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NARRATIVE DESCRIPTION AND CLASSIFICATION
RANN UTILIZATION CASE STUDIES

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REPORT TO

THE NATIONAL SCIENCE FOUNDATION

PREFACE

The research described in this report was carried out under Contract NSF-C76-17165 in 1976 and 1977. Dr. Samuel J. Raff, Division of Exploratory Research and Systems Analysis, served as Program Manager and participated directly in certain aspects of the study. Results obtained in a previous contract, NSF-C927, are included in the analysis. Drs. Robert M. Burger and Martin F. Massoglia directed and participated in the preparation of the case studies and are responsible for the analysis reported here. They were supported by a number of additional personnel from the Research Triangle Institute in the preparation of individual case studies and by consultants who critiqued and in some cases prepared individual case studies.

The information in this report complements that appearing in a companion report [Ref. 1] in which factors influencing utilization are analyzed.

SUMMARY

This report contains summary analyses and brief narrative descriptions of each of the 50 RANN projects on which the Research Triangle Institute (RTI) has prepared utilization case studies. The analyses and project descriptions are based on objective measures and factual information contained in the individual utilization case study reports.

Three levels of analyses are made. The 50 RANN projects are analyzed as a group. Analyses are also made by aggregating the projects by reported level of utilization and by area of application of the research products.

Narrative descriptions of the 50 projects are structured by administrative descriptors, research summary, dissemination summary, user impact, and project characteristics. The analyses described above are keyed to the last of these parameters and the level of utilization developed in the companion report. The individual case studies are classified by the following categories:

* * Nature of the Principal Product
* * Area of Application
* * Unusual Administration and Management Procedures
  Quality of Work
  Status of Research at the End of Grant
  General Awareness of the Work Among Potential and Actual Users
  Value of the Work to Potential and Actual Users
  Number of Users and Potential Users Interviewed by Type

Information for the asterisked categories was obtained from the Principal Investigators and the RANN Program Managers, for other categories from the responses of actual and potential users as reported in the individual case studies.

For the 50 RANN projects covered in this report there is a correlation between level of utilization and perceived user value. A similar correlation is indicated between level of utilization and research quality (as perceived by users).

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I. INTRODUCTION

A. General

This report contains summary analyses and brief narrative descriptions of each of the 50 RANN projects on which the Research Triangle Institute (RTI) has prepared utilization case studies. The analyses and project descriptions are based on objective measures and factual information contained in the individual utilization case study reports. Analyses and evaluations based on subjectively derived information are contained in a companion report [Ref. 1].

Because of this restriction and the small sample size (less than ten percent of the RANN program for the four year period ending in 74-75) meaningful conclusions are limited. Those that are possible cannot be generalized to the overall program.

Another factor limiting the applicability of any conclusions is the broad time span--1974 through 1976--over which the individual case studies were prepared. The analyses and narrative descriptions reflect the status of the 50 RANN projects at the time the case studies were prepared. Case studies and associated preparation dates are shown below:

Case Studies	Preparation Dates
1 through 21	March - April 1974 [Ref. 2]
22 through 31	May - June 1976 [Ref. 3]
32 through 41	June - July 1976 [Ref. 4]
42 through 51	August - September 1976 [Ref. 5]

While 51 case studies were prepared, only 50 RANN projects were covered. Two of the case studies, 5 and 41, covered the same research project.

B. Summary Analyses

Three summary analyses are included in this report. An analysis of the 50 case studies as a group is presented in Section II. For the analysis in

Section III the case studies are grouped by level of utilization, i.e., very high, high, average, low, and very low. Classification of each of the projects covered by the individual case studies by level of utilization was accomplished by a combination of subjective and numerical ratings. Classification methodology is described in the companion report [Ref. 1]. Section IV contains an analysis by area of application of each of the individual projects as described in paragraph C below.

C. Narrative Descriptions

The individual narrative descriptions of the 50 RANN projects covered in this report are contained in the Appendix. These descriptive summaries are structured by project descriptors, research summary, dissemination summary, user impact, and project characteristics. Reference to the specific materials in the case study is indicated by parenthetical notation of the page or pages of each of the reports referenced in paragraph A from which the information is derived. Elements of each component are listed below.

Project Description

Title

Case Study No.

Grant Award No.

Grant Period

NSF Funding

Principal Investigator(s)

It should be noted that only NSF funding is presented. Funding from other sources is not included.

Research Summary

The research summary contains the goals and objectives of the research, methodology as appropriate, and identification of results.

Dissemination Summary

The dissemination summary contains a description of the principal means used to disseminate the research results.

User Impact

The user impact section contains a measure of the degree of acceptance of the research by the users, identifiable impacts, and an evaluation of the ultimate significance of the research.

Project Characteristics

Each of the following characteristics of the research project is evaluated and classified in this portion of the individual project description.

The first three are based on information supplied by the RANN Program Manager and the Principal Investigator during the preparation of the case study, and from reports covering the research.

Nature of the Principal Product:

- Physical and chemical processes, devices, and proof of concept
- Information for policy or other guidance
- Computer programs
- User awareness

Area of Application

- Environmental Effects
- Policy Research
- Productivity
- Earthquake Engineering
- Solar Energy
- Energy Technology
- Weather Modification
- Fire Research

Unusual Administration and Management Procedures

Changes in Program Manager

Change in Principal Investigator

Change in Project Goals

Use of Advisory Boards

User Outreach Programs

Funding Limitations

The following project characteristics are based on the responses of potential and actual users interviewed during the preparation of the case study. It should be noted that the ratings within each category are relative and should not be construed as RTI's assessment, but rather as RTI's interpretation and synthesis of the information obtained during case study interviews, much of which reflected the potential and actual users' subjective evaluations of the research. For example, value of the research is that perceived by the individuals interviewed during case study preparation. In some cases, specific mention was made of actual or potential value; in others, the value was drawn by inference from respondent statements as reported in the individual case studies. Similar comments can be made relative to other project characteristics covered.

Quality of Work

Excellent

Very Good

Good

Fair

Poor

Status of Research at the End of Grant

Complete, objectives attained

Complete, objectives partially attained

Complete, objectives not attained

Continuing, meeting interim goals

Continuing, not meeting interim goals

General Awareness of Work Among Potential and Actual Users

Very High

High

Moderate

Low

None

Value of Work to Potential and Actual Users

Very High

High

Moderate

Low

None

Number of Users or Potential Users Interviewed by Type

Federal Government

Other Government

Industry

Public

Researchers

II. SUMMARY ANALYSIS (Numbers in parentheses refer to individual case studies)

Descriptors and evaluation of the 50 RANN projects covered in this study are summarized in Table 1. Analysis of these data indicates a correlation between utilization and user value. All of the projects classified as having a very high level of utilization are perceived to have a very high value by actual or potential users; all of the projects with a very low level of utilization are perceived by actual and potential users as having a very low value. Research quality was rated as excellent for all five projects showing a very high level of utilization. Table 2 summarizes the relationship between utilization level and perceived user value.

Table 2. Comparison of Level Utilization and Perceived User Value

Perceived Value	Percent Above Average Utilization	Level of Utilization Number of Projects					Percent Below Average Utilization
		Very High	High	Average	Low	Very Low	
Very High	100	5	3	0	0	0	
High	80	0	4	1	0	0	0
Moderate	22	0	4	9	4	0	22
Low	5	0	1	4	8	6	74
None	0	0	0	0	0	0	0
Not Determinable				1			

There appears to be a relationship between research quality as perceived by the users and the level of utilization. Table 3 summarizes this relationship.

Table 1. Project Summary

Utilization Level

Very High	5 projects --	1,2,12,14,36
High	12 projects --	7,18,20,21,22,24,33,35,37, 38,42,49
Average	15 projects --	3,5/41,8,9,13,16,17,19,28, 29,31,34,39,45,47
Low	12 projects --	4,10,11,15,23,26,27,30,32, 40,43,48
Very Low	6 projects --	6,25,44,46,50,51

Program Area

Environmental Effect	9 projects --	2,3,18,22,23,29,42,43,49
Policy Research	7 projects --	4,7,11,25,28,34,48
Energy Technology	5 projects --	15,19,26,31,39
Energy Policy	4 projects --	12,14,20,38
Local Government	4 projects --	9,10,21,35
Productivity	6 projects --	5/41,6,8,32,33,40
Earthquake Engineering	5 projects --	1,30,36,45,50
Solar Energy	5 projects --	13,16,17,46,51
Weather Modification	3 projects --	24,37,44
Fire Research	2 projects --	27,47

Research Product

Information for Policy and/or Other Guidance	24 projects --	2,3,4,7,8,10,11,12,14,20,21, 23,28,29,30,32,34,37,38, 43,47,48,49
Computer Programs	6 projects --	1,5/41,9,27,36,45
User Awareness	5 projects --	16,17,25,33,35
Physical Processes	7 projects --	5/41,13,18,24,39,40,44,50
Physical Devices	1 project --	22
Chemical Process	8 projects --	6,15,19,26,39,40,42,46,51
Chemical Devices	2 projects --	31
Proof of Concept	2 projects --	6,17

Grant Status

Complete, objectives attained	20 projects --	1,5/41,7,8,10,11,12,13,17, 22,26,28,29,34,38,44,45,47, 48,49
Complete, objectives partially attained	2 projects --	43,46
Complete, objectives not attained	1 project --	25
Continuing, meeting interim goals	23 projects --	2,3,6,9,14,15,16,18,19,20, 21,23,24,27,30,31,33,35, 36,37,39,40,42
Continuing, not meeting interim goals	4 projects --	4,32,50,51

Table 1. Project Summary (continued)

Research Quality		
Excellent	14 projects --	1,2,7,12,14,22,23,26,33, 34,36,39,42,47
Very Good	11 projects --	3,5/41,8,10,15,20,24,27, 31,38,40
Good	2 projects --	28,45
Fair	4 projects --	25,29,50,51
Poor	None	
Not determinable	19 projects --	4,6,9,11,13,16,17,18,19, 21,30,32,35,37,43,44,46, 48,49
User Awareness		
Very High	17 projects --	1,2,3,5/41,7,8,12,14,16, 20,22,25,26,28,31,36,38,42
High	15 projects --	4,6,11,18,24,29,30,35,37, 39,40,46,47,49
Moderate	11 projects --	9,10,13,15,17,33,34,43,45, 48,51
Low	6 projects --	19,21,23,27,32,50
None	1 project --	44
User Value		
Very High	8 projects --	1,2,7,12,14,20,22,36
High	5 projects --	18,24,31,33,38
Moderate	17 projects --	3,5/41,8,9,10,11,13,17,23, 28,30,34,35,37,39,42,49
Low	19 projects --	4,6,15,19,21,25,26,27,29, 32,40,43,44,45,46,47,48,50, 51
Not Determinable	1 project --	16

Table 3. Comparison of Level of Utilization and Perceived Research Quality

Perceived Research Quality	Percent Above Average Utilization	Level of Utilization Number of Projects					Percent Below Average Utilization
		Very High	High	Average	Low	Very Low	
Excellent	64	5	4	3	2	0	14
Very Good	27	0	3	4	4	0	36
Good	0	0	0	2	0	0	0
Fair	6	0	0	1	0	3	75
Poor		0	0	0	0	0	
Not Determinable			5	5	6	3	

Significant management factors are noted in 32 projects. Fourteen of these entailed changes in Program Manager or Principal Investigator. No evidence was uncovered to indicate that these changes had any deleterious impact on the research except in one case (46). Discontinuity in project management resulting from the sabbatical absence of the Principal Investigator was perceived as having deleterious effects on the research. Two changes in RANN Program Managers may have compounded this impact. This observation is supported by the fact that, although complete, the project's objectives were only partially attained. In addition, potential and actual users' perceptions of the value of the project were low.

Special NSF funding to enhance dissemination and ultimate utilization is reported in four projects (8, 28, 45, 51). These all had average or lower utilization. However, examination of the case studies reveals that of these four projects, one had a low, one average, and two high utilization effort. The two with a high utilization effort received only average levels of utilization. This illustrates the difficulty in drawing definitive conclusions from so small a sample without recourse to judgmental factors.

Lack of funds is reported as limiting dissemination in four projects (9, 25, 30, 42). However, no conclusions can be drawn as to impact on user awareness and level of utilization. User awareness for two of these projects was very high, and for one each, high and moderate. Level of utilization was rated as high, average, low, and very low.

An innovative contractual device enabling more NSF participation and guidance to the course of the research is being used in two projects (32, 33). Of these two projects, one (32) did not meet interim research goals because of delays in recruitment and appointment of a full-time Principal Investigator.

An education component is reported in six projects (1, 6, 15, 18, 23, 39). Graduate students supported by the research are reported as serving as a means of dissemination of research results when they obtain employment upon completion of their studies.

III. ANALYSIS BASED ON LEVEL OF UTILIZATION
(Numbers in parentheses refer to individual case studies)

A. Very High Level of Utilization

Five projects (1,2,12,14,36) are shown to have a very high level of utilization. Project descriptions are summarized in Table 2. Two of the projects are in the area of earthquake engineering (1,36), two in the area of energy policy (12,14), and one in environmental effects (2). Types of research product include computer programs (1,36) and information for policy and/or planning guidance (2,12,14). Significant management factors are noted in one project (12). During the course of the research, emphasis was changed to include consideration of social technologies as well as physical technologies as in an integrated technology assessment.

Research quality of all five projects is rated as excellent. User awareness and user value also receive the top rating, very high, for all five projects in this very high level of utilization category.

Two projects are complete and have attained their objectives (1,12). Three projects are still current and are meeting interim research goals (2,14,36). An average of 20 users or potential users were interviewed during case study preparation for each of these five projects. Users interviewed ranged from seven (14) to thirty-three (12).

B. High Level of Utilization

Twelve projects (7,18,20,21,22,24,33,35,37,38,42,49) are shown to have a high level of utilization. Project descriptions are summarized in Table 3. One of the projects covers policy research (7), four environmental effects (18,22,42,49), two energy policy (20,38), two local government (21,35), two weather modification (24,37), and one productivity (33). Types of research product included information for policy and/or other guidance (7,20,21,37,38, 49), physical processes (18,24), physical devices (22), chemcial processes

Table 2. Project Description, Very High Level of Utilization

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
1	Earthquake Engineering	Computer Programs	Excellent	Objectives Attained	Very High	Very High	29	-
2	Environmental Effects	Policy Information	Excellent	Meeting Goals	Very High	Very High	14	-
12	Energy Policy	Policy Information	Excellent	Objectives Attained	Very High	Very High	33	(1)
14	Energy Policy	Policy Information	Excellent	Meeting Goals	Very High	Very High	7	-
36	Earthquake Engineering	Computer Programs	Excellent	Meeting Goals	Very High	Very High	15	-

(1) Inclusion of social-technologies in the study resulted in more valuable and utilizable results

Table 3. Project Description, High Level of Utilization

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
7	Policy Research	Policy Information	Excellent	Objectives Attained	Very High	Very High	11	-
18	Environmental Effects	Physical Process	Not Determinable	Meeting Goals	High	High	Not Specified	(1)
20	Energy Policy	Policy Information	Very Good	Meeting Goals	Very High	Very High	13	-
21	Local Government	Policy Information	Not Determinable	Meeting Goals	Low	Low	20	-
22	Environmental Effects	Physical Devices	Excellent	Objectives Attained	Very High	Very High	8	(2)
24	Weather Modification	Physical Process	Very Good	Meeting Goals	High	High	12	-
33	Productivity	User Awareness	Excellent	Meeting Goals	Moderate	High	25	(3)
35	Local Government	User Awareness	Not Determinable	Meeting Goals	High	Moderate	10	(4)
37	Weather Modification	Policy Information	Not Determinable	Meeting Goals	High	Moderate	9	-
38	Energy Policy	Policy Information	Very Good	Objectives Attained	Very High	High	8	(5)
42	Environmental Effects	Chemical Processes	Excellent	Meeting Goals	Very High	Moderate	16	(6)
49	Environmental Effects	Policy Information	Not Determinable	Objectives Attained	High	Moderate	13	-

(1) Goals changed to meet specific needs identified during the research
(2) Two changes in Program Manager
(3) Use of a flexible contractual vehicle, the cooperative agreement
(4) Two changes in Program Manager
(5) One change in Program Manager
(6) Inadequate funding and nonparticipation of NSF in project publicity

(42), and user awareness (33,35). Significant management factors were noted in six projects. Research goals were changed in one project (18); program manager changes were experienced in three (22,35,38); lack of funding and nonparticipation of NSF in project publicity was reported for one (42); and innovative contracting procedures were used in one (33).

Research quality is rated as excellent in four cases (7,22,33,42), very good in three (20,24,38), and not determinable from case study information in five (18,21,35,37,49). Five projects are evaluated as having a very high user awareness (7,20,22,38,42), five as high (18,24,35,37,49), and one each as moderate (33) and low (21). User value is rated as very high for three projects (7,20,22), high for four (18,24,33,38), moderate for four (35, 37,42,49) and low for one (21).

Four projects are complete and have attained their objectives (7,22,38, 49), eight are still current and are meeting interim research goals (18,20, 21,24,33,35,37,42). An average of 13 users or potential users were interviewed during case study preparation for 11 of the projects in this category. Users interviewed were not specified in one case (18). Users interviewed ranged from eight (38) to twenty-five (33).

C. Average Level of Utilization

Fifteen projects (3,5/41,8,9,13,16,17,19,28,29,31,34,39,45,47) are shown to have an average level of utilization. Project descriptions are summarized in Table 4. Two projects are in the area of environmental effects (3,29), two in productivity (5/41,8), one in local government (9), three in the area of solar energy (13,16,17), three in energy technology (19,31,39), two in policy research (28,34), one in earthquake engineering (45), and one in fire research (47). Types of research product include information for policy and/or other guidance (3,8,28,29,34,47), physical processes (5/41,13,39), computer programs (5/41,9,45), user awareness (16,17); chemical processes (19,39),

Table 4. Project Description, Average Level of Utilization

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
3	Environmental Effects	Policy Guidance	Very Good	Meeting Goals	Very High	Moderate	8	(1)
5(41)	Productivity	Physical Process Computer Programs	Very Good	Objectives Attained	Very High	Moderate	6	-
8	Productivity	Policy Information	Very Good	Objectives Attained	Very High	Moderate	18	(2)
9	Local Government	Computer Programs	Not Determinable	Meeting Goals	Moderate	Moderate	14	(3)
13	Solar Energy	Physical Process	Not Determinable	Objectives Attained	Moderate	Moderate	10	(4)
16	Solar Energy	User Awareness	Not Determinable	Meeting Goals	Very High	Not Determinable	Not Specified	-
17	Solar Energy	User Awareness Proof of Concept	Not Determinable	Objectives Attained	Moderate	Moderate	14	-
19	Energy Technology	Chemical Process	Not Determinable	Meeting Goals	Low	Low	19	-
28	Policy Research	Policy Information	Good	Objectives Attained	Very High	Moderate	Not Specified	(5)
29	Environmental Effects	Policy Information	Fair	Objectives Attained	High	Low	7	(6)
31	Energy Technology	Chemical Devices	Very Good	Meeting Goals	Very High	High	10	(7)
34	Policy Research	Policy Information	Excellent	Objectives Attained	Moderate	Moderate	18	(8)

Table 4. Project Description, Average Level of Utilization (con.)

