WATER RESOURCES INFRASTRUCTURE ISSUES

OPTIONS FOR NATIONAL INFRASTRUCTURE RENEWAL*

Yacov Y. Haimes
Center for Risk Management of Engineering Systems
University of Virginia

Recently, several commissions have independently studied three seemingly unrelated critical national issues — the nation's deteriorating physical infrastructure, the nation's mismanagement of hazardous waste, and the nation's inadequate supply of trained engineers. In the 1990s, these problems are likely to generate major national crises unless we address them in a unified and holistic approach. The urgent need for restructuring our institutions to tackle these problems must be matched by public determination supported by a strong political will. For too long the United States has been dealing with these issues in a piecemeal, even niggardly manner. The resulting far-from-benign neglect can easily lead to serious socioeconomic consequences.

Introduction

Our physical infrastructure is deteriorating at an exceedingly dangerous rate. This includes our highways and bridges, mass transit, aviation facilities, water transportation, wastewater treatment, drinking water distribution systems, and a host of other public works and public facilities. In its final report to the President and to the Congress in 1988, the National Council on Public Work Improvement states: "After two years of study, the Council has found convincing evidence that the quality of America's infrastructure is barely adequate to fulfill current requirements, and insufficient to meet the demands of future economic growth and development" (National Council on Public Works, 1988). The Council estimates that Federal government outlays for public works capital investments have declined since their peak in 1972 of nearly $55 billion (1984 dollars) to approximately $45 billion in 1985.

This harsh, yet sober, indictment also appeared in a June 1987 Congressional Office of Technology Assessment staff paper (Office of Technology Assessment, 1987). The OTA paper recognizes that the nation's infrastructure is the physical framework that supports and sustains virtually all domestic economic activity; it is essential to maintaining international competitiveness as well. The paper further states that actual expenditures for public works are expected to meet only 35% to 60% of the estimated public works construction and repair needs. As a direct consequence of neglecting and mismanaging the maintenance of our infrastructure, it is estimated that over 100,000 bridges do not meet current engineering safety standards and that thousands of miles of pipes that constitute our water distribution systems are leaky. The Environmental Protection Agency, for example, estimates at $76 billion, the construction cost of wastewater plants needed between now and the year 2003.

The neglect and subsequent mismanagement of the nation's toxic and hazardous wastes echo the deteriorating infrastructure situation. A background paper published in January 1989 by the OTA (Office of Technology Assessment, 1989) highlights the enormous magnitude and unimaginable dimensions of the problems we face in hazardous waste management: "In our 1985 report 'Superfund Strategy,' we estimated the cost of future cleanups at about $300 billion by government and industry over about 50 years .... A more

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realistic estimate is perhaps $500 billion in cleanup costs . . . . However, until now government and industry have probably spent between $5 and $10 billion on cleanups — only 1% to 2% of what they may ultimately spend."

The third component of this triad of critical national issues concerns the supply of engineers. Engineering has a role to play in the solution of our enormous problems, with public works engineering particularly well suited to serve as an instrument of national purpose. Most infrastructure problems affect natural resource management objectives, and demand a coupling of engineering solutions with scientific input. In a working paper, Delli-Priscoli, Stakhiv, and Westphal state, "While the major environmental problems (e.g., waste cleanups) are primarily engineering problems, the programs for dealing with the problems are primarily run by scientists, public administrators and lawyers" (Delli-Priscoli et al., 1988).

The public engineering community, however, cannot be expected to solve ever more complex problems without a pool of qualified and talented engineers. The lack of an adequate number of trained engineers to do the job has also been addressed by at least two recent reports, by the OTA (Office of Technology Assessment, 1988) and another by the National Academy of Engineering (NAE). In its report, the NAE states that "the value of professional engineering expertise depreciates rapidly in many areas, so that obsolescence may become a serious problem as soon as 3 to 7 years after completion of formal education" (National Academy of Engineering, 1988). The OTA study states that in the early 1990s, the nation will experience a decline in the number of college-age students, although some increase can be expected before the turn of the century.

In summary, the neglect and mismanagement of the nation's infrastructure and hazardous waste stem from several trends — fiscal constraints, drifting objectives and priorities, lack of accountability, and a diminishment of engineering expertise. It seems that our modus operandi for engineering-based problem resolution has become grounded more on a combination of regulations and special interest programs than on engineering skills and sound economic and fiscal decision making, for which there are no substitutes.

