RISK-MANAGEMENT PRACTICES IN LOCAL COMMUNITIES

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# CONTENTS

<table>
<thead>
<tr>
<th>TABLES</th>
<th>.................................</th>
<th>v</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABSTRACT</td>
<td>..................................</td>
<td>1</td>
</tr>
<tr>
<td>KEY WORDS</td>
<td>..................................</td>
<td>1</td>
</tr>
<tr>
<td>PREFACE</td>
<td>..................................</td>
<td>2</td>
</tr>
<tr>
<td>I. THE CONCEPT OF RISK-MANAGEMENT</td>
<td>..................................</td>
<td>5</td>
</tr>
<tr>
<td>II. A SURVEY OF RISK MANAGERS</td>
<td>..................................</td>
<td>14</td>
</tr>
<tr>
<td>III. POLICY ALTERNATIVES</td>
<td>..................................</td>
<td>32</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>..................................</td>
<td>49</td>
</tr>
</tbody>
</table>
TABLES

1. A SUMMARY OF WHO WAS INTERVIEWED                     16
This paper discusses the current state of risk-management practices in local communities in the United States and offers some alternatives to present policies, which are mainly implicit rather than explicit attempts to limit overall risks of death and injury due to technological and natural causes. The article is divided into three sections. The first discusses the concept of risk-management as presently used in local government. The second section results from a limited survey of local risk-managers. The third section offers some policy alternatives. While generalization is itself risky, all of our observations point toward the conclusion that local government officials have little understanding of, hence little concern for the quantity of risk posed for citizens by various hazards. If it seems desirable to place risk-management decisions in the hands of local officials, then some capacity for risk quantification, hence comparison, must be developed. The bulk of the policy suggestions at the end of this paper concerns possible means through which this capacity might be augmented. We do not discuss specific risk-acceptance criteria or risk-management policies that might be adopted by cities, counties, and states because such are premature at the current state of practice.

KEY WORDS
Risk-management, local versus federal risk policy, risk-management alternative, risk manager interview.
This paper discusses the current state of risk-management practices in local communities in the United States and offers some alternatives to present policies. It is addressed to policymakers, specifically at the local and state levels, concerned with managing technologically based risks and environmental hazards.

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INTRODUCTION

This article addresses the question of how quantitative conceptions of risk and risk analysis can contribute to local government. Historically, local governments in the U.S. have had no quantitative conception of risk. Issues of public health and public safety have in the past been limited to hazards that are reasonably well understood and for which standards and codes specifying best practices have been developed by the engineering and public health professions. Technological changes and awareness of hazards that were earlier considered insignificant have compelled governments at all levels to consider risks that are not well understood and that cannot be eliminated completely, at least within constraints of existing resources. The alternatives for dealing with these kinds of risks are limited. In this article, it will be argued that a quantitative conception of risk and some formal risk analysis ought to be introduced into local government to address hazards of this sort.

Our argument is straightforward: Quantitative comparisons of risk may yield better policy judgments than the present system that depends heavily on reaction and regulations fixed by Federal agencies. We do not claim that risk models as complex as those used by Federal agencies, such as the Nuclear Regulatory Commission, ought to be developed by local governments. Clearly these are beyond their means and expertise. But we do argue that a quantitative conception of risks and a rudimentary capacity to make risk comparisons may enhance local government. Toward this end, we propose several alternate models of
local risk management. One of the alternatives, what we call the network model, we believe preferable to the others, and we make several suggestions for implementing it.
I. THE CONCEPT OF RISK-MANAGEMENT

This research began from a rational model of risk management. It assumed that many risks to life and health, other than occupational risks, fall within the purview of the local government and that these risks, while not completely understood, can be quantified, and that the mitigation of risk questions ought to be a key concern of local decisionmakers. A number of questions flowed from this model. One was whether a generic concept of risk informed local official's approaches to problems, that is, whether policies are directed toward reducing risk as much as toward regulating particular hazards such as air and water pollution, vehicular accidents, and the like. Another question was whether, given an orientation toward risk, alternative management strategies based upon different risk-acceptance criteria could be devised. A final question was whether optimal mixes of these strategies could be devised for various localities so that more rational, cost-effective risk-management practices could be implemented.

The last two questions were rendered almost from the outset of the research. The concept of risk, it was found, was not understood and did not inform the management of known hazards. One of the first tasks undertaken was identification of risk managers in several Western localities. The procedure used was straightforward: The office of the chief executive of each locality was contacted, and knowledgeable informants, normally persons with the title of "executive assistant" or "chief administrative assistant" were asked to identify the person and agency "principally responsible for managing risks to life and health,
other than occupational risk" in the locality. This procedure followed

techniques normally used to identify government agencies whose functions
are of interest,[1] but in this instance it evoked some unusual
responses. One kind of response was noncomprehension: Informants did
not understand the phrase "managing risks." At first, this kind of
response was met by suggesting specific hazards that might be managed
locally, but later we refrained from doing so and instead explored
whether the concept of risk was understood at all. In most instances it
was not. The idea that risks of death, injury, or other adverse
consequence, expressed as a probability, were to be reduced by local
government action proved elusive. Instead, reference was made to local
government functions such as police, fire, and health protection rather
than the outcome of these functions or their effectiveness in terms of
reducing risk. Noncomprehension, however, was not the model response to
our initial inquiries. More often, informants did designate one of two
types of persons as principal risk managers. One type was civil defense
or emergency preparedness coordinators, persons responsible for
anticipating and managing responses to catastrophic events such as
floods, earthquakes, and, of course, acts of war. The second type
designated as principal risk managers was insurance administrators
charged with maintaining financial protection against liability claims
and property losses.[2]

Not only did the initial interviews show the concept of risk to be
foreign to or extremely limited in local government, but they also

   University, Inc., 1977

[2] The term risk-management often appears on organization charts of
   comptrollers' offices and finance departments to designate units
   responsible for insurance administration.
revealed the near absence of formal risk-management activities. Formal risk-management normally entails the following: (1) A suspected source of risk is identified; (2) the degree of hazard posed by the source is estimated from either experimental or observational evidence and the level of exposure to the hazard is calculated so that an overall risk estimate can be made; (3) this level of risk is compared to previously established risk acceptance criteria; (4) policies are developed and implemented so that the risk does not exceed acceptable levels; and (5) a system of monitoring is set in place to insure the effectiveness of the policy. The terms identification, analysis, acceptance, policy, and monitoring describe these steps, each dependent upon the prior one. Little resembling this rational model of risk-management surfaced in our first conversations with local officials. Indeed, where we did find risk-management at the local level, it was at the end rather than at the beginning of the sequence. Identification of specific hazards posing risk does not normally occur at the local level. When it does, it is sporadic and usually as the result of a highly publicized incident such as a major fire or a toxic spill. Substances or activities posing substantial hazards are not actively sought. Quantification of risk is rare at the local level, and determination of acceptable levels is all but nonexistent. There is, of course, political determination of what hazards are tolerable and what are not, but this is far different from setting quantitative standards for acceptability. Specific policies for managing risks are sometimes enacted locally, usually at the behest of state and, in turn, federal authorities and rarely due to local initiative. Monitoring of hazards is, however, frequently a local function, undertaken, again, mainly in compliance with state and federal mandates.
Two key questions to be addressed, then, are why the rational model of risk management has not been incorporated or has been misunderstood in local government, and what alternatives exist to present patterns that might move local officials closer to this model. The first question cannot be answered entirely from observation, but it is possible to document how little the idea of risk-management, as distinguished from service delivery and protection of the public from acute hazards, has penetrated local government and to suggest explanations for this development. The second question requires that we consider and evaluate possible means through which formal risk-management can be introduced locally.

