (Heaney and Dickinson 1982:478).

If these conditions are not met there will be an incentive for some participants to leave the grand coalition in order to act independently or carry out their own joint project (Lejano and Davos 1995:1388). Therefore, if the cost allocation results in a charge that is more than the avoided or stand-alone cost (SAC) of any participant, the party or parties that are charged more will go at it alone and the economic efficiency of a joint cleanup effort will be lost (Butler et. al. 1993:10143). The importance of these issues lies in the fact that if the cost is too high there will be disincentives to participate, while if charges are too low, the total costs will not be covered (Loehman and Whinston 1975).

Concepts from cooperative game theory provide a logical and straightforward approach to the allocation of nonseparable costs among PRP groups. Cooperative game theory considers problems of fairness and equity in allocating costs among members of a group who voluntarily agree to cooperate, the focus is on ensuring the parties cooperation (Biddle and Steinberg 1984:16). In order to ensure that a coalition or sub-coalition is formed, it is necessary to ensure the following: (1) identification and allocation of each party's separable costs; (2) incentives for participation; and (3) the division of the perspective participants into PRP classes that are manageable. Once these conditions have been met the allocation committee, or entity, can identify coalitions or sub-coalitions and begin the process of implementing the proposed allocation method.

Identifying Each PRP's Separable Costs

Separable costs are defined as the difference between the cost of the coalition project and the cost of the project with the coalition omitted. They include direct costs and the incremental costs of changing the size of the coalition's cost elements. Calculating the separable costs for each PRP provides the following information: (1) it provides the allocation committee or entity with the necessary information for identifying each party's directly attributable cleanup cost, and (2) it helps each party determine the feasibility of acting independently or participating in the coalition. Separable costs can be expressed mathematically by:

$$sc(i) = c(N) - c[(N) - \{i\}] \qquad \forall i \in N \qquad (7)$$

Where:

$sc(i)$	=separable cost to PRP_i (or PRP group i)
$c(N)$	=total cost for the grand coalition of n groups
$c[(N)-\{i\}]$	=total cost for the grand coalition with PRP_i (or PRP group i excluded)

Assuming that each group has been allocated its separable costs, the remaining costs to be assigned are called nonseparable costs (NSC) (Heaney and Dickinson 1982:477). By allocating directly attributable cleanup costs, any attempt to allocate project costs based on cost causation is avoided.

Incentives for Joining A Coalition

Due to the nature of Superfund liability and the pitfalls of current allocation methods, there are significant incentives for the various parties to undertake a joint cleanup effort. Most significant among these incentives is the economic efficiency that can be attained because of economies of scope or commonality of interests (Lejano and Davos 1995:1387).[8] The obvious incentive is the aversion of joint and several liability and the possibility of bearing the full cost of the cleanup. Whether or not a party will respond favorably to these incentives and choose to participate in a joint cleanup effort will depend on its anticipated savings.

A PRP would presumedly compare the expected benefits and costs of acting independently, with those of participating in a coalition or sub-coalition. Therefore, a PRP would not participate in a coalition or sub-coalition if the expected cost of participating is greater than the expected cost of taking an independent action. This decision would be based on the calculated costs generated from equations (3) and (5). Therefore, it is important for the entity performing the allocation (preferably a neutral third party) to quickly identify each party's separable cost and establish an estimated cleanup cost. This cost will serve as the baseline for comparing the cost savings among a party's possible alternatives.

The incentives for participating in a coalition should be obvious to a PRP(s). Under the doctrine of joint and several liability, a PRP(s) could risk bearing the full cost of cleaning up a site if the decision is made to litigate the matter or if they choose not to respond. In most cases the size and financial assets of a PRP are likely to influence a firm's decision to litigate or negotiate a settlement with the EPA or fellow PRPs.[9] Generally, a negotiated settlement will result in a total cost that is substantially less than any settlement that may be obtained in court (Acton and Dixon 1992 and Probst et. al. 1995). Moreover, the opportunity to join a coalition would generally offer the PRP a reduction in overall costs.

Dividing Coalition Participants Into Discernible Classes

The presence of multiple PRPs generally creates heterogeneity among PRPs. Differences usually exist between PRPs in the type and quantity of waste contributed at the site, whether or not they have been named by the EPA, financial viability, and their general attitude toward the Superfund process. Any apportionment of responsibility involves allocation not only among the various classes of PRPs but also within each of those classes (Burt and Sanoff 1990:203). Therefore, in most cases it is beneficial to group PRPs into similar classes, based on the information gathered during the initial investigation.[10] These groups or classes are generally comprised of generator or transporter status PRPs, based on their involvement at the site. This classification system serves three important functions: (1) it divides the PRPs into manageable and well-defined units; (2) it provides a quick and easy way to determine directly attributable shares; and (3) it ensures that similar parties are allocated similar costs.

The Role of the Minimum Cost Remaining Savings (MCRS) Method

The purpose of this study is to develop an allocation method that effectively and efficiently allocates cleanup costs among multiple parties. The proposed model is based on the minimization of costs through cooperative participation. Therefore, the proposed allocation method incorporates the use of the minimum costs remaining savings (MCRS) method as a means of apportioning cleanup costs among a coalition of PRPs. The MCRS cost allocation method provides incentives for participating in a coalition by minimizing individual cost and maximizing individual savings (Heaney and Dickinson 1982).

