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Alternative Dispute
Resolution Series

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ENVIRONMENTAL ENDS AND ENGINEERING MEANS: BECOMING ENVIRONMENTAL ENGINEERS FOR THE NATION AND THE WORLD

May 1991

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The Corps Commitment to Alternative Dispute Resolution (ADR):

This working paper is one in a series of working papers describing applications of Alternative Dispute Resolution (ADR). The working paper is part of a Corps program to encourage its managers to develop and utilize new ways of resolving disputes. ADR techniques may be used to prevent disputes, resolve them at earlier stages, or settle them prior to formal litigation. ADR is a new field, and additional techniques are being developed all the time. These working papers are a means of providing Corps managers with examples of how other managers have employed ADR techniques. The information in this working paper is designed to stimulate innovation by Corps managers in the use of ADR techniques.

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ENVIRONMENTAL ENDS AND ENGINEERING MEANS: BECOMING ENVIRONMENTAL ENGINEERS FOR THE NATION AND THE WORLD

Alternative Dispute Resolution Series
Working Paper #4

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INTRODUCTION

Humanity is moving toward a new consciousness of Earth and nature. This consciousness has been stimulated by often confusing and bitter debates among the engineering and environmental communities. Unfortunately, such experience has left a stronger impression of adversarial rather than cooperative relationships. This impression is and will change. Evolutionary biology now points to cooperation rather than on self-interest competition as key to species survival and growth. Experimental game theorists (Axelrod) now show that truthful and cooperative relationships are most likely to produce best collective and individual benefits. Such is the theoretical back drop of modern Public Engineering.

At the bottom line, the public engineering community share interests with the environmental community that are far deeper than the often held adversarial positions they frequently defend. Public service engineers, the environmental community and the public(s), need credible governmental agents as instruments to achieve environmental goals. If government is viewed as incompetent, inefficient or untrustworthy, both the environmental community and the public engineers will suffer. In short, the environmental community and the engineers need one another. Credible government depends on being open and honest with the public. It also means achieving stated goals. Achieving goals means applying science to situations in the best way we know—in other words taking risks. That is engineering and that is how we will meet more of our environmental aspirations.

To reach environmental ends, the world needs engineering means. To employ engineering means requires justification in terms of environmental ends.

CURRENT TRENDS, SITUATIONS AND PROBLEMS

One could cite many trends which are driving to the conclusion stated above. Here are a few.

■ Our existing institutions do not fit emerging environmental problems

While the major environmental problems (such as waste and toxic cleanup) are primarily engineering problems, the programs for dealing with the problems are primarily run by scientists, administrators and lawyers. We are not suing our national resources of Federal public service engineers wisely. We need to find a way to put these engineering resources to work on the most salient public engineering problems. On the one hand, we could say that new institutions must be created. On the other hand, we could adopt a philosophy that current institutions can be made to service emergent needs.

■ Our institutional means for achieving environmental quality are increasingly inappropriate to meet the needs of environmental and economic health.

The National Science Foundation (1979) and the National Research Council (1986) show that the science of environmental impact analysis is deficient and should be upgraded. EIS's have become the major instrument in raising environmental consciousness and in leveraging environmental concerns to the decision process. However, the EIS debates focus primarily on procedure and, to some degree, even inhibit substantive scientific concerns from being considered. Posturing and positioning dominates over discover of substantive interests (Stakhiv, 1988). Recent OTA reports suggest that EPA contract management is inadequate and detrimental to achieving environmental means. The Department of Energy (DOE) is increasingly criticized for withholding public information about deficiencies in construction and in operations of nuclear power plants. These are only a few examples of how new agencies and instrumentalities designed to deal with environmental health are themselves becoming dated.

■ Federal Spending in natural resources is increasingly dominated by environmental concerns

In 1965, Water Resources spending accounted for 61% of total Federal spending for natural resources and the environment. In 1988, it accounted for 27%. At the

**The views presented here are those of the writer and do not necessarily reflect those of the U.S. Corps of Engineers*

same time, pollution control and abatement has grown from less than 10% to roughly 33% of total Federal spending for natural resources and the environment. In other words, Federal concern for natural resources—a traditional concern of the civil engineer—is rapidly being defined in environmental terms.

