

INSTITUTIONAL ISSUES AFFECTING THE TRANSPORT OF HAZARDOUS MATERIALS IN THE UNITED STATES: ANTICIPATING STRATEGIC MANAGEMENT NEEDS

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Summary

The transportation of hazardous materials occurs in the context of a complex and dynamic institutional environment. This environment is comprised of the attention and actions of a diverse cast of characters, ranging from the transport industry itself to self-appointed overseers of hazardous materials transport (HMT). In addition to concerns over protection of public health and the environment, institutional issues include discussions of the appropriate division of political authority and responsibility, trust in diverse political authorities, and financial liability and the provision of sufficient emergency response capabilities in the event of transport accidents. Changes in the institutional environment may be anticipated as the volume of HMT increases, as communications among institutional actors increase, and these actors become increasingly specialized and professionalized. Planning for such changes may profit from a consideration of alternative institutional management strategies emphasizing different degrees of openness among affected institutions.

Introduction

The transportation of hazardous materials in the United States occurs in the context of a complex and dynamic institutional environment. This descriptive statement is deceptively simple because, in the real world, it encompasses the attention and actions of an unbelievably large cast of characters, ranging from the transport industry, itself, to self-appointed overseers of hazardous materials transportation (HMT). Each individual and group involved in such activity operates simultaneously, responding to the most recent activities of others. Strategic and longer-range planning for HMT is less evident but equally necessary. However, if as a society we are to transport these materials in a manner that is politically acceptable and responsible as well as environmentally safe, such planning may be necessary.

This article summarizes some basic information about the institutional environment of HMT. In it I have borrowed freely from others who have

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investigated the topical area of HMT as well as related studies of hazardous and radioactive waste management, risk perception, multi-jurisdictional (i.e., federal) decision-making, interest group behavior, organizational behavior, and other facets of institutional life. This analysis should prove helpful to those persons within institutions who are charged with the responsibility of planning for the transport of hazardous materials. It should, further, be of some more general interest to those interested in decisionmaking about the management of "risky" technologies and materials.

Moving hazardous materials

On any given day, it has been estimated that 250,000 shipments of hazardous materials take place within the United States [1]. Generically, these materials include flammables, corrosives, explosives, poisons and radioactive materials. From a public perspective, as shaped by reliance on media reports of planned shipments or transport accidents [2], these materials may be perceived as more dangerous than these comparatively innocuous categories would connote. They include PCBs, chlorine, methylisocyanate, liquefied propane gas, torpedoes, gasoline, bombs, radioactive wastes and other materials.

Linkages between these materials, which have all received some notoriety in local if not the national and international media, and the act of transporting them, itself a potentially hazardous activity, have served to raise HMT as a significant public policy issue now on the agenda of various political jurisdictions. This is not to suggest that HMT has been ignored by decisionmakers. Rather, there is now a heightened awareness of the scale of HMT and of the potential for catastrophic accidents as well as less serious releases of hazardous materials to the environment. This renewed attention to HMT has effectively put the issue on the agendas of not only the federal government but also of state governments, municipalities and county governments. Legislative and judicial branches of government, as well as regulatory and executive agencies of each level of government, are also involved. So also are those in the private sector, including manufacturers, transporters or carriers, existing interest groups and trade associations. What is more, other nascent or emergent groups have become active on specific transport activities, based on the shipment of particular commodities in or across particular geographic regions.

Defining institutions

The relevant institutional environment for HMT can be defined as the formal and informal groups, industries, government agencies and political jurisdictions that can singly, collectively or interactively affect or be affected by the transportation of hazardous materials. Although the most commonly acknowledged institutions or institutional actors affecting HMT policy are

the federal and state governments and their implementation activities and regulatory requirements (discussed below), it is important to realize that the total institutional environment is much more complex and comprehensive than this. Local governments, the transportation industry, the media, public sector interest groups or trade associations, and public health and environmental interest groups, among others, can also be important as constrainers or facilitators of policy development and implementation. In other words, in a pluralist political system such as the United States these institutions constitute a policy system or arena [3, 4]. In addition, if hazardous materials transport is like other issues, particularly environmental policy issues [5-7], these parties will enter the policy arena at different times in HMT program planning and implementation processes, as points of conflict and opportunities for participation in the conflict emerge [3].