The overall idea is to delineate the boundaries of the core. Using a game theory approach, the boundaries of the core would be delimited. Then the minimum and maximum feasible costs for each participant are calculated. The minimum feasible costs correspond to the separable costs, while the remaining costs are prorated based on the difference between the participant's feasible maximum and minimum costs and the total difference (Heaney and Dickinson 1982:481). Therefore, for games with a core, the upper and lower bounds on each x(i) can be found by solving the following linear program:

$$
\begin{aligned}
&\text{max or min:} && x(i) && \\
&\text{subject to:} && x(i) \leq c(i) && \forall i \in N \\
&\sum_{i \in N} && x(i) \leq c(s) && \forall s \in N \qquad (8)\\
&\sum_{i \in N} && x(i) = c(N) && \\
& && x(i) \text{ unrestricted} && \forall i \in N
\end{aligned}
$$

If a game does not have a core, the solution to the linear program will be infeasible. An empty core indicates that no stable solution exists. Generally, this occurs when the additional savings from forming the coalition are relatively small. In such a case, the values of the characteristic functions for the *S*-member coalitions are relaxed until a core develops. The linear programming solution for this problem is:

$$
\begin{aligned}
&\text{minimize:} && \theta \\
&\text{subject to:} && x(i) \le c(i) && \forall i \in N \\
&\sum_{i \in S} && x(i) - \theta\, c(S) \le c(S) && \forall S \subset N \qquad (9) \\
&\sum_{i \in N} && x(i) = c(N) \\
& && x(i) \text{ unrestricted} && \forall i \in N
\end{aligned}
$$

Therefore, the optimal solution is the minimum value θ, which results in the formation of a core (Heaney and Dickinson 1982:480).

In summary, the minimum costs remaining savings (MCRS) solution procedure includes the following steps:

Step 1. Find the minimum $[x(i)_{min}]$ and maximum $[x(i)_{max}]$ costs that satisfy the core conditions graphically or by solving linear programs where a core exists (8) or where no core exists (9).

Step 2. Prorate the nonseparable cost (NSC), using:

$$\beta(i) = \frac{[x(i)_{max} - x(i)_{min}]}{\sum_{i \in N} [x(i)_{max} - x(i)_{min}]} \qquad \forall i \in N \qquad (10)$$

$$NSC = c(N) - \sum_{i \in N} x(i)_{min}$$

Step 3. Find the fair solution for each PRP or PRP group, using:

$$x(i) = x(i)_{min} + \beta(i)\ (NSC) \qquad (11)$$

(Heaney and Dickinson 1982:481). Using the MCRS solution method, even the most complicated cost allocation problems can be solved by satisfying the core conditions either graphically or by solving linear programs. However, additional work is required when a core does not exist (equation 9). Therefore, decision makers may decide to abandon the coalition if the cost allocation problem appears to be too complicated in comparison to the small amount of cost savings that will result (Heaney and Dickinson 1982:480).

Chapter Summary

The goal in allocating Superfund cleanup costs is to facilitate settlement among PRPs by generating an outcome that is equitable. The use of cooperative game theory principles enables the allocation process to be based on joint participation, which should minimize secondary litigation involving contribution claims. Such an outcome would presumedly minimize delays and transaction costs. The use of the MCRS solution method allows the allocation to be based on the minimum costs and maximum savings to each participant within the coalition. Therefore, the cooperative game theory principles discussed above are the basis for the proposed allocation method presented in this study.

Chapter Notes

1. According to the Federal Energy Regulatory Commission (FERC) this principle is firmly established in public utility regulation. Principles of fairness in ratemaking support the concept that those who are responsible for the incurrence of costs be the ones who bear those cost burdens. *See* Butler et. al. 1993:10138.

2. Butler also suggests that a cost allocation that cannot be performed on the basis of cost causation should be related to benefits received. Butler notes that although such an allocation may need to be based on an arbitrary decision, it is becoming common for judicial decisions to relate benefits received with equitable cost allocations. *See* Butler et. al. 1993:10138. This line of reasoning follows from the example of federal water resource development projects that are apportioned on the basis of the benefits to various consumers. However, Hird (and others) suggests that the fundamental problem of Superfund liability is that it attempts to finance present-day cleanups caused by past damages. This becomes a problem when responsible parties are either unable to absorb the cost, cannot be identified, or are not the parties that benefited from the improper dumping of the pre-CERCLA. *See* Hird 1993:327.

3. When the cost of producing two products in combination is less than the total cost of producing each product separately, the condition is called economies of scope. Economies of scope are generally defined as a less than proportionate increase in costs for a proportionate increase in outputs. *See* Biddle and Steinberg 1984:5. Therefore, the idea of economies of scope has been described as "subadditivity of costs", where subadditivity is sufficient to produce common cost savings. *See* Baumol et. al. 1982.

4. Common costs result when products are produced together when they could be produced separately. *See* Biddle and Steinberg 1984:5.

5. The presence of common costs generally results in the use of joint and several liability. Under CERCLA, the doctrine of joint and several liability does not require the government to establish a nexus (cause and effect relationship) between a PRP's waste and the release or threatened release that initiated the response action (Light 1990). Therefore, the cost of cleaning up "nonseparable" wastes can be allocated entirely to one party, without any regard to the party's actual contribution.