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
39	Energy Technology	Physical and Chemical Processes	Excellent	Meeting Goals	High	Moderate	9	(9)
45	Earthquake Engineering	Computer Programs	Good	Objectives Attained	Moderate	Low	10	(10)
47	Fire Research	Policy Information	Excellent	Objectives Attained	High	Low	5	(11)

(1) One change in Principal Investigator
(2) Special funding for dissemination of results
(3) Limited Utilization Funding
(4) One change in Program Manager
(5) Special grant for dissemination
(6) One change in Program Manager, one change in Principal Investigator
(7) One change in Program Manager
(8) One change in Program Manager
(9) Program Manager encouraged establishment of researcher-industry cooperation
(10) NSF assistance in publication of symposium proceedings
(11) Change of research emphasis from theoretical to practical application

chemical devices (31) and proof of concept (17). Significant management factors are noted in eleven projects. One project experienced a change in Principal Investigator (3), three changes in Program Manager (13,31,34), one change in both Principal Investigator and Program Manager (29). In one project, research emphasis was shifted from theoretical to practical applications (47). Special funding or NSF assistance for dissemination was experienced in three cases (8,28,45) and funding limitations were reported to have affected utilization in one project (9). In one research project research-industry cooperation was established and maintained with the encouragement of the Program Manager (31).

Research quality is rated as excellent on three projects (34,39,47), as very good on four (3,5/41,8,31), as good on two (28,45), as fair on one (29), and not determinable on five (9,13,16,17,19). Six projects are rated very high for user awareness (3,5/41,8,16,28,31), high for three (29,39,47), moderate for five (9,13,17,34,45), and low for one (19). For user value one project is rated high (31), nine as moderate (3,5/41,8,9,13,17,28,34,39), four as low (19,29,45,47), and one as not determinable (16). Nine projects are complete and have attained their objectives (5/41,8,13,17,28,29,34,45,47), six are still current and are meeting interim research goals (3,9,16,19,31,39). An average of 11 users or potential users were interviewed during case study preparation for 13 of the projects in this category. Users interviewed were not specified in two cases (16,28). Users interviewed ranged from five (47) to nineteen (19).

D. Low Level of Utilization

Twelve projects (4,10,11,15,23,26,27,30,32,40,43,48) are shown to have a low level of utilization. Project descriptions are summarized in Table 5. Three projects are in the area of policy research (4,11,48), two in productivity (32,

Table 5. Project Description, Low Level of Utilization

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
4	Policy Research	Policy Information	Not Determinable	Not Meeting Goals	High	Low	13	(1)
10	Local Government	Policy Information	Very Good	Objectives Attained	Moderate	Moderate	12	(2)
11	Policy Research	Policy Information	Not Determinable	Objectives Attained	High	Moderate	6	-
15	Energy Technology	Chemical Processes	Very Good	Meeting Goals	Moderate	Low	Not Specified	(3)
23	Environmental Effects	Policy Information	Excellent	Meeting Goals	Low	Moderate	25	(4)
26	Energy Technology	Chemical Processes	Excellent	Objectives Attained	Very High	Low	22	(5)
27	Fire Research	Computer Programs	Very Good	Meeting Goals	Low	Low	5	(6)
30	Earthquake Engineering	Planning Information	Not Determinable	Meeting Goals	High	Moderate	14	(7)
32	Productivity	Policy Information	Not Determinable	Not Meeting Goals	Low	Low	7	(8)
40	Productivity	Chemical and Physical Processes	Very Good	Meeting Goals	High	Low	12	-
43	Environmental Effects	Planning Information	Not Determinable	Objectives Partially Attained	Moderate	Low	13	-
48	Policy Research	Policy Guidance	Not Determinable	Objectives Attained	Moderate	Low	6	-

Footnotes on following page

Table 5 Footnotes

(1) Changes in project goals by eliminating models for actual plants
(2) One change in Program Manager, funding limitation limiting final report distribution
(3) Review Committee played an important role
(4) One change in Program Manager, one change in Principal Investigator
(5) Three changes in Principal Investigator
(6) One change in Principal Investigator, one change in Principal Investigator project management to NBS
(7) Delay in funding Phase II precluded field testing of the guidelines
(8) Delay in obtaining full-time Principal Investigator delayed industry acceptance of the program

40), two in energy technology (15,26), two in environmental effects (23,43), and one each in local government (10), fire research (27), earthquake engineering (30). Types on research product include information for policy or other guidance (4,10,11,23,30,32,43,48), chemical processes (15,26,40), physical processes (40), and computer programs (27). Significant management factors are noted in eight projects. In one case, a delay in obtaining a full-time Principal Investigator delayed industry acceptance of a joint industry-university cooperative research project (32). Research objectives were curtailed in one instance (4), the Review Committee played a significant role in one project (15), funding delays precluded the testing of guidelines in one case (27). Funding limitations were reported as limiting final report distribution (2). Changes in Principal Investigators were experienced in two projects (26, 27), and changes in both Program Manager and Principal Investigator in one instance (23).

Research quality is evaluated as excellent in two projects (23,26), very good in four (10,15,27,40), and not determinable in six (4,11,30,32,43,48). User awareness is rated as high in four projects (4,11,30,40), very high in one (26), moderate in four (10,15,43,48), and low in three (23,27,32). User value is rated as moderate in four projects (10,11,23,30) and low in eight (4,15,26,27,32,40,43,48). Four projects are complete and have attained their research objectives (10,11,26,48), one project is complete and has only partially achieved its objectives (43). Five projects are still current and are meeting interim research goals (15,23,27,30,40). Two projects are still current and are not meeting interim research goals (4,32). An average of 12 users or potential users were interviewed in the preparation of the case studies for eleven of the projects in this category. One case study did not specify the users interviewed (15). Users interviewed ranged from six (11,48) to twenty-five (23).

E. Very Low Level Of Utilization

Six projects are shown to have a very low level of utilization (6,25,44, 46,50,51). Project descriptions are summarized in Table 6. Two of the projects are in the area of solar energy (46,51); and one each in productivity (6), policy research (25), weather modification (44), and earthquake engineering (50). Types of research product include chemical processes (6,46,51), physical processes (44,50), user awareness (25), and proof of concept (6). Significant management factors are noted in five projects. One project experienced a change in Principal Investigator (6); in one, funding limitations precluded publication of a final report (25), in one, NSF provided special funding of a symposium (51), and in one, little communication between the Program Manager and the Principal Investigator was reported (50). One project was reported as having experienced discontinuity in management due to two changes in Principal Investigators and the sabbatical of the original PI.

Research quality is reported as fair on three projects (25,50,51) and not determinable on three (6,44,46). User awareness is rated very high on one project (25), high on two (6,46), moderate on one (51), low on one (50), and none on one (44). User value ratings are low on all six projects in this utilization level.

Three projects are complete with one each reporting objectives attained (44), objectives partially attained (46), and objectives not attained (25). Three projects are continuing,one of which is meeting interim goals (6), and two not meeting interim goals (50,51). An average of nine users or potential users were interviewed during preparation of the case studies on each of these six projects. Users interviewed ranged from four (50) to fifteen (46).

Table 6. Project Description, Very Low Level of Utilization

Case No	Research Area	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
6	Productivity	Chemical Process Proof of Concept	Not Determinable	Meeting Goals	High	Low	12	(1)
25	Policy Research	User Awareness	Fair	Objectives Not Attained	Very High	Low	11	(2)
44	Weather Modification	Physical Process	Not Determinable	Objectives Attained	None	Low	5	-
46	Solar Energy	Chemical Process	Not Determinable	Objectives Partially Attained	High	Low	15	(3)
50	Earthquake Engineering	Physical Process	Fair	Not Meeting Goals	Low	Low	4	(4)
51	Solar Energy	Chemical Process	Fair	Not Meeting Goals	Moderate	Low	6	(5)

(1) Two changes in Principal Investigator
(2) Funding limitation precluded publication of a final report
(3) Two changes in Program Manager and sabbatical of Principal Investigator may have caused discontinuity in project
(4) Little communication between Program Manager and Principal Investigator
(5) NSF funding of a symposium on the research

IV. ANALYSIS BASED ON AREA OF APPLICATION
(Numbers in parentheses refer to individual case studies)

A. Environmental Effects

Nine projects are classified as being the environmental effects program area (2,3,18,22,23,29,42,43,49). Project descriptions are summarized in Table 7. One project is classified as having a very high level of utilization (2), four as high (18,22,42,49), two as average (3,29), and two as low (23,43). Types of research products include information for policy and/or other planning (2,3, 23,29,43,49), physical processes (18), physical devices (22), and chemical processes (42). Significant management factors are noted in six projects. Two projects experienced changes in both Program Managers and Principal Investigators (23,29), one each, changes in Program Manager (22), and Principal Investigator (3). In one project, insufficient funding and nonparticipation of NSF in project publicity was reported (42). Goals were changed in one product to meet specific needs identified during the research (18).

Research quality is reported as being excellent in four projects (2,22, 23,42), very good in one (3), fair in one (29), and not determinable in three (18,43,49). User awareness is very high in four cases (2,3,22,42), high in three (18,29,49), moderate in one (43), and low in one (23). User value is reported as very high in two projects (2,22), high in one (18), moderate in four (3,23,42,49), and low in two (29,43).

Three projects are complete and have attained their research objectives (22,29,49), one is complete and has partially attained its objectives (43). The remaining five projects are continuing and are meeting interim research goals (2,3,18,23,42). An average of thirteen users or potential users were interviewed during case study preparation for eight of these projects. One case did not specify the number of users interviewed (18). Users interviewed ranged from eight (3,22) to twenty-five (23).

Table 7. Description, Environmental Effects Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
2	Very High	Policy Information	Excellent	Meeting Goals	Very High	Very High	14	-
3	Average	Policy Information	Very Good	Meeting Goals	Very High	Moderate	8	(1)
18	High	Physical Process	Not Determinable	Meeting Goals	High	High	Not Specified	(2)
22	High	Physical Devices	Excellent	Objectives Attained	Very High	Very High	8	(3)
23	Low	Policy Information	Excellent	Meeting Goals	Low	Moderate	25	(4)
29	Average	Policy Information	Fair	Objectives Attained	High	Low	7	(5)
42	High	Chemical Process	Excellent	Meeting Goals	Very High	Moderate	16	(6)
43	Low	Policy Information	Not Determinable	Objectives Partially Attained	Moderate	Low	13	
49	High	Policy Information	Not Determinable	Objectives Attained	High	Moderate	13	

(1) One change in Principal Investigator
(2) Goals changed to meet specific needs identified in the research
(3) Two changes in Program Manager
(4) One change in Program Manager, one change in Principal Investigator
(5) One change in Program Manager, one change in Principal Investigator
(6) Inadequate funding and nonparticipation of NSF in project publicities

B. Policy Research

Seven projects are classified as being policy research (4,7,11,25, 28,34,48). Project descriptions are summarized in Table 8. One each of the projects is reported as having a high level of utilization (7) and very low (25). Two are classified as average (28,34) and three as low (4,11,48). Types of research product include information for policy or other guidance (4,7,11,28,34,48) and user awareness (25). Significant management factors were noted for three cases. In one there was a change of project goals (4), in one a special grant was made for dissemination of research results (28), in one it was reported that funding limitations precluded publication of a final report (25), and in one a change in Program Manager (34).

Research quality is reported as excellent (7,34), good (28), fair (25), and not determinable (4,11,48). User awareness is reported as being very high in three (7,25,28), high in two (4,11), and moderate in two (34,48). User value ranged from very high (7) through moderate (11,28,34) to low (4,25,48).

Five projects are complete and have attained their objectives (7,11,28, 34,48), one is complete and has not attained its objectives (25). One is continuing but not meeting interim research goals (4). An average of eleven users or potential users were interviewed during preparation of the case studies for five of the projects in this category. Users interviewed were not specified in two cases (28,48). Users interviewed ranged from six (11,48) to eighteen (34).

C. Environmental Technology

Five projects are classified as being in the environmental technology area (15,19,26,31,39). Project descriptions are summarized in Table 9. Three projects are classified as having an average level of utilization (19,31,39) and two as low (15,26). Types of research product include chemical processes

Table 8. Description, Policy Research Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
4	Low	Policy Information	Not Determinable	Not Meeting Goals	High	Low	13	(1)
7	High	Policy Information	Excellent	Objectives Attained	Very High	Very High	11	
11	Low	Policy Information	Not Determinable	Objectives Attained	High	Moderate	6	
25	Very Low	User Awareness	Fair	Objectives Not Attained	Very High	Low	11	(2)
28	Average	Policy Information	Good	Objectives Attained	Very High	Moderate	Not Specified	(3)
34	Average	Policy Information	Excellent	Objectives Attained	Moderate	Moderate	18	(4)
48	Low	Policy Information	Not Determinable	Objectives Attained	Moderate	Low	6	

(1) Changes in project goals
(2) Funding limitation precluded publication of final report
(3) Special grant for dissemination
(4) One change in Program Manager

Table 9. Description, Energy Technology Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
15	Low	Chemical Process	Very Good	Meeting Goals	Moderate	Low	Not Specified	(1)
19	Average	Chemical Process	Not Determinable	Meeting Goals	Low	Low	19	
26	Low	Chemical Process	Excellent	Objectives Attained	Very High	Low	22	(2)
31	Average	Chemical Devices	Very Good	Meeting Goals	Very High	High	10	(3)
39	Average	Physical and Chemical Processes	Excellent	Meeting Goals	High	Moderate	9	(4)

(1) Review Committee played an important role
(2) Three changes in Principal Investigator
(3) One change in Program Manager
(4) Program Manager encouraged establishment of researcher-industry cooperation

(15,19,26,39), physical processes (39), and chemical devices (31). Significant management factors are noted for four projects. One experienced three changes in Principal Investigator (26), and one a change in Program Manager (31). In one case, the Review Committee played an important role (15). The Program Manager encouraged researcher-industry cooperation in another (39).

Research quality is reported as being excellent in two projects (26,39), very good in two (15,31), and not determinable in one (19). User awareness is rated as very high in two instances (26,31), high in one (39), moderate in one (15), and low (19). One each project is rated high in user value (31) and moderate (39). Three projects are rated low in this parameter (15,19,26).

One project is complete and has attained its objectives (26), the remaining four are continuing and are meeting interim research goals (15,19,31,39). An average of fifteen users or potential users were interviewed in the preparation of the case studies for four of the projects in this category. One case did not specify the number of users interviewed (15). Users interviewed ranged from nine (39) to twenty-two (26).

D. Energy Policy

Four projects are classified as pertaining to energy policy (12,14,20,38). Project descriptions are summarized in Table 10. In all cases the research product is classified as information for policy and/or other guidance. Significant management factors are noted in two projects. There was one change in Program Manager (12) and in one instance, research goals were changed during the conduct of the research (12).

Research quality is reported as being excellent (12,14) and very good (20,38). User awareness is rated as very high for all four projects; user value as very high in three (12,14,20) and one as high in the State in which the research was performed (38).

Table 10. Description, Energy Policy Products

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
12	Very High	Policy Information	Excellent	Objectives Attained	Very High	Very High	33	(1)
14	Very High	Policy Information	Excellent	Meeting Goals	Very High	Very High	7	
20	High	Policy Information	Very Good	Meeting Goals	Very High	Very High	13	
38	High	Policy Information	Very Good	Objectives Attained	Very High	High (3)	8	(2)

(1) Inclusion of social technologies in the study resulted in more valuable and utilizable results
(2) One change in Program Manager
(3) High in Texas, not determinable elsewhere

Two projects are complete and had attained their objectives (12,38), two are continuing and are meeting interim research goals (14,20). An average of fifteen users or potential users were interviewed during case study preparation for these four projects. Users interviewed ranged from seven (14) to thirty-three (12).

E. Local Government

Four projects are concerned with local government (9,10,21,35). Project descriptions are summarized in Table 11. Types of research products include information for policy and/or other guidance (10,21), computer programs (9), and user awareness (35). Significant management factors are noted in three cases. Limited funding for utilization and dissemination are reported for two projects (9,35). Two projects experienced changes in Program Manager (10,35).

Research quality is reported as being very good in one project (10), and not determinable from case study information for the remaining three. User awareness is rated as high for one project (35), moderate for two (9,10), and low for one (21). User value is estimated to be moderate for three (9,10,35) and low for one (21).

One project is complete and has attained its objectives (10). Three projects are continuing and meeting interim research goals (9,21,35). An average of fourteen users or potential users were interviewed during case study preparation for these four projects. Users interviewed ranged from ten (35) to twenty (21).

F. Productivity

Six projects are classified as being in the area of productivity (5/41, 6,8,32,33,40). Project descriptions are summarized in Table 12. Types of research product include physical processes (5/41,40), chemical processes

Table 11. Description, Local Government Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
9	Average	Computer Programs	Not Determinable	Meeting Goals	Moderate	Moderate	14	(1)
10	Low	Policy Information	Very Good	Objectives Attained	Moderate	Moderate	12	(2)
21	High	Policy Planning	Not Determinable	Meeting Goals	Low	Low	20	
35	High	User Awareness	Not Determinable	Meeting Goals	High	Moderate	10	(3)

(1) Limited utilization funding
(2) One change in Program Manager, funding limitations precluded publication of final report
(3) Two changes in Program Manager

Table 12. Description, Productivity Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
5/41	Average	Physical Process Computer Programs	Very Good	Objectives Attained	Very High	Moderate	6	-
6	Very Low	Chemical Process Proof of Concept	Not Determinable	Meeting Goals	High	Low	12	(1)
8	Average	Policy Information	Very Good	Objectives Attained	Very High	Moderate	18	(2)
32	Low	Policy Information	Not Determinable	Not Meeting Goals	Low	Low	7	(3)(4)
33	High	User Awareness	Excellent	Meeting Goals	Moderate	High	25	(4)
40	Low	Chemical and Physical Processes	Very Good	Meeting Goals	High	Low	12	

(1) Two changes in Principal Investigator
(2) Special funding for dissemination
(3) Delay in obtaining full-time Principal Investigator delayed industry acceptance of the program
(4) Use of a flexible contractual vehicle, the cooperative agreement

(6,40), computer programs (5/41), information for policy and/or other guidance (8,32), proof of concept (6), and user awareness (33). Significant management factors are noted in four projects. An innovative contractual vehicle, Cooperative Agreement, is being used for two projects (32,33). Delay in recruitment of a full-time Principal Investigator is reported as having delayed industry acceptance of a joint industry-university research program (32). In one project, special funding for dissemination of research results was made (8). One project experienced two changes in Principal Investigator (6).

Research quality is reported as being excellent for one project (33), very good for three (5/41,8,40), and not determinable for two (6,32). User awareness is rated as very high (5/41,8), high (6,40), moderate (33), and low (32). User value is rated as high for one case (33), moderate for two (5/41,8), and low for three (6,32,40).

Two projects are complete and have attained their objectives (5/41,8), three are continuing and are meeting interim research goals (6,33,40), one is continuing and is not meeting interim research goals (32). An average of thirteen users or potential users were interviewed during case study preparation for these six projects. Users interviewed ranged from six (5/41) to twenty-five (33).

G. Earthquake Engineering

Five projects involve earthquake engineering research (1,30,36,45,50). Project descriptions are summarized in Table 13. Types of research product include computer programs (1,36,45), information for policy and/or other guidance (30) and physical processes (50). Significant management factors are noted in three cases. Little communication between the Program Manager and Principal Investigator is reported in one case (50), NSF assisted in

Table 13. Description, Earthquake Engineering Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
1	Very High	Computer Programs	Excellent	Objectives Attained	Very High	Very High	29	
30	Low	Planning Guidance	Not Determinable	Meeting Goals	High	Moderate	14	(1)
36	Very High	Computer Programs	Excellent	Meeting Goals	Very High	Very High	15	
45	Average	Computer Programs	Good	Objectives Attained	Moderate	Low	10	(2)
50	Very Low	Physical Process	Fair	Not Meeting Goals	Low	Low	4	(3)

(1) Delay in Phase II funding precluded field testing of guidelines
(2) NSF assistance in publication of symposia proceedings
(3) Little communication between Program Manager and Principal Investigator

publication of research results in one (45), and delay in continuation funding is reported as having precluded field testing of guidelines in one project (30).