Relations among these institutions can be characterized by a number of basic patterns that are relevant to HMT. First, it should be understood that institutional actors attempt to fulfill their mandates, protect their constituencies, and guard their independence. For some institutions, members define these terms for themselves; for instance, some public health and environmental interest groups may claim that they represent the entire present and future populations of the United States. For others, however, the institution's legitimacy derives from a sworn obligation under the color of law to protect its constituency; for instance, among other obligations state and local government agencies have is a requirement to protect the public health and safety of their citizens.

Secondly, it should be noted that the primacy of one institution, including branches and levels of government, over another is not defined statically but is continually redefined as conditions change. What may be federally preempted today may revert to state authority tomorrow. If a trend can be identified, say even in the field of atomic energy and the movement of nuclear materials, it is probably that increasing levels of intergovernmental cooperation, coordination, consultation and concurrence are required*.

A third generic feature of the institutional environment is a concern for equity. The constitutional guarantees of equity through the equal protection and due process clauses of the 14th Amendment are especially important with regard to the consistency with which citizens and state and local governments are treated by the Federal government. Another way of stating this is that the Federal government may be required to afford the rights given to one citizen, state or local government to all others affected by the movement of the same commodity.

Finally, it is also important to note that whatever differences exist be-

*Although the U.S. Supreme Court's dismissal of *City of New York et al. versus the U.S. Department of Transportation* in March, 1984 [43], might be viewed as persuasive that DOT regulations (i.e., HM 164) preempt state and local jurisdictions on the routing of radioactive materials, the DOT is encouraging shippers to cooperate with state and local jurisdictions as they implement state preferred routes under DOT guidance [44, 45].

tween "reality" and perceptions of reality are relatively unimportant [8, 9]. It is the perceptions of the various institutional actors that define the institutional environment for HMT. Until perceptions are modified, it will make little difference what "in fact" constitutes the transport of hazardous materials. Institutional perceptions, in turn, are governed by multiple factors, including their formal and informal concerns and responsibilities, their trust in various authorities (i.e., other institutions), their knowledge of the overall policy system (i.e., generation, transportation, storage and disposal of all hazardous materials and wastes), the media, and other contextual variables.

Defining institutional issues

The concerns of interested parties and institutions are as diverse as their membership. As with hazardous and radioactive waste management generally [10], they include but are not limited to a number of generic issues such as:

- (1) the timely and environmentally sound transport and disposal of hazardous materials;
- (2) protection of public health and the environment;
- (3) awareness of proposed hazardous materials transport and management programs;
- (4) the appropriate division of political authority and responsibility in determining and implementing HMT and disposal policies and activities;
- (5) trust in political authorities in determining and implementing HMT and disposal policies and activities;
- (6) the equitable distribution of the costs, risks and benefits over space and time associated with hazardous materials transport and disposal;
- (7) the equitable distribution of liability for costs and risks associated with transport and/or disposal accidents; and
- (8) the provision of sufficient emergency response capabilities in the event of transport and/or disposal accidents.

This collection of generic institutional concerns, by itself, does little to facilitate the development of politically and technically sound HMT. That is, for strategic planning purposes, it is important to know which institution has which concerns, what can each institution do to press its concerns, and what is likely to be the evolution of institutional concerns over time. Table 1 represents a translation of these generic concerns into specific concerns and potential related demands of typical institutional actors for the transport of hazardous materials.

Although it is beyond the scope of this article to identify and discuss in detail the concerns of each of these actors, a number of points should be kept in mind in reading this table. First, although the entire set of institutional actors have different constituencies to satisfy and will likely employ different strategies to achieve their objectives, the goal of timely and environmentally sound transport and disposal of hazardous materials should be amenable to all affected institutions.

TABLE 1

Components of the institutional environment for HMT

Institution	Generic concern(s) and responsibilities	Specific hazardous material transport concern(s)	Examples of existing or potential related demand(s)
PUBLIC SECTOR — FEDERAL			
<i>Implementation</i>			
Shipper	Provide for environmentally sound transport and disposal of hazardous materials	Assure that HMT complies with planned generation, processing and disposal schedules	Maintenance of planned hazardous materials program and schedule; compliance with management directives, orders and contractual agreements
Traffic managers	Arrange for, negotiate and manage HMT	Negotiate shipping rates, schedules, operating conditions with carriers; provide orientation and training for hazardous material handling for operations personnel and state and local emergency response personnel; and ensure that carriers meet transportation and environmental laws and regulations	As key link in the chain of shipping hazardous materials, maintain sufficient authority to ensure timely transport of such materials
Carrier (see Private Sector)			
<i>Regulation</i>			
Department of transportation	Hazardous materials be transported in a manner that is safe and poses minimum threat to public safety	Compliance of affected parties (shippers, carriers, states) with Hazardous Materials Transportation Act, HM 164 and related statutes and regulations	Coordination of HMT with relevant federal and state authorities