6. A manager is encouraged to utilize a common service when it's use will result in a saving for the firm. As a result, the firm will become aware of the relative costs of both common and independent production. *See* Biddle and Steinberg 1984:18.

7. For subadditive games the set of imputations is nonempty, but the core may be empty. *See* Heaney and Dickinson 1982:478.

8. This line of reasoning follows from the methods used in allocating costs for multiagency water resource projects (Loehman and Whinston 1975, Heaney and Dickinson 1982, and Lejano and Davos 1995).

9. If a party does choose to dispute their relative contribution to a site they should be prepared to prove the divisibility of their wastes and provide some "reasonable basis for apportioning damages" (*United States* v. *Alcan Aluminum Corp.*, 964 F.2d (1992) and Harris and Milan 1992). Parties that can demonstrate that their wastes were stored at a particular location on a site, with limited migration from that location, and without combining with other wastes will be in the best position to prove divisibility and apportionability (Harris and Milan 1992). It is somewhat expensive for a PRP to prove divisibility and develop a meaningful apportionment on its own.

10. Classification could be based on various characteristics of the parties' contributions, including, but not limited to, the following: (1) volume; (2) toxicity; or (3) the relative risk to the human health and the environment. Classification could also be based on the parties' financial assets. Such classifications could possibly result in a party being placed in two or more classes, therefore, the party should only be accounted for through one class in order to avoid double counting.

CHAPTER IV

AN EMPIRICAL MODEL: METHODS AND RESULTS

Various methodologies, both qualitative and quantitative, and subjective and objective in nature, will be used in this study to address the issue of allocating financial responsibility among multiple PRPs in an efficient and equitable manner. The methods being used in this study include: providing incentives for participating in a joint cleanup effort, dividing coalition participants into well defined classes, and the use of the minimum cost remaining savings (MCRS) method. These methodologies combine to create a streamlined allocation method that facilitates negotiation and promotes cooperative participation among the involved parties. The result is an allocation method that minimizes each participant's cleanup costs while recovering the full cost assigned to that particular coalition.

Selected History of the Case Study Site

The Royal N. Hardage industrial waste site is located approximately 35 miles south-southwest of Oklahoma City, 15 miles southwest of Norman and one half mile west of Criner in McClain County, Oklahoma. The disposal site is located on a 160 acre tract of the Hardage family ranch. The site consisted of a number of permanent and temporary impoundments into which a variety of liquid, sludge, and solid wastes were disposed and mixed (Costello 1995).

On September 15, 1972, the Oklahoma State Department of Health (OSDH) granted Royal N. Hardage a license to construct, operate, and maintain a hazardous waste disposal facility for industrial and hazardous waste. From 1972 to 1980, over 20 million gallons of waste were transported to the site for storage and/or disposal by approximately 400 companies and state and federal government agencies. Until June, 1979, the Hardage-Criner site was the only permitted hazardous waste facility in Oklahoma (Costello 1995:1). In 1979, the site had reached its permitted capacity resulting in the use of unpermitted pits, improper maintenance and closure of existing pits, failure to retain runoff, and improper storage of wastes at the site. These activities resulted in a series of investigations by both state and federal agencies. The State of Oklahoma found that disposal activities at the site were in violation of the permitting requirements and administrative proceedings were initiated to revoke Hardage's permit.

Subsequent EPA investigations determined that disposal practices at the site had resulted in various degrees of contamination to the surface water, groundwater, and surface soil (Costello 1995). In September of 1980, the EPA sued Royal N. Hardage for site investigation costs and ordered him to remediate the site. Mr. Hardage closed the site in late 1980. Subsequently, Mr. Hardage filed bankruptcy in 1985 and was discharged from liability (Costello 1995:1). Appendix C provides a chronological listing of the Hardage-

Criner site history.

In 1984, the EPA notified companies that had legally disposed of wastes at the Hardage-Criner site that they were potentially responsible for cleanup at the site under CERCLA. Following this notification, more than 100 of the PRPs organized themselves into the Hardage Steering Committee (HSC) in order to coordinate the cleanup of the site. The EPA continued with numerous site investigations and divided the site into two operable units: (1) source control; and (2) management of migration. The HSC contested the EPA's evaluation of the site conditions and their decision to divide the site into source control and management of migration operable units. As a result, the HSC initiated their own evaluation of the site conditions and proposed an alternative remedy (Costello 1995:1).

In 1986, the EPA sued Hardage and 36 of the PRPs in order to recover costs and to implement the agency's selected remedy. Disputes between the EPA and the PRPs over the selection of an appropriate remedy continued for the next four years.[1] A remedy trial was held in December, 1989. In August, 1990, the Western District Court of Oklahoma ordered the parties to implement the proposed HSC remedy with certain modifications. The court-ordered remedy required the pumping and removal of waste, groundwater treatment, and containment of remaining wastes on-site (Costello 1995:2). Appendix D offers a detailed summary of the proposed remedial actions, including the court-ordered remedy.

As early as 1986, the HSC began conducting remedial measures to prevent any possible adverse environmental impacts from the site. The HSC repaired and stabilized various disposal units, installed security fencing, established a field office, and employed a full-time site supervisor. Additional measures included providing an alternative water supply to residents dependent upon domestic wells and the buy-out of existing grazing leases on the site in order to stop ongoing grazing. In addition, the HSC has acquired the acreage necessary to implement the institutional control portion of the remedy, provided routine site maintenance, and conducted ongoing site inspections (Costello 1995:2).

