

Case Study No.4

INNOVATIONS IN EARTHQUAKE AND NATURAL HAZARDS RESEARCH:
HAZARDS INSURANCE

Robert K. Yin
Gwendolyn B. Moore

April 1984

COSMOS
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Preface

The present case study is part of a project that is investigating the process by which innovations intended to reduce the effects of earthquakes and other natural hazards are utilized. The goal of the project is to improve the usefulness of these innovations to policy-makers, state and local officials, service providers, and citizens.

The case study is about the investigation of the decisionmaking processes of consumers in purchasing hazards insurance, conducted by a team of investigators headed by Prof. Howard Kunreuther of The Wharton School at the University of Pennsylvania. The case study is one of a series of nine--six will be widely disseminated, and three will be available to researchers upon request. In addition, a summary volume will discuss: the theoretical underpinnings of the project and its design and case selection procedures; the analyses across all nine cases; and specific policy recommendations--aimed at research investigators and R&D funding agencies--to promote the utilization of future research.

Several members of the Wharton project team were helpful in conducting this case study, and we would like to thank them. They include Kunreuther and Louis Miller (a senior researcher on the project), who gave generously of their time to be interviewed, responded to numerous questions about the project, and reviewed and provided useful comments on the draft of this case. We also wish to thank three other senior project team members--Paul Slovic, Ralph Ginsberg, and Philip Sagi--for reviewing and commenting on the draft case study. Finally, we appreciate the continuing support and assistance of William A. Anderson, our NSF project officer. This assistance notwithstanding, we alone are responsible for errors or omissions.

R.K.Y.

G.B.M.

Summary

The study of innovation can take many forms. One traditional dichotomy has been between knowledge production and knowledge use. The former includes such topics as creativity and invention, research and development (R&D) management, and commercialization processes; and the latter includes such topics as dissemination, diffusion, and utilization. Regardless of a study's focus, however, the objective is to improve society by understanding how new ideas are generated, produced, and used.

Innovations in Earthquake and Natural Hazards Research

The present case study focuses on knowledge use. The study analyzes how an innovation in earthquake and natural hazards research was used for practical and policy purposes, why utilization occurred, and what potential policy implications can be drawn. The case is the fifth of nine, all aimed at developing recommendations for improving research utilization in the future. (Six will be widely disseminated as final reports; three will be made available to researchers upon request.)

Research on earthquake and natural hazards offers a unique opportunity to study the utilization of innovations, because both social science and physical science innovations are relevant. For example, the first case in this series involved a social science innovation--the identification of local government liabilities in relation to losses due to earthquakes. The second case study was of a physical science innovation--a new and cost-effective process for evaluating and retrofitting unreinforced masonry buildings. Thus, the variety of innovations not only offers an opportunity to develop explanations for utilization, but also provides a chance to compare the utilization of social science and physical science innovations. Such a comparison has not, to our knowledge, been directly made in previous studies.

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One of the tentative, overall findings from the first five cases and others now underway is that the traditional dichotomy between the knowledge production and knowledge utilization processes may have been misguided. Fruitful utilization seems to occur when the two processes are intertwined. For example, in the second case, significant utilization occurred even before the research project had been completed. Thus, future research and policy actions may have to account for such complex and nonlinear outcomes.

The Innovation

The innovation in the present case study involved a conclusion that the consumer is a source of market failure in the earthquake and flood insurance markets. The project found that consumers did not follow a rational decisionmaking process in deciding whether to obtain hazards insurance, but rather followed a sequence of stages in which information was selectively screened. Further, it was found that the determinant of insurance purchase decisions was a social, not an economic factor.

The research addressed important theoretical and policy questions with a dual, field-based and laboratory-based approach. The project included a survey of 3,000 households in hazard-prone areas, laboratory experiments examining individual decisionmaking behavior, and the development of a computer model for studying the relative benefits and costs of hazard mitigation and recovery programs. The project was conducted at The Wharton School of the University of Pennsylvania, by a multi-disciplinary, social science research team which included economists, sociologists, psychologists, and management scientists.

Uses of the Research and Explanations for Use

The findings from the study were used to provide policymakers and insurance industry officials with a better understanding of the role of the consumer in purchasing earthquake and flood insurance. The case study discusses how the results of the project might have been used, and identifies specific ways in which the findings actually were used.

However, the overall use of the project's results was found to be rather limited, especially compared to the utilization experiences of some of the preceding case studies.

Despite the limited nature of utilization, the case study did identify events that occurred during the course of the project that explained the uses that did occur. Thus, the knowledge production and knowledge utilization processes were not as distinct or linear as suggested by previous research, but involved an intertwined set of events. For the Wharton project, these events included: 1) an active advisory committee, involving both federal policymakers and insurance industry officials; 2) the active participation of the principal investigator in a network of knowledge producers and knowledge users in the hazards field; 3) communications between project team members and potential users during the project and after the project was completed; and 4) the widespread dissemination of project results.

Overall, the case study concludes that the interactions of project team members within a continuously active network of knowledge producers and users adequately explain the utilization of the Wharton project results.

Policy Implications

Although the case study presents the experiences of but a single innovation, the policy implications are discussed to establish a within-case rationale for the findings. Along these lines, future policies likely to favor utilization are those deriving both from a problem-solving and a social interaction perspective, in contrast to those deriving from a research, development, and diffusion perspective. Should this finding, which is consistent with that of the other case studies of this series,* be replicated in the subsequent case studies, the aggregate results will provide strong support for guiding individual research investigators as well as the R&D policies of such agencies as the National Science Foundation, the National Institutes of Health, and other federal and private research-funding organizations.

*Three other cases, available for ordering, are listed on page ii.

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THE ROLE OF THE PUBLIC AND PRIVATE SECTORS
IN REDUCING LOSSES FROM SELECTED NATURAL HAZARDS--
A PROJECT OF THE WHARTON SCHOOL (UNIVERSITY OF PENNSYLVANIA)

I. INTRODUCTION

Natural disasters can lead to widespread financial losses to individuals, homeowners, businesses, and communities at large. These losses, together with expenditures made through federal disaster assistance programs, were rising rapidly through the 1960s. The costs of federal post-disaster relief rose from \$52 million in fiscal 1953 to over \$2.5 billion in fiscal 1973 (Kunreuther, 1973). Hurricane Betsy, Tropical Storm Agnes, and the great Alaska earthquake each served as vivid reminders of the devastating effects of natural disasters--especially floods and earthquakes.

Disaster insurance is one way of coping with the financial losses of these natural hazards. In the face of the continually rising disaster relief costs, a major federal flood insurance program--the National Flood Insurance Act of 1968--was enacted. This federal initiative was needed because such insurance was not readily available to residential property owners in flood-prone communities at premiums within the range of typical household budgets. Further, the initiative required flood mitigation activities by participating communities. In this manner, the insurance program was intended to have a dual effect: 1) spreading the risk between consumers, communities, and the government; and 2) reducing the extent of damage in the first place. The 1968 Act was modified and strengthened in 1973, and again in 1977. However, its essential elements and purpose remained the same.

During this same period, a major research project on disaster insurance was started by a team of investigators at The Wharton School at the University of Pennsylvania. The project, conducted between 1973 and 1977, investigated:

- the role insurance can play in mitigating losses from natural hazards;

- whether or not insurance coverage ought to be compulsory or voluntary; and,
- the decision processes used by consumers in risk situations.

The general findings from the project added to public and private awareness of the dynamics of insurance policies and practices.