Research quality is reported as excellent in two projects (1,36), as good in one (45), fair in one (50), and not determinable in one (30). User awareness is classified as very high (1,36), high (30), moderate (45), and low (50). User value is reported as being very high for two projects (1,36), moderate for one (30) and low for two (45,50).

Two projects are complete and have attained their objectives (1,45). Three projects are continuing, two of which are meeting interim goals (30,36) and one not (50). An average of fourteen users or potential users were interviewed during case study preparation for these four projects. Users interviewed ranged from four (50) to twenty-nine (1).

H. Solar Energy

Five projects involve solar energy (13,16,17,46,51). Project descriptions are summarized in Table 14. Types of research product include physical processes (13), chemical processes (46,51), user awareness (16,17) and proof of concept (17). Significant management factors are noted in three cases. Two projects experienced Program Manager changes (13,46). NSF funded a special symposium for dissemination of research results for one (51). In one project, absence of the Principal Investigator on a sabbatical is reported as having caused discontinuity in project management (46).

Research quality is reported as fair in one project (51) and not determinable for the remaining four. User awareness is classified as very high for one project (16), high for one (46), and moderate for three (13,17,51). User value is rated as moderate in two cases (13,17), low in two (46,51), and not determinable in one (16).

Table 14. Description, Solar Energy Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
13	Average	Physical Process	Not Determinable	Objectives Attained	Moderate	Moderate	10	(1)
16	Average	User Awareness	Not Determinable	Meeting Goals	Very High	Not Determinable	Not Specified	
17	Average	User Awareness Proof of Concept	Not Determinable	Objectives Attained	Moderate	Moderate	14	
46	Very Low	Chemical Process	Not Determinable	Objectives Partially Attained	High	Low	15	(2)
51	Very Low	Chemical Process	Fair	Not Meeting Goals	Moderate	Low	6	(3)

(1) One change of Program Manager
(2) Two changes in Program Manager and PI's sabbatical may have resulted in discontinuity in project management
(3) NSF funding and sponsorship of a symposium based on the research

Three of the projects are complete with two of these having attained their objectives (13,17) and one having only partially attained its objectives (46). Of the two continuing projects, one is meeting interim goals (16) and one is not (51). An average of eleven users or potential users were interviewed during case study preparation for these five projects. Users interviewed ranged from six (51) to fifteen (46).

I. Weather Modification

Three projects involve weather modification research (24,37,44). Project descriptions are summarized in Table 15. Types of research product include physical processes (24,44) and information for policy and/or other guidance (37). No significant management factors are noted.

Research quality is reported as very good for one project (24) and not determinable for the remaining two. User awareness for two projects is reported as high (24,37), and none (44). User value is classified as high (24), moderate (37), and low (44).

One project is complete and has attained its objectives (44). Two are continuing and meeting interim goals (24,37). An average of nine users or potential users were interviewed during case study preparation for these three projects. Users interviewed ranged from five (44) to twelve (24).

J. Fire Research

Two projects fall into this category (27,47). Project descriptions are summarized in Table 16. Types of research product include computer programs (27) and information for policy and/or other guidance (47). Significant management factors are noted for both projects in this category. Research emphasis changed from theoretical to practical applications in one case (47). In one project (27), the Principal Investigator was changed as well as the responsibility for the project transferred from NSF to NBS.

Research quality is reported as being excellent (47) and very good (27). User awareness is classified as high (47) and low (27). User value is rated as low for both projects.

One project (47) is complete and has attained its goals, one is continuing and is meeting interim research goals (27). In both projects, five users or potential users were interviewed during case study preparation.

Table 15. Description, Weather Modification Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
24	High	Physical Process	Very Good	Meeting Goals	High	High	12	
37	High	Policy Information	Not Determinable	Meeting Goals	High	Moderate	9	
44	Very Low	Physical Process	Not Determinable	Objectives Attained	None	Low	5	

Table 16. Description, Fire Research Projects

Case Study	Level of Utilization	Type of Research Product	Research Quality	End of Grant Status	User Awareness	User Value	User Surveyed	Management Factors
27	Low	Computer Program	Very Good	Meeting Goals	Low	Low	5	(1)
47	Average	Policy Information	Excellent	Objectives Attained	High	Low	5	(2)

(1) One change in Principal Investigator, transfer of Program Manager and program responsibility to NBS
(2) Change of emphasis to practical applications

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APPENDIX

NARRATIVE DESCRIPTION

RANN Utilization Case Studies 1 through 51

EVALUATION OF MODEL SOIL RESPONSE
TO EARTHQUAKE EXCITATION

CASE NO. : 1
AWARD NO.: Various
PERIOD : 6/72-6/74
FUNDING : $150,000 (Est.)

PRINCIPAL INVESTIGATOR: Dr. H. Bolton Seed
University of California at Berkeley

RESEARCH SUMMARY: This research was directed toward the study of soil response to earthquakes in order to provide a more realistic basis for design of structures in earthquake-prone areas (1-3). Three computer programs developed for this purpose represent the state-of-the-art. No equivalent programs are available (1-4). The three programs--SHAKE, QUAD-4, and LUSH--present increasing levels of complexity and precision with respect to geological structure and earth motions. SHAKE is a relatively simple program applicable to simple soil layers over bedrock while LUSH models have more complex soil structures, damping, and nonlinear responses as observed in earthquakes. QUAD-4 is of intermediate complexity and is used primarily for earthen dam analyses (1-9, 1-10).

DISSEMINATION SUMMARY: Research results were disseminated to the user community through publication in professional journals, presentations at technical meetings, participation at the policymaking level in professional societies, short courses at the Berkeley campus, and the use of the programs in engineering courses (1-12). In addition, information on the computer programs was made available through the National Information Service for Earthquake Engineering (1-13). Support of graduate students and their subsequent employment by users also served as a communications channel (1-23).

USER IMPACT: These programs are used by virtually every engineering firm in the United States engaged in earthquake analysis related to construction (1-4). They are incorporated in building codes and standards (1-4). Engineers accept the programs as either the best available or the only ones that will do the required job (1-14) and put them to almost continuous use (1-15). It is estimated that millions of dollars have been spent on computer time alone in using the models. They have been applied to billions of dollars of construction (1-4). The most profound utilization appears to be in nuclear power plant siting and design, bridge construction, and building codes. The ultimate significance of this research will be its contribution to reduction in personnel casualties and structural damage from earthquakes.

1. **PRINCIPAL PRODUCT** : Computer Programs
2. **PROGRAM AREA** : Earthquake Engineering
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Excellent (1-13 through 1-19)
5. **END OF GRANT STATUS** : Completed, objectives attained (1-3, 1-4).
6. **USER AWARENESS** : Very High (1-13 through 1-19)
7. **USER VALUE** : Very High (1-13 through 1-19)
8. **USERS SURVEYED** : Federal Government--5, Other Government--1, Industry--12, Public--3, Researchers--8

ENVIRONMENTAL POLLUTION FROM INDUSTRIAL DEVELOPMENT IN THE NEW LEAD BELT OF SOUTHEASTERN MISSOURI

CASE NO. : 2
AWARD NO.: GI-35981X
PERIOD : 6/71-9/75
FUNDING : $1,087,016

PRINCIPAL INVESTIGATOR: Dr. Bobby Wixon
University of Missouri--Rolla

RESEARCH SUMMARY: This research is the outgrowth of an earlier industry-university-government cooperative research effort in which it was determined that sulfur dioxide and sulfuric acid mist emissions from lead smelters were the cause of discoloration in the virgin forests surrounding the lead belt area (2-71). This project, focusing on the effects of heavy metals on the ecosystem, examines the external causes and effects on the forest ecosystem of heavy metals from lead processing operations, and develops information that can be used by State and Federal regulatory agencies and industry in minimizing adverse effects of heavy metals emissions (2-3). The project has produced a number of highly significant and useful findings concerning the emission, transport, deposition and effects of heavy metals and other pollutants associated with New Lead Belt activities (2-8). Research findings have resulted in the implementation of mill-mine wastewater treatment methods, control procedures for sulfur dioxide and acid mist emissions, and other methods for reducing contamination from lead smelters (2-6).

DISSEMINATION SUMMARY: Utilization and dissemination activities have been an integral part of this research project since its inception. Direct applications of the research findings have ranged from the development and installation of control measures by lead industries to the use of project data in establishing national emissions standards for the lead industry (2-12). Primary means of dissemination has been the development and maintenance of close working relationships with the diverse user community (2-19).

USER IMPACT: The results of the research have found acceptance by the user community. AMAX Lead Company has used project data to alleviate downstream pollution, to develop automatic shutdown procedures when sulfur dioxide emissions reached a selected level, and to develop procedures for abatement of fugitive emission from smelting operations (2-13). Missouri has used project data in the development of state standards and guidelines and in the enforcement of water quality standards (2-14, 2-15). The ultimate significance of this research will be its contribution to the maintenance of environmental quality during development of the lead mining industry in the Missouri New Lead Belt.

1. **PRINCIPAL PRODUCT** : Information for Policy Determination
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Excellent (2-18)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (2-6).
6. **USER AWARENESS** : Very High (2-11, 2-12, 2-19)
7. **USER VALUE** : Very High (2-12 through 2-16)
8. **USERS SURVEYED** : Federal Government--5, Other Government--4, Industry--5

ESTABLISHMENT OF OPERATIONAL GUIDELINES
FOR TEXAS COASTAL ZONE MANAGEMENT

CASE NO. : 3
AWARD NO.: GI-34870
PERIOD : 6/72-6/76
FUNDING : $803,000

PRINCIPAL INVESTIGATOR: Dr. E. G. Fruh
University of Texas at Austin
(Dr. R. S. Kier assumed this role during
Dr. Fruh's sabbatical during the 74-75 academic year.)

RESEARCH SUMMARY: The objective of this research is development of methodology and criteria for assessment of the economic and environmental impacts of Texas coastal zone management policies (3-10). During the first two years (1972-1974), personnel from the University of Texas at Austin working with the staff of the Division of Planning Coordination of the Governor's Office, developed quantitative criteria and methodologies for evaluating economic and environmental impacts of development in the Coastal Bend Region around Corpus Christi and applied them to example policy analyses in this typical Texas coastal zone area. During the second two-year phase, the criteria and methodology were to be used to evaluate impacts of proposed recreational-community development in coastal zone areas around Corpus Christi and on the conflicting agricultural, industrial, and recreational development demands in the south Texas-Rio Grande Valley area. These analyses would test the criteria and methodology on a local as well as on a regional scale. Finally, the research was to test the transferability of the criteria and methodology to a broader range of issues and conditions in Texas that are also representative of conditions in other States. At the same time, the social impact of various coastal zone policies would be evaluated (3-4, 3-5).

DISSEMINATION SUMMARY: Dissemination of research results is accomplished through direct links established between the research team and the State government, informal relationships developed during the conduct of the research, and through research seminars at the LBJ School of Public Affairs (3-9).

USER IMPACT: Primary impact has been on the members of the Texas State and local governments involved in coastal zone planning and management activities (Texas Land Commission, 3-17; Coastal Bend Council of Governments, 3-16; City of Corpus Christi, 3-16) and in the development of legislation (3-16, 3-17, 3-18). The ultimate significance of the research lies in its contribution to effective coastal zone planning in Texas and other States.

1. **PRINCIPAL PRODUCT** : Information for Policy Guidance
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS:** One change in Principal Investigator.

4. **RESEARCH QUALITY** : Very Good (3-15 through 3-19)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (3-4, 3-5).
6. **USER AWARENESS** : Very High (3-5)
7. **USER VALUE** : Moderate (3-15 through 3-19, 3-21, 3-22)
8. **USERS SURVEYED** : Other Government--5, Public--1, Researchers--2

NATIONAL ECONOMIC MODELS OF INDUSTRIAL WATER USE AND WASTE TREATMENT

CASE NO. : 4
AWARD NO.: GI-34459
PERIOD : 6/72-9/75
FUNDING : $934,000

PRINCIPAL INVESTIGATOR: Dr. Russell G. Thompson
University of Houston

RESEARCH SUMMARY: This research focused on the development of models that introduce industrial cost data and economic behavior into planning directed toward meeting demands for water and controlling water pollution (4-3, 4-4). Research was conducted on five important water-using industries with data and models developed for both existing plants and for plants on the drawing boards or just recently placed in operation. Effort was also directed toward the delineation of regional differences among plants in the same industrial category. However, on the recommendation of a Board of Consultants and with NSF approval, research was limited to the study of representative plants (4-7). The models being developed can identify methods for minimizing production costs under a given set of input parameters such as effluent charges,water prices, production constraints, and pollution abatement requirements (4-4).

DISSEMINATION SUMMARY: Research results were disseminated by means of technical reports, journal articles, presentations to user groups, and mass media articles. Dr. Thompson maintained regular contacts with known users (4-10). In addition, serendipitous contacts and the data collection effort resulted in a spreading of the results of this research (4-11).

USER IMPACT: Primary users, when the case study was prepared, included agencies of the Texas State government (4-12). The Texas Office of Information Services used the models in performing analyses for the Texas Governor's Energy Advisory Council (4-12). Resources for the Future used the models in evaluating environmental effects of alternative processes in steam-electric plants in the arid regions of the western United States (4-13). The models are also used in an economic and social analysis in the Houston-Galveston area under National Commission on Water Quality sponsorship (4-13). The ultimate significance of this research will be in its contribution in the development of policies on environmental management and on water use and treatment regulations (4-12).

1. **PRINCIPAL PRODUCT** : Information for Policy Guidance and Planning
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:** Changes in project goals by eliminating models for actual plants (4-7).
4. **RESEARCH QUALITY** : Cannot be determined from case study .
5. **END OF GRANT STATUS** : Continuing, not meeting interim goals (4-7)
6. **USER AWARENESS** : High (4-20)
7. **USER VALUE** : Low (4-20)
8. **USERS SURVEYED** : Federal Government--3, Other Government--3, Industry--5, Public--2

AUTOMATED COMPUTER-CONTROLLED BEAM BENDER
AUTOMATED BENDING SYSTEM FOR THE
FABRICATION OF SHIP FRAMES

CASE NO. : 5 and 41
AWARD NO.: GI-35994
PERIOD : 8/72-7/76
FUNDING : $279,000

PRINCIPAL INVESTIGATOR: Dr. Harry W. Mergler
Case Western Reserve University

RESEARCH SUMMARY: This research was directed toward the development of a computer-controlled method for the cold forming of ship frames that eliminates the requirement for individually fitting bent members to templates (41-3). A procedure has been developed utilizing four-point bending action achieving zero shear force bending over the bulk of the bend. Undesirable twisting and out-of-plane deformation have been eliminated; these problems are especially acute with beams with asymmetrical cross sections (41-9). The key control feature is the self-adaption operation that directs the bending with continuous correction for springback and out-of-plane deformation through the use of computer-controlled feedback (41-14). A scaled-down laboratory beam bender has been developed and demonstrated. Comparative cost data have also been generated (41-17, 41-18).

DISSEMINATION SUMMARY: In view of the limited ultimate user community, e.g., the U.S. shipbuilding industry, dissemination efforts were directed toward the Federal agencies with a stake in shipbuilding, e.g., the Maritime Administration and the U.S. Navy; the manufacturers of shipbuilding equipment; and the U.S. shipbuilding industry (41-21 through 41-27). Representatives of the shipbuilding industry have participated in the research program from its inception and have provided input to the research leading to the development of a scale model beam bender (41-16, 41-17, 41-23).

USER IMPACT: The primary user impact of the research has been the issuance of an exclusive licence to Hyde Products, Inc., Cleveland, Ohio to market the beam bender (41-25). The Maritime Administration is promoting the acceptance of the beam bender through cost-sharing the construction of production hardware (41-22). The U.S. Navy is considering funding full-scale demonstration of the beam bender for the U.S. shipbuilding industry (41-22, 41-32). The ultimate significance of the research will be its contribution to reducing costs of the U.S. shipbuilding industry, thereby making it more competitive and increasing U.S. production of ships (41-5).

1. **PRINCIPAL PRODUCT** : Physical Process and Associated Computer Software
2. **PROGRAM AREA** : Productivity
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Very Good (41-16 through 41-27)
5. **END OF GRANT STATUS** : Completed, objectives attained (41-3).
6. **USER AWARENESS** : Very High (41-27, 41-28)
7. **USER VALUE** : Moderate (41-16 through 41-27)
8. **USERS SURVEYED** : Federal Government--2, Industry--4

PRODUCTION OF INDUSTRIAL SWEETENER SYRUPS FROM CORNSTARCH

CASE NO. : 6
AWARD NO.: GI-34933
PERIOD : 7/72
FUNDING : $139,900

PRINCIPAL INVESTIGATOR: Dr. P. J. Reilly
Iowa State University at Ames

RESEARCH SUMMARY: This research is directed toward the development of improved methods for the production of industrial sweetener syrups from cornstarch through investigation of the theoretical and technical problems associated with replacing industrial batch processes for corn sweetner production with continuous flow processes (6-3). This involves studies on the kinetics, stability, and effect of mass transfer on immobilized glucoamylase and glucose isomerase, and on the joint stabilization of these two enzymes (6-4). Research is focused on the design, construction, and operation of a pilot plant to study the characteristics of immobilized enzymes in a pilot-scale application. The research has demonstrated the technical feasibility of a reactor vessel packed with active glucoamylase immobilized on a ceramic bead substrate. In addition, the impact of operating parameters on pilot plant output has been determined (6-12, 6-13).

DISSEMINATION SUMMARY: The use of a research advisory committee with industry representation is the primary means for disseminating results of this research project. Other dissemination media used in this project include formal presentation at scientific meetings and publication in scientific journals (6-14, 6-15). The use of the pilot facility for training graduate students in the operational techniques also serves as a dissemination medium, albeit long term in nature (6-15).

USER IMPACT: The impact of the research on potential users appears to be minimal. The research, to a great extent, is paralleled by similar research by the corn sweetener industry (6-17). While the potential users acknowledge awareness of the Iowa State research, they were reluctant to discuss their specific anticipated utilization of the immobilized enzyme research (6-16, 6-17). However, none of the 11 corn sweetner syrup manufacturers thought that immobilization of glucoamylase was important to the industry (6-18). In view of industry reluctance to discuss future plans, the ultimate significance of this research is difficult to evaluate.

1. **PRINCIPAL PRODUCT** : Chemical Process, Proof of Concept
2. **PROGRAM AREA** : Productivity
3. **MANAGEMENT FACTORS:** Two changes in Principal Investigator.

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (6-5)
6. **USER AWARENESS** : High (6-18)
7. **USER VALUE** : Low (6-17, 6-18, 6-22, 6-23)
8. **USERS SURVEYED** : Industry--12

A GUIDE TO MUNICIPALITIES FOR
CABLE TELEVISION FRANCHISING DECISIONS

CASE NO. : 7
AWARD NO.: GI-32107
PERIOD : 12/71-4/73
FUNDING : $267,000

PRINCIPAL INVESTIGATOR: Dr. Walter S. Baer
Rand Corporation

RESEARCH SUMMARY: The purpose of this research was to provide local governments with background information for decisions on cable television franchising. The focus was on the assembly and synthesis of data on cable television. Specific subjects included present-day cable television technology and economies, new technical developments, evolution of two-way communications and other services on cable, interconnection of local cable systems and national networks, community applications, organization and financing of local programs, alternative ownership policies, local franchising issues, special benefits to communities, and relationships among Federal, state and local regulations (7-3). While the research generally consists of a review of the state-of-the-art of cable television, original research on the financial aspects of cable television systems is also included (7-5).