The HSC has incurred substantial costs as a result of meeting the conditions set forth in the court-ordered remedy. As a result, the HSC has sought contribution from a number of parties involved at the site. On March 25, 1991, the HSC, comprised of 58 parties, entered into a settlement agreement with approximately 22 other parties. This study is, to some extent, based on the data provided by this settlement agreement. However, in order to avoid potential conflict, the HSC members and various third parties are not referred to by company name.

Methods

Due to the fact that these parties were in no way aware of their role in this study, certain assumptions were made involving their participation. This project assumes that each participant has been allocated it's separable costs. Therefore, the costs attributed to each participant represent the nonseparable costs (NSC) to be allocated to each party (*See* Table III and IV). A hypothetical incentive is also provided in order to accommodate the study. As a result, the formation of each coalition is based on it's calculated share of the total transaction costs associated with the settlement agreement. However, data on the transaction costs associated with the settlement was not provided. Therefore, in order to derive each coalition's calculated share, the data provided is used to extrapolate an estimated total of the transaction costs attributable to the settlement agreement. This extrapolation is based on the following steps:

Step 1. Identify the total transaction costs (T) associated with the total project costs (P). In this case $7,497,764 (*See* Table II).

Step 2. Identify the percentage share (S) of the total HSC settlement agreement costs (H) in comparison to the total project costs (P),

where

$$S = \frac{H}{P} \quad \text{or} \quad \frac{\$15,000,000}{\$59,543,500} \qquad (12)$$

$$= .25\%$$

Step 3. Identify the transaction costs attributable to the HSC settlement agreement (T_1), where

$$T_1 = ST \quad \text{or} \quad (.25)(\$7,497,764) \tag{13}$$

$$= \$1,874,441$$

Step 4. Identify each coalitions share (C_i) of T_1, where

$$C_i = \sum_{i \varepsilon N} c_i \, (T_1) \tag{14}$$

$$= (.0058) + (.0497)(\$1,874,441)$$

$$= (.0555)(\$1,874,441)$$

$$= \$104,031$$

Where:

c_i = each coalition member's settlement percentage (*See* Table III and IV).

The original HSC settlement agreement cost figures are detailed in Table III, while the extrapolated cost figures are detailed in Table IV. The new project cost (H_1) was derived in the following way:

$$H_1 = H + T_1 \tag{15}$$

$$= \$15,000,000 + \$1,874,441$$

$$= \$16,874,441$$

The new cost figures for each party were derived in the following way:

$$PRP_i = (c_i)(H_1) - PA \quad (16)$$

$$= (.0058)(\$16,874,441) - \$1,125$$

$$= \$97,872 - \$1,125$$

$$= \$96,747$$

Where:

PA = credit for 50% of past assessments

Therefore, the new cost figures represented in Table IV are the cost figures utilized in this particular study. For the purpose of this study, these cost figures also represent each PRP's nonseparable cost share of the HSC settlement agreement. As a result, it is assumed that each party has been allocated it's separable costs.

The four parties selected for this study were selected on the basis of their PRP status at the site. Of the 22 parties involved in the HSC settlement agreement, the PRPs represented constitute the transporter status PRPs. These four parties were grouped into a discernible class based on their transporter status. It was assumed, based on the discussions presented in Chapter III, that these parties would agree to participate in a joint clean up effort.

The following examples are for PRP 1 for coalition [12]. For games with a core, the upper and lower bounds for each participant can be found by solving the following linear program represented by equation (8):

max or min: $x(1)$

subject to: $x(1) \le 96747$

$x(2) \le 591558$

$X(1) + x(2) = 584274$

The upper and lower bounds for each coalition are summarized in Table VI. These bounds identify the maximum and minimum payment of each party in the coalition and are essential to performing the MCRS solution procedure. In summary, the minimum costs remaining savings (MCRS) solution procedure includes the following steps:

Step 1. Find the minimum $[x(i)_{min}]$ and maximum $[x(i)_{max}]$ costs that satisfy the core conditions graphically or by solving linear programs where a core exists (8) or where no core exists (9).

Step 2. Prorate the nonseparable cost (NSC), using equation (10):

$$\beta(1) = \frac{96,747 - 0}{(96,747 - 0) + (584,274 - 487,527)}$$

$$= \frac{96,747}{193,494}$$

$$= 0.5$$

$$NSC = 584,274 - 0 - 487,527$$

$$= 96,747$$

Step 3. Find the fair solution for each PRP or PRP group, using equation (11):

$$x(1) = 0 + (0.5)(96,747)$$

$$= 48,373.5$$

This process is repeated for PRP 2 and the individual members of each coalition. The cost figures presented in Table V will be used for calculating the maximum and minimum costs for each coalition structure. These costs are generated by solving the linear programming solution represented in equation (8). These bounds are then used to calculate the MCRS solution for each coalition structure. Table VII represents the least-cost solution for each coalition structure, as well as each coalition member's minimum cost.