This case study is about the utilization of the Wharton research on disaster insurance. The purpose of the case is to investigate how and why utilization occurred, with the goal of increasing the utilization of other research results in the future.¹ (The individuals interviewed as part of this effort are listed in Appendix A.) Thus, the case study:

- discusses the history of flood and earthquake insurance in providing protection from hazard-related losses;
- describes the origins of the Wharton research project;
- outlines the actual conduct of the project and its contribution to knowledge;
- identifies the ways in which the results of the project were used; and
- explains why such uses occurred.

Flood and Earthquake Insurance

Ten percent of all Americans live in designated flood hazard areas, and seventy percent live in areas which could suffer from destructive earthquakes (Kunreuther et al., 1977). Yet, only a very small proportion of those individuals have purchased insurance against potential losses, despite the availability of federally-subsidized flood insurance or privately-offered earthquake insurance. Table 1 presents a comparison of flood and earthquake insurance (as of 1978), and the following subsections describe the evolution of both types of insurance.

Table 1

COMPARISON OF FLOOD AND EARTHQUAKE INSURANCE COVERAGE
FOR SINGLE FAMILY RESIDENTIAL PROPERTY

	<u>FLOOD</u>	<u>EARTHQUAKE (California)</u>
Provided by:	Private insurance agents with the cooperation of federal government	Private insurance companies
Marketed by:	Any licensed property and casualty agent or broker	Any licensed property and casualty agent representing an insurance firm offering the coverage
Written as:	Separate flood insurance policy	Generally as an Earthquake Damage Assumption Endorsement to homeowners policy
Coverage:	Damage to insured buildings or contents resulting from floods, mudslides, or flood-related erosion	Earthquake caused damage to insured buildings or contents. No coverage for loss from fire, explosion, flood or tidal wave resulting from earthquake
Government subsidized:	Yes, for existing structures in participating communities	No
Deductible:	2 percent of loss or \$200, whichever is greater. Applied separately for buildings and contents	5 percent of actual cash value of policy
Payment of losses:	Replacement cost if insurance covers at least 80 percent of structure's value or maximum available coverage, whichever is less. Otherwise, actual cash value of losses	Replacement cost if insurance covers at least 70 percent of structure's value. Otherwise, homeowner pays portion of loss through coinsurance clause

Table 1, page 2

	<u>FLOOD</u>	<u>EARTHQUAKE (California)</u>
Written since:	1969	1916
Where written:	Only in participating flood prone communities	Anywhere in the state
Term:	One year	Length of term of the policy to which the endorsement is attached
Regulated by:	Federal Insurance Administration	State Insurance Commis- sioner
Rates set by:	Federal Insurance Administration	Private insurance firms according to state legis- lators. Most insurance firms use Insurance Services Office rates

SOURCE: Kunreuther, Howard, et al., Disaster Insurance Protection: Public Policy Lessons, John Wiley & Sons, New York, 1978a, pp. 42-43.

Flood Insurance. At the turn of the twentieth century, attempts by private insurance companies to offer flood insurance were halted by catastrophic losses suffered by the companies. These losses led the way for federal involvement in the provision of flood insurance. This turn of events was summarized by one source (Manes, 1938, p.161):

Losses piled up to a staggering total which was aggravated by the fact that this insurance was largely commonly treated in localities most exposed to flood hazard...By the end of 1928 every responsible company had discontinued this coverage.

After the 1920s, few private companies offered flood insurance to residential consumers. The almost certain losses from flooding made the underwriting of private policies of unlikely economic benefit to insurance companies, thus creating a need for federal involvement.

The federal government first became involved in flood insurance with the passage of the 1956 Flood Insurance Act. The Act, coming on the heels of the devastation from severe Midwestern floods and Northeastern hurricanes, established the Federal Flood Insurance Administration. Congress provided \$3 billion for subsidized flood insurance to be sold by private companies to homeowners. This Act was never implemented,² and it was not until after Hurricane Betsy in 1965 that Congress responded again to the need for some type of flood insurance protection.

Congress passed further legislation in 1968 that established the National Flood Insurance Program. The program's goal was to "reduce flood disaster losses by encouraging state and local governments to control unwise development of flood plains..." (Kunreuther et al., 1978a, p.28). In its original form, the program was entirely voluntary. However, because participation was voluntary, only 3,000 of the eligible 21,000 communities had enrolled in the program by 1972.

As one result of this low participation rate, the Flood Disaster Protection Act of 1973 was passed, which required flood insurance for any federally funded construction, and forbade federal banking institu-

tions from granting mortgages without requiring flood insurance.³ The 1973 Act also limited certain types of federal post-disaster assistance to only those communities that had enrolled in the insurance program. The 1973 legislation was effective in increasing participation, and by 1977, about 14,000 communities were participating in the program. Despite these changes, however, the 1968 Act had established the essential principles that underly today's federally supported flood insurance program.

Earthquake Insurance. Earthquake insurance is an entirely private-sector enterprise. The insurance is provided to consumers much like other types of property insurance, is regulated by state insurance commissioners, and is generally written as a rider to a homeowner's policy. Rates charged for coverage vary with the earthquake zone of the insured property, and the type of construction of the property.

While earthquake insurance is available throughout the United States, 75 percent of all policies in force are in California, and only 5 percent of California homeowners have the insurance (Kunreuther et al., 1978a, p. 38). In fact, an insurance agent in Coalinga, California--the location of a strong earthquake in May 1983--ran daily ads for earthquake insurance for one month prior to the earthquake. Not one person called--until after the May earthquake.⁴

The Origin of the Project

Preliminary Activities. Professor Howard Kunreuther, of The Wharton School, University of Pennsylvania, began doing disaster-related research at the Institute for Defense Analysis (Dacy and Kunreuther, 1969).⁵ He had learned about an abortive attempt to initiate a federal insurance program as early as the Truman administration. His understanding of disaster insurance issues was solidified during his six years as a faculty member at the University of Chicago, where he had numerous conversations with Gilbert White (a national leader in the hazards field, especially in the area of floods and flood-plain management). Kunreuther's interests in hazard insurance continued, and during 1972 and 1973, he was the staff consultant

for the Office of Emergency Preparedness/Office of Management and Budget Presidential Disaster Study Task Force. Much of his prior work on hazards insurance, including evidence compiled during his Task Force activities, was included in a monograph issued under the auspices of the American Enterprise Institute (Kunreuther, 1973).

Proposal Development and Project Award. Shortly after he joined the Wharton faculty in 1972, Kunreuther began to prepare a proposal to investigate a number of issues related to hazards insurance. The preliminary drafts of the proposal were submitted to the National Science Foundation's (NSF) new program for applied research--the Research Applied to National Needs (RANN) program--in 1972.

The project represented, in Kunreuther's words, an opportunity to investigate economic and psychological processes simultaneously, on a topic--insurance--whose examination had previously been dominated by economic models of rational decision-making behavior.⁶

The proposal was met with great interest, in part because the recent occurrences of Hurricane Agnes and the Rapid City flood had increased the national interest in disaster-related research. The impetus for the proposal had been supported by Kunreuther's participation at the Natural Hazards Research and Applications Information Workshop in the summer of 1972, where policymakers and hazards researchers gather for an annual meeting.⁷

The main features of the proposed project seemed appealing, for it was to address important theoretical and policy questions with a dual, field-based and laboratory-based approach, culminating in the development of an interactive computer model for disaster policy analysis. The combination represented an unusual opportunity to use multi-disciplinary, social science research (the research team included economists, sociologists, psychologists, and management scientists). The project was ultimately supported by NSF, and the following section discusses the conduct of the project and its results.

NOTES TO SECTION I

¹This case study is one of nine, each examining the utilization experience of a different natural hazards research project. The findings relating to the Wharton research are reported here; conclusions from all nine cases are reported in the summary volume.