TABLE 1 (continued)

Institution	Generic concern(s) and responsibilities	Specific hazardous material transport concern(s)	Examples of existing or potential related demand(s)
Other federal agencies	Agencies such as EPA, NRC, FEMA, comply with their Congressional mandate	HMT be managed in such a way as to meet their mandates	Coordination of HMT through their HQ and their regional offices
Congressional oversight and appropriations committees	Cost-effective and environmentally sound management of hazardous materials	Compliance of federal agencies with relevant federal laws and regulations, including the Nuclear Waste Policy Act, Atomic Energy Act, National Environmental Policy Act, Hazardous Materials Transportation Act, and Resource Conservation and Recovery Act	Annual oversight of federal agency hazardous material transport activities and budgets
Representatives of affected states	Equitable distribution of HMT costs, risks and benefits; protect interests of constituency	Routing of HMT, mitigation of potential adverse impacts; presentation of transport activities in media	Ongoing liaison with relevant federal agencies; adequate mitigation of potential adverse transport impacts
PUBLIC SECTOR — AFFECTED STATE			
Governor	Protect interests of his/her electorate	Assure state interests protected in HMT; secure appropriate state participation in transport through various executive agencies; seek mitigation for potential adverse transport impacts; protect public health and welfare	Ongoing liaison with shipper/carrier; secure assurance of health and environmental protection; participation in HMT planning and implementation
State legislature/representatives of affected districts	Protect interests of state legislative district's citizens	Equitable distribution of HMT costs, risks and benefits, full cognizance of hazardous material shipment	Ongoing liaison with shipper/carrier; provision of appropriate mitigation for potential adverse impacts of HMT; participation in planning and implementation

State Department of Transportation/ State Routing Agency	Safe transport of hazardous materials	Compliance of shipper/carrier with federal and state statutes and regulations; as state routing agency, select preferred routes for large quantity shipments of radioactive materials	Liaison with shipper/carrier; participation in HMT planning and implementation; approval of transport route; inspection of transport vehicles; participation as directed by state's governor
State Environmental Protection Agency, Public Health Dept. or Dept. of Natural Resources	Environmentally sound transport of hazardous materials, particularly with respect to public health	Shipper/carrier compliance with state laws and regulations; full sharing of relevant information	Participation in HMT planning and implementation; monitoring of transport
Civil Defense or Emergency Response Agency	Provision of adequate protection of population in emergency situations	Sufficient resources for independent state emergency response capabilities and planning; full sharing of relevant HMT information	Participation in HMT planning and implementation; pre-notification regarding shipments; education and training for emergency response capabilities
State Police	Protection of life and property	Shipper/carrier compliance with state highway and traffic code; adequacy of existing resources for HMT responsibilities	Provision of technical and/or financial assistance to meet HMT responsibilities

**PUBLIC SECTOR –
AFFECTED LOCAL JURISDICTION**

Major/City Manager	Protect interests of electorate	Equitable distribution of costs, risks and benefits of HMT; full cognizance of transport activities; shipper/carrier compliance with local ordinances	Ongoing liaison with shipper/carrier, adequate mitigation to offset adverse transport impacts; training of appropriate local personnel for accident scenario; participate in state's selection of preferred route
City or County Commission	Protect interests of electorate	Equitable distribution of costs, risks and benefits of HMT; full cognizance of transport activities; adequacy of existing local regulatory regime	Adequate mitigation for potential adverse transport impacts; comprehensive public information programs

TABLE 1 (continued)

