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FEDERAL NOISE RESEARCH

EPA
SUMMARY AND ASSESSMENT

JUNE 1978

OFFICE OF NOISE ABATEMENT & CONTROL
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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PREFACE

The United States Government is involved in research, development and demonstration (RD&D) activities related to aviation, surface transportation, machinery and construction equipment noise abatement and control through a number of its Agencies and Departments. In addition, considerable effort is expended in noise effects research to help identify and categorize the adverse health effects of noise. These programs vary in size and complexity, and objectives vary according to overall Agency charters, statutory authorities and other priorities.

One of the purposes of the Noise Control Act of 1972 was to establish a means of effective coordination of Federal research and development activities in noise research and noise control. The Act directs the Administrator of the EPA to compile and publish, from time to time, a report on the status and progress of Federal noise research and noise control programs. In early 1974, the Federal noise research coordination activity was initiated in accordance with Section 4 of the Act. Four interagency noise research panels were established in the areas of:

- o Aviation
- o Surface vehicles
- o Machinery
- o Effects.

Reports were issued by the panels in the March-May 1975 time period (Ref. 1-4). The reports summarized the FY 1973-75 ongoing and planned noise research, development and demonstration programs within the various Agencies of the Federal Government.

During 1976, the four panels were reconvened to update the data base and also:

- Assess the contribution of past, current and planned Federal Noise RD&D Programs, and
- Identify technology and noise effects needs to support a long range National Noise Abatement Strategy.

The Chairman selected for each panel was a senior representative of the Agency having maximum program content in the specific panel. The panel chairmen were:

o Aviation	Mr. Harry W. Johnson, Director Aeronautical Propulsion Division NASA
o Surface Transportation*	Mr. W. Harry Close, Director Office of Noise Abatement DOT
o Machinery and Construction Equipment*	Mr. Joseph A. Lamonica, Chief Division of Health, Coal Mine Safety and Health Mining Enforcement & Safety Administration DOI
o Effects	Dr. Henning E. Von Gierke, Director Biodynamics and Bioengineering Division Aerospace Medical Research Laboratory USAF, DOD

EPA provided secretariat support to each of the panels. The panels developed specialized reports covering the Research and Technology Development and Demonstration programs related to their area of concern (Refs. 5-8). The individual report formats were generally consistent with minor variations between them based upon the perceived needs of the Panel Chairman and Panel participants.

* Change in panel title from earlier report.

This summary report presents an EPA overview and assessment of the results of the panels' deliberations.

Each of the Panel Chairmen, as well as the panels' members, were provided an opportunity to comment on, (1) a preliminary draft and, (2) a final draft copy of this report. All of the comments were carefully considered and reviewed with the commenters. The final report includes those points deemed appropriate for inclusion herein.

However, the findings, conclusions, & recommendations in this assessment are EPA's and not necessarily those of any other agency.

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I. INTRODUCTION

Before any review or assessment of Federally funded noise research development and demonstration activities is made, it is appropriate to discuss briefly some of the significant, related topics which may influence the content of the Federal program.

A. OBJECTIVES

The primary objective of noise control research is to reduce the harmful physical and mental health effects attributable to noise generation. Because these effects exist, the need to regulate, develop alternate noise control programs, encourage new technological advances and conduct further research on these effects becomes apparent.

The identification of objectives, or goals, is multi-faceted. They can be specific or general, short range or long range, parochial or national. They can be single purpose or a contributing element of a broader plan.

Section 4(c)(2) of the Noise Control Act (NCA), acknowledges this diversified range of activity by requesting an assessment of each Federal Agency's noise research and noise control program in light of:

> "...the contributions of those programs to the Federal Government's overall efforts to control noise" (underline added)

B. FEDERAL SPONSORSHIP OF NOISE RESEARCH

At various times in the past, questions have been raised as to why the Federal Government should even be involved in noise research programs particularly those which relate to commercial products such as aircraft, trucks, buses, automobiles, etc. Federal sponsorship is necessary to identify and

inform the public at large that noise exposure has measurable, predictable effects which can be controlled through appropriate means.

While it may be argued that the major responsibility for developing the needed technology should rest with industry, in many cases investment by the Federal Government is necessary to help bring new technology into the marketplace or to stimulate industry developments. This Federal initiative is appropriate when:

- The market is not responsive to the demands (needs) of society (no industry incentive)
- A directed effort is needed to meet a National objective or National emergency
- Development costs exceed the financial capability of any one manufacturer despite the fact that the development may be in the best interests of the nation.