²For a detailed discussion of the problems with the 1956 Act, see: U.S. Congress, A Unified National Program for Managing Flood Losses, report of the National Task Force for Flood Control, 89th Cong., 2nd Sess., Washington, D.C., 1966.

³This requirement was eliminated by the Housing and Community Development Act of 1977, which made conventional mortgage funding again available to nonparticipating communities (Sorkin, 1982, p. 121).

⁴Information for this example was obtained during a telephone interview with Mr. Ed Hermanson, Property Claims Services, American Insurance Association, September 23, 1983.

⁵This book won the 1971 Elizur Wright Award for the publication that made "the most significant contribution to the literature on insurance."

⁶Interview with Kunreuther, June 16, 1983.

⁷It was Kunreuther's participation in these annual meetings which began his continuing dialogue with Gilbert White and others in the hazards research and policy communities. These annual meetings are convened by the Natural Hazards Research and Applications Information Center, University of Colorado, Boulder.

II. THE WHARTON SCHOOL PROJECT

The Wharton project on flood and earthquake insurance was carried out over a five-year period, with the support of three grants from NSF. At the heart of the project were three major analytic efforts:

- A large-scale survey of residents in hazard-prone areas,
- A set of laboratory experiments on risk-taking behavior, and
- A model-building effort based in part on the survey data and in part on data on SBA disaster loans to households.

Organization and Staffing

The project was centered at Wharton, with subcontracts to Temple University to conduct the field survey and to the Oregon Research Institute to conduct the laboratory experiments. The project also had an active advisory committee, representing various insurance associations and federal organizations, that met at least four times during the life of the project. The members of the advisory committee are listed in Table 2.

Howard Kunreuther, the principal investigator of the project, was (and still is) a senior member of the faculty of the Decision Sciences Department at Wharton. He had several collaborators, each of whom contributed in major ways to the research, including:

- Other faculty at the University of Pennsylvania (Wharton and other departments)--Ralph Ginsberg, Louis Miller, Philip Sagi, Bradley Borkan, and Norman Katz;
- A team of investigators led by Eugene Ericksen of the Survey Research Center at nearby Temple University; and
- A team of investigators led by Paul Slovic of the Oregon Research Institute.

Table 2

MEMBERSHIP OF THE ADVISORY COMMITTEE
OF THE WHARTON PROJECT*

George W. Baker, National Science Foundation
 Douglas Barnert, Texas Insurance Board
 Robert Bartlett, Small Business Administration
 Allen H. Barton, Columbia University
 George Bernstein, Federal Insurance Administration
 Donald C. Carroll, Dean, The Wharton School
 Gary Cobb, U. S. Water Resources Council
 Kenneth DeShetler, Insurance Commission of Ohio
 Thomas O. Dunne, Federal Disaster Assistance Administration
 Kenneth Ellis, Insurance Commission of Ohio
 Herbert Fritz, Property Insurance Plans Service Office
 Max Giles, Small Business Administration
 C. Robert Hall, National Association of Independent Insurers
 J. Robert Hunter, Federal Insurance Administration
 Theodore Levin, Federal Insurance Administration
 Fred Marcon, Property Insurance Plans Service Office
 Don Marvin, Small Business Administration
 Jack McGraw, Federal Disaster Assistance Administration
 Ugo Morelli, Federal Disaster Assistance Administration
 Keith Muckleston, U. S. Water Resources Council
 Cameron R. Peterson, Decisions and Designs, Inc.
 George R. Phippen, U. S. Army Corps of Engineers
 Ned Price, Texas Insurance Board
 Frank Thomas, U. S. Water Resources Council
 Gilbert White, University of Colorado
 Charles Wiecking, Federal Insurance Administration
 Sidney Winter, Yale University

*Affiliations shown were those at the time the Wharton project was being conducted.

Conduct of the Research Project

The Wharton project was conducted from July 1973 to September 1977, and was funded in three phases by NSF. During the first phase--ending in March 1975--the project conducted the survey of households, analyzed existing Small Business Administration (SBA) disaster loan data, and developed the parameters of a decision-oriented computer model. During the second phase of the project, funded under a separate award from March 1975 to March 1976, the project activities focused on the design and conduct of a series of laboratory experiments, as well as a detailed descriptive analysis of the survey data. During the third phase, from September 1976 to September 1977, the final development of the computer model was undertaken jointly with the Department of Civil Engineering. (See Table 3 for a list of the awards.) [A fourth award was subsequently made to extend the capabilities of the computer model developed during the project. Only one member from the original project team, Louis Miller, worked on the fourth award.]

Altogether, the project produced a wide variety of working papers, conference presentations, and journal articles. Also, two major documents--a book on the policy implications of the work (Kunreuther et al., 1978a) and a monograph on the decisionmaking model (Kunreuther et al., 1978b)--were products of the project. Appendix B contains a list of over 30 of the publications and presentations related to the entire project.

Field Survey of Homeowners. The survey covered 3,000 households in flood- or earthquake-prone areas. Half of the households had existing disaster insurance policies, and the other half did not. The survey questions, reflecting the theoretical orientation of the project as a whole, focused on two general propositions:

- that individuals use a rational decision-making process in attending to the perceived probability of a disaster, the perceived potential loss, and in making a decision about adopting insurance; and

Table 3

NATIONAL SCIENCE FOUNDATION SUPPORT
FOR THE WHARTON PROJECT

<u>Date Funded</u>	<u>Duration</u>	<u>Amount</u>
July 1973	18 months	\$429,600.
March 1975	12 months	\$148,850.
September 1976	12 months	\$197,600.

- that individuals follow a bounded rationality process (Simon, 1955 and 1959), in which relevant information is consciously (or unconsciously) excluded from the decision-making process.

The first proposition represented the traditional, economic approach to decisions, in which individuals are presumed to behave rationally and maximize their expected utilities. The second proposition represented a significant variant, in which individuals are believed to follow a sequential model, rather than considering all of the relevant information in a single step.

Analysis of Loan Data. The post-disaster behavior of SBA disaster loan recipients was examined using data of aid following five disasters: the Alaska earthquake (1964), the Fairbanks flood (1967), the California flood (1969), Hurricane Camille (1969), and the Lubbock tornado (1970). The socio-economic characteristics of the recipients were examined, along with the decisionmaking of recipients regarding the size, repayment periods, and repayment patterns of loans. The purpose of this analysis was to analyze the economic characteristics and behavior of individuals who relied on SBA assistance following disasters.

Laboratory Experiments. The laboratory experiments examined individual decisionmaking behavior under different situations, including variations in the probability of an event occurring, juxtaposed against variations in a range of potential losses. Two types of experiments were used--the "farm game" and the "urn game"--with participation by over 700 subjects. Figure 1 reproduces the urn game experiment.

The purpose was to understand the ways that individuals cope with low probability events and the circumstances which lead them to insure against potentially high losses. The experimental results were consistent with the survey findings.

Descriptive Analysis of Survey Data. This aspect of the project examined the types of loss and recovery experience of the homeowners from the field survey. The data were used to analyze the knowledge, attitudes, and behavior of homeowners toward mitigation and recovery

Figure 1

Reproduced from
best available copy.



THE URN GAME EXPERIMENT

Play This Insurance Game

How do *you* evaluate risks? When do *you* think its advisable to have insurance? How do *your* risk-and-insurance calculations compare with the judgments of other people? Here's a way to find out.