DISSEMINATION SUMMARY: Participation of potential users, i.e., local officials, educators, other professionals, citizen groups, and industry, formed the framework for dissemination (7-5, 7-6). Both unsolicited distribution and requests generated by an extensive advertising and publicity program resulted in a widespread distribution of project results (7-6, 7-7). In addition, project reports were published commercially to reach a wider audience (7-7).

USER IMPACT: The research has impacted on a wide and diverse audience. In Fresno, California the role of community groups in cable decisionmaking was based on this research (7-10). Philadelphia used information generated by the research in developing new franchise agreements and cable guidelines (7-11). The study results are also being used in university graduate telecommunications programs (7-12). The ultimate significance of the research lies in its contribution to improved and informed decisionmaking concerning cable television (7-13).

1. **PRINCIPAL PRODUCT** : Information for Policy and Other Guidance
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Excellent (7-10)
5. **END OF GRANT STATUS** : Completed, objectives attained (7-4, 7-5).
6. **USER AWARENESS** : Very High (7-5, 7-10 through 7-12)
7. **USER VALUE** : Very High (7-14, 7-15)
8. **USERS SURVEYED** : Other Government--5, Public--3, Research--2, Industry--1

INCREASING PRODUCTIVITY IN SERVICING CONSUMER DURABLES

CASE NO. : 8
AWARD NO.: GI-34841
PERIOD : 7/72-6/74
FUNDING : $412,800

PRINCIPAL INVESTIGATOR: Dr. J. H. Holloman
Massachusetts Institute of Technology

RESEARCH SUMMARY: This research evaluates alternatives for increasing productivity in servicing consumer durable products and/or reducing the need for service. This can reduce total owner costs (8-4). The project initially considered evaluating all home appliances, but ultimately focused on refrigerators and color television sets as being representative of electromechanical and electronic products, respectively. The research found that electrical power costs were a significant part of the life-cycle cost. The research also indicated that product reliability had increased substantially over the last decade and that reduced service costs are better achieved by improved product reliability than by a more efficient service industry (8-6).

DISSEMINATION SUMMARY: The results of this research have been disseminated through wide distribution of the final report, a national press conference, symposia, and meetings with industry, government, and consumer groups (8-7). Supplemental funding of $30,400 was provided for the preparation of a summary pamphlet and the national press conference (8-4, 8-7). Following the news conference information concerning the project appeared in over 600 newspapers throughout the United States, and feature articles appeared in over 30 national magazines (8-7).

USER IMPACT: Various government agencies have used the research results in furthering their own programs (Department of Agriculture, 8-14; Federal Trade Commission, 8-14; Federal Supply Service, 8-15; National Bureau of Standards, 8-15; Federal Energy Administration, 8-16). The League of Women Voters included the special research report in a kit distributed to their State and local branches (8-10) and a program based on the research was produced for airing on the Public Broadcasting series, "Consumer Survival Kit" (8-11). Industry has also used the research as input to market planning studies (Frigidaire, 8-12; Amana Refrigeration, 8-12; Carrier Corporation, 8-12). The ultimate significance of this research will be in its contributions to the development and public acceptance of consumer household durables with a minimum life-cycle cost and the savings in energy that will accrue from their use.

1. **PRINCIPAL PRODUCT**	:	Information for Policy Guidance and User Awareness
2. **PROGRAM AREA**	:	Productivity
3. **MANAGEMENT FACTORS:**		Special funding for dissemination of results (8-4).
4. **RESEARCH QUALITY**	:	Very Good (8-10 through 8-17)
5. **END OF GRANT STATUS**	:	Completed, objectives attained (8-17).
6. **USER AWARENESS**	:	Very High (8-7)
7. **USER VALUE**	:	Moderate (8-10 through 8-17)
8. **USERS SURVEYED**	:	Federal Government--12, Industry--4, Public--2

INNOVATIVE RESOURCE PLANNING AND
URBAN PUBLIC SAFETY SYSTEMS

CASE NO. : 9
AWARD NO.: GI-38004
PERIOD : 4/73-4/75
FUNDING : $700,000

PRINCIPAL INVESTIGATOR: Dr. Richard C. Larson
Massachusetts Institute of Technology

RESEARCH SUMMARY: This research addresses three major facets of urban public safety systems--evaluation criteria, models, and impacts of innovations (9-5)--with the goal of identifying improvements. Within the context of this research, urban public safety systems include police and emergency medical services. The overall objective is to develop policy-related procedures and guidelines for improved planning and decisionmaking (9-3). One product of the work is the refinement of a queuing model that facilitates computation of operational and performance measurement merits for police and emergency medical systems, and the application of this model in municipalities.

DISSEMINATION SUMMARY: The Principal Investigator's contacts with cities in the Boston area and the mailing of reports to a list compiled by consultation with Federal agencies, the International City Managers Association, and the International Association of Chiefs of Police, are the primary means by which results of the research have been disseminated. In addition, special on-campus seminar programs were used. A bimonthly newsletter is used to keep potential users informed of the progress of the research (9-12, 9-13). A project advisory board was also included as part of the dissemination effort (9-3).

USER IMPACT: Results of the research have been used to improve the quality of police service in several cities in the New England area. In Arlington, Massachusetts, more efficient use of police manpower was realized (9-14); in Boston queuing for police calls was reduced from 48 percent of all calls to seven percent, and police officers were released from clerical duties and placed on street duty (9-15). In the area of emergency medical services, the North Shore Health Planning Council (Region IV of the Massachusetts EMS districts) used the model to develop a new ambulance allocation system. This system had not yet been adopted at the time this case study was prepared (9-21). Ultimate significance of this research lies in its contribution to public safety in providing more prompt and more efficient police and emergency medical services (9-26).

1. **PRINCIPAL PRODUCT** : Computer Programs
2. **PROGRAM AREA** : Local Government
3. **MANAGEMENT FACTORS**: Limited utilization funding (9-24).

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (9-26)
6. **USER AWARENESS** : Moderate (9-24, 9-25)
7. **USER VALUE** : Moderate (9-24, 9-25)
8. **USERS SURVEYED** : Other Government--14

EFFECTIVENESS MEASUREMENTS FOR
LOCAL GOVERNMENT

CASE NO. : 10
AWARD NO.: GI-37180
PERIOD : 2/73-8/74
FUNDING : $345,500

PRINCIPAL INVESTIGATOR: Dr. Harry P. Hatry
Urban Institute

RESEARCH SUMMARY: The objectives of this research were to develop methodological tools for evaluation of the effectiveness of delivery of public services, and to test these tools in two cooperating cities (10-3). A basic analytical framework was developed, major obstacles were identified, and adjustments made to overcome these obstacles in application of the methodology in the two test cities (10-10). A multiservice citizens survey was developed to provide information on perception of service quality. A "trained observer" technique was developed to measure effectiveness of services amenable to visual inspection (10-11).

DISSEMINATION SUMMARY: Publication and distribution of project reports appear to have been the primary means for dissemination of research results (10-12). In addition, measurement techniques developed by the project staff were published in the International City Managers' newsletter, HUD newsletter, and in "The Nation's Cities" (10-12, 10-13).

USER IMPACT: Impact on users generally has been limited to Nashville, Tennessee and St. Petersburg, Florida, the two cooperating cities. In Nashville the effectiveness measures are being used by the mayor's central staff and the Finance Department in auditing the performance of line departments and in providing improved information to the city council (10-14, 10-15). In St. Petersburg, each service department is using effectiveness measures developed during the research (10-17). Data from a multiservice citizen's survey is being used to provide comparative data on productivity and effectiveness of public service delivery (10-17). This has resulted in reorganization of the Police Department, changes in Park and Recreation Department operating procedures, implementation of a new trash containerization project, and the institution of courtesy home fire inspections (10-7 through 10-19). Other cities are also using the effectiveness measures (Palo Alto, California 10-21, Charlotte, North Carolina, 10-22). The ultimate significance of the research lies in its contribution to the improvement of quality and reduction in cost of municipal services (10-23).

1. **PRINCIPAL PRODUCT**	:	Information for Policy and Planning Guidance
2. **PROGRAM AREA**	:	Local Government
3. **MANAGEMENT FACTORS:** a		One change in NSF Program Manager. Funding limitations are limiting distribution of final report (10-13, 10-25).
4. **RESEARCH QUALITY**	:	Very Good (10-12 through 10-23)
5. **END OF GRANT STATUS**	:	Complete, objectives attained (10-6 through 10-8).
6. **USER AWARENESS**	:	Moderate
7. **USER VALUE**	:	Moderate (10-24)
8. **USERS SURVEYED**	:	Other Government--12

ASSESSMENT OF RESEARCH ON NATURAL HAZARDS

CASE NO. : 11
AWARD NO.: GI-32942
PERIOD : 4/72-6/74
FUNDING : $798,900

PRINCIPAL INVESTIGATOR: Dr. G. F. White
University of Colorado in Boulder

RESEARCH DESCRIPTION: This research focuses on research efforts and research needs with regard to natural hazards. The overall objective is the provision of information on policy alternatives and evaluation of existing research concerning these hazards (11-3). The research included analyses of (1) existing data (2) the quality of the data, (3) the effectiveness of measures for coping with hazards, (4) the probable effectiveness of alternative methods, and (5) costs and benefits of the various methods (11-4). Fifteen natural hazards were studied. Analysis of current losses, benefits, and research activities indicated the state-of-the-art for coping with and the magnitude of each hazard. Alternative approaches or responses to natural hazards were developed through scenario analysis (11-6, 11-7).

DISSEMINATION SUMMARY: Dissemination of the research results was initiated by a national conference in October 1973. Approximately 150 contributors and potential users of the research critically reviewed the information and analysis for each hazard. Reports and monographs were distributed to a listing of about 1,000 potential users developed by canvassing Federal and State agencies. A newsletter was also used to report significant events and updated news of research efforts (11-11).

USER IMPACT: User impact cannot be fully assessed because the final report was just published. Some impact, however, can be identified. A 19-page booklet, "A Broadcaster's Guide to Planning for a Natural Disaster," was published and distributed by the National Association of Broadcasters (11-12). The research priorities established by the project team had a strong influence on NOAA's 1975 and 1976 budget (11-14). The American Red Cross made internal distribution of the project results (11-15). The Red Cross, with assistance from the National Weather Service, has initiated a program of tornado-drills in tornado-prone areas as a result of the research finding that effective dissemination of warning information was a more urgent need than new communication technology (11-15, 11-16). The ultimate significance of the research lies in its contribution to the reduction of losses in life and property from natural hazards.

1. **PRINCIPAL PRODUCT** : Information for Policy and Other Guidance
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Not determinable from case study data.
5. **END OF GRANT STATUS** : Complete, objective attained (11-8).
6. **USER AWARENESS** : High (11-13 through 11-16)
7. **USER VALUE** : Moderate (11-13 through 11-16)
8. **USERS SURVEYED** : Federal Government--4, Public--1, Researchers--1

ENERGY UNDER THE OCEANS--A TECHNOLOGY ASSESSMENT OF OUTER CONTINENTAL SHELF OIL AND GAS OPERATIONS

CASE NO. : 12
AWARD NO.: GI-29942
PERIOD : 10/71-5/73
FUNDING : $250,000 plus

PRINCIPAL INVESTIGATOR: Dr. D. E. Kash and Dr. I. L. White
University of Oklahoma

RESEARCH SUMMARY: This interdisciplinary integrated technology assessment of outer continental shelf (OCS) oil and gas operations was initially planned as a thorough review and commentary on existing and future physical technologies and technological alternatives for OCS oil and gas operations. Physical technologies were found to be relatively more stable than social technologies, e.g., the policy environment provided by government management and regulation of OCS development. As a result the study was reformulated to emphasize OCS policy issues in addition to the physical technologies (12-7). Specific policy recommendations for management and regulation of OCS oil and gas development were made (12-5).

DISSEMINATION SUMMARY: Primary dissemination of the research results was through the commercial publication of Energy Under the Ocean, a book based on the project results. The first 1,000 copies were purchased by NSF for distribution among government agencies with subsequent sales entirely to private and industry users. As of June 1975, the book was in its third printing of 2,500 copies (12-8). Dissemination was also accomplished by a one-week seminar on offshore energy development in 1972 (12-7, 12-8). Presentations at symposia, conferences, and congressional hearings also served to widen the distribution of project results (12-3).

USER IMPACT: The results of this study were used by a large number of Federal and State government agencies, by industry, by environmental interest groups, and by others interested in OCS oil and gas development (12-4). As a result of the study, the Bureau of Land Management required more extensive environmental impact statements for offshore leasing (12-11, 12-12). The U.S. Geological Survey has substantially modified and redirected its OCS management practices (12-12). NOAA has referenced and quoted the report in its handbook on OCS energy development (12-5). Study results were used in the development of new OCS-related legislation (12-17. The ultimate significance of this research lies in its contribution to reducing the United States' dependence on foreign oil through environmentally acceptable OCS oil and gas development.

1. **PRINCIPAL PRODUCT**	:	Information for Policy and Planning Guidance
2. **PROGRAM AREA**	:	Energy Policy
3. **MANAGEMENT FACTORS:**		Inclusion of social technologies in the study resulted in a more valuable and utilizable result.
4. **RESEARCH QUALITY**	:	Excellent (12-26, 12-27)
5. **END OF GRANT STATUS**	:	Completed, objective attained (12-5).
6. **USER AWARENESS**	:	Very High (12-27)
7. **USER VALUE**	:	Very High (12-27, 12-28)
8. **USERS SURVEYED**	:	Federal Government--17, Public--8, Industry--8

LOW COST CONTINUOUS FABRICATION OF SILICON SOLAR CELLS

CASE NO. : 13
AWARD NO.: GI-37067X
PERIOD : 3/73
FUNDING : $300,700

PRINCIPAL INVESTIGATOR: Dr. B. Chalmers, Howard University
Dr. A. I. Mlavsky, Tyco Laboratories, Inc.

RESEARCH SUMMARY: The objective of this research is to develop edge-defined, film-fed (EFG) growth technology, currently used in production of single-crystal aluminum oxide, for the production of low-cost continuous silicon crystal ribbon. The resultant single crystal silicon is to be used as substrates in the manufacture of low-cost silicon solar cells (13-5). Improvement in control of impurities and crystallinity during the research has enabled an increase in the efficiency of the silicon solar cells from an original 2 to 7.5 percent, approaching the 10 percent goal required for mass-produced devices; growth rate has been increased by 50 to 100 percent, and thinner and wider ribbons in lengths up to 6 feet have been routinely produced with the maximum continuous length pulled being 41 feet (13-8). The research has also resulted in the production of sufficient material for experimentation and evaluation by solar cell and other semiconductor device manufacturers (13-10).

DISSEMINATION SUMMARY: Research results have been reported through presentations by the principal investigators and their coworkers to industry, academia, and government organizations. Several of these meetings were NSF/RANN sponsored. The NTIS system has been the primary means for public access to the research results (13-13). Reliance on NTIS does not seem to be a satisfactory means for rapid dissemination of research reports (13-23).

USER IMPACT: Primary user impact has been in the form of a joint venture by Tyco Laboratories and Mobil Oil Company to commercially produce solar cells using the EFG process. Mobil plans to invest up to $30 million through 1982 to finance the further development of the EFG process and the other necessary fabrication operations required for the mass production of solar cells (13-20). The ultimate significance of this research lies in its contribution to the commercial application of solar energy (13-3, 13-4).

1. **PRINCIPAL PRODUCT**	:	Physical Process
2. **PROGRAM AREA**	:	Solar Energy
3. **MANAGEMENT FACTORS:**		One change in Program Manager did not appear to have a deleterious effect on the research.
4. **RESEARCH QUALITY**	:	Cannot be determined from case study.
5. **END OF GRANT STATUS**	:	Completed, objectives attained (13-8).
6. **USER AWARENESS**	:	Moderate (13-19, 13-23)
7. **USER VALUE**	:	Moderate (13-18)
8. **USERS SURVEYED**	:	Industry--6, Researchers--4

EVALUATION OF MEASURES FOR
CONSERVING ENERGY

CASE NO. : 14
AWARD NO.: GI-44#3
PERIOD : 7/70-
FUNDING : $680,000

PRINCIPAL INVESTIGATOR: Dr. D. N. Morris
Rand Corporation

RESEARCH DESCRIPTION: This research is directed to obtaining understanding of interactions between energy demand and supply, and to development of energy conservation measures (14-3). A major theme has been demand forecasting with emphasis on electrical energy and alternatives for reducing growth in energy consumption (14-4). Research products consist of analyses in report form of various energy-related subjects, e.g., industrial energy demand, effects of fuel price increases, projections of electrical energy demands, economic growth rates, gasoline conservation, and impacts of electricity price increases (14-3).

DISSEMINATION SUMMARY: Results of the studies have been disseminated through conferences, meetings, and public presentations; through direct interaction with, and testimony to legislators, legislative bodies, and public officials at all levels; and by means of an efficient publication system that results in automatic distribution of reports to about 300 addresses (14-4). Copies of the project reports are also available for purchase through Rand's publication department and NTIS. Over 18,000 copies have been distributed through these media (14-8).

USER IMPACT: Much of the user impact is untraceable because of the wide distribution and large number of recipients of the research results. However, the traceable portion is impressive (14-4). Rand project personnel have provided testimony before Congressional committees (14-25). The Federal Energy Administration reports that the Rand work had "a very high level of significance for FEA in transportation considerations" (14-8), and that the Rand work also influenced the promulgation of Federal guidelines on electricity conservation in lighting (14-8). Bills introduced in the California Assembly were based largely on analyses developed by the research (14-10 through 14-13). The ultimate significance of this research lies in its influence in the adoption of energy conservation measures by all levels of government and the public acceptance and use of such measures (14-7).

1. **PRINCIPAL PRODUCT** : Information for Policy Guidance
2. **PROGRAM AREA** : Energy Policy
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Excellent (14-7 through 14-15)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (14-17).
6. **USER AWARENESS** : Very High (14-15, 14-16)
7. **USER VALUE** : Very High (14-14)
8. **USERS SURVEYED** : Federal Government--2, Other Government--4, Researchers--1

NEW TECHNIQUES FOR GASIFYING COAL

CASE NO. : 15
AWARD NO.: GI-34286
PERIOD : 6/72-
FUNDING : $1,479,283

PRINCIPAL INVESTIGATOR: Dr. A. Squires
City University of New York

RESEARCH SUMMARY: Specific objectives are to provide a technical basis for pilot scale processes for producing fuel gases from coal. Emphasis is on fast fluidized beds and agglomerating fluidized beds that either react coal with hydrogen or gasify coal or coke with air and steam (15-3). "Coalplex," the focus of this project, is a conceptual integrated facility that converts coal to methane, benzene, and low-Btu gas (15-5). The research has resulted in the development of a fast fluidized bed reactor that produces a higher quality gas than conventional gasifiers. This system, the Mark I gasifier, results in a 99 percent conversion of coal to gas, and is apparently ready for commercialization (15-7).

DISSEMINATION SUMMARY: Dissemination of the research results to immediate users--the energy industry and government policymakers--has been through the Project Review Committee, public briefings, presentations at scientific meetings, publications in professional journals, academic instruction, graduate student training, and personal interactions between the project team and potential users (15-10, 15-11).

USER IMPACT: Information generated by this research is being applied by a variety of users. Members of the project team are consulting with Union Carbide on a major coal gasification effort (15-12), and with the U.S. Bureau of Mines on the Synthane process development (15-12). The "Squires reaction" is being applied independently by Consolidated Coal Co., Westinghouse, Air Products, Inc., U.S. Steel and Heurtey (France) in large-scale development of fuel gas desulfurization (15-13). The ultimate significance of this research lies in its contribution to the commercialization of processes for converting U.S. high-sulfur coal into environmentally acceptable gaseous fuels.