Some specific benefits of Federal research sponsorship are:

- Industry is apprised of the dedicated Federal objectives for noise abatement and control with an incentive for participation.
- Provides timely research results for early implementation of noise reduction actions.
- The results of Federally funded RD&D programs, in both effects and technology, are available equally to all manufacturers and to the public, whereas results of industry RD&D are closely held and would not provide a broad base of understanding or application potential.
- Federal initiatives in RD&D insures the availability of a strong, National technology base.

- Technology transfer to other products or spin-off opportunities for other applications may be realized.

C. OTHER NOISE RESEARCH ACTIVITY

While this report only considers the Federal Agencies' in-house and contracted efforts in noise research, it must be recognized that these are complementary to other funded research activities.

Industry

Various trade associations and individual company spokesmen have indicated that significant amounts of company funds are utilized for noise research and development. However, information regarding the extent of such activity as well as the specific results of such research, which is usually of a proprietary nature, are not generally available. In addition, the assumed threat of regulatory actions usually precludes the release of such data to the Government.

A partial recognition of such activity can be gleaned from the proprietary data reported under the DOD/NASA Aviation Independent Research and Development program, which indicates approximately $10-11 million was spent by the aviation industry in acoustic research in both FY 1975 and 1976. Approximately 20% of this (or $2 million/year) was industry funded. The Federal Government accounted for the remaining funds to help support the maintenance of a strong, competitive, industrial technology base, vital to both national security and the economy.

University

The report of the EPA-sponsored seminar on University Noise Research (Ref. 9) identified approximately $7 million of university effort in noise research in the U.S. over the past several years. Of this, more than $1.5 million represented sponsorship by other than Federal Agencies. These included

specific industries and trade associations and State and local governments, as well as self-sustaining university programs.

Foreign

Recent surveys of 37 foreign countries and international organizations have provided information on more than 1000 noise research programs which included approximately 200 projects in the area of noise effects research (Ref. 10-13). While funding levels were reported for only 28% of the technology oriented projects these totaled over $30 million.

The major portion of the funding identified in the referenced reports was provided by governmental agencies.

The noise problem is of international concern and corrective measures developed and demonstrated in one part of the world can be applied elsewhere to the benefit of all.

D. RD&D EXCLUSIONS

The three technology panels generally agreed that studies which are designed to evaluate existing or planned technology developments in terms of costs, benefits and impact effects would not be considered as research expenditures. They felt that this type of activity is usually undertaken to support regulatory and vehicle certification actions and therefore would not directly contribute to future noise control technology. However, EPA believes that in some instances these studies can and do contribute to the identification of future technology needs. These technology assessment studies are separately identified in this report. (Section III-E and Appendix A).

E. PANEL REPORT STRUCTURE

The 1978 Federal Interagency Noise Research Panel Reports (Ref 5-8) were structured somewhat differently than the earlier (1975) reports (Ref 1-4). In order to provide some data comparability, modifications were made to the previous FY 1973 and 1974 data in order to make them consistent with the current data.

These modifications included the following:

1. The current Federal noise data base does not uniformly include manpower costs for program management or in-house research activity. In particular, NASA manpower costs are not reported in the current Aviation Panel Report (Ref. 7) although the high level of NASA in-house manpower funding was included in the earlier report. That data has been excised for this summary analysis to facilitate a direct comparison with the previous report.

2. Studies and analyses directed at technology assessment for regulatory or certification purposes have been deleted in the identification of "noise research" funds. However, this data, primarily relating to EPA and FAA activity, is reported separately herein.

3. Some of the projects reported in the 1975 Surface Vehicle report related to construction equipment and were therefore transferred to the old Machinery panel data base to be consistent with the present reporting of machinery and construction noise research.

4. Much of the earlier reported activity for FY 1974 and 1975 was either incomplete or estimated. The more recent reports provide final FY 1974/75 project and expenditure data.

This summary presents a broad general overview of the Federal Noise Research activities. Specific program and project details are reported in the (4) panel reports (Ref 5-8).

The panel reports reflect the currency of program information as of February, 1978. An attempt was made to maintain a high degree of consistency in project reporting and categorization both within the individual panels as well as across the panels. In addition, care was taken to avoid "double-counting", particularly where one Agency was conducting research with joint or full sponsorship from another Agency. Although there may still be some inconsistencies, anomalies, or omissions in the panel reports, the available information was adequate and sufficient for EPA to develop specific conclusions and recommendations.

II. SUMMARY

A. TOTAL FEDERAL NOISE RESEARCH FUNDING

Figure 1 portrays the total Federal funding for noise research for the period FY 1973-78.* The research reported includes programs in:

- o Basic research (including noise effects)
- o Technology development
- o Technology demonstrations

Two specific demonstration programs, (refan & retrofit), are highlighted in the Figure since they represent significant additions to a baseline $26-28 million Federal noise research effort. Both programs are discussed in more detail subsequently.