Institution	Generic concern(s) and responsibilities	Specific hazardous material transport concern(s)	Examples of existing or potential related demand(s)
Fire Department, Police Department, Civil Defense	Protection of life and property	Adequacy of existing resources to participate in nominal or accident HMT scenarios; shipper/carrier compliance with local ordinances	Provision of technical and financial assistance to facilitate satisfactory completion of HMT responsibilities
Public Health Agency/Hospitals	Protection of public health through preventive and remedial actions	Adequacy of medical and public health resources to address potential HMT related health effects	Full cognizance of transport source terms and other technical assistance to facilitate job performance in the event of an accident
Planning Department	Provide reliable community management strategy and tools to local decisionmakers; plan for achievement of community goals	Adequacy of existing local regulations, shipper/carrier compliance with local regulations; adequacy of community resources to address HMT impacts	Providing of technical, planning and financial resources to meet HMT demands; at direction of mayor/city manager/county commission, participate in state's selection of preferred route for nuclear materials transport
PUBLIC SECTOR — ASSOCIATIONS			
National Conference of State Legislatures	Provide members with sufficient resources to address common problems	Adequacy of state legislation to protect public health and the environment from potential adverse impacts of HMT	Participation in HMT planning through review and comment procedures
National Governor's Association (NGA)	Provide members with sufficient resources to address common problems	Adequacy of state administrative and political resources to protect public health and environment from potential adverse impacts of HMT	Participation in HMT planning through review and comment procedures
National Association of County Officials (NACO)	Provide members with sufficient resources to address common problems (primarily for rural)	Adequacy of local ordinances to protect public health and the environment from potential adverse impacts of HMT	Participation in HMT planning through review and comment procedures

National Conference of Mayors Provide members with sufficient resources to address common problems Adequacy of local ordinances to protect public health and the environment from potential adverse impacts of HMT Participation in HMT planning through review and comment procedures

PRIVATE SECTOR

Carriers/transportation industry (contract or common) Safe transport of hazardous materials at reasonable cost Compliance with relevant DOT regulations and other requirements; coordination through shipper/traffic managers Ability to determine routes within constraints of HM 164 (nuclear materials)

Mass media — national and affected state/local Ability to provide comprehensive and accurate reportage of public issues Understanding the technical, political and institutional parameters of HMT; being provided comprehensive and accurate information on a timely basis Freedom of the press; access to all relevant information; assistance in understanding technical material; factual assessment of uncertainties; search for newsworthy issues

Environmental and public health interest groups

a. national Protection of public health and the environment Potential adverse HMT impacts to public health and the environment; candor with which shipper/carrier acknowledges uncertainties with hazardous materials storage, transport and disposal Participation in HMT planning and implementation; monitoring of transport and disposal

b. state/local The Not In My Back Yard (NIMBY) syndrome; protection of public health and the environment; equitable distribution of society's costs, risks and benefits Inequitable distribution of costs, risks and benefits of HMT; inadequate participation in HMT planning and implementation Participation in HMT planning; design of appropriate mitigation for potential adverse impacts; state/local receipt of appropriate mitigation



Second, although at any given point in time the "legitimate" distribution of political authority and responsibility may be determined, the dynamic character of the American political system results in changing distributions of authority and responsibility [11]. This "moving target" dimension, characteristic of policymaking in general and regulatory decisionmaking in particular, has often been identified as a significant problem affecting the efficiency of public and private sector activities in the United States [12-14].

Third, the interest of national and state and local interest groups in HMT is substantial and is likely to remain so, given a pervasive lack of trust by citizens in virtually every level and branch of government [10, 15]. Although the Administrative Procedures Act, the National Environmental Policy Act, the Hazardous Materials Transportation Act (HMTA), the Nuclear Waste Policy Act and other relevant federal and state statutes have encouraged and increased public participation in decisionmaking, this significant institutional change has not resulted in uniformly greater trust in administrative processes.

Fourth, the distribution of costs, risks and benefits of HMT is likely to be perceived as inequitable. In the case of origin/destination sites and states, the relevant political jurisdictions may well perceive that they have received or will receive some benefits in terms of jobs, taxes (or payments in lieu of taxes in the case of federally or state owned generating, processing or disposal facilities), and indirect economic benefits associated with such facilities and, perhaps, even of transporting hazardous materials to and from these facilities. Other than compliance with the U.S. Constitution (i.e., supremacy clause, commerce clause) and a sense of performing a "patriotic duty," intermediate transport states and local jurisdictions currently have few incentives to cooperate willingly with the transport of hazardous materials. In fact, the preponderance of state and local legislative requirements affecting the transport of hazardous and radioactive materials may be interpreted as a response to the net disbenefits of such activity.

Finally, it should be noted that most of these issues can best be dealt with prior to the actual shipment of hazardous materials. At the time of transport, shippers or their agents (e.g., carriers) are responsible for dealing with all institutional concerns instantaneously. If a shipper, such as the United States government, plans a series of shipments to complete the movement of a particular commodity from one or more sources to one or more destinations, an equivalent level of planning may be desirable to determine the most effective as well as most efficient way to deal with the full range of institutional issues. This could especially be true if, as is often the case, HMT is an essential but only an intermediate step in an overall policy objective (e.g., shipping defense nuclear wastes for disposal at WIPP or chemical munitions for disposal at a large-scale demilitarization facility).