Results

The following conditions were satisfied for each coalition: (1) the cost assigned to each PRP was less than or equal to it's cost of acting independently; (2) the total cost was allocated; and (3) the cost assigned to any sub-coalition (*S*) was less than or equal to the cost that the sub-coalition would have received by acting independently from the grand coalition *N*. The coalitions formed in this study were all feasible coalitions and fell within the core of the game. No participant, or group of participants, was charged more than its cost of acting alone (*See* Table VII).

The success of this study can be measured by: (1) the realized savings or economies of scope; and (2) the fact that the total cost attributable to each coalition structure was allocated. First, the savings (economies of scope) realized from the formation of these cooperative coalitions can be expressed in terms of both individual savings (*See* Table VII) and coalition structure savings (*See* Table VIII). These savings are significant when compared with the avoided or stand-alone costs (SAC). Secondly, the costs assigned to each coalition structure were completely allocated (*See* Table V and IX).

The decision to participate in a particular coalition may be based on the following factors (but is not limited to): (1) overall cost savings; (2) negotiations with other participants; or (3) an existing agreement between all participants. In the absence of a pre-existing agreement, each party will inevitably select the solution that minimizes cost and maximizes savings. For example, comparing the assigned cost for [12], [34] coalition structure versus the [1234] coalition structure, PRPs 1 and 4 would prefer the two-party coalition structures. However, PRPs 2 and 3 are the big losers if the two-party coalition structure is selected (*See* Table VII). Similar comparisons could be made between all the coalition structures.

A closer examination of Table VII indicates that the two-party coalition structures offer significantly different individual savings when compared to the three-party coalition structures. Presumedly, the members of the two-party coalition structures would be inclined to base their decisions to participate in a particular coalition on their individual cost savings. Therefore, any subsequent decision would be the result of continued negotiation among the various two-party coalition members. Similarly, the members of the three-party coalition structures would be more inclined to participate in the grand coalition, due to the slight increase in individual cost savings.

In terms of total cost savings, the least-cost solution is represented by the coalition structure [1234]. When compared with the total cost of each party acting independently, the [1234] coalition structure offers a total savings of $444,057 (*See* Table VIII). Therefore, in this particular case, the allocation entity would presumedly select the least-cost solution represented by the coalition structure [1234]. Furthermore, some consideration may be given to each of the cost solutions represented by each of the two-party coalition structures. However, if the selection of the allocating entity results in a charge that is greater than that of any sub-coalitions charge, there will be an incentive for those participants to leave the grand coalition and go at it alone. Therefore, in order to avoid any continued negotiations or delays, the allocating entity may choose to arrange a nonbinding allocation of responsibility (NBAR) based on the solution that represents the least-cost when compared to the avoided or SAC totals (preferably a binding allocation of responsibility).

The fact that these parties did not voluntarily agree to participate in this study did not, in any way, compromise the results. However, the fact that the allocation itself was based on extrapolated data (due to the need to provide a hypothetical incentive) could have affected the results of the study. The linear programming equations generated some very similar cost figures. These cost figures were particularly similar among the three-party coalitions, while the two-party coalitions were better scaled (*See* Table VI). Furthermore, the MCRS equations generated very similar results among the three-party coalitions. As a result, the cost allocations for each member remained constant, regardless of the member's coalition affiliation (*See* Table VII).

These similarities could be attributed to the close scaling of the linear programming results. The similarities could also be attributed to the fact that the cost allocations were based on extrapolated data, rather than data generated from the outset of the HSC settlement. In short, the lack of specific and meaningful data relating to individual transaction costs could have generated the similarities. Some of the coalition structures (namely the three-party coalition structures) are not very "attractive" solutions, this is a reflection of the numbers. However, the overall results generated from the MCRS solution procedure indicate that such a method could produce significant cost savings for each coalition.

Chapter Summary

The methods presented in this chapter are similar to other methods that have been used to allocate costs among multiple parties (PRP classification and volume based settlement percentages). Due to the unique circumstances of each case, variations of these methods and others could play a major role in the cost allocation method selected for a particular problem. However, the methods used for extrapolating the data used in this study may not be necessary for other cost allocation problems. Furthermore, the results of each case will vary based on the site conditions, the financial viability of each PRP, the similarities among the PRPs, the incentives provided, and various other factors.

Chapter Notes

1. The Hardage-Criner Superfund Site is unique in that it is the only case in which the government allowed the PRPs (HSC) to dispute the preferred remedy.

TABLE II: Summary of Costs Associated with the Remedial Measures Ordered by the Court in August 1990.

	Remedy Including Court Order Additions
Vertical Liquid Recovery Well System	
Equipment, Installation/Evaluation	$2,412,000
NAPL/Water Treatment/Destruction	$6,458,000
Well System	$ 792,000
Permanent Site Facilities	$ 570,000
Treatment Plant	$ 956,000
Monitoring Wells	$ 33,000
Composite Cap	$4,120,000
V-Shaped Interceptor Trench	$6,230,000
Land Purchase	$1,000,000
Site Restoration	$ 214,000
Temporary Construction Facilities and Monitoring	$ 577,000
Closure of Existing Facilities	$ 366,000
System Startup	$ 460,000
Community Relations Program	$ 315,000
CONSTRUCTION SUBTOTAL	$24,503,000
Bid and Scope Contingency	$ 4,900,600
TOTAL CONSTRUCTION COSTS	$29,403,600
*Engineering and Design	$ 2,057,896
*Construction Management	$ 2,057,896
*EPA Oversight	$ 1,028,948
*General Liability Insurance/Performance Bond	$ 882,384
*Legal Services	$ 1,470,640
TOTAL ONSITE COSTS	$36,901,564
O&M Costs/Routine Equipment Replacement	$15,262,000
Major Remedy Repl. Contingency	$ 7,379,913
TOTAL PRESENT WORTH COST	$59,543,500

*Transaction costs; $7,497,764

Source: HSC 1991 (slightly modified).