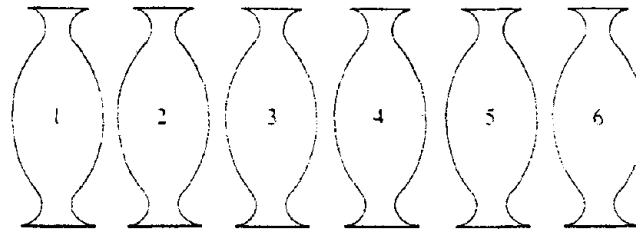
Below are six urns containing both black balls and white balls. You must draw a ball out of each urn. If you draw a white ball you will not suffer any loss. But if you draw a black ball you will suffer a loss.

Each urn contains 1000 balls. The number of black balls increases with each urn while the loss for picking a black ball decreases proportionately.

You have the opportunity to "purchase" insurance against the loss you would incur if you draw a black ball at any time.

The table below shows your *potential loss* from drawing a black ball from each urn. It also shows the *likelihood* that you will actually draw a black ball and incur a loss. Finally, it shows you that the *cost* of taking out insurance to cover the potential loss is the same for each urn. You can buy policies for any number of urns or for none.

Now figure out for which urns you would buy insurance.



White Balls	999	995	990	950	900	750
Black Balls	1	5	10	50	100	250
Potential Loss	\$1000	\$200	\$100	\$20	\$10	\$4
Insurance Premium	\$1	\$1	\$1	\$1	\$1	\$1
Check to Buy Insurance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Now that you have made your insurance "purchases," turn to page 35 to see how they compare with the "purchases" made by 700 other people who played the game in the course of the research de-

scribed in the article.

This game was designed by Paul Slovic, Baruch Fischhoff and Sarah Lichtenstein at Decision Research in Eugene, Oregon.

SOURCE: Kunreuther, Howard, "Why Aren't You Insured? Even Noah Built an Ark," The Wharton Magazine, Summer 1978, p. 33.

processes other than insurance. The purpose of the analysis was to understand the role of past experience with hazards in changing homeowners' concern for hazard mitigation.

Computer Modeling. The analysis of existing loan data and the development of the computer model also reflected the theoretical orientation of the project. The purpose of the computer model was to study the relative benefits and costs of alternative hazard mitigation and recovery steps. The model facilitated examination of disasters of varying severity and different policy conditions on the part of federal agencies and underwriters. (For an operational description of the model, see Katz and Miller, 1977; and Kunreuther et al., 1978b.)

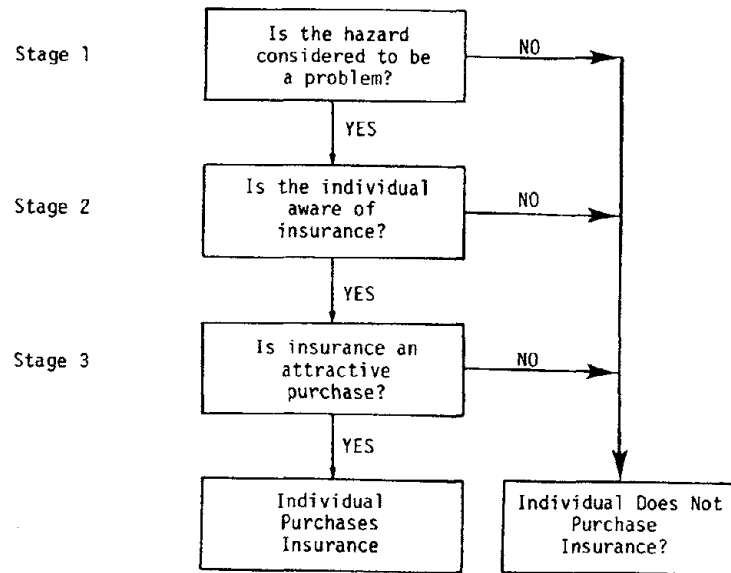
Project Results

The principal finding from the research project was that individuals were not concerned with or worried about events whose probability was below some threshold (Kunreuther et al., 1978a, p. 236). On this point, the experimental results were consistent with the survey findings. People were willing to insure against less serious situations of higher probability of occurrence, rather than insuring against more serious potential losses with a lower probability of occurrence.

Thus, the major project conclusion was that the consumer did not follow a rational process in considering hazards insurance, and for this reason "...the consumer was the source of market failure" (Kunreuther et al., 1978a, p. 244). The entire decision process was therefore found to follow a sequence of three stages, in which information was selectively screened, as shown in Figure 2. For most disasters, individual decisionmakers rarely advanced beyond the first stage.

Two other project conclusions emanated from these results. First, a consumer's avoidance of disaster insurance was not linked with any expectation of federal post-disaster aid (Kunreuther et al., 1978a, p. 237). (This linkage had been erroneously assumed by many to have been a major factor in low disaster insurance participation rates.) In

Figure 2

STAGES OF INDIVIDUALS' INSURANCE
PURCHASE DECISIONS

SOURCE: Kunreuther, Howard, et al., Disaster Insurance Protection: Public Policy Lessons, John Wiley & Sons, New York, 1978a, p. 56.

fact, most people were unaware of the existing assistance programs and thus had not assumed that the federal government could help them recover from disaster losses.

Second, the most important determinant of the purchase of disaster insurance was a social (and not economic) factor: If an individual thought--from prior experience--that a disaster was likely to be a serious problem, and if the individual knew a friend or neighbor who already had disaster insurance, the individual was more likely to purchase such insurance for the household. If only one or the other of these two conditions existed (but not both), the probability of purchasing insurance was much lower, as is evident from examining the probabilities shown in Table 4.

These results were compiled in draft form by June 1976, and copies of the draft report were circulated to over 100 individuals for comment. In July, the project team also convened an advisory committee meeting and two roundtable discussions at the Natural Hazards Workshop of that year. The final manuscripts, describing the entire project (Kunreuther et al., 1978a) and describing the final computer model (Kunreuther et al., 1978b), were published in 1978.

Policy Implications and Contribution to Social Science. The major policy implication from this research was that voluntary insurance programs, or even highly subsidized ones, were unlikely to succeed on a large scale, and therefore other institutional changes were needed if increases in disaster insurance were desired. Thus, public and private policymakers could not rely on simple market mechanisms to increase the adoption of disaster insurance. In this sense, the consumer's behavior was a source of market "failure," and other steps would have to be taken to offset this problem.

Within the broader context of contemporary social science, the Wharton project represented a significant contribution to new knowledge, especially economic theory. The combination of field and experimental data, along with the multi-disciplinary approach and the challenge to prevailing economic models, were appropriately summarized by Nobel laureate Kenneth Arrow, in his foreword to the final manu-

Table 4

INSURANCE PURCHASE REGRESSION FOR FLOOD SAMPLE

$$\begin{aligned}
 & \text{Probability of homeowner purchasing insurance} = 0.045^a + \\
 & \left\{ \begin{array}{l} .0 \quad \text{if not high school graduate} \\ .051 \text{ if at least high school graduate} \end{array} \right\} + \\
 & \left\{ \begin{array}{l} .0 \quad \text{if low income} \\ -.029 \text{ if medium income} \\ -.055 \text{ if high income} \end{array} \right\} + \\
 & \left\{ \begin{array}{l} .0 \quad \text{if not married} \\ .030 \text{ if married} \end{array} \right\} + \\
 & \left\{ \begin{array}{l} .0 \quad \text{if mildly risk averse} \\ .069 \text{ if some risk aversion} \\ .131 \text{ if highly risk averse} \end{array} \right\} + \\
 & \left\{ \begin{array}{l} .549 \text{ if thinks hazard serious problem and knows someone with insurance} \\ .434 \text{ if thinks hazard minor problem and knows someone with insurance} \\ .245 \text{ if thinks hazard not a problem and knows someone with insurance} \\ .198 \text{ if thinks hazard serious problem and doesn't know anyone with insurance} \\ .142 \text{ if thinks hazard minor problem and doesn't know anyone with insurance} \\ .0 \quad \text{if thinks hazard not a problem and doesn't know anyone with insurance} \end{array} \right\} + \\
 & \left\{ .017 \times \log(\text{subjective probability of disaster}) \right\} + \\
 & \left\{ -.0032 \times \text{age (in years)} \right\} + \\
 & \left\{ -.00039 \times \text{years lived in house} \right\} + \\
 & \left\{ \begin{array}{l} .015 \text{ if can't estimate future damage} \\ -.159 \text{ if thinks will suffer no future damage} \\ .0015 \times \text{estimate of future damage (in \$1000) if think will suffer some} \end{array} \right\} + \\
 & \left\{ \begin{array}{l} -.026 \text{ if lives in coastal zone A} \\ -.010 \text{ if lives in coastal zone B} \\ -.068 \text{ if lives in riverine zone A} \\ .0 \quad \text{if lives in riverine zone B} \end{array} \right\} \\
 & R^2 = .307
 \end{aligned}$$