Assessing the existing institutional environment

The fragmentation in political authority shown in Table 1 exhibits the current institutional environment for HMT. While it is substantially comprehensive in its coverage of the kinds of institutions that occupy significant positions in the relevant policy system, in no way does it capture the variability that exists within similar institutions. For instance, a complete understanding of the existing institutional environment regarding states affected by a particular HMT activity would require an examination of the laws and regulations of origin, destination and transport corridor states, as well as of the less formal policy orientations of current state legislatures and administrations.

There is a substantial federal and sub-federal regulatory infrastructure within which HMT takes place. The HMTA, which governs the transport of all hazardous materials including radioactive materials, is administered by the U.S. Department of Transportation (DOT). The DOT has promulgated an extensive regulatory regime addressing hazardous materials transport by all modes (e.g., truck, rail, air, and barge) by both public and private sector shippers and carriers (49 CFR 171–177). In addition, the Environmental Protection Agency and all states are in the process of implementing the Resource Conservation and Recovery Act (RCRA) to regulate all hazardous waste management activities “from cradle to grave,” including transportation (RCRA transport requirements accept and build on DOT regulations). Other federal agencies, such as the Nuclear Regulatory Commission, the Federal Emergency Management Agency, and the Occupational Safety and Health Administration have other roles which at the present time may seem less significant. Abbott et al. [1] present a good compendium of the existing federal (and state) HMT regulatory system.

In addition to the federal regulatory regime which incorporates packaging, placarding, labeling and routing requirements, many states and local governments have promulgated additional HMT regulations. As long as these requirements are consistent with the purposes of HMTA (i.e., enhance overall public safety) and do not unreasonably burden interstate commerce, such regulations are deemed valid by DOT and must be followed. For instance, the prohibition by the State of Washington of HMT during adverse weather conditions and extensive planning for emergency response capabilities by many states (e.g., Illinois, Virginia, South Dakota, Tennessee and Pennsylvania) comply with the purposes of HMTA and do not adversely affect interstate commerce. Abbott et al. [1] and Fore et al. [16] identify existing state regulatory requirements for HMT and many local requirements.

The range of regulatory requirements being adopted by various states and local governments for transportation and other hazardous materials management activities seems to be growing substantially and will likely continue to grow with increased media attention and with the diffusion of regulatory information across political jurisdiction (see below). Factors potentially ac-

counting for the growth of institutional activity regarding HMT are addressed in the following section.

The future institutional environment for HMT

Current observers of hazardous waste and materials policy concur that the policy system is changing rapidly [6, 17, 18]. The existing institutional environment may change in the future, even radically within a short time frame. The nation's experience with Love Canal, Times Beach, the Bhopal accident in India and the natural gas explosion in Mexico City have sensitized the public and virtually every relevant institution to such an extent that even an intensive monitoring effort would not likely capture the full range of changes in policy direction found in various parts of the United States. Future dramatic events of a similar nature could result in both profound and/or incremental unanticipated changes in the institutional environment. This section addresses potential changes in the institutional environment for HMT through an identification of basic factors likely to affect the long-term evolution of HMTs institutional environment.

The future institutional environment for HMT can only be known to the extent that plausible theories of institutional and technical innovation and diffusion can be constructed and corroborated. Although we are far from that goal, substantial research has been conducted that identifies likely major contributors to future institutional action. These contributors, or causal agents, can be thought of as scenarios, trends and variables.

In the context of this analysis, scenarios refer to events that are judged likely to induce affected federal, state and local governments and other relevant institutions to initiate action potentially affecting HMT. They include, among others, the announcement of HMT actions and routes, perceived problems at hazardous materials management facilities, and reported transport accidents. Unlike trends and variables potentially affecting HMT, these scenarios or events may be considered as specific interventions which alter the institutional environment in discrete ways. For most institutions, actions can only be taken in a reactive mode once these scenarios occur.

Trends refer to the characteristic relations among institutions identified earlier and to specific existing trends in radioactive and hazardous materials management, such as consolidation of management authority for all "risky" technologies, concerns about emergency response [19-24], and the NIMBY (Not in my backyard) syndrome [25, 26] and efforts to devise mitigation and incentive schemes to combat this syndrome [10, 27-29]. As previously noted, increasing levels of intergovernmental and interinstitutional cooperation, consultation, coordination and concurrence will likely be required.