TABLE III: Cash Amounts and Percentages for the HSC Settlement Agreement at $15,000,000.

PRP	Volume	*c*(*i*)	% Share	*PA*	Net Payment
1	32,692	.0058	$87,156	$1,125	$86,031
2	486,890	.0497	$745,604	$247,102	$498,502
3	1,400,000	.1429	$2,143,906	$78,116	$2,065,789
4	376,740	.0384	$576,925	$78,391	$498,534

Source: HSC 1991 (slightly modified).

TABLE IV: Cash Amounts and Percentages for the HSC Settlement Agreement at $16,874,441.

PRP	Volume	*c*(*i*)	% Share	*PA*	Net Payment
1	32,692	.0058	$97,872	$1,125	$96,747
2	486,890	.0497	$838,660	$247,102	$591,558
3	1,400,000	.1429	$2,411,358	$78,116	$2,333,242
4	376,740	.0384	$647,979	$78,391	$569,588

Source: HSC 1991 (slightly modified).

TABLE V: Total Cost to be Allocated to Each Coalition.

Coalition	Total Cost
1	$96,747
2	$591,558
3	$2,333,242
4	$569,588
12	$584,274
13	$2,151,260
14	$583,485
23	$2,563,783
24	$996,008
34	$2,562,994
123	$2,649,658
124	$1,081,883
134	$2,648,869
234	$3,061,392
1234	$3,147,267

TABLE VI: Lower and Upper Bounds On Costs for Four-Party Cost Game.

Coalition	Party Bounds: L=Lower - U=Upper ($)			
	PRP 1	PRP 2	PRP 3	PRP 4
	L-U	L-U	L-U	L-U
12	0-96,747	487,527-584,274	-	-
13	0-96,747	-	2,054,513-2,151,260	-
14	13,897-96,747	-	-	486,738-569,588
23	-	230,541-591,558	1,972,225-2,333,242	-
24	-	426,420-591,558	-	404,450-569,588
34	-	-	1,993,406-2,333,242	229,752-569,588
123	85,875-85,876	498,398-498,399	2,065,384-2,065,385	-
124	85,875-85,876	498,398-498,399	-	497,609-497,610
134	85,875-85,876	-	2,065,384-2,065,385	497,609-497,610
234	-	498,398-498,399	2,065,384-2,065,385	497,609-497,610
1234	85,875-85,876	498,398-498,399	2,065,384-2,065,385	497,609-497,610

TABLE VII: Cost Allocations for Optimal Solution and Intermediate Solutions

Coalition Structure for Least-Cost Solution	Least-Cost Solution	MCRS Cost Allocation ($)			
		PRP 1	PRP 2	PRP 3	PRP 4
1,2,3,4	$3,591,324	96,747	591,558	2,333,242	569,588
12, 34	$3,147,268	48,373.5	535,900.5	2,163,324	399,670
13, 24	$3,147,268	48,373.5	508,989	2,102,886.5	487,019
14, 23	$3,147,268	55,322	411,049.5	2,152,733.5	528,163
123, 4	$3,219,246	85,875.33	498,398.33	2,065,384.33	569,588
124, 3	$3,415,125	85,875.33	498,398.33	2,333,242	497,609.33
134, 2	$3,240,427	85,875.33	591,558	2,065,384.33	497,609.33
234, 1	$3,158,139	96,747	498,398.33	2,065,384.33	497,609.33
1234	$3,147,267	85,875.25	498,398.25	2,065,384.25	497,609.25

TABLE VIII: Total Savings Realized by Each Coalition Structure.

Coalition	Total
12, 34	$444,056
13, 24	$444,056
14, 23	$444,056
123, 4	$372,078
124, 3	$176,199
134, 2	$350,897
234, 1	$433,185
1234	$444,057

TABLE IX: Total MCRS Cost Allocation for Each Coalition.

Coalition	Total Cost Allocated To Each Coalition	MCRS Cost Allocation ($)			
		PRP 1	PRP 2	PRP 3	PRP 4
1,2,3,4	$3,591,324	96,747	591,558	2,333,242	569,588
12	$584,274	48,373.5	535,900.5	-	-
13	$2,151,260	48,373.5	-	2,102,886.5	-
14	$583,485	55,322	-	-	528,163
23	$2,563,783	-	411,049.5	2,152,733.5	-
24	$996,008	-	508,989	-	487,019
34	$2,562,994	-	-	2,163,324	399,670
123	$2,649,658	85,875.33	498,398.33	2,065,384.33	-
124	$1,081,883	85,875.33	498,398.33	-	497,609.33
134	$2,648,869	85,875.33	-	2,065,384.33	497,609.33
234	$3,158,139	-	498,398.33	2,065,384.33	497,609.33
1234	$3,147,267	85,875.25	498,398.25	2,065,384.25	497,609.25

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Having established an understanding of the decision criteria and methods that can be utilized in the allocation process, the next step is to develop a formal allocation process. It is clear that each Superfund case will present it's own unique set of circumstances, such as missing data, orphan shares, and PRPs who choose not to participate in the process. In many circumstances, applying volumetric or toxicity based methods would be an arbitrary attempt at allocating cost shares among multiple PRPs. Therefore, it is important to realize that no one allocation method will apply in all cases. Equitable factors, technical complexities, and site specific conditions require that each allocation method address the unique circumstances of each case. Even if the process is formalized, the allocators must continue to use highly selective and unique allocation methods.