It should be emphasized that this article operates throughout on the assumption that greater attention to risk as such and more explicit risk-management policies are desirable for local communities, even though few risk-management policies are in place at the present time. In a subsequent article, we will consider the appropriateness of formal risk-management at different levels of the public sector by making explicit comparisons of local practices, where risk is rarely quantified, and patterns in Federal agencies, where substantial experience in probabilistic risk assessment has been accumulated.

Types of Local Risk-Management

Three ways of dealing with risk surfaced in the initial conversations with city, county, and state officials. One we call management by reaction; the second we call management by compliance; and the third we specify as analytic or formal risk-management. These three
types differ somewhat from the generic approaches to risk developed by Slovic et. al., [Ref] in part because they apply specifically to local government. In particular, what we call reactive risk-management is a form of what Slovic et al. calls "bootstrapping" or incremental decisionmaking. However, risk-management by reaction is principally a short-term and sometimes highly political response to hazards that possibly demand more careful planning for long-term mitigation.

Risk-management by reaction. Risk-management takes place by reaction when a life-threatening situation or events causing loss of life lead to measures intended to prevent their recurrence. These measures are implemented swiftly and in most cases without careful analysis of probable costs and benefits. Myriad instances of reactive risk-management at the local level have come to our attention in the course of this research, including the following:

- LNG was banned from a major harbor after fire and explosion of an empty oil tanker. LPG, whose physical properties are almost identical to LNG, was not banned, and it continues to be transported through this harbor.
- Only after a disastrous apartment house fire was a local ordinance requiring fire doors enacted.
- Another apartment house fire triggered enactment of an ordinance requiring smoke detectors in all dwelling units.
- Discovery of trace amounts of TCE in drinking water caused closure of water wells in a wide area.
- The use of an extremely effective nematode killer, DBCP, was effectively banned when a high incidence of sterility was detected among workers in a plant manufacturing the substance.
Several elements are common to situations where reaction governs risk-management. One is a highly publicized event. Normally, government temporizes. A speedy response to any potential hazard occurs only when substantial attention is given by the media. Thus, for example, an unnoticed tenement fire would be much less likely to result in a smoke detector ordinance than a fire in a luxury high-rise. A second element is conversion of scientific questions concerning risk into political issues of public safety and protection. Generally, this requires that someone in a visible elected or appointed office adopts the issue as his or her own. The smoke detector ordinance is again illustrative. The public investigation of the high-rise fire that culminated in the ordinance was undertaken, in part, to draw attention to a municipal fire commission that had always been overshadowed by its counterpart local police commission. A third characteristic of reactive risk-management is its short time frame. Problems arise swiftly and vanish from public view once some action has been taken, regardless of the effectiveness of the measures enacted.

A somewhat different and less dramatic form of risk-management by reaction occurs when last year's disaster triggers this year's emergency planning. Southern California, in particular, experiences a cycle of drought-brush fire-rain-flood and mudslide. Only in the aftermath of the "fire season," which strips foliage (and dwellings) from hillsides can the potential for floods and slides be ascertained and preventive measures taken, which comprise mainly the deployment of personnel and equipment. This type of risk-management is reactive because it operates on a year-to-year basis without analysis of long-term risks.
Risk-management by compliance. Risk-management occurs by compliance when rules, codes, standards, and statutes govern decisions affecting life and health. Compliance is distinguished from reaction in that it is orderly rather than ad hoc. The same standards, more or less, apply to all similar cases. Compliance is also distinguished from more analytic approaches in that the standards themselves rather than independent risk-assessment and risk-acceptance criteria inform choices. Myriad examples of risk-management by compliance can be given:

- The amounts and types of wastes discharged into public waterways, the disposal of hazardous wastes, and the levels of contaminants in public drinking water are limited by federal regulations promulgated by the EPA.\[3\]
- Seismic design for buildings, transporting storage of hazardous materials, and highway safety are regulated by state and local building codes and statutes.
- The design of electrical generation and transmission networks, waterworks facilities, and dams and bridges as governed by professional engineering standards.

Risk-management by compliance sometimes entails what Slovic et. al. [Ref.] calls "bootstrapping" whereby precedent and political and economic realities shape standards, and it sometimes entails "professional management," whereby judgements of experts are relied upon. However, risk-management is by compliance so long as decision-makers rely upon standards and codes set by others without attention to a guiding concept of risk or explicit risk-acceptance criteria.

\[3\]These regulations, of course, are determined in part by analytic studies, but analysis does not enter into local decisionmaking.
Risk-management by analysis. Analytical methods for dealing with risk combine most of the elements of the formal risk-management model discussed above. Specifically, there is an effort to confine overall of risk within levels believed acceptable, however the latter are determined. The analytic approach is distinguished from reactive risk-management in that it involves quantification and estimation of risk prior to decisions. Analysis is distinguished from compliance in that it does not automatically accept standards set elsewhere. Examples of the analytic approach to risk-management in state and local government include the following:

- The final physical plan for major harbor facilities in a large port was made contingent upon detailed analysis of risks under alternative scenarios. Planning studies for a proposed LNG terminal at another port were also contingent upon risk analysis.

- The design—but not the siting—of a regional hazardous waste disposal facility was based upon engineering criteria that included explicit estimation of risk.

- Analytical techniques were used by an air pollution agency to document that levels of airborne carcinogens were several orders of magnitude more risky than allowable levels of the same contaminants on water.