1. **PRINCIPAL PRODUCT** : Chemical Process
2. **PROGRAM AREA** : Energy Technology
3. **MANAGEMENT FACTORS:** Review committee played an important role (15-19, 15-20).
4. **RESEARCH QUALITY** : Very Good (15-17)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (15-8, 15-13).
6. **USER AWARENESS** : Moderate (15-12 through 15-17)
7. **USER VALUE** : Low (15-19)
8. **USERS SURVEYED** : Not available from data in the case study.

TRANSPORTABLE SOLAR ENERGY
RESEARCH LABORATORY

CASE NO. : 16
AWARD NO.: GI-41537
PERIOD : 11/73
FUNDING : $625,000

PRINCIPAL INVESTIGATOR: Mr. Robert Le Chevalier, Honeywell, Inc.

RESEARCH SUMMARY: The objectives of this project are to collect data on the performance of a solar energy conversion system, to test the system and its components in actual operation, and to communicate the potential of solar energy conversion systems to community leaders in education, engineering, science, government, and industry (16-3). During the first nine months of the program, the Transportable Solar Laboratory (TSL) was designed, fabricated, and tested (16-8). The TSL contains a solar energy collector and distribution system, and instrumentation and data collection systems. These are installed in an 8 x 45-foot van and a 12 x 50-foot mobile office. The key component of the solar energy heating and cooling system is a flat plate collector array consisting of individual panels approximately 3 x 4 feet, water is the basic working fluid of the system. The instrumentation and data collection systems accumulate data on key operating conditions at key points in the system under various climatic conditions (16-10). The TSL also includes a visitors reception area where static and audio-visual presentations on solar energy conversion are made (16-5). As of May 1975, the TSL had collected data and had been demonstrated at 15 sites of the United States (16-18).

DISSEMINATION SUMMARY: Demonstrations, audio-visual presentations, and special briefings to, and personal interactions of the project staff with visitors to the TSL, are the primary means for disseminating information on the project (16-17). Press briefings and VIP briefings for local officials, legislators, architects, heating contractors, and others involved in solar energy decisionmaking, were held in approximately half of the cities visited. Handouts, in the form of press kits, were prepared for each location (16-18, 16-19).

USER IMPACT: User impact directly attributable to the TSL cannot be assessed because of the large number of visitors at the demonstrations and their exposure to other sources of solar energy information (16-19). The ultimate significance of this research lies in its influence on decisionmakers at all levels, in adopting solar energy conversion systems.

1. **PRINCIPAL PRODUCT** : User Awareness
2. **PROGRAM AREA** : Solar Energy
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (16-5, 16-6).
6. **USER AWARENESS** : Very High (16-19)
7. **USER VALUE** : Cannot be determined from case study.
8. **USERS SURVEYED** : Cannot be determined from case study.

SOLAR SCHOOLS DEMONSTRATION PROJECT

CASE NO. : 17
AWARD NO.:
PERIOD : See following page
FUNDING :

PRINCIPAL INVESTIGATOR (s):

Timonium Elementary School Project:	I. R. Barr, AII
Grover Cleveland School Project:	Al Arken, General Electric Space Division
Northview Junior High School Project:	John Kopecky, Honeywell, Inc.
Fauquier High School Project:	Dr. George Szego, Inter-technology Corporation

RESEARCH SUMMARY: These proof-of-concept experiments studies demonstrate use of solar energy for supplying part of the heating requirements for four public schools. The overall objective was to demonstrate that solar heating is a technologically viable option as an energy source (17-3). The solar heating systems used in all four projects were of the same basic design. All systems were operative by mid-April, 1974, and data collected during the remainder of the heating season (17-3). Each system was instrumented for evaluation of performance and provided with automatic controls for the various operating modes, e.g., heating, storage, and heating plus storage (17-4). Performance data under diverse operating conditions were obtained. The results indicate that operating costs were low and substantial fuel savings resulted. However, actual and projected construction costs were higher than could be economically justified under conditions existant during the demonstration period (17-11, 17-12).

DISSEMINATION SUMMARY: Dissemination of research results has been primarily through demonstration at the sites and the briefing of visitors to the model schools. Special visits of interested groups, e.g., legislators, state governors, were arranged and information specific to these potential user groups provided during the visits (17-13). In addition, there was some serendipitious dissemination through contractor-subcontractor relationships during the construction and operation of the four systems (17-12). As of April 1971, a short film of the program had been shown to an estimated 5,000,000 television viewers and a theater audience of over 600,000 (17-21).

USER IMPACT: The impact of the four projects is difficult to trace and evaluate (17-12). Each of the four contractors have continued their interest in solar energy systems, and are currently pursuing programs in this area (17-16 through 17-18). The impact of the demonstration project

1. **PRINCIPAL PRODUCT** : Potential User Awareness, Proof of Concept
2. **PROGRAM AREA** : Solar Energy
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Complete; objectives attained (17-23).
6. **USER AWARENESS** : Moderate (17-13, 17-14)
7. **USER VALUE** : Moderate (17-11, 17-12)
8. **USERS SURVEYED** : Industry--10, Public--4

USER IMPACT (continued)

on the school systems has been generally favorable. However, the economics of new construction or retrofitting may preclude adoption of solar heating systems for school heating (17-20). The ultimate significance of this demonstration project lies in its contribution to the development of solar heating systems that are economically acceptable.

PROJECT DATA

Timonium Elementary School, Baltimore, Maryland

Contractor: AAI
Award No.: C-871-1
Period: 1/74-
Funding: $490,000 (approximate)

Grover Cleveland Middle School, Boston, Massachusetts

Contractor: General Electric Space Division
Award No.: C-869
Period: 1/74-
Funding: $541,000

Northview Junior High School, Minneapolis, Minnesota

Contractor: Honeywell, Inc.
Award No.: C-870-1
Period: 1/74-
Funding: $398,000

Fauquier High School, Warrenton, Virginia

Contractor: Intertechnology Corporation
Award No.: C-868-1
Period: 1/74-
Funding: $292,000

A COMPREHENSIVE RESEARCH PROGRAM ON MANAGEMENT OF HEAT REJECTED FROM LARGE POWER PLANTS

CASE NO. : 18
AWARD NO.: GI-34932
PERIOD : 7/72
FUNDING : $389,300

PRINCIPAL INVESTIGATOR: Dr. G. S. Trezek and Dr. V.E. Schrank
University of California at Berkeley

RESEARCH SUMMARY: This research focused on the improvement of methods for waste heat disposal from large power plants in an environmentally acceptable manner. While conservation of energy is not a primary goal, it is of interest (18-3). Three mechanisms of waste heat rejection are under study (1) heat transfer across the air-water interface, (2) heat transfer by water droplets, and (3) heat transfer by mechanical/thermal mixing. Infrared sensing of thermal plumes was investigated to verify computed outfall temperature patterns (18-6). Emphasis has been on performance of spray ponds to include studies of water loss and effects of spray nozzle distribution patterns. A computer model for predicting cooling tower performance has been developed and basic hydraulic studies conducted on the behavior of thermal plumes from the discharge of heated water into the environment (18-7). The research also encompasses the study of methods for utilization of rejected heat or hot water. The project team is currently studying the possibility of optimizing a cooling system through the proper mix of cooling mechanisms (18-8).

DISSEMINATION SUMMARY: Primary means for dissemination of research results has been through periodic meetings with technical personnel from industry, environmental, and other user communities (18-4). In addition, a series of reports and other technical publications were prepared (18-10). Graduate students participating in the project also serve as a means of dissemination. Many of them have joined the industrial cooling tower industry on graduation (18-15).

USER IMPACT: This research has had a significant impact on various aspects of waste heat management (18-16). The effectiveness of spray ponds for meeting the requirements of AEC (now Nuclear Regulatory Commission) was demonstrated at the Rancho Seco Nuclear Generating Station being constructed by the Sacremento Municipal Utilities District (18-10). A manufacturer of spray nozzles has changed designs (18-12). A one-tenth scale physical model is being built for the Pacific Gas and Electric Company to study thermal discharge effects (18-15). The ultimate significance of this research lies in its contribution to environmentally acceptable methods for waste heat disposal.

1. **PRINCIPAL PRODUCT** : Physical Processes
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS:** Goals changed to meet specific needs identified during the research (18-6).
4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (18-16).
6. **USER AWARENESS** : High (18-9 through 18-16)
7. **USER VALUE** : High (18-9 through 18-16)
8. **USERS SURVEYED** : Not specified in case study.

SOLVENT REFINED COAL STUDIES

CASE NO. : 19
AWARD NO.: GI-34932
PERIOD : 4/73
FUNDING : $220,000

PRINCIPAL INVESTIGATOR: Dr. Z. L. Taylor
Auburn University

RESEARCH SUMMARY: This research focuses on the reaction dissolution step of the Solvent-Refined Coal (SRC) process (19-5). Detailed studies are being conducted on the mechanism of coal dissolution as a function of solvent type, rate-limiting factors, dissolution kinetics, and dissolution flow modeling (19-5, 19-7). The overall goal is the development of an understanding of the basic dissolution process that will provide a rational basis for improvements in reactor design (19-7). Process variables affecting the extract-mineral separation process will be the subject of future study (19-7). Conclusions and findings of the research to date have been applied in the SRC pilot plant operated by Southern Services, Inc. (19-16, 19-17).

DISSEMINATION SUMMARY: Close association with the Southern Services, Inc., and the Office of Coal Research have been the primary means for disseminating research results (19-11, 19-16). Transfer of technology emanating from the research is stimulated through an active Project Review Committee (19-17). In addition, numerous presentations have been made to local and regional industrial, governmental, and professional groups (19-19).

USER IMPACT: Impact on potential users has been limited to Southern Services, Inc. and the Office of Coal Research (OCR). Information developed at the SRC pilot plant has been incorporated in modification of the Fort Lewis, Washington pilot plant operated by the Office of Coal Research (19-11). Eventually the data will be incorporated into the design of a 10,000 ton/day SRC plant (19-11). The ultimate significance of this research lies in its contributions to the development of coal conversion systems that will permit the environmentally acceptable use of high-sulfur coals.

1. **PRINCIPAL PRODUCT** : Chemical Process--Solvent Refined Coal
2. **PROGRAM AREA** : Energy Technology
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim objectives (19-7).
6. **USER AWARENESS** : Low (19-14 through 19-17) (19-18)
7. **USER VALUE** : Low (19-16, 19-17)
8. **USERS SURVEYED** : Federal Government--3, Industry--16

ENERGY CONSERVATION AND THE ENVIRONMENT

CASE NO. : 20
AWARD NO.: AG 398 A#1
PERIOD : 7/70
FUNDING : $500,000/year

PRINCIPAL INVESTIGATOR: Dr. Roger S. Carlsmith
Oak Ridge National Laboratory

RESEARCH SUMMARY: This research initially focused on three broad program areas: (1) energy conservation, (2) coal systems studies, and (3) energy research information (20-3). As of the time the case study was prepared, the latter two areas were funded under separate NSF grants (20-3). The energy conservation group investigates opportunities to conserve energy through use of technology and changes in individual behavior; the coal systems group considers constraints on coal production and estimates, the environmental and monetary costs of alternative mining strategies; and the energy information group disseminates energy-related information. The overall objective of the project is the provision of energy information to decisionmaking at all levels (20-5).

DISSEMINATION SUMMARY: Results of the research have been disseminated through technical reports, presentations at professional meetings, personal contacts, testimony at hearings, and in the publication Energy Abstracts for Policy Analyses (20-4). Although many of the research results have value and appeal to the general public, little effort for dissemination in this area has been expended (20-5). Symposia have also been used as a dissemination means (20-7).

USER IMPACT: Research results have found wide use with regulatory and decisionmaking bodies: The Ohio Power Siting Commission in forecasting energy demands (20-10); the General Accounting Office in recommending upgrading of HUD insulation standards (20-13), HUD in the development of upgraded insulation standards (20-13, 20-14); the General Services Administration in the procurement of window air conditioners (20-15); and the Federal Energy Administration in preparing proposals to Congress (20-16). The ultimate significance of this research lies in its contribution to making the United States more energy self-sufficient through conservation measures.

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Energy Policy
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Very Good (20-5)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (20-4, 20-5).
6. **USER AWARENESS** : Very High (20-4, 20-5)
7. **USER VALUE** : Very High (20-8 through 20-17)
8. **USERS SURVEYED** : Federal Government--7, Other Government--2, Industry--3, Public--1

TECHNOLOGY INTEGRATION IN CITY OPERATION

CASE NO. : 21
AWARD NO.: GI-34903
PERIOD : 6/72
FUNDING : $178,000

PRINCIPAL INVESTIGATOR: Mr. W. Donaldson
City of Tacoma, Washington

RESEARCH SUMMARY: This project is intended to demonstrate the extent to which science and technology can improve the delivery of municipal services. Emphasis is on the identification of technology that can be transferred successfully into city operations (21-3). A team of industrial, university, and city participants in Tacoma, Washington, is seeking solutions to specific problems defined by city officials and is developing an institutional capability within the City of Tacoma to sustain technology transfer upon termination of NSF funding (21-3). A Technology Transfer Center has been established in the city government structure to accomplish this (21-3).

DISSEMINATION SUMMARY: Dissemination efforts to other cities have consisted of technology transfer field days (two), fire department field days (two), and numerous publications and presentations by key personnel (21-5). In addition, Boeing, the industry member of the project team, is marketing computer software, developed during the research, to other cities (21-5).

USER IMPACT: Impact of the research has been primarily on the City of Tacoma in the establishment of a special office for technology transfer within the governmental structure (21-3). The ultimate significance of this research lies in the degree to which other cities adopt this method for identifying and utilizing technology in the solution of city problems and in the improvement of city operations.

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Local Government
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (21-11), (21-12).
6. **USER AWARENESS** : Low (21-12)
7. **USER VALUE** : Low (21-12), (21-13)
8. **USERS SURVEYED** : Federal Government--2, Other Government--15, Industry--1, Researchers--2

DEVELOPMENT OF X-RAY FLUORESCENCE ANALYSIS AND APPLICATION TO ATMOSPHERIC AEROSOLS

CASE NO. : 22
AWARD NO.: GI-32932
PERIOD : 3/72-6/76
FUNDING : $264,400

PRINCIPAL INVESTIGATOR: Dr. T. A. Cahill and Dr. F. P. Brady
University of California at Davis

RESEARCH SUMMARY: The development and evaluation of X-ray analytical techniques for quantitative analysis of materials related to energy and environmental activities were undertaken in this project (22-3). Emphasis was on X-ray fluorescence (XRF) and ion-excited X-ray emission (IEXE) methods of elemental analysis. The research has resulted in an improved IEXE analysis system, an automated XRF system, computer codes for automated sample analysis, alpha particle scattering techniques for analysis of light elements, and inexpensive atmospheric sampling techniques (22-5).

DISSEMINATION SUMMARY: The primary media for dissemination of research results was the intense involvement of the project team with the user community, cooperative programs, project reports, and publication in technical journals (22-12, 22-13).

USER IMPACT: The results of the research have been accepted by the user community. The developed system has been applied to the analysis of over 30,000 samples for the California Air Resources Board alone (22-14). Other government and private organizations have used the system for the analysis of environmental samples (22-14 through 22-18). The system has also been applied to the elemental analysis of materials in the search for new heavy elements (22-19). At least ten facilities have been, or are, in the process of being created for performing analyses using hardware, techniques, and software developed by the Davis team (22-5). The ultimate significance of the research will be its contribution to the enhancement of environmental quality by permitting accurate and cost-effective determination of atmospheric pollutants.

1. **PRINCIPAL PRODUCT** : Physical Devices--X-Ray Fluorescence Analysis Systems
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS**: Two changes in RANN Program Managers. Did not seem to have a deleterious effect on the project.
4. **RESEARCH QUALITY** : Excellent (22-20, 22-22)
5. **END OF GRANT STATUS** : Completed, objectives attained (22-23, 22-24).
6. **USER AWARENESS** : Very High (22-13 through 22-19, 22-20, 22-21)
7. **USER VALUE** : Very High (22-13 through 22-19)
8. **USERS SURVEYED** : Other Government--3, Researchers--5

DREDGE SPOIL DISTRIBUTION AND ESTUARINE EFFECTS

CASE NO. : 23
AWARD NO.: GI-34346
PERIOD : 7/72-
FUNDING : $1,146,500

PRINCIPAL INVESTIGATOR: Dr. L. Slotta and Dr. W. L. Schroeder
Oregon State University

RESEARCH DESCRIPTION: The objective of this research is to identify, assess, and develop techniques that minimize environmental impacts of estuarine dredging (23-6). During the research, the scope was expanded to include other estuarine disturbances, e.g., shipping (23-9), as well as long-term chronic perturbations of the estuarine environment (23-11). A conceptual model developed during the research permits the systematic analysis of the complex estuarine benthic systems by a two-dimensional depiction of the three-dimensional relationship between sediment organic content and rate of sediment turnover, and selected valuables such as sediment particle size and sulfide content of the area under study (23-9). The research will culiminate in a specific guideline for assessment of impacts of dredging on estuarine ecosystems (23-12).

DISSEMINATION SUMMARY: Personal contacts by the project staff, publication in scientific journals, conferences, and workshops are the primary media for dissemination of research results (23-14). An extension specialist on the project staff has conducted mini-workshops, seminars, and conferences on coastal and estuarine management for the general public and the scientific and governmental sectors (23-15). The advisory committee also serves as a dissemination means (23-15). A symposium/workshop covering the guidelines for impact assessment is planned (23-14). Dissemination is taking place through graduate students after completion of their studies at Oregon State University (23-17).

USER IMPACT: Impact on potential users has been limited generally to the Pacific area (23-29). The U.S. Army Corps of Engineers has used the research results in evaluating environment impacts from dredging operations (23-17), in temporally and spatially scheduling dredging operations (23-18), and in a hopper dredging project (23-19). The National Marine Fisheries Service is using research concepts for evaluating proposed dredging projects (23-21). The ultimate significance of the research lies in its contribution to maintenance of environmental quality in estuaries subject to dredging.

1. **PRINCIPAL PRODUCT**	:	Information for Policy and Planning Guidance
2. **PROGRAM AREA**	:	Environmental Effects
3. **MANAGEMENT FACTORS:**		One change in Program Manager, one change in Principal Investigator.
4. **RESEARCH QUALITY**	:	Excellent (23-26)
5. **END OF GRANT STATUS**	:	Continuing, meeting interim goals (23-28).
6. **USER AWARENESS**	:	Low (23-29)
7. **USER VALUE**	:	Moderate (23-17 through 23-25)
8. **USERS SURVEYED**	:	Federal Government--13, Other Government--3, Industry--3, Researcher--6

LABORATORY CLOUD SIMULATION TO SUPPORT WEATHER MODIFICATION RESEARCH AND FIELD PROGRAMS

CASE NO. : 24
AWARD NO.: GI 32894
PERIOD : 71-
FUNDING : $478,000

PRINCIPAL INVESTIGATOR: Dr. K. L. Grant and Dr. M. L. Corvin
Colorado State University

RESEARCH SUMMARY: This project provides a facility for regular testing of aerosol generators used in cloud seeding and for conducting cloud physics research (24-8). The test facility consists of a 1 m^3 or cubic meter isothermal cloud chamber; a 1 m^3 or cubic meter controlled slow-expansion cloud chamber, and a 9 m variable-flow, vertical dilution tunnel (24-9). This facility can evaluate devices for the artificial nucleation of clouds in terms of the density of nuclei produced under a set of standard conditions and procedures.