National Infrastructure Corporation

During the 101st Congress, Senator P. Moynihan introduced a bill (S.220) to establish a National Infrastructure Corporation. As stated in the bill, its purpose "shall not be considered to be a provider of infrastructure services, but rather a technical and financial resource for the benefit of existing infrastructure providers at all levels. The purpose of this act is to reaffirm the Federal Commitment to investment in the national public works infrastructure, in a manner that will stimulate greater investment by other levels of government and the private sector . . . ". By moving to establish a National Infrastructure Corporation, the Congress is responding to many of the issues that are at the heart of the infrastructure crisis. High on the agenda is the financial one. Indeed, local governments have become increasingly burdened with financing the construction and maintenance of the public works infrastructure. The Federal share of public investment dropped from 31% in 1960 to 27% in 1985, while the local share rose from 41% to 49% during the same period.

One of the strengths of Senator Moynihan's bill is that it recognizes the centrality of research and development to halting and reversing the deterioration of our national infrastructure. The importance of research and development (R & D) to our competitive stance has been recognized recently by a wide spectrum of constituencies. R & D that can improve the infrastructure is just as important, but its urgency has not yet commanded national attention. A report published by the National Research Council, states that "current research and development on infrastructure is uneven across the various modes of infrastructure, with some commanding considerable resources while others are underfunded and facing significant challenges" (National Research Council, 1987).

Redirecting our Institutional Resources

A substantive and effective increase in Federal governmental involvement requires more than simply the addition of more funds. Appropriate engineering manpower and expertise and effective institutional structures are also needed, all of which are costly in terms of time and money. Can such an investment be justified on the basis of national cost-effectiveness? Can we find the engineers and scientists needed for this overall challenge? And can we wait a decade or two for such a focus of resources to deliver results, or are there better options? Fortunately the Federal bureaucracy shows signs of awakening to the needs of addressing these questions in a systematic way. The Federal government unquestionably has many fine engineering-based departments, such as NASA, the Department of Transportation, Interior, and Agriculture, and the U.S. Army Corps of Engineers. These agencies are cognizant of the dire need to improve and sustain the public works infrastructure and are recognizing the functional and economic relationships between their respective areas of responsibilities. For example, the Corps of Engineers not only has the needed technical expertise, but it also could reallocate its resources to meet most of the infrastructure challenges. The Corps possesses many of the requisites essential for addressing the infrastructure challenges — well-trained engineers, a proven track record, and the experience in such activities as management, financing, cost-sharing, economic analysis, and partnership programs. In other words, The Corps has adapted well to the current realities of comprehensive planning and management for diverse construction activities and rehabilitation programs that include toxic and hazardous waste remediation. The encouraging trend of Federal agencies to use systematic and integrated actions to tackle the Nation's infrastructure problems is exemplified in recent comments made by General H. J. Hatch, Chief of Engineers, in addressing the Public Works Session of the National Civil Engineering Research Needs Forum, Washington D.C., January 28, 1991. In his talk, General Hatch announced a new initiative by the Corps of Engineers to promote and conduct broadly-based discussions on public works infrastructure problems and issues. These discussions will be aimed at establishing an agenda for developing a national public works strategy and will involve primary Federal public works departments/agencies, state and local governments, public interest groups, and the private sector. Another encouraging example of a Federal agency's new systems approaches to public works and investment is the Department of Transportation's policy document "Moving America," February 1990, which among other goals, enunciates a policy to "increase emphasis on integrated state, local and regional transportation planning, including efforts to coordinate land use and transportation planning and investment decisions" (U.S. Department of Transportation, 1990).

Where We Should Be Going

How can we reduce the risk of a major catastrophe, not only for our generation, but also for our children's? We must certainly develop new technologies for detecting structural fatigue and make use of newly available composite materials to lengthen the physical life of our roads, bridges, and other facilities; we must improve future response to these infrastructure concerns by making a cross-disciplinary effort in our classrooms and laboratories; we must develop more effective management tools for the planning, design, construction, maintenance, and operation of large-scale public works; and we must overcome the tendency to perceive the maintenance and rehabilitation of public works as less glamorous and less worthy than their construction. The realization of all these important steps, however, would not be a panacea for the enormous problems mentioned at the beginning of this editorial. What is imperative is that some basic systems engineering principles must be adhered to in the reallocation and redirection of our national institutional resources. It is essential that we approach the three critical concerns — the deteriorating physical infrastructure problem, the hazardous waste management problem, and the urgency of training more engineers — from a more systematic and holistic viewpoint. Such systems thinking must transcend

current reliance on conventional policy options that are restricted to or limited by the existing institutional and organizational bureaucracy.

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