Analytic studies of risk are often undertaken to satisfy federal funding requirements; this is the case, for example, for port facilities. In other instances, risk analysis consists of the
application of engineering and statistical principles to well-delineated problems such as the design of a disposal facility and estimation of morbidity and mortality rates. Exceptionally, analytic approaches to risk are used to frame policy decisions at the local level, but only in unusual circumstances.
II. A Survey of Risk Managers

In order to document somewhat systematically the impressions formed in the initial interviews, a limited survey of local and state risk managers was undertaken. Since concepts of risk analysis and management are at best poorly understood by local officials and encompass potentially all local government activities, it was decided to limit the survey to managers responsible for risks associated with the drinking water and the disposal of hazardous wastes. A procedure similar to that followed in our initial inquiries was used to locate informants at the state level: A knowledgeable informant in the Governor's office was asked to give the title and name of the persons principally responsible for management of risks arising due to contamination of drinking water as well as disposal of hazardous chemical wastes. These two persons, or in some instances their immediate subordinates, were interviewed. Before the interviews with state officials were terminated, informants were asked for the titles of persons at the county (or regional) and municipal levels who had similar risk management responsibilities. The names of such persons in selected counties and municipalities were also sought. In each of two counties as well as of two cities in a state, interviews were then conducted with the persons designated by their state-level counterparts. In each state, then, it was intended to interview two officials at the state level and two officials in each of two counties and two cities.

Our interviews combined both open- and closed-ended questions. Informants were asked a variety of specific questions, for example: "Do
you monitor hazardous activities to insure compliance with standards?"

Following each closed-ended question, however, the informant was asked
for comments or elaboration. For example, if it was indicated that
hazardous activities were monitored, we would ask the informant to
specify which activities were monitored and with what intensity. The
interviews were conducted by both mail and telephone. Copies of the
interview form were mailed several weeks in advance to prospective
informants. Informants were asked to complete the questionnaire but not
return it. Instead, it was indicated that a researcher would call to
discuss the answers on the telephone. This procedure allowed informants
both to gather necessary information well in advance of direct
interviews and to comment thoughtfully upon the individual questions.
As will be noted below, the discursive comments made by informants
changed substantially the way one might have interpreted the responses
to forced-choice items if the latter were considered alone.

The two states chosen for this limited survey were Oregon and
California. The localities were Multnomah and Lane Counties as well as
the cities of Portland and Eugene, Oregon, and Los Angeles and Riverside
Counties as well as the cities of Los Angeles and Riverside, California.
Four officials at the state level, eight from counties or regional
authorities, and eight from cities, then, were to have been interviewed.
Not all of the assigned informants could be reached, however, so that a
total of nineteen interviews were completed. (See Table 1.) Overall,
five state officials, seven at the county or regional level, and seven
in cities cooperated in the survey. (An extra interview was obtained at
the state level because the California Water Resources Board shares with
the Department of Health responsibility for drinking water
contamination.) No claim is made for the representativeness of this small sample of risk-management officials. Indeed, it is unlikely that the representativeness of any sample could be determined as there is no clearly defined population of risk managers who are potentially the subjects of study. However, the survey does provide direct information on the beliefs and perceptions of selected risk managers and thereby complements some of the observations made above.

Several broad issues were covered by the survey. One is the extent to which the full spectrum of risk-management activities are carried out in local government. Another is the adequacy of existing scientific and technological information, man-power, and legal authority with which to manage hazards effectively. A third topic is the adequacy of current organizational arrangements among federal, state, and local authorities concerned with risks, as well as the desirability of a centralized risk-management office in each locality.
Local Risk-Management Practices

Given that risk is associated with almost all activities of government and the limited scope of this research, a compilation of local risk-management activities would not be feasible even if it were desirable. We can, however, draw some observations about how local officials think of risk, which elements of the overall risk-management process outlined above tend to be present in local administration and which tend not to be, and the relative importance of analytical as opposed to other means of making decisions concerning risk.

The first and perhaps most important observation to be drawn from the interviews is that local risk managers tend not to think of risk quantitatively, although this is somewhat less the case for state as opposed to city, county, or regional officials. The interviews did not ask directly how risk is conceived of, as this would have yielded only perfunctory answers. We did inquire, however, whether priorities for which hazards receive the most attention has been established, and, if so, "How has it been done?" Almost all informants said that priorities had been established, but few indicated that they were based upon quantitative assessments of risk. Some of local officials' responses to the probe concerning how priorities were established include the following:

- "Things on a complaint basis..."
- "[Everything gets] about the same priority. We're a three-man department."
One local official denied that her agency set any priorities—"We believe in state and county preemption"—and five were unable to respond to the probe about how priorities were set. By contrast, one official stated that his agency's priorities were determined by an assessment of the impact of various hazards upon public health, while another stated that priorities were the result of "determination of the difference between ambient standards and maximum concentrations and the relative ability to achieve the standards." In short, only two of fourteen local informants suggested that their efforts were directed toward mitigating hazards that either posed the greatest risks or were most easily controlled.

Informants in state agencies generally gave much richer responses to questions concerning priorities for hazards receiving the most attention. One (of five) could not indicate what priorities were set, but the other four indicated the following as determining which activities take precedence over others:

- "Priorities have been shifted from acute to carcinogenic and toxic--concern at the federal level has prompted this."
- "Generally respond to toxics. In most cases, priorities are site, not hazard relative."
- "Public health is first major priority, environmental damage second."

- "Ignitability, corrosivity, radioactivity, and toxicity [above specified levels]."

The last two state officials had at least an implicit if not explicit quantitative conception of risk.

A similar pattern of responses emerged when officials were asked directly about their role in formulating and executing risk-management policies. Informants were asked, whether their agencies were responsible for identification of new hazards. Three of fourteen local officials claimed that their agencies did do this, but they were unable to elaborate further. Four others gave highly qualified positive responses:

- "Yes, but it is not sophisticated."

- "Not consistently."

- "Bacteriological only--other [organics] are done by the EPA."

- "On an incidental basis."

The remaining seven local officials indicated that they did not direct effort toward identification of new hazards or that they did not understand the question. A typical reply indicating non-comprehension was, "We identify pollutants exceeding established limits."

Responses of state officials to the item concerning identification of new hazards did not differ greatly from those of their local counterparts. One gave an unqualified "Yes," which was not elaborated, and another indicated that unique conditions in his state compelled his
agency to search for new hazards. One state informant gave a flat negative response—"We do not define new dangers,"—while two indicated incomprehension as noncomprehension as follows:

- "Yes, we do routine inspections."
- "Monitoring and enforcing pollution laws."

Informants were also asked whether "estimating risks associated with hazards" was undertaken by their agencies. Four of the fourteen local officials responded affirmatively, but without elaboration or comment. (Three of these four had also responded affirmatively to the question concerning identification of new hazards, also without elaboration, suggesting a predisposition toward positive responses or what survey practitioners call "yes effect.") Two more local officials gave qualified affirmative responses as follows:

- "Embryonic."
- "Very partially, i.e., aluminum in water."

Six local informants gave outright negative responses to the question concerning estimation of risk associated with hazards, and the answers of two others indicated non-comprehension:

- "We certify contaminants by EPA or regional standards."
- "Review 1977 regulations under the Clean Water Act."

Responses of state-level informants as to whether they attempt quantitative estimation of risk differed somewhat from those of local informants. One stated "yes" without elaboration, the same informant who gave an unqualified affirmative response to the earlier item about risk identification. (We suspect "yes effect.") Two responded
affirmatively, stating that their toxicology laboratories made risk assessments. A fourth informant stated that risk estimates were not made for the following reason:

- "They are not worth the safety savings,"

while the fifth informant responded incomprehensibly:

- "Monitoring water quality."