■ Environmental health and environmental quality go beyond political and disciplinary boundaries

Solving environmental problems requires agreements among organizations and peoples under different political jurisdictions. This is a problem familiar to water resources professionals. It is one of the reasons the U.S. Corps of Engineers, years ago, organized around river basins. There is conflict in the way nature has organized versus man's political diversions. We have only to look at our inability to place NIMBY'S (Not-In-MY-Backyard) such as waste sites. Apparently our political institutions do not allow broad enough regional trade-off among NIMBY'S. We must either restructure our current institutions or find new and effective ways of negotiating among our current political jurisdictions to achieve solutions to difficult problems such as siting and waste clean-up.

■ We are increasingly mired in a psychology of constraints and limits

Numerous commentators have marveled at the recent history of strange alliance among economists and environmentalists, particularly in the water resources field. Both find shared interests in constraining and limiting traditional water resources development. While reacting to and stopping projects may have been useful to raise our consciousness, it is not sufficient to achieve environmental and economic health. While it is true that a good rule is often "when in doubt, do nothing," such a rule cannot be sustained forever. As long as we continue to make policy in the spirit of constraint and limit, we will increasingly be dominated by a fear of the future. We must overcome that fear and act to create rather than react to our future.

■ A changing nature of professionalism throughout society and Public Engineering

Something is happening throughout society. When presented with the statement "the government cannot be trusted to do what is right," 23 percent of the American public agreed in 1958. In 1980, 73 percent agreed! (Keiman, 1987) Something is happening! Much of the public holds bureaucrats and professionals in low esteem. Although one can say that Americans always criticize the government, it is more than that. Studies in the 1920's and 30's show much higher esteem for government institutions and bureaucrats.

Throughout society the very meaning of professionalism is changing. Patients no longer say "cure me," they participate with doctors in their own diagnosis and treatment. Clergy may no longer maintain strict distinctions between the "lay" and "religious" and may no longer consider themselves the sole salvation mediators between heaven and earth. Lawyers can no longer neglect avenues of alternative dispute resolution or avoid linking their individual actions to the overall state of social justice. Should engineers be surprised when "Joe Six-pack," who uses a power plant feels a right in influencing its design or location?

Professionalism includes not only the final goods and services provided, but also the means employed to deliver those goods and services. The means by which the goods and services are delivered establish a relationship with public clients and/or customers

■ Changing nature of administrative processes in the democratic state

Since the late 19th century, the United States has blended the separation of power doctrine with a distinction between administration and legislation. Agencies such as the Corps have come to recognize the blending as a distinction between technical versus political. Although this is theoretically plausible, the distinction rarely fits reality. Leaders have to publicly recognize that we operate in a gray area between technical and political. Our integrity and professionalism will be found in the way we explicitly blend, rather than separate these issues.

Furthermore, the administering of laws has come to look more and more political. Legislatures seem to write legislation that is more general than specific. Judges shy away from substantive judicial review and review procedure. Thus technical agencies, such as the Corps,

are placed in the position of distributing to the people benefits and costs of its programs. This is especially true in the environmental area. Who sacrifices what for the implementation of national policy comes to roost right on the doorstep of the Corps. Therefore, the technical agency begins to look more and more like the distributor of political benefits than the implementor of narrow technical decisions. This will continue. Engineers must accept it and must adopt a leadership role in this area.

Tensions among a political, a management, and an engineering sense of ethics are normal and often healthy. Much of the history of American civil engineering has been written around managing such tension. But the balance is fragile. It can easily tip, especially in times such as the last 10 years, when social values and public expectations are rapidly changing. At worst, the professional engineer begins to believe subconsciously, if not consciously, that politics is bad, irrational, and unethical. This is dangerous in a democratic society because the engineer retreats to a world of technical idealism. If that happens, professional existence can become either coping by incrementally conceding to evil or by constantly making valiant last stands for honesty and purity. Such feelings can fuel the mirror imaging of political and managerial supervisors.