While the dollar level of funding for noise research has remained essentially level during this period, the resulting activity level has steadily decreased due to inflationary effects. The total FY 1977 funding, for example, represents a 20% reduction in activity compared with the same funding level in FY 1973. Technology programs (exclusive of noise effects) have experienced a 30% reduction.

Figure 2, and Table 1, present the same data distributed by Panel area of interest.**

One area indicating a significant and steady increase in dollar expenditures is in noise effects research, which almost doubled in four years. The primary areas of emphasis have been in investigations of:

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* FY 1976 data includes transition quarter funding.
** FY 1978 estimates indicate that increased emphasis is planned in all Federal Noise Research areas. However, previous experience suggests that these funds may be subject to Agency reprogramming as other priorities arise during the year.

FIGURE 1

TOTAL FEDERAL NOISE RESEARCH

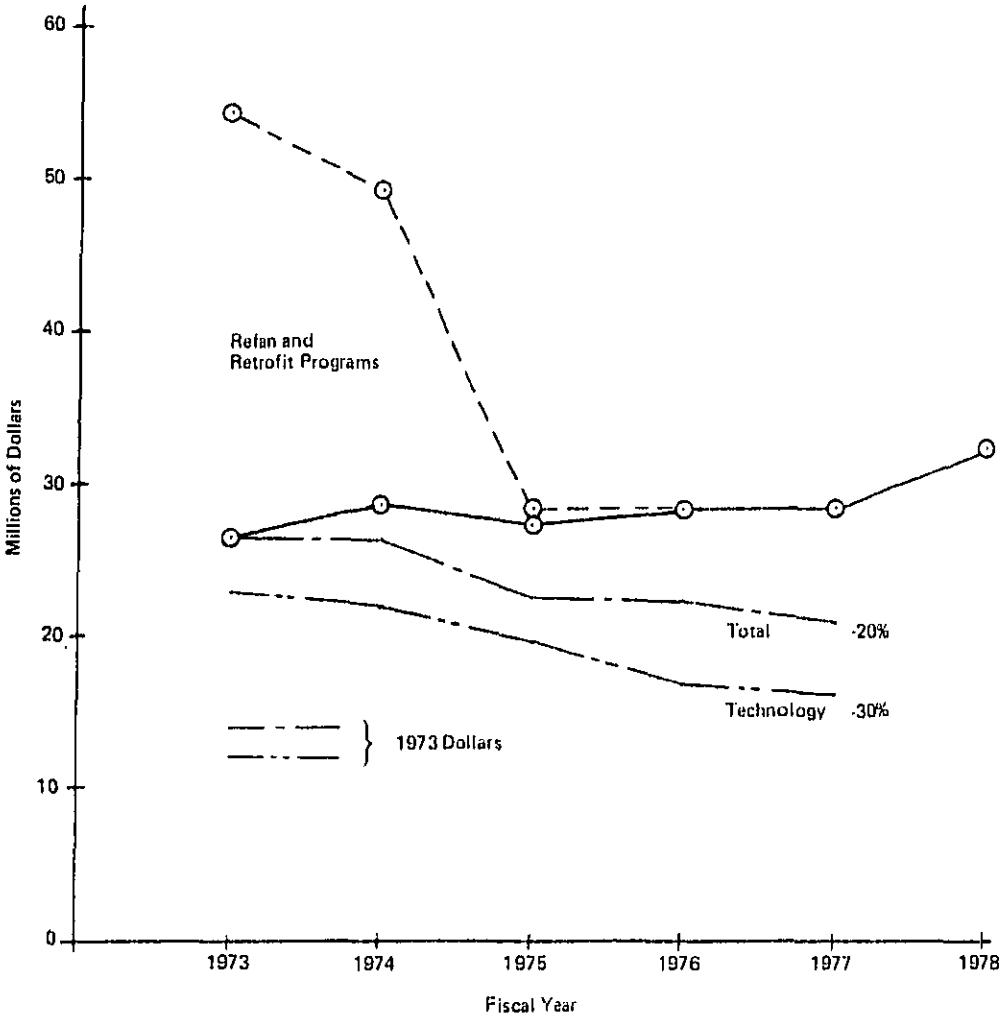


FIGURE 2

FEDERAL NOISE RESEARCH

BY

PANEL AREA OF INTEREST