A generalization that might be drawn from these responses is that quantification of risk occurs only when technical expertise is available within an agency.

A further question asked informants whether they were responsible for setting safety standards. Almost all local risk-management officials indicated little or no involvement in setting standards or policies; those who did indicated only marginal involvement—for example, in formulating building codes or "working practices" aimed at achieving Federal or state standards. One local informant stated unequivocally that he had standard-setting responsibility, but he answered every question "yes." State officials were not dramatically different. Three of the five whom we contacted indicated that they rely basically upon the EPA and other Federal agencies in setting acceptable limits for risk, one indicated that his agency was wholly responsible for water standards, regardless of EPA rules, and another state official indicated, without elaboration, that he had standard-setting authority, but he too answered every question "yes." We had expected to find more state involvement in determining acceptable levels of water pollution and chemical contamination given that the states have primacy to fix rules more stringent than those set by Federal agencies, and especially
since California was one of the two states covered. It may be, however, that the possibility of preemption by Federal agencies renders their state counterparts, even those with adequate scientific capacity, reluctant to move from evidence concerning the riskiness of a hazard to policies setting maximum allowable levels.

Several broader questions were asked to elicit comments concerning risk-management policies. The one yielding some of the most interesting responses asked risk managers to describe their "general policy with respect to risk-management decisionmaking." Informants were asked to rank three options as follows:

- **Laissez-faire**: Risk decisions are normally left to the private sector except when public health and safety are clearly threatened.
- **Incremental**: Risk management decisions are made by government, consistent with political, economic, and scientific realities.
- **Formal**: Problems are anticipated and decisions are made on the basis of a scientific analysis of risks.

All five state officials and all but two local officials ranked the "incremental" option first. (The two local officials indicating preferences for formal methods gave very terse responses throughout the interview, which provided little indication as to whether or not they understood the meaning of formalization.) One state official commented on the "incremental" option as follows: "This is where we are." With regard to formal methods, he stated, "This is where we would like to be." Another state official indicated bluntly that, "I don't have time and resources" for formal risk analysis. Local officials, by contrast, had remarkably few comments when probed about general risk-management
decisionmaking procedures. Two perceived a trend in the direction of increased formalization, even though they retained incremental practices. And one official stated most graphically his agency's policy, which was classified as incremental: "If it's in the sewer, we're there."

Just as there was near unanimity that local risk-management policy is determined for the most incrementally rather than through formal means, there is also near unanimity that local and state risk managers have responsibility for monitoring hazards and intervening when standards are violated. All five state officials said they had monitoring and enforcement responsibilities as did all but two of the fourteen local officials contacted. One of the two local officials not having these responsibilities was principally a planner, and the other held a policy-making position in a major's office. It should be noted that how monitoring is understood may differ for state and local agencies. State agencies are generally responsible for receiving information generated by their local counterparts but not direct supervision of hazardous activities. Local agencies, by contrast, operate in the field and deal directly with sources or carriers of contamination.

Even though the monitoring functions may differ at state and local agencies, officials at both levels indicated that substantial portions of their agencies' effort is devoted to monitoring and enforcement activities. Of the ten informants who were able to estimate the proportion of their time devoted toward monitoring and intervention when standards are violated, five stated that seventy-five percent or more of their work fell into these categories, four estimated that fifty to
seventy-four percent of their time was directed toward monitoring enforcement, and one said that forty percent of the effort of his agency was monitoring and enforcement. These results confirm the pattern suggested in our exploratory interviews, namely that the principal risk-management of activities of local government are directed toward compliance with standards set elsewhere, and that the identification of new hazards and estimation of risks associated with these hazards, are largely absent from local and to some extent state levels of government.

The Adequacy of Resources

The interviews also included a battery of items concerning the adequacy of fiscal, scientific, and technical resources available to local risk managers. None of these questions, save for one, indicated any important unmet need of risk managers. Some of the comments given in response to probes accompanying the forced-choice questions indicated why this is so.

Informants were asked whether they strongly agreed, agreed, disagreed, or strongly disagreed with the statement, "There is adequate coordination between local, state, and Federal agencies to manage the hazards under my jurisdiction." Among state officials, two agreed, two disagreed, and one disagreed strongly. A similar pattern characterized local officials' responses: Two agreed strongly, five agreed, four disagreed, and three disagreed strongly. The following open-ended probe elicited relatively few comments, but those that addressed the substance of the resource issue suggested why the closed-ended responses were so scattered:
"Do not have adequate resources for water programs others just barely adequate. Not keeping up with technical improvement."

"[Agree] for major hazards such as heavy metals...enough for mundane hazards."

"We have a six-person office for monitoring 20,000 hazards waste generators." "...to the extent that some hazards, though identified, may not be highly prioritized."

One informant clearly lacked sufficient staff, but the others perceived that greater funding would permit them to maintain surveillance over a greater array of hazards, some possibly posing substantial risk. These comments together with the responses to the agree-disagree question suggest considerable uncertainty in the risk manager's role: While there are generally sufficient resources to monitor hazards that now receive attention, all of the risks that should be monitored are not known and should be pursued. Risk managers perceiving large numbers of unregulated hazards, then, perceive resources to be inadequate, while those not sharing this belief do not.

Informants were also asked for their agreement or disagreement with a statement that scientific and technical information about risk "is easily accessible to decision makers." As before, no clear pattern emerged from the closed-ended responses. Two state officials agreed, and three disagreed. Of the twelve local risk managers who answered the question, seven agreed, four disagreed, and one disagreed strongly. Few discursive comments were elicited from those who agreed with the statement, but some of those who disagreed observed the following:
o "Little staff time is available to locate technical information."

o "Lots of loopholes in research."

o "Very little meaningful and particularly accessible information."

o "It is not. It takes money to get and must be updated along the way, which takes more money."

Again, these scattered comments do not form the basis for any strong inferences, but the near absence of elaboration from those agreeing that scientific and technical information is available together with the problems noted by those disagreeing suggest that at least some officials feel the need for more and more readily available risk information.

This impression is suggested by responses to a third open-ended item, "There is need for additional quantification of hazards to assist decision making." **Four of five state officials strongly agreed with this statement,** and one disagreed. **Four of thirteen local officials responding to this item expressed strong agreement,** and seven more agreed. Two locals officials disagreed. There was greater consensus on this item than on any other opinion question in the survey, and the comments elicited by our open-ended probes were among the most forceful encountered:

o "Lack of resources for us to do [quantification]. I would like to know what part per million chlorine kills giardia (a protozoan)."
"Toxicity of many existing chemicals not well defined."

"Feds have to do it. State doesn't have the research resources."

"Toxics are a new field."