Political managers' cynicism is reaffirmed by the "narrow-mindedness" and arrogance of technical professionals. The political professional's role becomes to either manipulate or just plain steamroll over an otherwise uncreative and inert mass of engineers. Therefore, we must find alternatives to both technical elitism and populist demagoguery.

DILEMMAS WITHIN THE ENVIRONMENTAL COMMUNITY

While there seems to be much agreement on major environmental problems, there are some disconnects between public perceptions and environmental experts over the most salient and dangerous environmental problems. There is also increasing disconnect between the means to achieve environmental goals and the ideologies the environmental community often espouses.

For example, look at Sustainable Development. Sustainable development is rapidly becoming the byword among environmental communities. Making sustainable development a reality requires reconciliation between the environmental community's conservationist roots and its newer public safety and health spirit. At the turn of the century, T. R. Roosevelt, Pinchot and others catapulted conservation into high public policy visibility. However, conservationism was utilitarian in spirit. It sought to maximize beneficial use while minimizing resource costs in service of human quality of life.

The environmental movement born in the 1970's moved far more toward the spirit of setting absolute standards for health and safety as protection against impending crisis or apocalyptic ethics for addressing public policy. The utilitarian approach seeks to weigh good against bad for each action in a given situation. While the utilitarian uses the same principles across situations, the balancing might not always produce the same answer. The absolute approach seeks to discover the rules of law and set standards which must be met in all situations. The rigidity of this approach does buy certainty and one type of equity—that all are in some way treated alike. However, it also can bring obsessive legalism. Unfortunately, the utilitarian approach as used resources field, with stylized and often narrow procedures also looks rigid. Thus, the question becomes who defines what is the: good versus the bad or; benefit versus cost.

The environmental community is also struggling over how to move beyond negative-reactive to proactive-creative stances. The time has passed when access, visibility and credibility are derived from the shared experience of being negative. This movement from the pessimistic to more optimistic approach taps subconscious conflicts within the environmental movement.

Much of the motivational hooks used by the environmental community have been apocalyptic. That is, they have built on a guilt that what we have done in the past has been wrong or they have built on a vision of impending doom and gloom. Theologically, that seems like focussing on the fallen nature of man. However, the movement to become proactive focuses more on

optimism, liberty and the freedom that man has to co-create the kind of future quality of life he chooses.

In this vein, much of the philosophical and more theological speculation within the environmental movement is looking toward ideas of creativity and the creation myths of humanity. This focus on creation and creativity has also led to a blending of feminist views of history with what we already know about the so-called left-brain/right-brain dichotomies in man. This dilemma is more than esoteric.

The tension between the creative-optimistic and the pessimistic-guilt philosophies within the environmental community will, in the short run, grow. At the bottom line it raises the practical question—"What is environmental success? What is it we want to create?"

The tension between the conservationist utilitarian spirit and the newer absolutionist public health spirit creates some ethical dilemmas as well. For example, should public policy posture of the environmentalist be policeman or participant? Is it ethical to establish unmeetable goals as standards for public action that has major distributional effects across social classes? Is such an approach recommended when we know that it will depreciate the value or even the legitimacy of the very government instrumentality asked to implement it? Is it ethical to use natural absolutes when we really know that nature, as a baseline, is itself change?

Indeed, there seems to be a general confusion within the environmental movement about man-nature relations. What is natural and what is man generated? Nature is change, it is dynamic. While we seek no-net loss of wetlands, we know that non-man generated, or "natural", causes exceed man-made causes of wetland loss. Nature's destruction to nature, such as Mt. St. Helen's, often vastly exceeds anything the most ambitious engineer could dream up. Who issues God the permits for such action? In this confusion over the relationship of man and nature, some environmental ideologies begin to translate into a deep denial of progress. Man and ecosystem become a zero sum gain. Any gain for man is loss for the ecosystem. Indeed, the man-nature distinctions, either explicitly or implicitly used in environmental debate often build on an unclear sense of status quo.