DISSEMINATION SUMMARY: Direct discussions with other researchers, publication of technical papers, and participation in symposia and conferences are the primary media for dissemination of results of the research (24-14).

USER IMPACT: Approximately 95 percent of the artificial nucleating agent generating devices in use in the United States, and a large percentage of those in use in other western bloc nations have been calibrated by the research facility. Testing has been carried out for U.S. Federal and local government agencies, foreign government agencies, domestic and foreign universities, and commercial organizations (24-14). The ultimate significance of this research lies in its contribution to the success of this country's weather modification programs.

1. **PRINCIPAL PRODUCT** : Physical Process - Test Facility
2. **PROGRAM AREA** : Weather Modification
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Very Good (24-20, 24-24)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (24-4, 24-6).
6. **USER AWARENESS** : High (24-22)
7. **USER VALUE** : High (24-15 through 24-20)
8. **USERS SURVEYED** : Federal Government--3, Other Government--2, Industry--7

FEASIBILITY STUDY: COORDINATION OF DATA COLLECTION ACTIVITIES ON THE NATION'S BUILDING INVENTORY

CASE NO. : 25
AWARD NO.: P313303/C310-266
PERIOD : 7/73-2/74
FUNDING : $25,000

PRINCIPAL INVESTIGATOR: Mr. R. M. Dillon
National Academy of Sciences

RESEARCH SUMMARY: This research addresses the feasibility of coordinating data collection activities and survey procedures relating to establishing the characteristics of the nation's housing, buildings and related facilities (25-4). The study concluded that while it would be desirable to coordinate data collection and survey activities among the many organizations involved, further study is necessary to determine the degree of coordination required. This follows from the magnitude of the problem and the complexity and scope of the data needs of the various and diverse users (25-9).

DISSEMINATION SUMMARY: Because of funding limitations, the research results have not been presented in a final report (25-6). Primary means of dissemination has been through active participation of the potential users in the conduct of the feasibility study (25-11). In addition, workshops were used (25-10).

USER IMPACT: Other than making potential users aware of the problems involved in acquiring the complex and diverse information on the nation's building inventory, there has been little impact on the user community (25-10 through 25-16). Funding limitations and the fact that the research was inconclusive insofar as the feasibility of a coordinated building inventory system is concerned, has limited user impact (25-18). The ultimate significance of this research cannot be determined from information contained in the case study.

1. **PRINCIPAL PRODUCT** : Potential User Awareness
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS**: Funding limitations preclude publication of a final report (25-6).
4. **RESEARCH QUALITY** : Fair (25-17, 25-18)
5. **END OF GRANT STATUS** : Completed, objectives not attained (25-17).
6. **USER AWARENESS** : Very High (25-10 through 25-16)
7. **USER VALUE** : Low (25-18)
8. **USERS SURVEYED** : Federal Government--6, Other Government--3, Industry--2.

BIOLOGICAL CONVERSION OF ORGANIC REFUSE TO METHANE

CASE NO. : 26
AWARD NO.: GI-39191
PERIOD : 6/73-5/76
FUNDING : $284,900

PRINCIPAL INVESTIGATOR: Dr. J. T. Pfeffer
University of Illinois

RESEARCH SUMMARY: This research deals with the anaerobic digestion of organic refuse to produce methane (26-3). It included an evaluation of the potential of biological fermentation of urban refuse to produce methane, generation of process data required for design of large-scale systems, and development and validation of a mathematical simulation of the process (26-4). Research results include development of reliable design parameters, evaluation of the dewatering characteristics of the residue slurry, determination of means to increase process efficiency, and evaluation of residue utilization (26-4). An analytical model was developed for computer simulation and economic evaluation of process configurations and operating conditions (26-4).

DISSEMINATION SUMMARY: Dissemination of research information was accomplished by contact with the user community through public media news releases, personal contact, trade journals, and trade organizations. Presentations were made at symposia and conferences, publication in technical and scientific journals, and periodic formal reports (26-11, 26-12, 26-22). In addition to broad newspaper and television coverage in the midwest, national coverage was achieved on a segment of the NBC Today Show (26-22).

USER IMPACT: Primary user impact has been the funding of a "proof of concept" plant by ERDA (26-24). ERDA is also planning to apply bioconversion to generate methane for agricultural residues and the Department of Agriculture is currently evaluating the use of feedlot wastes as a source of methane (26-24). The ultimate significance of this research lies in its contribution to the development of an energy source to supplement fossil fuel and to the development of an economically and environmentally acceptable means for the disposal of urban refuse (26-31).

1. **PRINCIPAL PRODUCT** : Chemical Processes
2. **PROGRAM AREA** : Energy Technology
3. **MANAGEMENT FACTORS:** Three changes in Principal Investigator.

4. **RESEARCH QUALITY** : Excellent (26-23)
5. **END OF GRANT STATUS** : Completed, objectives attained (26-6).
6. **USER AWARENESS** : Very High (26-24)
7. **USER VALUE** : Low (26-24, 26-25)
8. **USERS SURVEYED** : Federal Government--4, Other Government--2, Industry--6, Researchers--10.

FIRE AND SMOKE SPREAD IN CORRIDORS

CASE NO. : 27
AWARD NO.: AEN-73-07749
PERIOD : 2/73-
FUNDING : $132,000

PRINCIPAL INVESTIGATOR: Dr. K. T. Yang, Dr. J. R. Lloyd, Dr. M. C. Dorn
University of Notre Dame

RESEARCH SUMMARY: This research focuses on the development of improved methods for predicting the movement of fire and smoke in enclosed areas (27-3). Overall goal is the development of a model that predicts fire and smoke behavior as a function of availability of combustible material, building geometry, and properties of lining materials and contents (27-3). The Fire Research Center, National Bureau of Standards (NBS), is collaborating in this research effort (27-7). The predictive model being developed will permit the simulation of large-scale fire tests and subsequent validation of the simulation through actual testing (27-7).

DISSEMINATION SUMMARY: Exchange of information between the research team and NBS has been the primary means for the dissemination of research results (27-5). A public awareness and education program has been initiated by NBS involving contacts with individuals and organizations having a professional interest in fire prevention and controls (27-5). A film presentation of the experimental studies is in the planning stages (27-15).

USER IMPACT: Because the project is still in its initial stages, the user audience is limited to technical fire researchers and academic theorists (27-5). The primary user, Fire Research Group at NBS, has not been significantly influenced by the research to date although NBS did suggest several simulation cases (27-16). The research findings have been incorporated in academic and training programs for Defense Civil Preparedness Agency personnel (27-17). The ultimate significance of this research lies in contribution to the reduction of losses from building fires through the development of a better understanding of the behavior of fire and smoke in enclosed spaces (27-19).

1. **PRINCIPAL PRODUCT** : Computer Programs: Fire and Smoke Spread Simulation Models
2. **PROGRAM AREA** : Fire Research
3. **MANAGEMENT FACTORS**: One change in Principal Investigator, transfer of the Program Manager and management to NBS.
4. **RESEARCH QUALITY** : Very Good (27-9)
5. **END OF GRANT STATUS** : Continuing, meeting interim objectives (27-21).
6. **USER AWARENESS** : Low (27-5, 27-15)
7. **USER VALUE** : Low (27-5, 27-16)
8. **USERS SURVEYED** : Federal Government--4, Industry--1.

COMPUTER ABUSES

CASE NO. : 28
AWARD NO.: GI-37226
PERIOD : 2/73-12/73
FUNDING : $39,000

PRINCIPAL INVESTIGATOR: Mr. D. B. Parker
Stanford Research Institute

RESEARCH SUMMARY: This research demonstrated that computer abuse is a serious and growing problem deserving national attention (28-3). A problem of national concern was identified and the involvement of computer in incidents of abuse established (28-3). Definition of the nature and extent of the problem will result in better approaches to reducing the problem (28-8). Case studies were performed to illustrate computer abuse; to explain how crimes, such as embezzlement, are changed in scale where computers are involved; to develop a typology of computer abuse; and to illustrate the social and legal implications (28-9).

DISSEMINATION SUMMARY: Publications in technical and trade journals, presentations at professional meetings, and wide distribution of the final report were the principal dissemination modes used (28-20, 28-21). Distribution of the final report was enhanced by special NSF funding--$18,000--for this purpose (28-3, 28-4). As a result of these efforts, information about the project and the subject of computer abuse appeared in national news magazines (28-21). A data bank on the case studies has been established with abstracts available for use in a time-shared computer service (28-21). The research results were presented to potential users in a culminating conference (28-11).

USER IMPACT: While the project reports have been widely disseminated, impact on the potential user community has been limited to the development of an awareness of the problem (28-13 through 28-21). The research has resulted in the funding of numerous follow-on studies (22-18, 22-19), and has found its way into computer sciences curricula (28-16, 28-17). The ultimate significance of this research lies in its contributions to the development of technical counter measures against computer abuse and to making the general public, legislators, computer scientists, auditors, and academia aware of the nature and extent of the problem (28-12, 28-13).

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:** Special grant for dissemination (28-3, 28-4).

4. **RESEARCH QUALITY** : Good (28-22)
5. **END OF GRANT STATUS** : Completed, objectives attained (28-3).
6. **USER AWARENESS** : Very High (28-20, 28-21)
7. **USER VALUE** : Moderate (28-13, 28-21)
8. **USERS SURVEYED** : Cannot be determined from case study.

PROBLEMS AND RESEARCH PRIORITIES IN
THE ROCKY MOUNTAIN REGION

CASE NO. : 29
AWARD NO.: GI-39421
PERIOD : 6/73-3/75
FUNDING : $114,800

PRINCIPAL INVESTIGATOR: Dr. S. M. Newhold
Utah State University

RESEARCH SUMMARY: The focus of this research was on the identification of specific research problems relating to environmental concerns of the Rocky Mountain region and on recommendations for funding priorities (29-4). A hierarchy of committees and task forces consisting of members of the research and user communities was organized to formulate and guide project activities (29-4). Separate task forces developed information on aspects of the environmental problem; five on resources, two on human systems, and one on the ecosystem (29-7). A synthesis workshop was used to identify important themes and gaps in the task force reports (29-8). Finally, through content analyses , the research needs identified during the project were prioritized (28-8).

DISSEMINATION SUMMARY: Heavy involvement of the research and user community in all phases of the research was the prime means of dissemination (29-4). Universities engaged in the research held open meetings on their campuses to keep the public and others informed on progress (29-12). Task force reports and a final report also served to disseminate information developed during the research (29-33).

USER IMPACT: The principal impact on the users has been the development of an awareness of their respective interests and concerns on the environmental problems and research priorities in the Rocky Mountain area (29-13). There are some indications this project was one factor among many that resulted in the formation of the Rocky Mountain Research Institute (29-13). Perhaps the major user impact is the better understanding of each other's problems by the diverse users who were brought together by the project (29-14, 29-17, 29-22, 29-23). The ultimate significance of this research lies in its contribution to identifying the significant environmental problems in the Rocky Mountain area and to obtaining a commitment of resources to solve these problems (29-4, 29-9).

1.	**PRINCIPAL PRODUCT**	: Information for Policy and Planning Guidance
2.	**PROGRAM AREA**	: Environmental Effects
3.	**MANAGEMENT FACTORS:**	One change in Program Manager. One change in Principal Investigator.
4.	**RESEARCH QUALITY**	: Fair (29-12 through 29-22)
5.	**END OF GRANT STATUS**	: Completed, objectives attained (29-8, 29-9).
6.	**USER AWARENESS**	: High (29-4)
7.	**USER VALUE**	: Low (29-12 through 29-22)
8.	**USERS SURVEYED**	: Federal Government--2, Other Government--5,

DEVELOPMENT OF A PLAN TO MAXIMIZE THE LEARNING FROM DESTRUCTIVE EARTHQUAKES

CASE NO. : 30
AWARD NO.: GI-38318
PERIOD : 5/73-12/75
FUNDING : $189,000

PRINCIPAL INVESTIGATOR: Dr. C. M. Duke, Mr. D. F. Moran
Earthquake Engineering Research Institute

RESEARCH SUMMARY: The objective of this research was to develop a plan to maximize the collection and dissemination of information from destructive earthquakes (30-3). Project elements were (1) identification of specific subjects and areas of interest, (2) development of a methodology for collecting the necessary information, and (3) development of a means for dissemination of the results of the investigations (30-3). A set of five manuals, Learning from Earthquakes, was prepared to provide guidance to the earthquake investigators in identifying, collecting, and recording data (30-4). This project constitutes the first phase of a three-phase program to maximize learning from earthquakes. Phase II covers the identification of resources to make the plan a viable one, and Phase III the implementation of the plan during an investigation following a destructive earthquake (30-11). Phase II was funded in April 1976 (30-24).

DISSEMINATION SUMMARY: No formal program for dissemination and familiarization with the guides on a national scale has taken place (30-6, 30-14). The earthquake Engineering Research Institute, the institutional grantee, provided information concerning the research as part of service to its members (30-6, 30-23). Presentations based on the research have been made at three national professional meetings (30-6).

USER IMPACT: Impact on the potential users of this research has been minimal. Delay in funding of Phase II of the research precluded use of the guidelines following major earthquakes in Guatemala and Italy (30-24, 30-25). The ultimate significance of this research lies in its contribution to the reduction of losses from earthquakes, by providing a systematic procedure for obtaining earthquake information.

1.	**PRINCIPAL PRODUCT**	Information for Planning Guidance
2.	**PROGRAM AREA**	Earthquake Engineering
3.	**MANAGEMENT FACTORS:**	Delay in funding Phase II precluded field testing of the guidelines (30-24, 30-25).
4.	**RESEARCH QUALITY**	Cannot be determined from case study.
5.	**END OF GRANT STATUS**	Continuing, meeting interim objectives (30-4).
6.	**USER AWARENESS**	High (30-14 through 30-23)
7.	**USER VALUE**	Moderate (30-14 through 30-23)
8.	**USERS SURVEYED**	Federal Government--4, Other Government--2, Industry--6, Researchers--2

RESEARCH AND DEVELOPMENT ON LITHIUM/SULFUR SECONDARY BATTERIES

CASE NO. : 31
AWARD NO.: AG000349
PERIOD : 2/72-2/74
FUNDING : $1,050,000

PRINCIPAL INVESTIGATOR: Mr. F.J. Cairns and Dr. Paul Nelson
Argonne National Laboratory

RESEARCH SUMMARY: This research is directed toward the development of a lithium/sulfur battery cell with cost, performance, and cycle life characteristics that will result in its becoming an efficient method for storing electrical energy (31-3, 31-5). Two demonstrations are planned for multicell batteries developed in this project. The first will be in a compact automobile in 1978, and the second a 10 megawatt battery in 1981, at a test facility being planned by ERDA, Argonne National Laboratory, and the Electric Power Research Institute (31-5). Research to date has resulted in doubling cell capacity with little or no degradation in cycle life. New concepts developed include the use of a solid lithium-aluminum cathode, an improved iron sulfide anode, and boron nitride separators. A major breakthrough necessary for commercialization appears to be a significant reduction in the cost of the boron-nitride separator. Carborundum Corporation is currently addressing this problem (31-5).

DISSEMINATION SUMMARY: The primary means of dissemination of research results is a program wherein battery and other interested manufacturers are invited to work with the project team in a paid capacity for periods of up to one year. This permits industry to identify development problems and participate in their solution; thereby becoming better qualified to bid on future development contracts (31-13). Information on research results has also been disseminated through traditional media such as the popular press, scientific literature, technical meetings, information exchanges between contractors, and demonstration projects (31-13, 31-14).

USER IMPACT: The results of the research to date appear to have been accepted by users (Gould, Inc., 31-14; Catalyst Research Corporation, 31-16; Eagle Pitcher Industries, 31-18; General Motors, 31-23). The ultimate significance of the research will be its contribution to the commercialization of an efficient and relatively inexpensive battery system for use in the automotive and utilities industries.

1. **PRINCIPAL PRODUCT** : Chemical Devices--Secondary Batteries
2. **PROGRAM AREA** : Energy Technology
3. **MANAGEMENT FACTORS:** One change in Program Manager. Did not appear to have a deleterious effect on the program.
4. **RESEARCH QUALITY** : Very Good (31-25)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (31-3).
6. **USER AWARENESS** : Very High (31-14 through 31-23)
7. **USER VALUE** : High (31-14 through 31-23)
8. **USERS SURVEYED** : Federal Government--3, Industry--7

CREATING AND EVALUATING AN EXPERIMENTAL INDUSTRY-UNIVERSITY FURNITURE R&D APPLICATIONS INSTITUTE

CASE NO. : 32
AWARD NO.: CG-0004
PERIOD : 7/73-9/78
FUNDING : $708,700

PRINCIPAL INVESTIGATOR: Mr. H. Burton
North Carolina State University (NCSU)

RESEARCH SUMMARY: This project is one phase of a three-part experiment designed to explore the feasibility of linking university R&D capabilities and resources with industry's needs to move technology more quickly into the market place (32-3). This project is a component of the overall NSF/RANN program, "Experiment in Cooperative Research," which is to determine if Federal funding of cooperative industry/university R&D programs will stimulate continued funding by industry (32-3). Under joint university and industry sponsorship, a Furniture R&D Applications Institute was established at NCSU with the purpose of increasing the rate of innovation in the furniture industry through jointly funded R&D designed to meet the industry's current needs (32-7). Federal seed money is used to stimulate lasting and mutually profitable industry-university R&D associations with complete financial support coming from the industry (32-9, 32-10).

DISSEMINATION SUMMARY: There are two potential user communities for the results of this project: government and private nonprofit agencies with interest in stimulating research and adoption of innovations in traditional industries, and the furniture industry itself (32-14). Dissemination of research information to the first user group has been through project reports, primarily to NSF/RANN, to the second user group through interaction and cooperative research projects with the furniture industry (32-4, 32-24, 32-25).

USER IMPACT: Impact on the government and private nonprofit user communities cannot be assessed until the overall NSF/RANN program, "Experiment in Cooperative Research," is completed (32-14). Impact on the furniture industry has been limited to individual cooperating firms and is not industry wide (32-15). Specific examples include, demonstration of a patented chair frame construction process (32-17), improvement in production control and scheduling (32-17, 32-18), improved quality of furniture (32-18), and energy conservation (32-16). Ultimate significance of the research lies in its influence in obtaining furniture industry funding for cooperative research programs and translation of the experiences to other industries through the NSF/RANN program.

1. **PRINCIPAL PRODUCT**	:	Information for Policy Guidance
2. **PROGRAM AREA**	:	Productivity
3. **MANAGEMENT FACTORS:**		Delay in obtaining full time Director (PI) maybe delayed industry acceptance of the program (32-23).
4. **RESEARCH QUALITY**	:	Cannot be determined from case study.
5. **END OF GRANT STATUS**	:	Continuing, not meeting interim goals (32-23).
6. **USER AWARENESS**	:	Low (32-15, 32-21)
7. **USER VALUE**	:	Low (32-15)
8. **USERS SURVEYED**	:	Industry--7

INNOVATION CENTERS EXPERIMENT

CASE NO. : 33
AWARD NO.: See below
PERIOD : 7/73-9/78
FUNDING : See below

PRINCIPAL INVESTIGATOR: Dr. G. G. Udell, University of Oregon
Dr. Yao Tzu Li, Massachusetts Institute of Technology (MIT)
Dr. D. M. Bauman, Carnegie-Mellon University (CMU)

	Oregon	MIT	CMU
Award No.:	CG-00001	CG-00002	CG-00003
Funding:	$793,650	$1,125,000	$1,075,000

RESEARCH SUMMARY: As part of the NSF/RANN Innovation Center's Experiment, three university innovation centers have been created to determine whether changes in educational patterns can produce increased innovative capabilities in students (33-3). These centers offer courses in entrepreneurship and innovation, expose students to the entrepreneurial process, and actively promote innovation (33-3). At MIT focus is on supplemental educational experiences in idea generation and development of new products or services, at CMU it is on new venture initiation, and at Oregon, idea and invention evaluation and transfer to the commercial sector (33-4). For the centers to remain active upon termination of NSF funding at the end of this five-year experiment, income from other sources must become available. It is planned that this be accomplished at CMU through reimbursement for services provided to new ventures; at MIT through royalties from inventions and from gifts and contracts; and at Oregon through the accumulation of fees for invention evaluation (33-8, 33-9).