"Haven't quantified 'large dose.' What does that mean? Scare tactics used."

"We based most decisions on experience. Having quantitative analysis would be helpful."

"Always a need and very expensive to obtain materials in print."

"(Should be) coupled with definition of who or what is to be protected."

There is, of course, the possibility that the near-unanimous support for additional quantification reflects one more "yes effect," but this seems unlikely in light of the discursive responses elicited in open-ended probes. Furthermore, as shown above, local risk managers do not themselves engage in quantification of risk, and they tend not to think of the risks presently managed in quantitative terms. It may be that the thinking of risk managers is, in fact, little different from ours. They perceive, correctly, that there has been little quantification of hazards and that a quantitative conception of risk is absent from current practices. They may perceive also, again correctly, that they have little capacity to undertake quantification of risks with present resources and probably will not have in the future sufficient resources to do this. Nonetheless, they may still believe strongly that augmented quantitative data are needed for them to function as effectively as they might as risk managers.
In sum, there is no clear consensus among local risk managers concerning the adequacy of fiscal resources available to their agencies or the adequacy of scientific and technical information that is available to decisionmakers. There is strong consensus, however, that additional quantification of hazards is needed to aid decisionmaking. Some of the comments made in response to probes concerning the need for additional quantification as well as other statements indicating inexperience if not unwillingness to quantify risks locally suggest, however, that quantitative estimation of riskiness ought to be developed by Federal rather than state and local agencies.

The Adequacy of Existing Organization for Risk-Management

Several items aimed at assessing the adequacy of current organizational forms for managing risks were also incorporated into our interviews. One question asked local managers to agree or disagree as to whether, "The legal authority I have in managing risks is adequate." There was near consensus on this issue: Four state officials agreed and one disagreed; of the nine local officials who responded, three agreed strongly and six expressed agreement. Much less consensus was exhibited as to whether "adequate coordination" exists among local, state, and Federal agencies charged with managing hazards. Four state officials agreed and one disagreed--the latter observing, however, that, "It's beginning to happen." Local officials, however, were of more mixed views concerning the adequacy of coordination. One agreed strongly that coordination was adequate and six expressed agreement, while five disagreed, and one expressed strong disagreement. (One official did not respond.) Their comments are instructive, as they indicate even less
satisfaction with existing arrangements than the closed-ended question would suggest:

- "Locals must respond directly to the Feds, and Feds don't keep on top of things."
- "Direct link between locals and Feds--everyone is floating around."
- "Disputes over Hazardous Waste Control Law over local authority."
- "[Agree] overall--not for radioactive and other exotic wastes."
- "Very little coordination."
- "Agencies still fighting for authority."
- "Regulatory agencies are understaffed--poor coordination."

There is no sure explanation for the discrepant views concerning the adequacy of coordination help by state and local officials, but in all likelihood this reflects their different functions. The states make policy by accepting Federal standards or exercising primacy, whereas local entities implement Federal or state policies posing numerous questions of intent and jurisdiction. Because the latitude of localities' is more constrained than states', localities may be more sensitive to difficulties of coordination.

Informants were also asked to agree or disagree as to whether a "centralized risk-management" office would be useful. The question was in all likelihood worded improperly as "centralized risk-management office" was not defined, and for this reason several informants declined to respond. Those who did respond were not particularly supportive of the idea: One state official agreed strongly, two agreed, and two
disagreed, while four local officials agreed strongly, two agreed, and four disagreed. Four local officials declined to answer. Very few discursive comments were given in reaction to our probes concerning the desirability of a centralized risk-management office, but two, which were completely spontaneous, should be reproduced:

- "[Should be done] at the Federal level! Need for a network or a simple telephone number that we can call for a history of cleanups and effects of particular chemicals."
- "Need for standardization across hazards."

Some informants, then, but by no means all, perceive a need for orderly and organized information than presently exists concerning risks to life and health.

Overall, the interview responses suggest that local officials, although not their state-level counterparts, feel somewhat put upon by an intergovernmental system that holds them responsible for executing risk-management policies without defining authorities and jurisdictions of the various state and Federal agencies that participate in the policy making process. There is no perceived lack of legal authority with which to manage risks, nor is there overwhelming sentiment favoring centralization of risk-management. Rather there is a perceived absence of coordination, which is probably the result of a system that separates policy formation from its implementation, and in which there are multiple policymaking bodies at both the state and Federal levels of government who are sometimes in disagreement as to procedures as well as the substance of what they are doing.
Summary

Firm conclusions cannot be drawn from a survey of nineteen informants because they do not represent all risk managers adequately. Nonetheless, some of the more striking results do give pause. Identification of new hazards and quantification of risk are not features of local government, except incidentally. Priorities in dealing with risks are not based on assessments of riskiness. Almost all policymaking is incremental, based on the past, rather than formal, based on scientific analysis of risks. The resources available to local agencies to do what they are now doing may or may not be adequate; the pattern is ambiguous. The adequacy of information provided to decisionmakers also may or may not be adequate. There is overwhelming agreement, however, that additional quantification of hazards would be of assistance in local decisionmaking. At the same time, at least from the perspective of city, county, and regional agencies, coordination among the various bodies charged with risk-management is inadequate. There are frequent complaints about both substantive and jurisdictional issues arising due to combined state and Federal supervision of local risk-management practices. A straightforward suggestion arising from these data, then, is that local communities might be given more and more timely scientific data concerning risk while, at the same time, they might be freed somewhat from Federal, and to a much lesser extent state, policies mandating levels of acceptable risk. This suggestion entails a fairly basic shift in the present apparatus for formulating implementing risk-management policies, and it will be discussed as one of several options in the concluding section of this article.
III. POLICY ALTERNATIVES

Just as the subject of local risk-management is diffuse and complex, so are judgments to overall risk-management processes and their implementation. Not only are values involved—some people in some localities prefer certain kinds of risk and levels of risk and others—but there are also technical questions, for example, costs due to externalities in information versus costs incurred by highly centralized administration. For this reason, the alternatives developed here are in all likelihood incomplete and in some respects impractical. One should never underestimate the importance of trial and error in shaping any existing system.

The following characteristics and constraints have guided the formulation of alternative risk-management systems that are intended to deal with risk as such rather than with specific hazards facing localities:

1. **Almost all risk-management policy** in the United States that is a result of analytic approaches derives from **Federal action**. For the most part, identification of hazards, estimation of risks, risk acceptance, and articulation of risk-management policies as rules and regulations occur centrally, while implementation of policies is delegated to local authorities.

2. Just as it is impossible to delineate all risks, **it is impossible to delineate all risks for which policy is set Federally and all for which there is local discretion**. Generally, the greater the extent to which identification of a risk depends upon scientific
determination as opposed to casual observation, and the greater the extent to which risk acceptance depends upon, again, scientific determination rather than the political process, the greater the Federal role in risk-management policy.