As environmental leaders critique the past and look to the future, the issue of purpose has become paramount. The question is how will we know if are successful in our environmental efforts? Barry Commoner's (1988) critique of environmental progress is instructive. He shows how we have either reduced, eliminated, or failed to reduce or eliminate certain toxic elements in the air and our water. Yet we are left with a sense of a series of battles but no sense of the war.

Now that the public is greatly concerned about our environmental health, we need to have a better sense of the overall "war." We must know what battles we could lose so that we somehow don't lose the war. Thus, Commoner calls on environmentalists to go beyond immediate issues and look to the means of production for solutions to environmental problems. This is a debate over the purpose or ends for which we humans strive. Developing the notion of shared purpose is not easy and it will probably only emerge on the basis of doing and building and developing and then critiquing.

The environmental community must be careful to avoid the syndrome that "to accept environmental ethics we must deny our past." Much of the environmental debate depends on the understanding of man as a historical actor. Humans must be seen in the context of their environment and situations as they sees it at the time. Humans must act in the context of what their reason tells them about their surroundings.

In fact, this is what man has done throughout the past. We must understand that in the 1930's when we built dams we were acting out of the same spirit. We must be careful, to be more gentle with ourselves and our past. The environmental community needs to learn how to call us to understand our interaction with the ecology today without criticizing our past to the point of forcing us to deny that past. To do so will alienate us from our history, a trend which some say is already occurring. But without a shared sense of history, a people cannot generate a sense of destiny. And, a sense of destiny is needed to achieve sustainable environment and build an

ethic of stewardship. Engineers must learn from the past in light of what we know today. The message is not to deny or invalidate the 25 years of that engineer. Rather it is to channel that engineer's 25 years experience in ways that help us meet needs as we understand them today.

DILEMMAS IN THE ENGINEERING WORLD

If the Civil Engineer is going to achieve the ASCE's goal of; "delineating the role of civil engineering as the primary link between construction related technology and society and stepping forward to lead in finding solutions to environmental and infrastructure deterioration, the public civil engineer will have to broaden their self-image beyond exclusive design-construction to program management."

Much of civil and water resources engineering has been viewed primarily as structural intervention into natural systems. Such interventions are justified for the best of reason—to minimize stress on the social system, and to create growth opportunities. While useful, this view can be dangerously limiting. Engineering can subtly become the application of one set of solutions to many problems. The problems then become defined more through a narrow understanding of possible technical solutions than through a broader understanding of social needs. Many engineers talk about the old days. Those were the days when civil engineers wore white hats, when civil engineers did great things for people—built dams, lit up valleys, and helped people rebuild from a depression. These same engineers are now often seen as problems or as wearing black hats.

One reason the white hats have become black is their "technicalization" of the profession. Engineers often define their profession as a finite set of solutions applicable to a wide range of problems, rather than as a capability for serving public needs or for creative problem solving.

Roots of such a mind set can be found in the history of Civil Engineering and engineering education. In the Civilized Engineer, Samuel Florman goes back to ancient Greece to find historical roots of valuing science above practical knowledge. While science has clearly informed engineering, the U.S. engineering profession, built from craft guilds and frontier pragmatism, has often emphasized a less than elite industrial class mentality. But engineering is full of contradictions and must seek balance among these contradictions, such as practice versus theory; craftsmanship versus science, and military necessity and civic benefit (p.64) Therefore, Florman:

> *...pleads the cause of a humanistic professionalism of ennobled engineering that will rise out of the ashes of vocational training. (p.173)*

In his book The Tower and the Bridge (1983), David Billington shows how engineering done in the context of economic efficiency and aesthetic constraints can be creative. He traces structural engineering in the U.S. and shows how it is really a new art form. Like Florman, he places art and creativity in the center of civil engineering.