^aEstimated probability of homeowner purchasing insurance who:

- (a) is not a high school graduate,
- (b) has low income,
- (c) is not married,
- (d) is not risk averse,
- (e) thinks there is no hazard problem while not knowing anyone with insurance,
- (f) expects \$1 future damage,
- (g) lives in riverine zone B.

SOURCE: Kunreuther, Howard, et al., An Interactive Modeling System for Disaster Policy Analysis, Institute of Behavioral Science, Boulder, Colorado, 1978b, p. 83.

script (Kunreuther et al., 1978a, p. vii):

The...study is path breaking in opening up a new field of inquiry, the large-scale study of risk-taking behavior. For the first time the analysis has used not only market behavior, or how much insurance is bought, but also the direct questioning of motives such as a sociologist might do.

The empirical results are certainly disconcerting from the point of view of generally accepted theory and equally so for believers in the omnicompetence of the market system. Even someone like myself, with a very qualified view of the market system and a sharp belief in its limits, has to be surprised at the failure of the flood-insurance market.

Because of the importance of this phenomenon, the Wharton investigators have continued, to this day, to examine related decision processes, such as preventive health practices, automobile regulation, negotiation and compensation in relation to hazardous waste sites, and the siting of liquefied natural gas facilities.

As a result of the project's significant contribution to knowledge, the findings and their implications were influential to policymakers and to insurance industry officials. The next section discusses specific ways in which the research findings were put to use.

III. THE USES OF THE WHARTON PROJECT RESULTS

The knowledge produced by the Wharton project has been used to influence how individuals think about earthquake and flood insurance. This section discusses the ways in which the Wharton project results might have been used and the extent to which the results were actually used.

Potential Uses and Users

The results of a research project can, theoretically, be used for enlightenment, decisionmaking, or practice purposes.

Enlightenment "use" is a general recognition of, or orientation to, social science issues (Weiss, 1979). An enlightenment use may be said to "begin" when new knowledge raises awareness of certain issues, and be "completed" when the new knowledge is codified (e.g., a common vocabulary emerges, or basic issues in an ongoing debate are recognized and defined). Such enlightenment uses are difficult to disentangle from the effects of information available from other sources. However, the Wharton results nevertheless had the potential of changing the way policymakers and others think about earthquake and flood insurance, in that the research challenged the commonly-held view of consumers' motivations in deciding to purchase insurance.

Decisionmaking use occurs when research helps to shape legislative initiatives, codes or regulations, or program activities (e.g., establishment of a federal flood insurance advertising campaign). Such use can be readily observed--e.g., legislation is introduced, considered, or passed; a program is proposed, funded, or implemented. The Wharton results could have been used as the basis for decisionmaking in at least two ways: 1) to develop legislation dealing with earthquake and flood insurance issues, and 2) to develop plans or programs to take into account the fact that consumers are unlikely to adopt earthquake or flood insurance voluntarily.

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Practice use occurs when research influences change in agency, organizational, or professional practice. This type of use--e.g., the introduction and use of new technology, or the creation of professional certification requirements--is also observable in the actions of agencies and organizations. For this type of use, the Wharton project could have suggested specific activities on the part of insurance firms or agents that would promote the adoption of hazards insurance.

In total, each of these potential uses represents some change in how individuals think about or act with regard to a given issue--in this case, earthquake and flood insurance. Of these, the Wharton project was potentially relevant to all three types of potential uses. The full array of potential uses and users of the results of the Wharton project is summarized in Table 5.

Actual Uses of the Wharton Project's Results

The primary use of the results of the Wharton project was in changing how policymakers and insurance officials think about hazards insurance and consumer decisionmaking. That is, because the results showed that insurance could not simply be offered on a voluntary basis to consumers, officials had to consider other institutional changes if insurance was to be purchased.

Increased Awareness of the Role of the Consumer. As a result of the Wharton project, insurance agency and federal officials now have a better understanding of the role of the consumer in purchasing earthquake and flood insurance. Officials in insurance agencies readily acknowledge this contribution of the Wharton project.¹ As one interviewee reported, "It's not the failure of the insurance industry to promote disaster coverage--it's the failure of people to respond."² In addition, federal officials in agencies with flood insurance responsibility acknowledge that the Wharton project's results have influenced the views of policymakers regarding hazards insurance.³

Insurance Industry Practices. The formulation of insurance underwriting policies and related promotional activities involve multiple considerations, including a company's competitive position, the cost-

Table 5

POTENTIAL USES OF THE WHARTON PROJECT RESULTS

TYPE OF USE	PRIMARY USERS
<u>Enlightenment</u>	
To increase the awareness among consumers of the likelihood and potential costs of various disasters	State Officials Local Officials Insurance Companies Disaster Planning and Management Organizations (e.g., American Red Cross)
<u>Decisionmaking</u>	
To have mortgage institutions require flood or earthquake insurance as a prerequisite for mortgage approvals	Federal Officials State Officials Banking Regulatory Bodies
To develop legislation to link insurance coverage with other disaster mitigation and planning activities	Federal Officials
To develop state- and federally-supported programs to help local governments and citizens cope with issues relating to hazards insurance, mitigation, and recovery strategies	Federal Officials State Officials
<u>Practice</u>	
To encourage insurance companies and agents to provide more information about the availability of insurance and existing rates to consumers	Insurance Regulatory Bodies (e.g., State Insurance Commissions) Insurance Companies Insurance Agents

benefit implications of a given coverage, and the norms of industry practice. The Wharton project has contributed to how officials within the insurance industry think about earthquake and flood insurance, as previously noted. While certain insurance company practices were suggested by the study--e.g., increasing commissions, designing campaigns to sensitize individuals to the real risks of hazards--no specific practices of this sort were actually uncovered by the present case study. The reason for this may be threefold: 1) Much of the information about internal decisionmaking and policy-setting is proprietary; 2) The multiple factors involved in changes within individual companies make the isolation of the influence of individual factors extremely difficult; and 3) It is possible that insurance companies may not readily innovate unless "told"--i.e., regulated--to do so.

However, there appears to be a general perception within the insurance industry that industry practices have changed since the Wharton project. For example, one interviewee noted that "...we [the insurance industry] can't stick to our prior cost-benefit notions..." when selling insurance.⁴ While no specific evidence could be found that would confirm the influence of the Wharton findings on those practices, industry officials are clearly aware of the work done at Wharton and acknowledge its influence on their overall thinking about hazards insurance.