3. Federal preemption of risk-management policy has both advantages and disadvantages as discussed below:

B. Advantages of Federal preemption of risk-management policy. Federal preemption of risk identification, acceptance, and policy appear to overcome some obstacles that would be posed by purely local control. These obstacles include local inaction, externalities in information, uncertainties and risk analysis, and what we call the pattern of pluralistic ignorance where some uncertainties are overcome. Each will be discussed seriatim:

- Local inaction. As noted above, the history and structure of local government tend against formation and implementation of policies regulating intangible risks whose effects operate over years and are uncertain.

- Externalities in information. Substantial costs are incurred in risk identification, acceptance, and policy formation. Should risk data developed locally remain proprietary, then substantial duplication of effort and expenditure would occur. Should these data be widely disseminated, then the costs of developing this information would not be equitably shared. The problem of externalities compels some centralization of risk-management activities at the Federal level although not necessarily the present form of centralization.
o Uncertainties associated with risk data. For broad classes of hazards, there is no scientific consensus as to their "no-effect" levels. Additionally, there is dissonance as to trade-offs between risks and costs of mitigation. These uncertainties render justification of any local risk-management policy difficult, particularly should a contiguous jurisdiction impose different standards. Uniform Federal standards do not remove actual uncertainty from risk estimates, but they do offer the possibility of a definitive judgment as to what levels of risk are acceptable and what are not.

o Pluralistic ignorance. By obscuring substantial uncertainty as to their effectiveness, regulations set centrally ease the task of local officials charged with monitoring and enforcing compliance. Local officials and citizens need not understand the scientific basis, or lack of same, for Federal policies in order to understand that they are authoritative. Presumably, the best scientific talent has contributed its understanding to the formation of Federal policy, and the Federal political process adds to its legitimacy. A degree of rationality and acceptability is, therefore, attributed to Federal regulations that might not, in fact, be warranted and might not hold were the same regulations developed locally.

B. Disadvantages of Federal Preemption. The preponderant Federal role in risk-management activities incurs some costs or disadvantages, including lacunae in risk identification, erosion of local decisionmaking capacity, and insensitivity to local preferences.


- 35 -

- Lacunae and risk identification. Many hazards, while ubiquitous, first manifest themselves in localized settings, especially industrial locations where the work force is exposed to much higher levels of contaminants and pollutants than the general public. High rates of morbidity and mortality affecting relatively small populations are likely to be obscured by low prevalence of a hazard hence ignored. No data exists concerning the relative risk of highly localized sources of air pollution and water contamination compared to risks caused by more widespread hazards.

- Erosion of local decisionmaking capacity. Both technical and political capacities of local communities to make risk-management decisions are diminished by Federal preemption. Tolerance levels determined by local or state authorities may be revised (usually downward) by Federal agencies once they have completed independent studies of hazard, leading local officials to be disinclined to address the issue of risk other than by complying with Federal statutes and regulations. A parallel problem operates in the political context: Local officials who initiate risk-management policies may be severely embarrassed when their judgments are questioned or countermanded at the Federal level.

- Insensitivity to local preferences. Risk-management entails balancing of quantities that are non-commensurable--expenditures and regulations against lives and health. For this reason, there will be substantial
variance in risk acceptance. How much risk is tolerable and at what cost will differ substantially across localities. This is partially a matter of the economics of health and safety, but not completely so as it also involves the balancing of certain costs with uncertain benefits. Variations in preferences as well as variations in local conditions to which the Federal policymaking apparatus may be insensitive yield substantial suboptimalities at the local level when uniform risk-acceptance standards are imposed.

6. Risk judgments are comparative. Most risks are not susceptible to simple means of mitigation that have not already been found, and for this reason further risk reduction involves the trade of risks for dollars or of risk for one another. These tradeoffs in the past have been somewhat more implicit than explicit, but explicit comparison, often in the form of cost-benefit analysis, is likely to be required in the future. Comparison entails quantification. At some point in an overall system of risk-management, although not necessarily at the local level, explicit quantification of risks and of costs of mitigation must take place. A critical issue, then, is at what level or levels of the intergovernmental system in the United States the technical capacity to make quantitative risk judgments should be located, and how much capacity should exist for interpreting these data at each level. At present, this capacity lies almost entirely at the Federal level and only slightly in city, county, or regional authorities.

7. Risk judgments may vary across localities. There are two sources of likely variation in risk judgments across localities, one physical and one political. Localities vary greatly in geography,
climate, and industrial mix such that the presence of a particular hazard or a particular level of a hazard may be acceptable in one locality but unacceptable in another. Additionally, citizen preferences may vary substantially across localities such that an overall level of risk that is acceptable in one is not acceptable in another, or, alternatively, costs of hazard mitigation that are acceptable in one are not acceptable in the other. Uniform Federal regulations governing risk, then, can incur substantial suboptimalities.

8. **Risk judgments require legitimacy.** Because risk analysis deals with probabilities rather than certainties, any judgment is subject to challenge on scientific grounds. Such challenges can undermine the entire risk analysis enterprise unless there is consensus that the best available evidence and expertise has been used in formulating standards. Needless to say, such consensus is difficult to achieve when localities are making independent assessments of risks associated with the same hazards.

9. **Risk judgments may need revision in light of information concerning new hazards and new information concerning the riskiness of known hazards.** The probabilistic character of risk judgments also renders the data on which they are based subject to continual revision. These revisions have two sources, the detection of previously unknown hazardous substances or of substances previously thought benign as hazardous, and new experimental or epidemiological evidence modifying existing risk estimates. Risk judgments, then, must be based on the cumulated experience of both researchers and localities and must, therefore, be open to modification.
10. The burden of making risk judgments should be distributed equitably. Information concerning risks to life and health is not only probabilistic but it is also costly. This leaves little incentive for a single locality to invest substantial sums in replicating analyses done elsewhere, and there is substantial incentive to appropriate, without compensation, analyses constructed elsewhere. Some means of equitably distributing costs of risk analysis, particularly the identification of previously unknown hazards and the quantification of risks associated with them, is needed to insure that it is undertaken at all. In the past, the principal means of insuring equity in the distribution of costs has been reliance upon the federal government.

The constraints of comparability of risk judgments, variability across localities, legitimacy, openness to revision in face of new information, and equitable distribution of costs are inconsistent with one another in some respects. For example, comparability of risk judgments requires a level of scientific and technical expertise whose costs are not easily distributed equitably among units of local government; variability in risk judgments across localities and change in them over time contribute little to their legitimacy; and the values underlying comparability, which, again, demands scientific technical expertise, may be totally at odds with differences in subjective preferences that give rise to variations in risk judgments across localities. No single optimal pattern of risk-management activities, then, will emerge out of these constraints. Indeed, a number of possible management models are suggested, the choice between them depending upon the relative importance attributed to the various
constraints but, importantly, also upon the capacity of localities and
the federal government to pursue innovative forms of administration.