DISSEMINATION SUMMARY: User participation is the prime method of dissemination (33-15). Through the initiative of NSF/RANN Program Manager, considerable attention has been given to the experiment by the popular news media (33-15). Dissemination has also resulted through the many visitors, including a number from other countries, that have been attracted to the Centers (33-15).

USER IMPACT: During the first three years of this experiment 33 new ventures have been started with the assistance or direct involvement of the innovation centers. In 1975, sales were reported at $2,700,000 and employees of these companies numbered about 200. The ultimate significance of this research will be in its contribution to innovative entrepreneurship as the innovation centers become permanent and are replicated, and the success of graduating students as innovators and entrepreneurs as they become part of the commercial/industrial sector (33-33).

1. PRINCIPAL PRODUCT :	Potential User Awareness
2. PROGRAM AREA :	Productivity
3. MANAGEMENT FACTORS:	Use of a flexible contractual vehicle, the cooperative agreement.
4. RESEARCH QUALITY :	Excellent (33-21, 33-33)
5. END OF GRANT STATUS :	Continuing, meeting interim goals (33-6).
6. USER AWARENESS :	Moderate (33-21, 33-33)
7. USER VALUE :	High (33-33)
8. USERS SURVEYED :	Federal Government--11, Other Government--2, Industry--9, Researchers--3

THE LESS CASH/LESS CHECK SOCIETY: AN IN-DEPTH TECHNOLOGY ASSESSMENT

CASE NO. : 34
AWARD NO.: C844/ERP-7302746
PERIOD : 9/73-6/75
FUNDING : $221,966

PRINCIPAL INVESTIGATOR: M. L. Ernst
Arthur D. Little, Inc.

RESEARCH SUMMARY: This research is a technology assessment of the expanding applications of electronic fund transfer systems (EFTS) in the United States (34-5). Objectives were to identify the possible ways that EFTS may be introduced in the United States, groups potentially affected, and the potential beneficial and deleterious impacts of this technology (34-4). Various policy options and their impacts on the introduction of EFTS as well as first and higher order effects on different sectors of society were assessed (34-4). Research methodology was an iterative one in which each phase consisted of (1) specification of EFT technology and possible paths of introduction, (2) identification of potential impacts, and (3) analysis of the relationships between technological scenarios and impacts (34-11).

DISSEMINATION SUMMARY: Primary dissemination was through wide distribution and exposure of the final report (34-22). A nationwide news release resulted in extensive coverage including an article in the New York Times (34-22). The Principal Investigator has testified before a number of Congressional subcommittees and committees (34-15). The User Advisory Committee was used as a channel for reaching representatives of the various impacted sectors (34-15). Members of the project team have published articles and have made a number of presentations at national conferences (34-15).

USER IMPACT: The short time that the final report has been available--approximately five months--precludes any major impact on policymakers. However, it is expected that major impact will occur over the next few years (34-23). The ultimate significance of this research lies in its contributions to the implementation of a national EFTS that optimizes beneficial impacts and minimizes detrimental effects on society.

1. **PRINCIPAL PRODUCT** : Information for Policy Guidance
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:** One change in Program Manager.

4. **RESEARCH QUALITY** : Excellent (34-21)
5. **END OF GRANT STATUS** : Completed, objectives attained (34-22, 34-23).
6. **USER AWARENESS** : Moderate (34-4, 34-14)
7. **USER VALUE** : Moderate (34-15)
8. **USERS SURVEYED** : Federal Government--8, Industry--5, Public--2 Researchers--3

URBAN TECHNOLOGY SYSTEM

CASE NO. : 35
AWARD NO.: C834
PERIOD : 7/73-11/77
FUNDING : $4,355,930

PRINCIPAL INVESTIGATOR: Mr. R. J. Phillips
Public Technology, Inc.

RESEARCH SUMMARY: The Urban Technology System (UTS) is one of three experiments to test the effectiveness of Federal incentives in stimulating the utilization of technology by local governments (35-3). The UTS comprises 27 participating local government units, 15 technical backup sites (universities, research institutes, and private firms), and a coordinating, management body (Public Technology, Inc. [PTI]). A technically trained Technology Agent (TA), partially funded by the local government unit, is placed in each test site to serve as the focal point for transfer of technology to local government operations (35-5). The program is currently in the operational phase with the final phase, documentation of system performance, yet to be started (35-10).

DISSEMINATION SUMMARY: The UTS is in itself a channel for dissemination of research information (35-11). Successful application of technology at one of the 27 local units is made available to other sites through "UTS Briefs." This communication between the Technology Agent and UTS is expected to result in more rapid diffusion of problem solutions to other test sites faced with similar problems (35-11). A bimonthly newsletter provides visibility of UTS to local governments not participating in the program (35-11). Close working relationships between PTI and national and international associations concerned with problems of state and local government administrative officers also consitutes a channel for dissemination of research information (35-25).

USER IMPACT: There have been 95 specific cases of technology being applied to solve problems experienced by local governments (35-13). These range from improvements in the physical infrastructure to improvement in management and control of the delivery of public services (35-14). The favorable impact of UTS is evidenced by the fact that all of test site cities have increased their contribution to the TA's salaries from 10 to 80 percent (35-13). The ultimate significance of this research lies in its contributions to improving local government operations through the application of existing and new technology.

1. **PRINCIPAL PRODUCT**	:	Potential User Awareness and Experiment Results
2. **PROGRAM AREA**	:	Local Government
3. **MANAGEMENT FACTORS:**		Two changes in Program Manager did not seem to have any deleterious effects.
4. **RESEARCH QUALITY**	:	Cannot be determined from case study.
5. **END OF GRANT STATUS**	:	Continuing, meeting interim goals (35-5).
6. **USER AWARENESS**	:	High (35-27)
7. **USER VALUE**	:	Moderate (35-26)
8. **USERS SURVEYED**	:	Other Government--8, Industry--1, Public--1

ENERGY ABSORPTION CHARACTERISTICS OF STRUCTURAL SYSTEMS SUBJECTED TO EARTHQUAKE EXCITATION

CASE NO. : 36
AWARD NO.: AEN 73-00732-A02
PERIOD : 11/74-4/76
FUNDING : $994,500

PRINCIPAL INVESTIGATOR: Dr. R. W. Clough
Earthquake Engineering Research Center

RESEARCH SUMMARY: The objective of this research is obtain an improved capability for predicting the response of structures by use of analytical digital computer procedures (36-5). Performance of test structures, subjected to simulated earthquake loadings in a test facility, is measured and the experimental results used in defining mathematical models that reliably and accurately represent the observed performance (36-5). The models of each test structure of an assembly are mathematically assembled to simulate the response of the complete assembly (36-5, 36-6). The test facility consists of a 20 x 20 foot "shaking table" that subjects test structures weighing up to 100,000 pounds to simultaneous horizontal and vertical motions of earthquake intensity (36-6).

DISSEMINATION SUMMARY: Research data have been disseminated through reports and presentations at conferences and symposia (36-12). Copies of the structural analysis computer programs developed during the project are available for purchase from the National Information Service for Earthquake Engineering (36-12).

USER IMPACT: The impact on the user community cannot be directly assessed. However, considerable impact is inferred from the use of the computer programs emanating from the research. Of the 15 users contacted, 10 have used them in their work (36-13 through 36-20). One user found the project data useful in the development and review of building codes (36-14). The ultimate significance of this research lies in its contribution to reducing losses from earthquakes through improved building design and building codes.

1. **PRINCIPAL PRODUCT** : Computer Programs
2. **PROGRAM AREA** : Earthquake Engineering
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Excellent (36-14, 36-15)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (36-3 through 36-5).
6. **USER AWARENESS** : Very High (36-13 through 36-19)
7. **USER VALUE** : Very High (36-20)
8. **USERS SURVEYED** : Federal Government--3, Other Government--3, Industry--5, Researchers--4

METROMEX

CASE NO. : 37
AWARD NO.: Numerous
PERIOD : 71-76
FUNDING : $2,980,000

PRINCIPAL INVESTIGATOR: Mr. S. Changnon, Illinois State Water Survey
Dr. H. Ochs, Illinois State Water Survey
Dr. R. Braham, University of Chicago
Dr. A. Auer, University of Wyoming
Mr. R. Dirks, University of Wyoming
Dr. E. Uthe, Stanford Research Institute

RESEARCH SUMMARY: METROMEX is a 5-year coordinated multiproject effort which is studying inadvertent weather modification in the St. Louis area. Objectives are to determine the extent and nature of the effects of urbanization on precipitation and related weather conditions; to determine causes for these effects, and to develop means for predicting these results and for transferring this knowledge to other urban complexes (37-3). It has been determined, for example, that summer rainfall is significantly higher downwind of St. Louis than in comparable surrounding areas. The net effect of this altered precipitation is an estimated two to five percent increase in agricultural yield, and about a six percent differential in farmland values (37-4, 37-5).

DISSEMINATION SUMMARY: The Illinois State Water Survey (ISWS), Mr. Changnon in particular, has been the prime mover in disseminating results of the research. ISWS has made 39 technical presentations and 22 public presentations (37-16). Over 100 articles have been published in technical journals (37-12). Mass media have been used to keep the general public informed (37-12). A review of METROMEX findings and impact on urban and suburban hydrology is scheduled for publication in the Water Resources Bulletin and for presentation at the First National Conference on Inadvertant Weather Modification in 1977.

USER IMPACT: Impact has been primarily on State and local agencies in around metropolitan St. Louis. The U.S. Army Corps of Engineers used METROMEX rainfall data in a flood control design (37-13). The Illinois EPA is using project data in a study of flow in sewer lines (37-14). Further impact can be expected when procedures for translation of the St. Louis results to other areas are more explicit (37-16). The ultimate significance of this research lies in its contributions to a better understanding of how industrialization and urbanization inadevertantly modify weather processes and how advantage may be taken of that phenomenon (37-3).

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Weather Modification
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot determine from case study.
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (37-16).
6. **USER AWARENESS** : High (37-16)
7. **USER VALUE** : Moderate (37-16)
8. **USERS SURVEYED** : Federal Government--2, Other Government--6, Industry--1

THE TEXAS ENERGY ADVISORY COUNCIL
RESEARCH PROJECT

CASE NO. : 38
AWARD NO.: GI-44085
PERIOD : 5/74-5/75
FUNDING : $534,000

PRINCIPAL INVESTIGATOR: Dr. A. E. Dukler
Governor's Energy Advisory Council, State of Texas

RESEARCH DESCRIPTION: The purpose of this project was to develop a model for the utilization of technology in state policy decisions on energy related matters. The model, successfully applied in Texas where policy-making is a highly diffuse process, should be applicable in other state governments where policymaking is more centralized (38-25). Thus the primary objective was to produce information on which public policy, legislation, and research programs could be based (38-17). Funds were used to upgrade State and regional responses to the energy crises (38-3). Funding was channeled through the Governor's Energy Advisory Council (GEAC) with the Principal Investigator serving as Executive Director. Four core programs: supply and demand, environmental and social factors, legal and regulatory aspects, and new technology were established. Other programs dealt with such topics as interactions between State policies and nuclear power development, energy awareness, and transportation policy alternatives (38-9, 38-10).

DISSEMINATION SUMMARY: Dissemination was accomplished primarily through intensive interaction between the participants of the program and key state government decisionmakers (38-18). The GEAC Executive Committee, chaired by the Lieutenant Governor, was also a significant avenue for dissemination (38-19). Copies of the full final report were distributed to the principal energy agency of all other states and numerous other out-of-state users (38-23). Results of the program and follow-on projects are described ten times yearly in a GEAC supported newsletter published by Texas A&M University (38-20).

USER IMPACT: Impacts have been generally limited to Texas. Economic models developed by the research were used by the Texas Legislature (38-20). The Texas Legislature has become increasingly aware of the need for a scientific basis for decisionmaking (38-20), and project-developed data were used in proposing legislation to the 1975 legislature (38-12). The GEAC has been institutionalized in the Texas State Government (38-15). The project has also resulted in changes in programs and activities of the energy industry in Texas (38-19, 38-20). The ultimate significance of this research lies in its use and contribution to energy management and conservation programs in all 50 states (38-25).

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Energy Policy
3. **MANAGEMENT FACTORS:** One change in Program Manager did not seem to have any deleterious effects.
4. **RESEARCH QUALITY** : Very Good (38-19 through 38-23)
5. **END OF GRANT STATUS** : Completed, objectives attained (38-6, 38-7).
6. **USER AWARENESS** : Very High (38-23)
7. **USER VALUE** : High in Texas (38-24). Not determinable elsewhere.
8. **USERS SURVEYED** : Other Government--5, Industry--2, Researchers--1

TERTIARY OIL RECOVERY

CASE NO. : 39
AWARD NO.: GI-42492
PERIOD : 4/74-10/77
FUNDING : $349,900

PRINCIPAL INVESTIGATOR: Dr. W. H. Wade and Dr. R. S. Schechter
University of Texas at Austin

RESEARCH SUMMARY: This research focuses on the reduction of interfacial tension between captive crude oil and brine through the addition of chemical surfactant materials (39-3). Studies are being made of properties of surfactants, and of crude oils and the rock environments in which they are found, factors that jointly influence the interfacial tensions between brine and crude oil (39-3). Characteristics of the chemical-oil-brine-rock system that affect the capability and persistency of the surfactants in reducing interfacial tension are also being studied (39-3). Knowledge of these relationships will contribute to the design of an economically feasible tertiary recovery system for extracting crude oil remaining in reservoirs after primary and secondary extraction (approximately 70 percent of the oil) (39-6, 39-7). During the initial phase of the project, an improved method was developed for measuring interfacial forces as low as 10^{-5} dyne/cm (39-9).

DISSEMINATION SUMMARY: Primary means for dissemination of project information is the advisory panel with membership from the petroleum industry, academia, and government energy activities (39-12, 29-22). The principal investigators and their associates have made presentations and conducted seminars for industry (39-4, 39-12, 39-24). Graduate students trained by the project, are moving to jobs where they can apply their knowledge to solution of problems of enhanced oil recovery (39-4).

USER IMPACT: Ultimate impact on the petroleum industry in terms of enhanced oil recovery will not be realized until after completion of the research in October 1977. Interim research results, however, have impacted on the user community, especially on public and private researchers, fifty of whom have purchased and are using the spinning drop tensiometer developed by the research team to measure interfacial tensions (39-11). The course of industry's research in enhanced oil recovery has been influenced by the research results to date (39-12). The ultimate significance of this research lies in its contribution to making the United States energy-sufficient by enhancing recovery of crude oil from U.S. oil fields.

1. PRINCIPAL PRODUCT	:	Physical and Chemical Processes
2. PROGRAM AREA	:	Energy Technology
3. MANAGEMENT FACTORS:		Encouragement for establishment of researcher-industry cooperation by the Program Manager.
4. RESEARCH QUALITY	:	Excellent (39-14, 39-19)
5. END OF GRANT STATUS	:	Continuing, meeting interim goals (39-21).
6. USER AWARENESS	:	High (39-14 through 39-19)
7. USER VALUE	:	Moderate (39-14 through 39-19)
8. USERS SURVEYED	:	Federal Government--1, Industry--7, Researcher--1

ASSESSMENT OF A NEW TEXTILE TECHNOLOGY

CASE NO. : 40
AWARD NO.: GI-43105
PERIOD : 4/74-4/77
FUNDING : $300,000

PRINCIPAL INVESTIGATOR: Dr. William K. Walsh
North Carolina State University (NCSU)

RESEARCH DESCRIPTION: The objective of this research is to assess the potential of electron and ultraviolet radiation curing of resins in textile products as an alternative to conventional thermal curing (40-5). The study focuses on the radiation curing of adhesives and fire retardants (40-5). Applications are also being investigated in six specific areas; nonwoven fabric bonding, flocked fabrics, pigment print bonding, crimp stabilization in bulk yarn, flammability of synthetic fibers, and flammability of cellulosics (40-6, 40-7). Laboratory experiments are being conducted using equipment that simulates the production exposure levels on stationary fabric rather than on the moving webs found in textile production. While satisfactory for the study of radiation curing, this procedure cannot produce treated fabric in sufficient quantities for test market evaluation. A pilot facility will be required for this purpose (40-8). Research accomplishments include a significant improvement in film properties for fabric coatings and finishes, improvements in pigment printing, and development of low-volume resin coating techniques (40-9).

DISSEMINATION SUMMARY: Data generated by this project have been disseminated to the textile industry, suppliers of textile chemicals, and radiation equipment manufacturers, primarily through the Advisory Committee (40-4). Short courses and seminars at NCSU have also served as dissemination mechanisms (40-4, 40-13). Procedures and results of laboratory investigations have been documented (40-13). Presentations have been made at several technical conferences (40-13). The Principal Investigator frequently serves as a consultant for textile firms interested in exploring particular applications of radiation curing (40-13).

USER IMPACT: The principal impact on the user community has been the role of the project in providing a focal point for technology and development in a high risk area, so that as conditions become favorable, industry will be in a position to adopt the technology (40-34). Several firms are currently investigating application of radiation curing on a laboratory scale (30-4) and are revaluating their position on radiation curing of resins (40-17, 40-21). The ultimate significance of this research lies in its contribution to productivity improvement in the textile industry and in providing research services to an industry that traditionally has a low level of R&D (40-3).

1. **PRINCIPAL PRODUCT** : Chemical and Physical Processes
2. **PROGRAM AREA** : Productivity
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Very Good (40-30)
5. **END OF GRANT STATUS** : Continuing, meeting interim goals (40-9).
6. **USER AWARENESS** : High (40-4, 40-14 through 40-27)
7. **USER VALUE** : Low (40-4, 40-8, 40-29, 40-30, 40-31)
8. **USERS SURVEYED** : Industry--12

DEVELOPMENT OF ANALYTICAL METHODS FOR DETERMINATION OF TRACE ELEMENTS

CASE NO. : 42
AWARD NO.: AEN-18932-A01
PERIOD : 8/72-1/77
FUNDING : $304,900

PRINCIPAL INVESTIGATOR: Dr. P. W. West
Louisiana State University

RESEARCH SUMMARY: The objective of this research is the development of simple and inexpensive methods for detection and qualification of trace elements in the environment (42-3). Microdetermination methods have been developed for manganese in airborne particulate samples, and copper, cadmium, and zinc in waters (42-10, 42-11). New analytical techniques have been developed for measuring sulfuric acid aerosols (42-11). Investigation of permeation sampling techniques has resulted in the development of a vinyl chloride badge dosimeter (42-13).

DISSEMINATION SUMMARY: Dissemination efforts have been directed primarily to the industrial and institutional people having problems in trace element analysis (42-23). The popular news media have been used to call attention to products of the research (42-23). Development and maintenance of close working relationships with the American Society for Testing Materials (ASTM), and the United Nations Scientific Committee for Problems of the Environment (SCOPE), have also served as effective dissemination channels (42-4, 42-23). Dissemination methods ranging from technical publication to lecture/workshop tours have been geared to a specific product or interest group (42-15).