Comparison between Potential and Actual Uses

Although the Wharton project could have led to three types of use--enlightenment, decisionmaking, and practice--evidence of only enlightenment use was found. Regarding decisionmaking use, for instance, officials at the Federal Emergency Management Administration (FEMA), the Army Corps of Engineers, and the Senate Commerce Committee were contacted. Although these persons were generally aware of the project, they were not able to identify specific decisions or policies that had been based on the results of the research. Regarding practice use, in spite of the fact that insurance practices were perceived to

have changed, no specific actions could be identified. To this extent, the utilization of the project results was limited.

Moreover, the enlightenment outcomes were not highly visible or extensive. Insurance industry officials and policymakers were generally aware of the project, and acknowledged that it had contributed to a recognition of the importance of the consumer's role in insurance purchase decisions. However, this general awareness was not necessarily shared broadly. For instance, to identify possible decisionmaking and practice uses, individuals in the insurance industry were contacted. Although it is quite difficult to identify the person within an insurance company who might be knowledgeable about such research as produced by the Wharton project, once having made contact, only two of six individuals were aware of the Wharton study. Both of these individuals had in fact served on the project's advisory panel, suggesting a lack of any broader diffusion of ideas. Another six officials were identified but failed to return phone calls.

In summary, although utilization did occur, the effects appeared not to be as widespread as might have been possible, given the project's findings. Nevertheless, utilization in the form of enlightenment did occur, and the next section analyzes the possible reasons for such utilization.

NOTES TO SECTION III

¹ Interview with C. Robert Hall, National Association of Independent Insurers, November 28, 1983

² Interview with Ed Hermanson, Property Claims Services, American Insurance Association, September 23, 1983.

³ Interviews with Ugo Morelli and Richard Krimm, Federal Emergency Management Administration, November 28, 1983.

⁴ Interview with C. Robert Hall, National Association of Independent Insurers, November 28, 1983.

IV. EXPLAINING UTILIZATION

One criterion for defining a successful research project is when the "new knowledge, insights, and techniques that are produced [by it are] applied" (Glaser and Taylor, 1973, p. 140). A number of studies have been devoted to understanding the factors that influence the success of research projects and the utilization of their results by three potential audiences or "users" (see, for example, Glaser and Taylor, 1973; White and Haas, 1975; Ball and Anderson, 1977; Weiss, 1980):

- Policymakers, at the federal, state, and local levels, who must make decisions about resource allocations, program support, or new legislation and regulations;
- Service Providers, who are involved in the operation of actual services, e.g., emergency and disaster planning and relief activities; and
- Citizens, who may be the victims of earthquakes and other natural disasters.

Other researchers are not included as potential users of natural hazards research. While other researchers do indeed use research results, their utilization experiences do not raise the same public policy questions as use by the three preceding audiences.

The purpose of the present case study is to draw from what is known about the utilization process, and compare it with the NAS utilization experience, to develop specific, operational advice to promote the utilization of the results of natural hazards research by policymakers, service providers, and citizens.

Models of Research Utilization

A number of explanatory models of the knowledge dissemination and utilization process have been developed--three by Havelock (1969) and four additional ones by Weiss (1979).¹ The seven models predict the

presence or absence of different kinds and sequencing of events and interactions in the utilization process, and help to identify the activities that are likely to promote dissemination and utilization.

However, the models are, as a group, overly general. They provide too broad and diverse a perspective for specific operational action, should one desire to promote utilization in the future. Thus, the purpose of case studies such as the present one is to compare the models with actual experience, in the hope of discovering which models may be more critical and what specific actions might be considered in the future. In this sense, the models provide the opportunity for a "pattern-matching" effort (Campbell, 1975), where the preferred model becomes the one that is most consistent with the known facts of a situation. As an example of but one part of a pattern, for the problem-solver model to be supported, a practical or decisional problem must have been identified before the research was initiated; the model would not be applicable if the research had not addressed a problem specified before the research was started. Through this type of "matching" of circumstances between case experience and a theoretical model, consistent and operational explanations of utilization behavior can be generated.

The three Havelock models are:

- the problem-solver model,
- the research, development, and diffusion model, and
- the social interaction model.

The four Weiss models are:

- the political model,
- the tactical model,
- the enlightenment model, and

- the research as intellectual enterprise model.

For the present case study, the three Havelock models are relevant, and are discussed below. The Weiss models deal with situations inappropriate to the Wharton case, and hence, are not discussed.²

The Problem-Solver Model. This model assumes that knowledge utilization is part of a user's problem-solving process, where the user specifies a problem and research is conducted to address it. The model is thus "user-oriented" and asserts that:

- the user's world is the only sensible place from which to begin to consider utilization;
- knowledge utilization must include a diagnostic phase where user-need is considered and translated into a problem statement;
- any external assistance [to the user] should primarily serve as a catalyst, collaborator, or consultant on how to plan change and bring about a solution;
- internal knowledge retrieval [by the user] and the marshalling of internal resources should be given at least equal emphasis with external retrieval; and
- self-initiation by the user or client system creates the best motivational climate for lasting change (Havelock, 1969, p. 11-13).

The crux of the problem-solver model as an explanation for utilization rests on a two-fold "pattern" of characteristics: 1) that research is initiated to address a previously-defined problem, and 2) that potential users are instrumental in defining the research problem.

The problem-solver model partially explains the utilization of the Wharton results. The first pattern suggested, that the research be initiated to address a previously-defined problem, is somewhat evident in the case. In the initial funding proposal, Kunreuther notes an "increasing interest by practitioners and government officials about

developing alternatives to ... relief policy" (Department of Management, 1973, p. 5). Kunreuther was aware of these needs from prior interactions he had had with policymakers and others regarding the hazards insurance topic. For example, Gilbert White (of the Natural Hazards Research and Applications Center, University of Colorado) had shared with Kunreuther discussions White had had with Federal Insurance Administration (FIA) officials. White had conveyed to Kunreuther his perceptions of "what FIA needed."³ Also, FIA and FDAA officials served on the project's advisory committee. Thus, when the project began, it was with the knowledge of the general needs of potential users.

There is no evidence in the Wharton case, however, to support the second characteristic of the problem-solver model. That is, potential users were not specifically involved in defining the problem that was addressed in the research. This absence may be conjectured as one reason why broader utilization did not occur.

The Research, Development, and Diffusion Model. The research, development, and diffusion model (RD&D) presents the utilization process as a linear sequence of activities. These activities are represented by a three-fold pattern of characteristics where: 1) the research to be performed is defined by the knowledge producer; 2) the idea being pursued moves from basic and applied research to development, packaging, and dissemination and utilization; and 3) the ultimate use of the research takes place in a commercial marketplace. Although this model is often considered in connection with the development and commercialization of "hardware" innovations (e.g., teflon-coated cookware), it is equally applicable to social science research where the "product" of the research can be, in Yin and Heinsohn's (1980) terms, "usable products--e.g., instruments, handbooks, manuals, and other social science tools."

Some limited understanding of the utilization of the research comes from the first characteristic of the RD&D model. That is, the Wharton researchers and other project team members were pursuing research that was "basic" from the point of view of at least two fields--economics and decision sciences. The results of the research

were published in academic journals, and the theoretical contributions of the project--aside from its policy relevance--were recognized. Otherwise, the RD&D model does not contribute to understanding the utilization of the project's results.

The Social Interaction Model. This model emphasizes communications between knowledge producers and users, especially through interpersonal networks, as a key to utilization. The user's networking characteristics should follow four basic principles:⁴

- The social network of the user is important and must be operative before utilization will succeed.
- Personal, one-to-one contacts within the network are important forces in facilitating utilization.
- The greater number and variety of "reference groups" a user has, the more likely the user is to be innovative and use new ideas.⁵
- The user's position in that network will help to predict utilization behavior.