Models of Risk-Management

Five models of local risk-management are proposed. One is the
present system, largely dominated by the Federal government, whose fit
with the five constraints outlined above is outlined briefly. The
second model buttresses the present system by strengthening local
capacities to utilize competent professional judgment in managing
diverse risks. This model is called the "weak" risk manager, or "weak"
office of risk-management. The third alternative ties risk managers,
who occupy relatively weak offices at local, state, and Federal levels,
into a network that facilitates sharing of data on hazards, risks
associated with them, and risk acceptance criteria as well as policy.
The fourth alternative is the "strong" risk manager who is charged with
the full spectrum of risk-management activities, from risk
identification to policy and implementation. This "strong" risk
manager, importantly, is a local rather than a Federal official. The
fifth model is one of radical decentralization of risk-management,
whereby prima facie evidence of riskiness above a low threshold compels
the source of risk, whether an agency of local government, or owner of
property or of means of transport, to obtain appropriate risk studies
showing the safety of proposed activities before proceeding with them.

The existing system. The present system of local risk-management
combines a number of weaknesses but some strengths. The greatest
strength is equity. Costs are distributed more or less evenly across
localities, and substantially similar levels of hazard mitigation
result, save for instances where states or localities apply standards
more stringent than those of the Federal government. Legitimacy is fairly high as standards are authoritative if accepted grudgingly. Quantification of risk is undertaken in the formulation of risk-management criteria, but not in their implementation. There is no provision for trading hazards and their attendant risks against one another. Revision and updating of standards occur somewhat haphazardly, as there is no systematic means of cumulating the experiences of diverse localities. Not only is there little coordination between local and state agencies, but various Federal offices' charged with enforcement of environmental and safety laws often do not communicate with one another. Finally, little allowance is made for variation in risk-management policies across localities, whether due to physical conditions or citizen preferences, as uniform standards are applied in most instances.

The "weak" risk manager. A modification of the existing system buttresses capabilities of local and state governments by introducing an office specifically charged with managing risks, but with limited powers. A distinctive feature of this office would be expertise: Its incumbent would understand the scientific basis, or lack of same, for regulations and professional standards governing local practices. The incumbent would seek, in selected instances, flexibility in the application of regulations and professional standards because of unique local circumstances. Additionally, under the "weak" risk-management model, the reactive style of risk-management would give way to a more anticipatory mode. Questions concerning the likelihood of flood, fire, tornado, and the like would be raised, and local responses would be keyed to probabilities rather than perceived certainties induced by panic. The "weak" risk manager would not be charged with identification
of new hazards, quantification of risks, or formulation of risk acceptance criteria, as he would not have resources with which to accomplish these. He would hold, however, general authority over implementation of various policies directed at reducing risk. The role of the "weak" risk manager, then, is a means of augmenting professional competence among local officials whose basic job is to administer Federal and to a lesser extent state regulations governing hazardous activities.

The model of the "weak" risk manager has many of the equity advantages of the present system. The legitimacy of risk judgments would probably be somewhat greater under this alternative than the extant system. Risk comparisons and quantification might be slightly augmented by the "weak" model of the risk manager, but lacking the wherewithal for original investigation, these advantages would be slight. The "weak" risk manager might also provide slight advantages in the revision and updating of standards, but his effect would be minimal as no formal means is provided, whereby, his judgments can serve to inform the Federal policy-making apparatus. The "weak" risk manager might also be able to take slight cognizance of local preferences in his judgments, but, as before, his latitude is limited as he has at best an advisory role in the formation of policy.

The "weak" risk manager may be among the least costly and controversial of alternatives to the present system, for it requires only training or upgrading of present local employees or, possibly creation of a small number of additional positions in the largest jurisdictions. It is a matter of imparting competence, and not of constructing new bureaus with broad responsibilities.
The "network" of risk managers. Network approaches to administration are not widely understood because they are at odds with a conception of command hierarchy that permeates most thinking about organizations, especially governmental agencies. Structurally, networks consist of totally, or nearly totally, interconnected nodes such that any person has access to any other. There is no hierarchy of intermediate offices. Operationally, coordination of action in networks is secondary to the capacity of individuals to draw information and expertise from other members of the system. Network approaches to administration become feasible only where reliable and cheap technologies for storing and transferring information are available. Such is the case with large commercial data banks that are accessible by telephone from anywhere in the United States.

There are a number of alternative designs for a network approach to local risk-management, but the basic elements in any network approach might be as follows: First, information about risks is stored centrally. Any risk-management information system presupposes at least one and probably several schemes for ordering and classifying hazards that satisfy criteria of overall inclusivity as well as exclusivity of categories. (Several such schemes are suggested in the Solomon et al. [Ref. 1].) Estimates of riskiness both for the general population as well as for high-exposure groups are provided for each hazard, but these estimates are subject to change as experience is accumulated. Second, information about localities is also maintained. Not only are risk profiles prepared and continually updated for a number of representative localities, but so are geographic, demographic, climatological, and
economic data describing them. Of particular importance is information describing the type and location of industrial, transportation, and waste disposal facilities. Third, information entering the system, which originates from a variety of sources including local community, state, and Federal agencies, as well as universities and research laboratories, is filtered through a national (although not necessarily Federal government) body responsible for maintaining the risk-management system. Fourth, local representatives, perhaps called "risk managers," would be trained in utilization of the system so that they can determine for local policymakers (1) the riskiness of specific hazards, (2) the overall level of risk due to known technological and natural hazards affecting their citizens, and (3) hazards likely to be present based on the experience of other cities, counties, and states but not yet detected locally.

The network approach to local risk-management appears, on the surface, to offer the possibility of equitable distribution of costs. Presumably, although not necessarily, Federal dollars would cover the cost of the risk-management information system, while utilization of the system would be funded locally. Externalities in information costs are largely avoided. The legitimacy of risk judgments arising from this approach would, in all likelihood, be high since the estimates of risk associated with particular hazards would be based upon the best available evidence and expertise while, at the same time, risk acceptance and policy would be left to local determination. Quantification of risks at the local level, which allows for comparative risk assessment, is enhanced substantially compared to the existing system and the "weak" model of risk-management discussed above. The
network approach also provides explicitly for revision and updating of risk information, which is not possible under the previous models. Finally, the network model also accommodates variations in risk judgments across localities. It is to be anticipated, however, that divergences in risk acceptance standards across localities might not be dramatic since quantitative comparisons would force explicit policy judgments which, if substantially different from the norm, could prove to be political liabilities.

The feasibility of the network approach to risk-management cannot be determined at the present. There is little experience in nonhierarchical forms of administration, especially in the public sector, at present, and, additionally, it is not now clear how objective risk data can be organized so that they are maximally useful to local officials. Both of these considerations need further exploration and will be discussed in the concluding section of this report.