USER IMPACT: Acceptance of the improved analytical methods developed by the project team depends on whether or not environmental regulatory agencies accept and approve them as standard or acceptable procedures (42-26). The products of this research are either currently being used or are being evaluated (42-16). Eleven procedures emanating from the research has been included in a SCOPE manual, two are currently being evaluated for adoption by ASTM (42-4). The ring-oven technique for trace element determination has been commercialized and is available as a standard analytical technique (42-10). Ultimate significance of this research lies in its contribution to environmental quality by the provision of simple and inexpensive methods for trace element analysis (42-3).

1. **PRINCIPAL PRODUCT**	:	Chemical Process - Trace Element Analysis
2. **PROGRAM AREA**	:	Environmental Effects
3. **MANAGEMENT FACTORS:**		Inadequate funding and nonparticipation of NSF in project publicity (42-26).
4. **RESEARCH QUALITY**	:	Excellent (42-24)
5. **END OF GRANT STATUS**	:	Continuing, meeting interim goals (42-4).
6. **USER AWARENESS**	:	Very High (42-16 through 42-23)
7. **USER VALUE**	:	Moderate (42-25, 42-26)
8. **USERS SURVEYED**	:	Federal Government--3, Other Government--2, Industry--10, Researchers--1

THE DELAWARE ESTUARY SYSTEM: ENVIRONMENTAL IMPACTS AND SOCIOECONOMIC EFFECTS

CASE NO. : 43
AWARD NO.: FI-33269
PERIOD : 4/72-10/73
FUNDING : $380,000

PRINCIPAL INVESTIGATOR: Dr. W. S. Gaither, University of Delaware
Dr. R. Patrick, Philadelphia Academy of Natural Sciences
Gen. W. Whipple, Jr., Rutgers University

RESEARCH SUMMARY: The basic research objective was to determine if and how the Delaware estuary could be managed both to satisfy socioeconomic demands for growth and to maintain or upgrade environmental quality (43-4). The research was to be conducted in two phases; Phase I was to be the development of a proposal for research identified as being necessary for sound management of the estuary system, and Phase II the implementation (43-6). Upon completion of Phase I, the consortium of the institutions listed above dissolved and Phase II was never funded as an entity (43-7). Selected components of the proposed research, however, were individually funded (43-7). Specific areas addressed by the project were: (1) sources and fates of pollutants in the estuary, (2) future net increases in pollutants, (3) possibilities of reduction in net pollution through treatment, (4) impacts of present and future pollution on estuarine ecosystems and recreational water quality, and (5) socioeconomic impacts (43-7).

DISSEMINATION SUMMARY: The principal investigators were reluctant to make wide dissemination of the Phase I results to preclude hasty action that might be taken without adequate scientifc foundation (43-5, 43-6). The members of the research consortium were the primary users of the Phase I research and therefore the team itself served as a dissemination channel (43-6).

USER IMPACT: The primary impact of the research has been the initiation of several research projects that were recommended by the Phase I research (43-6). Three components were individually funded by NSF (43-10), and at least four by the Department of the Interior (43-14). Secondary impact will not be felt until these followon projects are completed (43-13). The ultimate significance of this research lies in its contributions to the environmentally acceptable development of the Delaware estuary.

1. **PRINCIPAL PRODUCT** : Information for Planning Guidance
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Complete, objectives partially attained (43-21).
6. **USER AWARENESS** : Moderate (43-13 through 43-19)
7. **USER VALUE** : Low (43-13 through 43-19)
8. **USERS SURVEYED** : Federal Government--7, Other Government--6,

SEQUENCE EFFECTS OF HETEROGENEOUS NUCLEATION

CASE NO. : 44
AWARD NO.: GI-34807
PERIOD : 6/72-9/74
FUNDING : $140,200

PRINCIPAL INVESTIGATOR: Dr. R. L. Steele
Desert Research Institute

RESEARCH SUMMARY: This project is concerned with artificial cloud seeding to induce rain or otherwise modify the behavior of clouds. It addresses the effects of the sequence of events and the nucleating efficiency of the seeding materials (44-4). The study required the simulation of an atmospheric updraft through stages of successively lower temperature and pressure, and permitting condensation to occur as appropriate to the controlled initial total water content (44-4). The research resulted in the conclusion that the sequence of events had no operational significance on nucleating efficiency (44-4). Seeding at a predetermined temperature level within a cloud or seeding below the cloud should be equally effective if the nucleating agent reaches the required temperature level within the cloud (44-9).

DISSEMINATION SUMMARY: Direct discussion with other researchers, publication of technical papers, and participation in symposia and conferences were the dissemination modes used for this project (44-10).

USER IMPACT: The results of the research were not such as to encourage anyone engaged in cloud seeding to change his procedures (44-4). The ultimate significance of this research lies in its confirmation that already existing nucleation methods and techniques were suitable and effective (44-5).

1. **PRINCIPAL PRODUCT** : Physical Process
2. **PROGRAM AREA** : Weather Modification
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined.
5. **END OF GRANT STATUS** : Complete, objectives attained (44-4).
6. **USER AWARENESS** : None (44-11, 44-13)
7. **USER VALUE** : Low (44-5, 44-11, 44-13)
8. **USERS SURVEYED** : Federal Government--1, Other Government--2, Industry--2

DYNAMIC INSTABILITY AND ULTIMATE CAPACITY OF INELASTIC SYSTEMS PARAMETRICALLY EXCITED BY EARTHQUAKES

CASE NO. : 45
AWARD NO.: NSF-GI-34966
PERIOD : 6/72-9/75
FUNDING : $20,300

PRINCIPAL INVESTIGATOR: Dr. F. Y. Cheng
University of Missouri at Rolla

RESEARCH SUMMARY: This research developed an analytical method for determining the nature of dynamic instability in structural systems and studied the response of structural systems subjected to vertical pulsating loads and to lateral foundation movements resulting from earthquakes (45-3). An analytical procedure was developed (45-6), instability criteria were formulated, finite element matrixes derived, and numerical methods for computer solution developed (45-4).

DISSEMINATION SUMMARY: Dissemination of research information was accomplished by publication in national journals and international conference proceedings (45-7). The Principal Investigator annually has conducted a one-week course, "Computer Methods of Optimal Structure Design" (45-11). During these courses, computer programs based on the research are distributed to course participants (45-11). An international symposium on earthquake structural engineering, planned for August 1976, will also provide a means for disseminating research information (45-12).

USER IMPACT: The Primary user of the research has been the Principal Investigator in his courses and other research. Impact on other users has been minimal because the conceptual and theoretical nature of the research makes it difficult for practitioneers and other researchers to follow (45-12). User impact may be increased when Part II of the final report is published and distributed (45-12). The ultimate significance of this research lies in its contributions to reduction of losses from earthquakes through improved building design.

1. **PRINCIPAL PRODUCT** : Coputer Programs
2. **PROGRAM AREA** : Earthquake Engineering
3. **MANAGEMENT FACTORS**: NSF assistance in publication of symposia proceedings (45-12).
4. **RESEARCH QUALITY** : Good (45-7 through 45-11)
5. **END OF GRANT STATUS** : Complete, objectives attained (45-6).
6. **USER AWARENESS** : Moderate (45-7 through 45-11)
7. **USER VALUE** : Low (45-12)
8. **USERS SURVEYED** : Federal Government--3, Industry--4, Researchers--3

INVESTIGATION OF THIN FILM SOLAR CELLS BASED UPON Cu_2S AND TERNARY COMPOUNDS

CASE NO. : 46
AWARD NO.: GI-381024
PERIOD : 7/73-8/76
FUNDING : $268,300

PRINCIPAL INVESTIGATOR: Dr. J. J. Loferski
Brown University

RESEARCH SUMMARY: This project focused on the investigation of solar cells based on thin film of Cu_2S and ternary compounds (46-6). Difficulties were encountered in the production of stable and reproducible thin films (46-6). The overall objective was to determine the potential of these materials for low-cost, continuous production of solar cells with a conversion efficiency of about six percent (46-8). Measurements were made of the potential difference of Schottky barriers formed by various metals on Cu_2S (46-11). A method for complete conversion to Cu2S of a copper layer deposited on cadmium sulfide resulted in cells with efficiensies of up to one percent (46-12). Heterojunction solar cell structures were developed that yielded a six percent efficiency when Cu_2S was deposited by evaporation (46-13).

DISSEMINATION SUMMARY: Dissemination efforts included distribution of progress reports and participation in conferences and workshops (46-7). General distribution of research reports is being achieved through NTIS (46-13).

USER IMPACT: The uncompleted nature of the research resulting from the difficulties encountered in the production of stable and reproducible thin film has resulted in minimal user impact (46-12). The ultimate significance of this research lies in its contribution to the development of a terrestrial solar cell with the efficiency and cost that will make it competitive with fossil fuel as a source of energy (46-5).

1.	**PRINCIPAL PRODUCT**	Chemical Process--Solar Cells
2.	**PROGRAM AREA**	Solar Energy
3.	**MANAGEMENT FACTORS:**	Two changes in Program Manager and PI's absence for one year may have resulted in discontinuity (46-22).
4.	**RESEARCH QUALITY**	Not assessable from case study information.
5.	**END OF GRANT STATUS**	Complete, objectives Partially attained (46-7, 46-21).
6.	**USER AWARENESS**	High (46-14 through 46-20)
7.	**USER VALUE**	Low (46-14, 46-18, 46-19, 46-20)
8.	**USERS SURVEYED**	Federal Government--6, Industry--5, Researchers--4

FIRE WHIRL AND FIREBRAND IN MASS FIRES

CASE NO. : 47
AWARD NO.: GI-1037201
PERIOD : 2/73-8/75
FUNDING : $72,400

PRINCIPAL INVESTIGATOR: Dr. R. S. L. Lee
State University of New York at Stony Brook

RESEARCH SUMMARY: This research is directed toward the development of a better understanding of the behavior of mass fires (47-3). Emphasis is on the study of the formation of vortices and their role in spreading fire in wildlands and urban environments (47-6). Tests were conducted in a simulator consisting of a sophisticated exhaust gas removal system, a two-phase flow system that can incorporate liquids or solids, and a two-dimensional laser-doppler anenometer precision flow measurement system (47-6). Fire whirl and firebrand phenomena were described from analysis of data from major fires and the results simulated in the test facility using burning piles (47-4, 47-7). Studies were also conducted of the effect of external vortex activity on the internal flow field in high-rise building fires (47-5). Initially the project was a basic, scientific research endeavor. However, on encouragement of the Program Manager, the effort specifically addressed fire whirl and firebrand activity in wildland and urban fires (47-5).

DISSEMINATION SUMMARY: Research results were disseminated through immediate publication in technical journals and participation in national and international symposia (47-5). Two user groups were addressed; members of fire prevention associations and academically oriented researchers (47-14).

USER IMPACT: This research has resulted in a significant contribution to the state-of-the-art of fire spread behavior (47-15). Research results have been used in forest fire control operations and training (47-11). Explanation of fire whirl behavior was used in the investigation of flammability of potential firebrand materials and in the development of a fire spread simulation model (47-12). The ultimate significance of this research lies in its contribution to reducing loss of life and property in urban and rural fires (47-15).

1. **PRINCIPAL PRODUCT**	:	Information for Policy and Planning Guidance
2. **PROGRAM AREA**	:	Fire Research
3. **MANAGEMENT FACTORS:**		Change of emphasis to practical applications on the encouragement of the Program Manager (47-5).
4. **RESEARCH QUALITY**	:	Excellent (47-10 through 47-12, 47-15)
5. **END OF GRANT STATUS**	:	Complete, objectives attained (47-15).
6. **USER AWARENESS**	:	High (47-10 through 47-13)
7. **USER VALUE**	:	Low (47-14)
8. **USERS SURVEYED**	:	Federal Government--2, Other-Government--1, Industry--1, Public--1

A STUDY OF TELEVISION NETWORK REGULATION

CASE NO. : 48
AWARD NO.: GI-38909
PERIOD : 6/72-6/75
FUNDING : $73,500

PRINCIPAL INVESTIGATOR: Dr. S. M. Besen
Rice University

RESEARCH SUMMARY: This research was designed to develop a telecommunication policy study group to investigate the impact of Federal regulations on economic success and performance of TV networks, and to assess the viability of a fourth national TV network (48-11). Models were developed to examine policy options on potential growth and the effects of Federal Communication Commission (FCC) policy on network-affiliate relationships (48-12, 48-13). From its inception, the project emphasized the development of a research capability rather than on the solution of a specific problem (48-6). Long-term objectives were to provide impact to the decisionmakers in the field of TV network regulation.

DISSEMINATION SUMMARY: The products of the research were published by business and economic journals and distributed to policy agencies (48-5, 48-6).

USER IMPACT: Telecommunications policy research has been institutionalized at Rice University (48-6). Models developed during the research have been used to examine the impact of Federal regulations on network-affiliate relationships and to analyze alternate proposals to expand the number of UHF stations serving the public (48-4). One of the models has been used in the study of expansion of UHF stations, two papers were placed on the FCC docket of proceedings to increase the number of VHF stations, and research papers have been used by the staffs of the House Subcommittee on Commerce and the Office of Telecommunications Policy in their investigations and analysis of TV network regulation (48-6). The ultimate significance of this research lies in its contribution to the development of national TV network and programming responsive to the needs and desires of the viewing audience.

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Policy Research
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Not assessable from case study information.
5. **END OF GRANT STATUS** : Complete, objective attained (48-6).
6. **USER AWARENESS** : Moderate (47-16 through 47-18)
7. **USER VALUE** : Low (47-16 through 47-18)
8. **USERS SURVEYED** : Federal Government--5, Researchers--1

CRITICAL PROBLEMS OF THE COASTAL ZONE

CASE NO. : 49
AWARD NO.: GI-31758
PERIOD : 11/71-4/73
FUNDING : $123,800

PRINCIPAL INVESTIGATOR: Dr. B. H. Ketchum
Woods Hole Oceanographic Institution

RESEARCH SUMMARY: The objective of this research was the identification of critical problems of the coastal zone and an evaluation of how amenable they might be to scientific investigation (49-4). Ten 5-member working groups prepared and circulated papers on assigned topics. This was followed by a workshop at which a book was written presenting findings and recommendations on coastal zone natural and behavioral science (49-4). A text, The Water's Edge, Critical Problems of the Coastal Zone, was published by the MIT press in 1972.

DISSEMINATION SUMMARY: Participation in the workshop and publication of The Water's Edge were the only avenues of dissemination (49-11).

USER IMPACT: Primary user impact has been in the use of project information in program development and review of proposals by providing Federal Program Managers with a perspective of coastal zone management (49-24). The text, The Water's Edge, has also been used in university programs (49-12 through 49-15). State agencies have used the text for inservice orientation and training (49-15, 49-16, 49-17). The ultimate significance of this research lies in its contribution to the environmentally acceptable development of this nation's coastal zone.

1. **PRINCIPAL PRODUCT** : Information for Policy and Planning Guidance
2. **PROGRAM AREA** : Environmental Effects
3. **MANAGEMENT FACTORS:**

4. **RESEARCH QUALITY** : Cannot be determined from case study.
5. **END OF GRANT STATUS** : Complete, objectives attained (49-24).
6. **USER AWARENESS** : High (49-12 through 49-22)
7. **USER VALUE** : Moderate (49-12 through 49-22)
8. **USERS SURVEYED** : Federal Government--2, Other Government--5, Public--2, Researchers--4

AN ENGINEERING FEASIBILITY STUDY OF AN IONOSPHERIC TECHNIQUE TO IMPROVE TSUNAMI WARNING SYSTEMS

CASE NO. : 50
AWARD NO.: GI-34973
PERIOD : 6/72-5/76
FUNDING : $115,000

PRINCIPAL INVESTIGATOR: Dr. P. C. Yuen
University of Hawaii

RESEARCH SUMMARY: The feasibility of measuring the Doppler shift in a high frequency radio signal occurring in the upper atmosphere due to an acoustic wave generated by Rayleigh surface waves, and the use of these measurements in a tsunami warning system are the subjects of this research (50-3, 50-5). To detect the Doppler shift, a high quality high frequency electromagnetic wave is reflected from the ionosphere to a ground-based receiver where the signal is compared to that from a calibrated oscillator. Any change in the ionosphere through which the wave signal passes will result in a shift in the phase of the signal between the transmitter and receiver. This change is detected and recorded. Computer techniques are then used to predict the epicenter of the event that caused the ionospheric disturbance (50-6, 50-9). Operation of the system during an actual earthquake and comparison of actual and predicted epicenters permits refinement of the prediction methodology (50-11).

DISSEMINATION SUMMARY: There has been little if any dissemination of research results. Ultimate dissemination is planned through the incorporation of the system into the already existing Pacific Tsunami Warning System (PTWS) (52-12). One annual report was prepared, a paper describing the Doppler instrumentation techniques was published in the IEEE proceedings, and a paper was presented to the American Geophysical Union in 1973 (50-15).

USER IMPACT: There has been little if any impact on PTWS, the ultimate user, due to the incompleteness of the research (50-17, 50-24). The ultimate significance of this research lies in its contributions to the reduction of life and property losses from tsunamis by the development of an effective warning system (50-3).

1. PRINCIPAL PRODUCT	:	Physical method-instrumentation system
2. PROGRAM AREA	:	Earthquake Engineering
3. MANAGEMENT FACTORS:		Poor communication between Principal Investigator and program Manager (50-21).
4. RESEARCH QUALITY	:	Fair (50-18 through 50-20, 50-23)
5. END OF GRANT STATUS	:	Continuing, not meeting interim goals (50-5).
6. USER AWARENESS	:	Low (50-18)
7. USER VALUE	:	Low (50-24)
8. USERS SURVEYED	:	Federal Government--2, Researchers--2

PHOTOCHEMICAL CONVERSION OF SOLAR ENERGY

CASE NO. : 51
AWARD NO.: GI-38103
PERIOD : 6/73-3/77
FUNDING : $461,000

PRINCIPAL INVESTIGATOR: Dr. N. N. Lichtin
Boston University

RESEARCH SUMMARY: This cooperative effort between Boston University and Exxon entails fundamental investigations of photochemical processes and applied research on photoconversion cells (51-3, 51-4). Studies have been conducted on iron-thionine and iron thiazine photogalvanic cells, on fundamental chemistry of the electrolytes, and on fuel production through the photoreduction of ferric bromide (51-4). Photoreduction studies were discontinued in 1975 in order to concentrate on the photogalvanic cell research (51-6). The best sunlight engineering efficiency attained to date with iron-thionine cells has been 0.1 percent (51-6) as compared with the research objective of 5 percent (51-10).

DISSEMINATION SUMMARY: Dissemination efforts have been limited to periodic project reports, the staging of an NSF sponsored workshop in 1974, and presentations at the International Conference on the Photochemical Conversion and Storage of Solar Energy in 1976.

USER IMPACT: Little, if any, impact on potential users was noted (51-15 through 51-19). The ultimate significance of the research lies in its contributions to the commercialization of a solar energy conversion system.

1. **PRINCIPAL PRODUCT** : Chemical Process - Photochemical conversion
2. **PROGRAM AREA** : Solar Energy
3. **MANAGEMENT FACTORS**: Funding and sponsorship of a symposium on the research.

4. **RESEARCH QUALITY** : Fair (51-14)
5. **END OF GRANT STATUS** : Continuing, not meeting interim goals (51-20).
6. **USER AWARENESS** : Moderate (50-14)
7. **USER VALUE** : Low (50-14, 50-20)
8. **USERS SURVEYED** : Researchers--6