Traditional allocation methods fail to consider economies of scope, and they attempt to establish causation where no causation can be established due to the presence of common costs. Public utility regulators spent years searching for a nonarbitrary method of allocating the common costs associated with providing public utility services before realizing that such a method was impossible due to economies of scope. For the environmental community to travel down that same path would be a wasted effort (Butler et. al. 1993).

Therefore, the success of an allocation process will depend on a commitment of the involved parties to achieving as fair a solution as the facts of the case and the tools at their disposal will allow. As a result, the allocation model presented in this study attempts to address the presence of economies of scope, the allocation of common costs, and the cooperative participation of multiple parties. The model picks up where the traditional allocation methods leave off, providing a systematic approach for allocating the common or nonseparable costs that remain after the apportionment of any direct or separable costs using traditional approaches. The method also ensures the cooperative participation of the involved parties by providing significant incentives for participating in a joint cleanup effort.

Recommendations

Several recommendations could be made for further research concerning cost allocations under CERCLA. However, there are some important issues that must be considered before any further research is conducted. In order for any allocation method to be successful (including the one presented in this study) the EPA must be willing to consistently apply the settlement alternatives provided by

SARA and multiple parties must be willing to participate in joint cleanup efforts. Once these conditions are met the involved parties must identify a neutral third party for constructing and implementing the selected allocation method.

The organizational structure of any allocation process will rely on the EPA's aggressive use of the alternative settlement approaches provided by SARA. When used consistently, these alternatives will promote an efficient and equitable allocation process in the following ways: (1) the performance of NBARs will provide the information necessary for an informed allocation; (2) the use of mixed funding and *de minimis* settlements will eliminate contentious and inconsequential cost shares; and (3) issuing covenants not to sue will promote PRP cooperation by providing releases from future liability. In the short term, these alternatives will facilitate negotiations and in the long term, they will help curb the transaction costs incurred by all parties.

Given the litigious nature of the Superfund process it is imperative that the cooperative participation of the involved parties be obtained. An allocation method based on cooperative participation promotes the negotiation process and prevents an onslaught of unwarranted contribution claims. This will ultimately result in a less contended cost allocation as well as an overall reduction in delays and transaction costs.

In order for an allocation method to be successful it must incorporate the use of a neutral third party. The entity would preferably work closely with the Steering Committee in recommending settlement alternatives, appropriate allocation methods, and facilitating communication among the involved parties. However, the primary function of the entity would include establishing the guidelines for participation and implementing the selected allocation method. A similar recommendation can be found in the Clinton Administrations proposed "Superfund Reform Act of 1994." Under this proposal, the EPA would conduct a routine PRP investigation, notify all PRPs of the results of the investigation, and provide them with a list of "neutral" persons whom the EPA has determined are qualified to perform an allocation. If the PRPs cannot agree on a neutral allocator within thirty days, the EPA will appoint one. The agency will make available to the allocator and PRPs all information pertinent to the site. If the parties are unable to voluntarily agree on an allocation method, the allocator would prepare a nonbinding allocation based primarily on the equitable factors found in the Gore amendment (Hall et. al. 1994:1492).

This proposal is a very sound solution to streamlining the negotiation process. However, it would be significantly improved if the final settlement was a binding allocation, rather than a nonbinding allocation. Furthermore, the neutrality of a third-party allocating entity would provide the parties with a stronger incentive to actively participate in the negotiations. More importantly, such an approach would ensure that the parties to the settlement would fulfill their individual commitments. As a result of the parties being bound by the settlement agreement, the cleanup would be less likely to be jeopardized or delayed due to continued litigation.

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APPENDIXES

APPENDIX A

COMPLETE DEFINITIONS OF SETTLEMENT ALTERNATIVES UNDER SARA

- *Nonbinding Preliminary Allocations of Responsibility (NBARs)*. NBARs allow the EPA to "allocate percentages of the total response costs among PRPs" at a site. An NBAR is a statement from the EPA that identifies the PRPs, the nature and volume of the waste contributed by each party, and a ranking of the substances by volume. NBARs are not binding on the government and may not be admitted as evidence in court. The EPA must provide the information to PRPs involved in settlement negotiations (Cross 1988).

- *Mixed Funding Settlements*. SARA authorizes the EPA to use Superfund monies to make up some or all of the "orphan shares" at a site. Under mixed funding, the EPA and settling PRPs share the cost of a response action (Hedeman et. al. 1991). There are three types of mixed funding arrangements: (1) a preauthorization, where PRPs agree to do the work and the EPA authorizes a claim against the Superfund for some or all of the response costs; (2) a cashout, where the EPA does the work and the PRPs pay some of the costs; and (3) a mixed-work, where the EPA and the PRPs both perform separate tasks at the site (Hall et. al. 1994).