Civilization requires civic or city life and city life forms around civil works: for water, transportation, and shelter. The quality of the public city life depends therefore on the quality of such works as aqueducts, bridges, towers, terminals and meeting halls: their efficiency of design, their economy of construction and the visual appeal of their complete forms. At their best, these civil works function reliably, cost the public as little as possible.

In his classic address to the American Society of Civil Engineers in 1890, J.E. Watkins stated "the engineering profession typifies better than does any other the restless progressive practical spirit which needs once again to be unleashed in service of environmental goals. Our public engineers, the Corps of Engineers particularly, must move beyond seeing themselves as a set of solutions seeking application to problem solvers.

The environmental community, as it struggles with the concepts of creative versus reactive or preservation is also touching a fundamental thread of the engineers' tradition. The engineer, as creator, is an important part

of the civil engineers history which has been forgotten. It is only in the late 19th century that the architect and engineer become distinguished in our own society. Historically, artist, architect and engineer were far more blended than we have come to view the profession in the 20th century.

We seem to have lost the idea of engineer as architect, artist and dreamer. Walking through the halls and offices at West Point, one is struck by numerous remarkable sketches and drawings done by now rather famous cadets. Lacking photography and satellites, young engineer cadets were trained and evaluated as artists to increase their proficiency for surveying and mapping. What, today, so explicitly taps this artistic and creative spirit? In our dialogue with the environmental community the creative will be brought back to the center of professional consciousness. Indeed, in thinking about the creative aspects of engineering, the engineer may rekindle some flames in his own past.

The assumption is often made, with some justification, that the engineer is a left-brain analytical as opposed to the right-brain nurturing person. But it is interesting that there is a great right-brain tradition in engineering which is built on a creative spirit, the same creative spirit which is driving and nurturing, creative and feminine, which the environmental community has brought us in touch. So, the environmental engineer faces the exciting prospect of rediscovering part of his own tradition.

WHO IS THE ENVIRONMENTAL ENGINEER? THE OLD VERSUS THE NEW ENGINEER

To begin with, the environmental engineer is not simply a retread sanitary engineer Clearly our society certainly needs to elevate its concern about waste beyond a degrading garbage man picture if we are to do anything about hazardous and toxic waste. The "environmental engineer" of today is proactive, creative and seeks to bring environmental concerns into the design phase of engineering and thus create and mold new options. In defining a new environmental engineer, we must be careful not to deny the validity of our past, but to affirm a need for that past experience and to liberate that experience in service of our emergent new understanding of goals of health and development. So what is the difference between old and new environmental engineers? Let us look at three macro areas of difference.

■ Professional and Public Ethics

The 1970's brought environmental impact assessment, social impact assessment, and technology assessment. In the 1980's we have risk assessment. Should we be surprised that in a period of austerity, of shifts between environmental quality and economic development values, and of calls for growth, that managing uncertainty and assessing risk become important? After all, if we are to do the same or more with less, what are the risks? Who is going to take the risk, and to what extent? The assessment and the assignment of risk goes to the heart of what it means to be an engineer. It goes directly to the distinction often made between performance and design criteria.

A recent article in the Washington Post, "The Slippery Ethics of Engineering," uncovers further complexity in the engineer's ethical role. Taft Broome states that there are new ideas about what engineering means:

> *...engineering is always an experiment involving the public as human subjects. This new view suggest that engineering always oversteps the limits of science. Decisions are always made with insufficient information. In this view, risks taken by people who depend on engineers are not really the risks over some error of scientific principle. More important and inevitable is the risk that the engineer, confronted with a totally novel technological problem, will incorrectly intuit which precedent that worked in the past can be successfully applied this time. ...Interestingly these new moral dimensions are not being created primarily by philosophers. They are the works of engineers themselves.*

Broome further states:

> *...Most engineers regard the public as insufficiently informed about engineering intuition—and lacking the will to become so informed—to assume respon-*

sibility for technology and partnership with engineers or anyone else. They are content to let the public delude itself into thinking that engineering is an exact science or loyal to the principles of conventional sciences (i.e., physics, chemistry)

Broome (1986) states that the practice of using intuition leads to conclusions put forth by others that engineering is an experiment involving the public as human subjects.