This analysis also considers the importance of a number of variables in contributing to the probability of institutions initiating actions affecting HMT. Following the lead of previous research, I have considered the extent to which regulatory restrictions and other institutional activities may vary

systematically with a number of independent variables. These variables include the degree of pollution problem [17, 30–32], communications and diffusion of innovation patterns [33–35], bureaucratic specialization and legislative professionalization [17] and other intervening variables*.

Degree of pollution problem

Adapting the research of Lester et al. [17], Sabatier [14], Game [31], and Beasley and Johnson [32] on the extent to which the severity of pollution problems leads to pressures or demands for strong environmental protection policies, this variable can be defined in this case as the extent to which an institution is subject to HMT activity. Operationally, one could expect that an institution would score high on this variable when it learns of plans for HMT and its potential role in shipment.

For federal regulators (e.g., DOT, EPA, NRC), their activity derives from sets of congressional mandates such as HMTA, RCRA and the Atomic Energy Act. Institutional involvement for state and local government jurisdictions would be expected to vary directly with a number of conditions, including: the toxicity and quantity of hazardous materials to be transported within or across their borders; the number of citizens potentially exposed to the materials; the extent of non-federal institutional liability and responsibility for such activity; recent experience with analogous pollution problems; and other political pressures placed on them to become involved.

Attention of the mass media to HMT is also likely to vary with the degree of pollution problem relative to other newsworthy issues [35]. The national media's increasing coverage of hazardous and radioactive waste disposal and transportation would indicate that a judgment has been made that such issues are important and should be high on the public agenda. This trend appears to coincide with actual or perceived increases in waste transport and disposal activity and with increasing media attention to associated issues of concern, including public health and the environment. The mass media of affected state and local jurisdictions would be expected to be especially attentive to HMT with the incidence of accidents and/or proposals for future shipments.

Involvement of national public health and environmental interest groups (e.g., Sierra Club and Natural Resources Defense Council) would also be expected to vary directly with the scale of HMT in the United States and elsewhere. While the amount of hazardous materials to be shipped may be insignificant compared to the total quantity of commodities shipped, national interest groups may appear to pay a seemingly inordinate amount of atten-

*Possible intervening variables and indicators include socio-economic status [46], population size [47], media coverage [35], governmental centralization [48] and electoral competition and participation [49]. These have been eliminated as significant independent variables because they are incorporated, in one way or another, among those variables already identified.

tion to HMT because of the existence of stringent regulations governing HMT and the associated fiduciary responsibility of regulatory agencies.

Interest groups in affected states or localities might be expected to be particularly active in HMT, and the intensity and scope of their activity may vary with the extent to which their members and other members of the public would be exposed to such activities. In this case, the term "exposed" refers not only to its technical denotation (i.e., as expressed in lethal and sublethal health effects in the event of an accident) but also to perceived risk of chronic or acute exposure.

Communication and diffusion of innovation patterns

One of the primary consequences of this nation's emerging status as an information society [35, 36] is the substantial increase in communications among all institutions about the problems they face and the strategies they employ to resolve these problems. Although this phenomenon applies to all of the relevant institutions that might affect HMT, it is particularly germane to affected state and local governments, public sector associations, the mass media, and national and state/local interest groups.

As indicated in prior research [33, 34, 37], definite patterns of substantive and regional communications and diffusion of innovation among state and local jurisdictions have appeared in the recent past. Government personnel tend to identify leaders in particular policy arenas (e.g., environmental protection and noxious facility siting policy) and in particular regions. In the case of HMT these patterns would be expected to continue so that bell-weather states and communities would emerge, become well known to other affected states and communities, and provide policy guidance to those jurisdictions. In short, it should be acknowledged that state and local governments are already sophisticated about hazardous materials management and will continue to communicate with one another, either directly or indirectly through relevant public sector associations (see below) about alternative strategies to protect public health and the environment. For instance, it might be expected that the State of New Mexico would become such a state because of the rights and responsibilities it obtained in its stipulated agreement with the Department of Energy (DOE) regarding the transport of defense nuclear wastes to the Waste Isolation Pilot Plant near Carlsbad, New Mexico [38]. In that agreement it was acknowledged that:

- (1) the Price Anderson Act would provide indemnity coverage for transporting defense nuclear wastess through the state and its subdivisions, including coverage for theft or sabotage;
- (2) DOE would assist New Mexico in securing technical and financial assistance for emergency response preparedness and provide the balance of financial assistance needed after exhausting other federal resources; and
- (3) DOE would allow and reimburse the state for monitoring nuclear

waste transport within its borders, monitoring points of origin, and inspecting vehicles at points of entry into and out of the state.