- *De Minimis Settlements*. Under SARA, the EPA may enter into *de minimis* settlements. These settlements include only a minor portion of the response costs and a relatively minor amount of the total contribution, in terms of volume and toxicity. The settlements allow small contributors to resolve their liability in the early stages of the negotiation process (EPA 1991).

- *Covenant Not to Sue*. The EPA may grant a "covenant not to sue" to settling PRPs who agree to perform a RD/RA. This covenant releases settling PRPs from either present or future liability, or both. These covenants are typically utilized in *de minimis* settlements (EPA 1991). The covenant will generally apply only to matters such as criminal liability, natural resources damages, liability of the PRP for off site disposal of wastes, or liability to state governments. They do not protect parties from future liability resulting from circumstances that were unknown at the time of the negotiations (Hedeman et. al. 1991).

APPENDIX B

COMPLETE DEFINITIONS OF SUPERFUND CLEANUP STAGES

The EPA classifies each site according to the most advanced stage to which it has progressed (*Source*: EPA 1991:10 and Acton and Dixon 1992:63). The stages include the following:

- *Site Discovery*. Identifying hazardous substance releases through formal and informal investigations.
- *Preliminary Assessment*. Evaluating existing site-specific data for early determination of need for continued action.
- *Site Inspection*. Assessing on-site conditions and characteristics if an HRS score should be calculated.
- *Hazard Ranking System (HRS) Score*. A mathematical assessment of relative risks posed by a site.
- *NPL Listing*. Determining those sites that are eligible for a Superfund financed remedial action.
- *Site Investigation*. Investigations are conducted to determine the nature and extent of the contamination at the site and what remedies are feasible.
- *Remedy Selected*. The cleanup strategy is selected for at least one operable unit. Operable units designate particular areas of the site or one component of the remedy when EPA chooses to proceed with the cleanup in stages.
- *Remedy Design*. The design of the technical specifications for the selected remedy.
- *Cleanup Ongoing*. Cleanup of at least one operable unit has been initiated.
- *Construction Complete*. The capital investment for all operable units has been conducted. Some sites in this stage may be undergoing long-term treatment, operation and maintenance, or monitoring.
- *Delisted from NPL*. The EPA formally removes the site from the NPL.

APPENDIX C

HARDAGE-CRINER SITE HISTORY

- Site Operation 1972-1980
- Site Closure and EPA Site Investigations 1980-1986
- Hardage Steering Committee Site Investigations 1986-1989
- Trial on Remedy Selection 1989
- August, 1990, Federal Judge Selects Hardage Steering Committee's Proposed Remedy with Certain Modifications
- September, 1990, Remedial Design and Remedial Actions Begin
- May, 1993, Remedial Design Completed
- October, 1993, Construction Contract Signed
- November, 1993, Construction Started
- May, 1994, V-Trench Construction Completed
- March, 1995, Water Treatment Plant Brought On-Line
- September, 1995, Long Term Remedy Operation and Maintenance Started

Source: Costello 1995:8.

APPENDIX D

SUMMARY OF SITE REMEDIES

The Environmental Protection Agency's Proposed Remedy:

- Remove a "substantial portion" of the wastes and hazardous substances from the site through excavation; and
- use a "soil vapor extraction" method to remove highly toxic and mobile compounds from the subsurface.
- *Estimated Costs.* The government estimated the costs to be approximately $70 million. The defendants estimated the costs to be approximately $150 million.

The Hardage Steering Committee's Proposed Remedy:

- The placement of recovery wells in the barrel impoundment;
- construction of a V-shaped interceptor trench to provide hydraulic control of source areas by capture and removal of contaminated groundwater and non-aqueous phase liquids for treatment;
- construction of various interceptor wells;
- surface water monitoring;
- construction of a water treatment system for groundwater;
- institutional controls, including the acquisition of adjacent property, the provision of an alternative water supply, site security and a fence; and
- placement of a composite cap over source areas to "prevent direct contact with waste, control surface water flow into source areas, limit erosion of affected soils, reduce infiltration of precipitation, and provide passive gas collection and treatment".
- *Estimated Costs.* Both parties estimated the costs to be approximately $54 million.

The Court-Ordered Remedy:

- In addition to the various aspects of the HSC remedy, the Court ordered that liquid recovery wells be placed in the main disposal area due to "the clear evidence presented at trial of barrel deposits in the main disposal area".

- *Estimated Costs*. The costs for the court-ordered remedy were estimated to be approximately $59 million.

Source: Costello 1995.

VITA 2

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Master of Science

Thesis: ALLOCATING FINANCIAL RESPONSIBILITY UNDER CERCLA: AN EMPIRICAL MODEL

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OKLAHOMA STATE UNIVERSITY
INSTITUTIONAL REVIEW BOARD
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Proposal Title: ALLOCATING FINANCIAL RESPONSIBILITY UNDER CERCLA: AN EMPIRICAL MODEL

Principal Investigator(s): Keith Willett, Kevin E. Readnour

Reviewed and Processed as: Exempt

Approval Status Recommended by Reviewer(s): Approved

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Comments, Modifications/Conditions for Approval or Reasons for Deferral or Disapproval are as follows:

Signature: John H. Wheeler [signature] Date: January 24, 1996

Chair of Institutional Review Board