The "strong" risk manager. The "strong" risk manager is charged with a full range of responsibilities, from risk identification to risk acceptance and implementation of policy. He is a self-contained unit of local government that does not rely heavily upon the scientific capabilities or expertise of other governmental units, although it may make use of scientific and engineering expertise drawn from a variety of sources. An office like that of the "strong" risk manager, although at the state rather than the local level, is described in a chapter of the final report from this research.

The consequences of the "strong" risk-management model for the constraints outlined above are fairly obvious. To begin, substantial inequities are created. Localities either duplicate one another's risk-
management activities, incurring substantial costs, or behave opportunistically by relying upon analyses done by others, thereby creating substantial externalities in information in that a small number of localities bear the brunt of expenditures without compensation. The legitimacy of risk-management judgments would also be problematic, as adjacent localities could, in principal, arrive at widely varying risk estimates for the same hazards. Quantification and comparative risk judgments would be undertaken under the "strong" risk-management model, but the capacity of the local officials to draw effectively upon experiences of other localities and to revise and update risk estimates would be limited. Variations in risk acceptance and policy across localities would, of course, be substantial. The "strong" risk-management model is inherently unstable because it offers little incentive for any single locality to invest adequately in risk identification, quantification of risk, and even risk acceptance.

Radically decentralized risk-management. It is possible to imagine, if not implement, a scheme that moves the locus of much of the risk-management process to units even smaller and less aggregated than local governments, namely to the sources of risk themselves. Under radically decentralized risk-management, officials would determine activities that are presumptively risky—for example, certain types of construction, transportation, storage and disposal of hazardous materials, and the like. In order to be licensed for any presumptively risky activity, a formal risk analysis, i.e., quantitative estimation of risks, would have to be undertaken or commissioned by the person, company, or agency planning the activity and the results of the analysis would have to fit within an overall risk acceptance framework developed
locally. Radical decentralization, then, removes the public sector from risk identification and quantification, save for projects that are initiated by public bodies themselves.

The radically decentralized model has heuristic value, because it compels sources of potential risk to bear the costs of determining actual risk, allows for comparative risk judgments based on quantification, and allows for variation in risk acceptance due to local preferences. However, radical decentralization, to even a greater extent than the "strong" model of risk-management, either is extremely costly and inequitable due to duplication of effort, or is fraught with externalities and the "free-rider" problem so that risk analyses done for one individual or agency are appropriated by others without compensation. Neither is a satisfactory state of affairs, hence radically decentralized risk-management would, under most circumstances, be even less stable than the "strong" risk-management model discussed above.

Comment. Constraints of comparability, which entails quantification, legitimacy, and equity tend toward centralization of an overall risk-management system, whereas constraints posed by incomplete knowledge of hazards and the risks they pose, which require continual revision of risk estimates, and by variations in local preferences concerning risk acceptance tend toward decentralization. A mixed system for managing the entire range of risks affecting local entities appears, therefore, to be suggested. Such a mixed system emphasizes cooperation among local, state, and Federal authorities rather than, on the one hand, regulation and mandated compliance, and, on the other hand, inattention to significant differences in preferences for risk.
acceptance across local jurisdictions. A mixed system that emphasizes cooperation also minimizes needless duplication of effort and externalities in information costs that would characterize any decentralized system, and it maximizes the possibility for cumulation and sharing of risk-management experiences of localities. The "network" model outlined above is closest to a mixed system.

Implementing the Network Model

The network model may function most effectively within the constraints bounding an overall system for local government risk-management, but because the concept is novel and relies upon information technologies not heretofore utilized by city, county, and state governments, some developmental work will be needed before its implementation could begin. Three kinds of developmental work are indicated. One is a policy study that would identify changes in Federal regulations and authorities needed for effective networking. The second is construction of alternative models of information systems that would be the core of the cooperative risk-management network. A third study would be experimental, aimed at determining the likely utilization and effectiveness of a risk-management information network.

Policy study. As has been shown above, almost all local government risk-management policy is an extension of Federal policy, save for traditional public safety functions. The Federal strategy has, in the past, been one of management through regulation based on the best available evidence. A shift away from the regulatory mode and toward the dissemination of reliable information ought, therefore, to be explored as a possible means of beginning implementation of the network
concept. The details of such a study cannot be outlined here. Suffice it to say that possible statutory as well as organizational changes aimed at shifting activities from rule-making to the gathering and dissemination of reliable risk data need to be reviewed.

**Information Study.** How risk data are to be organized, classified, updated, and disseminated most effectively requires careful exploration. To begin, classification or taxonomy of risk, following the report of Solomon et al., is the first step in the development of a risk-management information system, what kinds of classification or taxonomy best fit the capabilities of local governments needs to be determined. How risk estimates are to be updated is also problematic and requires the development of decision criteria. Additionally, substantial differences in exposure to hazards mean that discrepancies between risk estimates applying to high-exposure groups and those applying to the public at large will depend upon how one defines high-exposure groups. How newly discovered hazards are to be added to the categorization or taxonomy of risks needs also to be explored as to possible procedures for removing sources no longer believed hazardous. Additionally, certain physical characteristics of the system—for example, where the data files can be located and how they are to be accessed and updated—need to be designed.

**Utilization study.** Perhaps the most important question is whether, given appropriate shifts in Federal policy as well as the availability of "state of the art" risk data, local policymakers would in fact utilize this information, thereby, anticipating risks and making quantitative risk judgments. Perhaps the only means of approaching this problem is through a controlled experimentation. Two matched groups of
localities would have to be selected, one group provided with detailed data concerning at least one significant type of hazard (e.g., organics in ground water or hazardous chemical wastes), and one not. The experimental group would be observed to determine if they utilize the data, whether the data enter into actual risk decisions, whether risk experience across localities is cumulated and risk estimates thereby revised, and whether the quality of overall risk-management is improved as gauged by conventional criteria of efficiency or cost-effectiveness, and equity. Several years would be needed to undertake such an experiment and evaluate the results; indeed, a substantial period of time would be needed even to design such an experiment. Such an experimental approach is needed, however, to determine whether viable alternatives exist to the present pattern of risk-management, which from the Federal perspective operates largely through regulation but is executed, at the local level, largely through compliance.

CONCLUSION

This article has explored the applicability of quantitative risk management in local government. We have shown that quantitative conceptions of risk are not frequently understood at the local level, that few risks are actually quantified, and that risk management activities are rarely determined on the basis of explicit risk-acceptance criteria. Interviews with local officials suggest that little likelihood exists that this situation will change fundamentally given current resource constraints. However, there was near unanimity among officials whom we interviewed that the present system that separates policy formation—principally at the helpful federal level—
from implementation at the local level may be unworkable and that more quantitative data concerning risk would be helpful to local decision making. The network structure for risk management under which data would be cumulated centrally but accessed locally for the purpose of improving risk management was offered as the most promising alternative to the existing system. Its appropriateness remains to be determined, most likely in experimental or quasi-experimental studies.