One of the primary purposes of public sector associations such as the National Conference of State Legislatures (NCSL) and the National Governors Association (NGA) is to serve as a clearinghouse for policy information relevant to their members. As such, these organizations provide their constituents with information about what other members are doing, offer guidance to their members, and, on issues perceived to be especially important, may convene a subset of its members on a task force to develop model statutes, ordinances and other policy documents.

The mass media will obviously play an important role in communications about HMT. Media representatives may be expected to rely on leaders in their own midst (i.e., those reporters with national reputations on environmental issues such as HMT and disposal or newspapers with comparable reputations) and on the wire services (e.g., AP and UPI) and major news networks.

Finally, national and state/local interest groups have become increasingly networked with one another regarding common policy issues. For national interest groups, this network may extend to the point of informal agreement on the division of oversight responsibilities and interest group strategy and tactics (e.g., the Sierra Club lobbies and the Natural Resources Defense Council litigates). State and/or local interest groups have likewise become networked with one another to the extent that community groups opposed to the siting of hazardous waste facilities (i.e., the NIMBY syndrome) are increasingly beginning to communicate directly with one another about their common concerns [39].

Institutional specialization and professionalization

A third dominant theme in research on trends in institutional activity states simply that increases in institutional specialization and professionalism are accompanied by increases in regulatory activity and other institutional behavior [14, 17, 40, 41]. Although this phenomenon may well be characteristic of all of the institutional actors potentially affecting HMT, it seems particularly relevant to regulatory agencies, state and local governments, and national-scale institutions such as public sector associations, the mass media and interest groups.

Regulatory agencies have been characterized recently as extremely fragmented with pockets of specialization capable of regulating the minutiae of various activities as well as the broader activities themselves [12, 13]. As more and more activities have come under regulatory umbrellas specified by diverse congressional mandates, the opportunity for increasing specialization has increased concomitantly. In the case of HMT, the DOT has major regulatory responsibility, but a number of others (e.g., the EPA, Federal Emergency Management Agency, and Nuclear Regulatory Commission) could conceivably play smaller roles. To this list should be added any agency acting

as the shipper, such as the Departments of Defense or Energy. To combat this fragmentation and to avoid duplicative regulation, agencies have often entered into memoranda of understanding (MOU). It should be noted, however, that bureaucratic organizations such as regulatory agencies are themselves so specialized, professionalized and decentralized as to limit the effectiveness of conventional interorganizational management tools.

Many state governments and some local governments have also become increasingly specialized and professionalized. More populous and resource-rich governments have in many cases developed professional staffs that rival federal efforts. One of the difficulties accompanying such development is the existence of substantive variability among jurisdictions in terms of their ability to participate effectively in HMT.

Organizations on a national scale have also developed professional capabilities to participate effectively in matters such as HMT. Although there is, again, some variability in capabilities, this may be compensated for by significant communications capabilities as noted earlier.

Summary

The foregoing analysis reveals an institutional environment characterized by substantial complexity and fragmentation and multiple opportunities for diverse institutions to intervene in the HMT process. It has further identified some variables that would tend to indicate that these characteristics are likely to dominate the future of HMT, at least in the near-term. Eventually we, as a society, may modify our productive capacity to reduce the generation of hazardous materials, but that is not likely to occur any time in the near future. Enhanced communications among and increasing specialization within institutions, on the other hand, are both likely to continue unabated. For all of these reasons, it seems desirable to identify strategies to optimize the utility of such characteristics and minimize their disruptive influences.

Strategic planning for HMT

Of the approximately 250,000 daily shipments of hazardous materials in the United States, how many could or should be based on more detailed and comprehensive planning than is currently the case? Which shipments do or could pose significant problems for the public or for the various institutions that represent the public? In short, to what extent do the information and analysis presented here impinge on HMT?

As indicated in the research on policy analysis and agenda development [5, 6, 14], these questions are not directly answerable. The changing natures of the policy and regulatory systems indicates that it is a matter of judgment as to when and under what conditions institutions need to revise operational behavior.

In some sense, answers to the above questions will only become apparent

when and if an individual shipper or carrier is kept from doing the job. An injunction may be filed, activists may engage in civil disobedience, interest groups may succeed in lobbying efforts in legislative chambers. If the HMT industry experiences either real or perceived increases in its accident rate, it can anticipate having to develop contingency plans allowing them to pursue their objectives in other ways, such as alternative routes [42], modes, throughput and so forth. If the media concentrates either on accidents or on planned shipments of hazardous materials, shippers and carriers can anticipate having to enhance their strategic planning capabilities.