Beyond these principles, the crux of the social interaction model is a three-fold "pattern" of characteristics: 1) knowledge producers and users will belong to some overlapping network; 2) communication between them will occur while the research is in progress; and 3) communication will continue, or occur, after the research is completed.

The social interaction model explains much of the utilization of the Wharton project results. First, the knowledge producers (i.e., Wharton and project staff) and knowledge users (e.g., federal policy-makers) exchanged ideas regularly through the annual Natural Hazards Workshops in Boulder, Colorado. Further, Kunreuther was already active in the hazards community through his early work, including a presentation at the Department of Commerce Conference on Seismology and Engineering Seismology in 1967, and consultancies to the Office of Emergency Preparedness in 1968 and the NSF in 1969. Through this early work, he also became acquainted with C. Robert Hall, a senior member of

the insurance industry.⁶ Thus, even before the Wharton project began, Kunreuther had links to key insurance and policy officials.

The second characteristic of the social interaction model also is evident in the case of the Wharton project. The active participation of the advisory panel during the life of the project assured that the research team interacted with potential users. Therefore, both insurance industry and federal officials were informed of the project's progress and preliminary outcomes during the course of the work, and at the same time, project staff had an opportunity to hear the views of these potential users. Further, during the project, Kunreuther and other project staff participated in the annual Natural Hazards Workshops, where researchers and policymakers come together to discuss the results of research and the needs of policymakers.

Finally, the third characteristic of the social interaction model--continuing communication between producers and users after a project is completed--is also evident in the Wharton case. For example, in 1978, Kunreuther addressed the 60-member Property Insurance Committee of the National Association of Independent Insurers on the individual behavior aspects of his Wharton research.⁷ He also has continued to be active professionally in the area of risk insurance, and has published many articles since the time of the project (e.g., Kunreuther, 1982; and Kunreuther et al., 1983). In addition, other members of the project team have been called upon to testify before Congressional leaders (e.g., Vinso and Miller, 1979), and have continued to develop concepts that emerged during the Wharton project (e.g., Slovic, 1978).

Summary. The nature and extent of utilization of the Wharton project's results can be explained by comparing the pattern of events in the project with three models of the utilization process: the problem-solver model; the RD&D model; and the social interaction model. Much of the utilization of the Wharton project's results can be explained by matching the activities of the project with the characteristics of the social interaction model. Further understanding of the utilization comes from the problem-solver model, while the RD&D model

contributes to the understanding only marginally.

Implications for Future Utilization Activities

The present case study covers just one set of experiences in which research was put to use. The purpose of the case study is not just to explain the utilization outcomes, but is also to discuss the implications for future activities to promote research utilization.

Fifteen potential utilization-oriented activities have been identified as opportunities for taking action to promote utilization.⁸ These activities have been categorized to reflect their apparent role with regard to the problem-solver, RD&D, and social interaction models. Such a nonoverlapping scheme necessarily oversimplifies each activity, as some may be partially relevant to more than one model. Nevertheless, our desire was to examine the policy implications in this more simplistic manner, and there was sufficient match between the activities and the models to feel confident about the appropriateness of the basic scheme.

Table 6 presents the 15 activities, organized according to the three models, and indicates the actions that can be taken (either as part of the research project or by a research funding agency) to initiate each of the activities. The remainder of this section reviews the experience of the Wharton project as a way of suggesting which activities might be more preferred in the future. (The numbers in parentheses in the following paragraphs correspond to the number of the activity in Table 6.)

Activities Consonant with the Problem-Solver Model. Neither of the two activities for promoting utilization associated with the problem-solver model was evident in the Wharton case.

Activities Consonant with the RD&D Model. None of the eight activities deriving from the RD&D model were apparent in the Wharton case.

Activities Consonant with the Social Interaction Model. Three of the seven activities associated with the social interaction model were observed in the Wharton case. The first was the participation of a user advisory panel (9), which met three times during the life of the

Table 6

ACTIVITIES FOR PROMOTING THE UTILIZATION OF
RESEARCH FINDINGS

Activity and Associated Model	Individual Research Project Action	R&D Funding Agency Action
<u>Problem-Solver Model:</u>		
1. User-oriented guidelines for new research.	Conduct some type of needs assessment at start of project.	Encourage and support R&D agenda conferences dominated by users.
2. Training sessions and workshops for users.	Initiate and conduct specific sessions during and after project.	Encourage and support specific sessions.
<u>Research, Development, and Diffusion Model:</u>		
3. Researcher-oriented guidelines for new research.	Review literature and consult other investigators at start of project.	Encourage and support R&D agenda conferences dominated by researchers.
4. Formal reviews and syntheses of previous research.	--	Support such research syntheses projects
5. "Development" and applied research projects.	--	Support "development" and applied research projects.
6. Researcher training and communication.	Enhance researcher training and professional development in project work.	Support researcher training and communication activities or programs.

Table 6, page 2

Activity and Associated Model	Individual Research Project Action	R&D Funding Agency Action
7. Commercial trade shows.	Participate in such shows at end of project.	Support trade shows.
8. Marketing and advertising of new products.	Do marketing and advertising.	--
<u>Social Interaction Model:</u>		
9. User advisory panel for individual research projects.	Use panel for life of project.	Require panel.
10. Research applications conferences.	Project staff should sponsor or attend conferences.	Encourage and support conferences.
11. Report dissemination.	Disseminate project reports.	Support computer- based clearinghouses and information services.
12. Special newsletters and journals about research findings and users' needs and experiences.	--	Support newsletters and journals.
13. Summer "institutes" for researcher-user interaction.	--	Support summer institutes.
14. Changes in practitioner certification requirements.	*	Support practitioner associations in reviewing certifi- cation requirements.
15. Changes in practitioner standards and codes.	*	Support practitioner associations in reviewing standards and codes.

*These two activities are mainly undertaken by professional associations.

project, and contained both insurance industry and federal officials on the panel. The second strategy, research applications conferences (10), was evident when Kunreuther discussed the project at a NSF-RANN conference in 1976. The third strategy observed was a widespread dissemination (11) of project results. The dissemination took a number of forms: a summary of the project's findings (Kunreuther et al., 1977); a book (Kunreuther et al., 1978a); a description of the computer model (Kunreuther et al., 1978b), and numerous other publications and presentations (see Appendix B for a partial listing).

Summary. This section has indicated several specific activities that can help to promote utilization. Three of these activities were clearly evident in the Wharton case. These activities, and others listed in this section, provide an illustration of how policies might be designed to promote increase research utilization in the future.

NOTES TO SECTION IV

¹Weiss actually specified seven models, but three corresponded with the three Havelock models. Thus, those three Weiss models are not identified here, but are described in detail in the summary volume.

²The political and tactical models explain utilization as a function of political strategy or bureaucratic tactic, where the research is "used" to support a predetermined position or to fend off criticism. The enlightenment model deals with the use of a body of research ideas, often accumulated over a period of many years. Finally, the "research as intellectual enterprise" model de-emphasizes the importance of individual research efforts in favor of the pursuit of knowledge generally.

³Interview with Gilbert F. White, Natural Hazards Research and Applications Information Center, November 29, 1983.

⁴Actually, Havelock specified six assumptions relative to the social interaction model. Two are not included here: one that deals with the adoption behavior of users, and the other that deals with how strategies to influence adoption decisions change with the five phases in the adoption process (awareness, interest, evaluation, trial, and adoption). Because adoption deals with knowledge user rather than the knowledge producer behavior, these two aspects of the social interaction model are not discussed relative to the Wharton utilization experience.

⁵A "reference group" represents a set of individuals possessing attitudes and behaviors that the user perceives as normative.