We are part in parcel of that environment for which we plan. When we start planning we interact with and change that environment for which we plan. Our engineering and planning themselves become change agents. Thus, we can subtly cross the line from scientific to self-fulfilling prophecy—or modern mythmakers!

At the bottom line we must move from the patemalutic to informed consent view of our professional ethics (Broome, Thompson). We must bring people to the idea of choosing the level of risks rather than seeing themselves a passive recipient of risk. This informed consent model of professional ethics means we will become balancers and facilitators more than dictators of specific solutions. We must focus, not just on the acts, but our relationship to those who are acting.

Publicly, we must move from standards to guidelines or principles. In philosophical terms, this means moving from absolutist to utilitarianism as the basis of policy making. As we have already noted, we should be moving to blending our public health absolute preservation and our conservative utilitarian traditions. Accountability, performance and power sharing will become part of the public ethic we must foster. As engineers, we must move even further to blending and mixing quality and quantification in our approaches.

■ Self Definition

Although design construct are central to the new public service engineer, there is more. The new engineer must broaden the concept of engineering many have held in the last 50 years. The new engineer seeks to uncover shared values and interests underneath positions held by adversaries and create new alternatives based on those values and interests. For example, the water engineer already looks beyond just structural solutions, to mixes of structural, natural and behavioral actions to solve problems.

We must move from seeing ourselves as a set of solutions seeking application to seeing ourselves as problem solving capacities. We must move from defining ourselves purely as engineer constructors or designers to engineer managers and stewards. We must move from defining ourselves as manipulating things to managing systems, people and life. We must come to see our milieu not as machines but as growing interdependent biological entities.

■ We must move from a mechanistic view to a biological paradigm

At least since the first space photographs of Earth, we have been moving away from the Newtonian enlightenment image of the universe as a clock on mechanism to the universe as a biological entity that grows, decays, evolves, transforms and lives. No longer can we see man as separate from nature. Indeed, even the most apparently inert matter is, in some way, organic and living. Modern physics has changed our most basic scientific images of subject-objective distinctions.

We must build to grow. We must move from a domination idea to a nurturing idea. We must move from being observer of events around us to understanding that we are, inevitably, participants in those events. We must view our actions in the long as well as the short term and we must decide on actions in terms of how we think the world should be.

CONCLUSION

Throughout our Nation and the world, environmental consciousness has been raised. Now, public service engineering, management, design, and even construction is needed to meet those environmental goals we have and are setting. In the U.S., we must realign our public institutions to achieve a better balance between public service engineering capacity and environmental work throughout the nation. As we move to seek a better balance, debate within the environmental, engi-

neering and development communities will intensify. However, as the rallying cry of sustainable development is showing, these debates will lead to greater understanding of shared interests and values among these communities. The major philosophical meeting ground will be the emergent realization of our need to create new alternatives and to proactively create the future we seek to mold.

The only way to reach the ends of sustainable development is with the means of engineering skill. Now is the time to place the power of this Nation's public engineering capacity in service of environmental goals and to consciously choose and create our future.

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Humanity is moving toward a new consciousness of Earth and nature. The conscicusness has been stimulated by often confusing and bitter debates among the engineering and environmental communities. Unfortunately, such experience has left a stronger impression of adversarial rather than cooperative relationships. This impression is and will change. At the bottom line, the public engineering community share interests with the environmental community that are far deeper than the often held adversarial positions they frequently defend. Public service engineers, the environmental community and the public(s), need credible governmental agents as instruments to achieve environmental goals. If government is viewed as incompetent, inefficient or untrustworthy, both the environmental community and the public engineers will suffer. In short, the environmental community and the engineers need one another. To reach environmental ends, the world needs engineering means. To employ engineering means requires justification in terms of environmental ends.

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