In any case, there are some shippers of hazardous materials that can count on having to engage in strategic planning for HMT immediately. Public sector shippers, such as the Departments of Energy and Defense, that are currently planning on transporting spent nuclear fuel, defense nuclear wastes, munitions, and so forth in the near- and longer-term will be facing an institutional environment either similar to that confronting them today or one which insists on greater attention to the institutional issues identified in this analysis. Similarly, large corporations that ship large volumes of hazardous materials on a regular basis can safely assume that they will face the same dilemma. Other, smaller scale private sector firms shipping hazardous materials may be able to operate as they currently do — assure themselves that they and their carriers comply with existing regulations promulgated and enforced by the DOT, EPA, other federal agencies, and affected state and local jurisdictions.

For public sector and large private sector shippers, what could or should be done to ensure future viability? Like other controversial policy issues, they have to be aware of the complex and dynamic institutional environment they face. They need to be aware of one of the most difficult problems facing centralized or federal decisionmakers — the moving targets of public acceptance and pluralistic control of policy decisions. They cannot control their environment; neither can they be assured that what is acceptable now will remain so in the long term.

What can be done, or at least what can be tried, is to develop and implement planning and decision systems that address institutional complexity. Two separate approaches to managing the institutional environment for HMT might be tested. For the first approach, the shipper might follow the following steps:

- (1) identify relevant institutions for particular HMT;
- (2) submit transportation plans to relevant institutions for their information and comments;
- (3) determine whether existing plans respond to the critical concerns of these institutions;
- (4) identify what modifications to existing plans would be necessary to enhance their acceptability to the relevant institutions; and
- (5) assess whether such modifications are feasible, economic, and efficient in terms of the ultimate objectives of the particular HMT (e.g., disposing spent nuclear fuel, disposing defense nuclear wastes, dis-

posing hazardous chemical wastes or munitions, providing manufacturing feedstocks).

Once such a paper experiment has been completed, the shipper might experiment with the results in a field setting — implement the modified transport plan.

The other alternative would be to approach the particular HMT in a more costly manner and in a way potentially less likely to resolve institutional issues pro-actively. The shipper would

- (1) identify relevant institutional actors for a particular HMT;
- (2) try to anticipate likely institutional concerns and potential strategies and tactics;
- (3) develop contingency plans for each tactic that might be employed; and
- (4) prepare to implement each contingency plan in the event that it is needed.

The basic differences between these alternative approaches, which are summarized and compared in Table 2, is that for the first the shipper explicitly interacts with other institutions prior to shipment and submits its plans to public scrutiny well before actual shipment. It does not guarantee the impossibility of eleventh hour intervention, but it should decrease the probability of such an occurrence. It also shifts the cost of identifying institutional concerns to the institutions involved. The second approach insulates the shipper from public scrutiny until actual shipment, allowing for the possibility of intervention but also anticipating such intervention with contingency

TABLE 2

Comparison of alternative HMT institutional management strategies

Step	Strategy No. 1 "open"	Strategy No. 2 "closed"
Identify relevant institutional actors	x	x
Submit HMT plans to relevant institutional actors for review	x	
Identify institutional concerns, strategies and tactics	x	x
	(by institutions)	(by shipper)
Determine adequacy of existing HMT plans	x	
Identify required: HMT modifications contingency plans	x	x
Assess feasibility, efficiency of modifications contingency plans	x	x
Plan/implement modified HMT plan contingency plan	x	x

plans. The second approach may also be costly, in the sense that the shipper would have to develop internal expertise regarding the institutional environment it may not currently have. There is also the real possibility that no amount of internal expertise, short of institutional espionage, would be adequate to the task.

The trade-offs involved with these two approaches ultimately have to be balanced by the shipper. Retaining proprietary control of hazardous materials shipments may be deemed more important than the extra costs incurred and more important than decreasing the probability of last second intervention. If such is the case, then clearly the second approach to managing the institutional environment would be preferred. Alternatively, if the shipper deems it more important to enhance the probability of unimpeded shipment and minimize the cost of obtaining accurate and relevant institutional information, then the first approach would be preferred.

What should be acknowledged is that one of these approaches to the management of the institutional environment, or some other alternative, is probably necessary. The public and their institutions are sufficiently aroused to insist on a better job of HMT than has conventionally been the case.

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