⁶In an interview with C. Robert Hall, National Association of Independent Insurers, on November 28, 1983, he reported that he had first contacted Kunreuther shortly after reading the book The Economics of Natural Disasters: Implications for Federal Policy (Dacy and Kunreuther, 1969). Hall and Kunreuther began a continuing dialogue at that time (approximately 1970-71), and Hall was subsequently a member of the project's advisory committee.

⁷Interview with Chuck Fritzel, National Association of Independent Insurers, November 28, 1983.

⁸This list was compiled from two sources. First, some activities were adapted from an article by Robert K. Yin and Margaret K. Gwaltney (Yin and Gwaltney, 1981). Second, a meeting was convened during the present case study of a number of government policymakers and others engaged in supporting or using natural hazards research. At that meeting, a number of activities, based on the experience of those present, were added to the Yin and Gwaltney list.

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Appendix A

PERSONS INTERVIEWED FOR THE CASE STUDY*

George Bernstein, Private Attorney (advisory panel)

Chuck Fritzel, National Association of Independent Insurers

C. Robert Hall, National Association of Independent Insurers (advisory panel)

Richard Krimm, Federal Emergency Management Administration

Howard Kunreuther, The Wharton School, University of Pennsylvania (principal investigator)

Louis G. Miller, The Wharton School, University of Pennsylvania (senior investigator)

Ugo Morelli, Federal Emergency Management Administration (advisory panel)

Gilbert F. White, Natural Hazards Research and Applications Information Center (Advisory panel)

*Affiliations listed are those of the interviewees at the time this case study was being conducted. The formal role played in the Wharton project, if any, is noted in parentheses.

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Appendix B

PUBLICATIONS AND PRESENTATIONS RELATED
TO THE WHARTON PROJECT
(1973-1983)

1983

1. "Misinformation and Equilibrium in Insurance Markets," in J. Finsinger (ed.), Economic Analysis of Regulated Markets, Macmillan, London--H. Kunreuther.
2. "Public Protection Against Misperceived Risks: Insights from Positive Political Economy," Public Choice--H. Kunreuther, M. Paule, J. Vopel.

1982

1. "Societal Decision Making for Low Probability Events: Descriptive and Prescriptive Aspects," in Liquified Energy Gas Facility Siting, Proceedings of an IIASA Task Force Meeting, Laxenburg--H. Kunreuther, J. Linnerooth, R. Starnes.
2. "Decision Making for Low Probability Events: A Conceptual Framework," in H. Kunreuther (ed.), Risk: A Seminar Series, IIASA, Laxenburg--H. Kunreuther.
3. "The Economics of Protection Against Low Probability Events," in G. Ungson and D. Braunstein (eds.), New Directions in Decision Making: An Interdisciplinary Approach to the Study of Organizations, Kent Publishing, Boston--H. Kunreuther.

1981

1. "Natural Disasters and their Long-Term Effects: A Commentary," in J. Wright and P. Rossi (eds.), Social Science and Natural Hazards, Abt Books, Cambridge, Mass.--H. Kunreuther.

1979

1. "The Changing Societal Consequences of Risks from Natural Hazards," Annals of the American Academy of Political and Social Science--H. Kunreuther.
2. "Contingency Planning Against Low Probability Events," Best's Review--H. Kunreuther, B. Borkan.

3. "Why Aren't They Insured?" The Journal of Insurance--H. Kunreuther.
4. "An Experimental Study of Insurance Decisions," The Journal of Risk and Insurance--H. Kunreuther, P. Schoemaker.
5. "Data Needs for Disaster Policy Making," in Natural Hazards Data Resources: Uses and Needs, Institute of Behavioral Science, Boulder, Colo.--L. Miller, H. Kunreuther, J. Vinso.
6. "An Interactive Modeling System," Department of Decision Sciences Working Paper, The Wharton School, University of Pennsylvania, Philadelphia, Pa.--L. Miller and N. Katz.

1978

1. Disaster Insurance Protection: Public Policy Lessons, Wiley Interscience, New York--H. Kunreuther, R. Ginsberg, L. Miller, P. Sagi, P. Slovic, B. Borkan, N. Katz.
2. An Interactive Modeling System for Disaster Policy Analysis, Institute for Behavioral Science, Boulder, Colo.--H. Kunreuther, J. Lepore, L. Miller, J. Vinso, J. Wilson, B. Borkan, B. Duffy, N. Katz.
3. "Even Noah Built An Ark: Why aren't you insured?" Wharton Magazine--H. Kunreuther.
4. "Economics, Psychology and Protective Behavior," American Economic Review: Papers and Proceedings--H. Kunreuther.
5. "Guidelines for Coping with the Impact of Natural Disasters and Climatic Change," in The Future of Risk, Risk Studies Foundation, New York--H. Kunreuther.
6. "Protection Against Low Probability Events: A Sequential Model of Choice," in Proceedings of the Seventh Annual Pittsburgh Conference on Modelling and Simulation--H. Kunreuther.
7. "Towards a Community Disaster Model for Policy Analysis," Mass Emergencies--L. Miller, B. Borkan, and others.
8. "A Statement to the Small Business Administration Subcommittee of the U.S. Senate," April 27--L. Miller, J. Vinso.
9. "Economics, Psychology, and Protective Behavior," The American Economic Review--H. Kunreuther and P. Slovic.
10. "The Psychology of Protective Behavior," Journal of Safety Research--P. Slovic.

11. "Accident Probabilities and Seat Belt Usage: A Psychological Perspective," Accident Analysis and Prevention--P. Slovic, B. Fischhoff, and S. Lichtenstein.

1977

1. "Preference for Insuring Against Probable Small Losses: Insurance Implications," The Journal of Risk and Insurance--P. Slovic, B. Fischhoff, S. Lichtenstein, B. Corrigan, and B. Combs.

1976

1. "Reducing Losses from Selected Hazards: Role of the Public and Private Sectors," in Proceedings of the RANN 2 Symposium, Washington, D.C.--H. Kunreuther.

2. "Limited Knowledge and Insurance Protection: Implications for Natural Hazard Policy," The Wharton School, University of Pennsylvania, Pa.--H. Kunreuther, R. Ginsberg, I. Miller, P. Sagi, P. Slovic, B. Borkan, and N. Katz.

1974

1. "Economic Analysis of Natural Hazards: An Ordered Choice Approach," in Gilbert F. White (ed.), Natural Hazards: Local, National, and Global, Oxford University Press--H. Kunreuther.

2. "Decision Processes, Rationality, and Adjustments to Natural Hazards: A Review and Some Hypotheses," in Gilbert F. White (ed.), Natural Hazards: Local, National, and Global, Oxford University Press--H. Kunreuther, P. Slovic, G. White.

3. "Disaster Insurance: A Tool for Hazard Mitigation," Journal of Risk and Insurance--H. Kunreuther.

1973

1. "Values and Costs," in Building Practices for Disaster Mitigation, National Bureau of Standards, Washington, D.C.--H. Kunreuther.

2. Recovery from Natural Disasters: Insurance or Federal Aid? American Enterprise Institute for Public Policy Research, Washington, D.C.--H. Kunreuther.

RELATED PUBLICATIONS
by COSMOS Corporation

The following publications may be of further interest to the reader.
They are available from COSMOS Corporation.

Yin, Robert K., Case Study Research: Design & Method, Sage Publications, Beverly Hills, in press. (Draft xerox copies available for \$25.00.)

Yin, Robert K., The Case Study Method: An Annotated Bibliography, 1983-84 ed., COSMOS Corporation, September 1983. (\$7.00)

Yin, Robert K., Peter G. Bateman, and Gwendolyn B. Moore, Case Studies and Organizational Innovations: Strengthening the Connection, COSMOS Corporation, September 1983. (\$15.00)