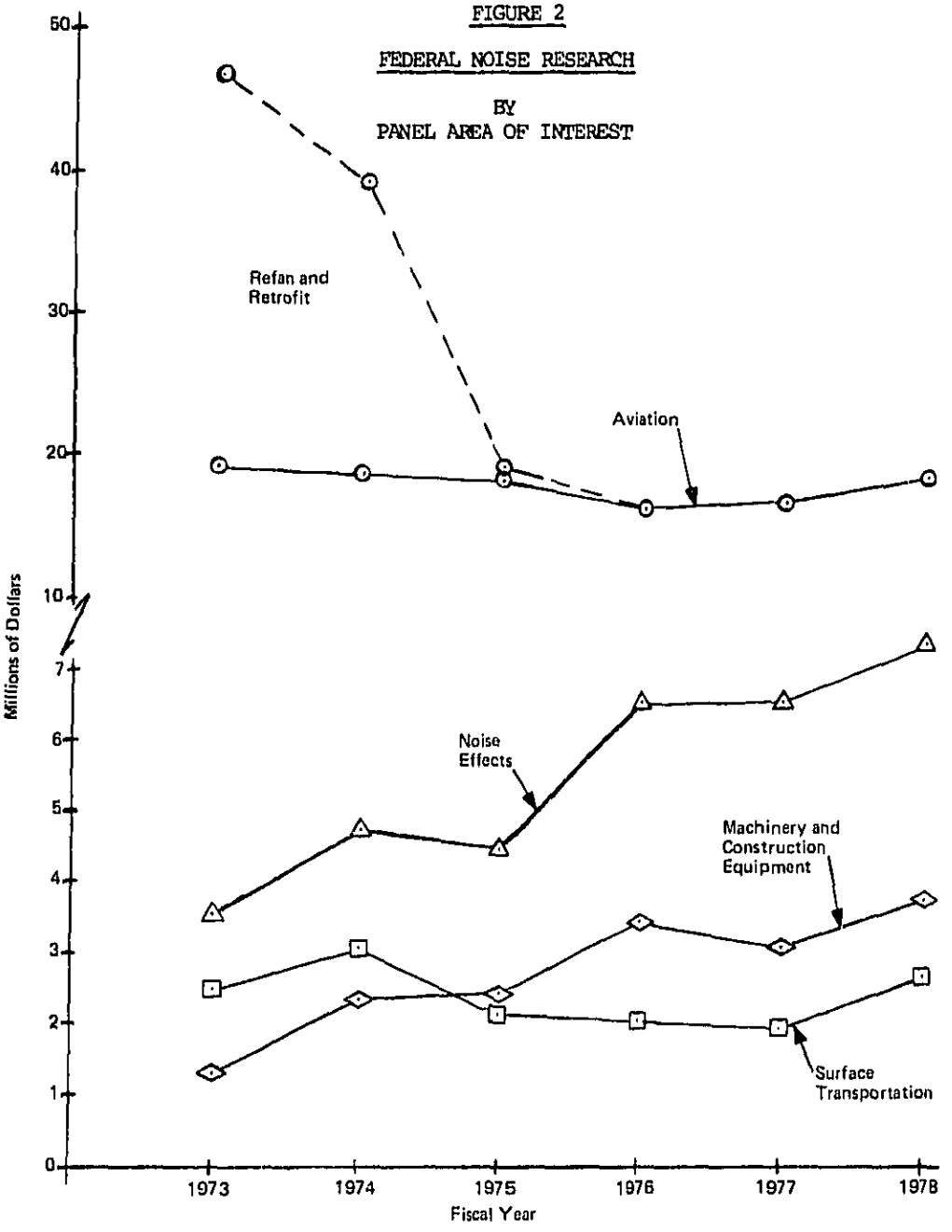


TABLE 1
FEDERAL NOISE RESEARCH FUNDING**
(THOUSANDS OF DOLLARS)

	FISCAL YEAR					
	1973*	1974*	1975	1976	1977	197
AVIATION	46966	39233	19154	16118	16840	183
NOISE EFFECTS	3566	4756	4427	6543	6567	738
SURFACE TRANSPORTATION	2472	3054	2144	2047	1961	268
MACHINERY AND CONSTRUCTION EQUIPMENT	1282	2344	2405	3446	3084	372
TOTAL	54286	49387	28130	28154	28452	321

*Data From References 1-4 (Modified For Consistency With References 5-8)

**Does not Include Studies/Analyses in Support of Certification/Regulatory Actions

***Estimated

- o Noise induced hearing loss
- o Individual behavior effects (psychological and performance)

The primary stimulus for the significantly increased funding in these two categories was the need for the development of supporting data for improved near term occupational hearing conservation programs, particularly within DOD. The other categories of noise effects research are indicated in Table 2.

More than 60% of the total Federal funding effort in noise research has been for programs aimed at reducing aircraft-generated noise. The data for FY 1973-78 indicates a base program in aviation noise research of $16-19 million/year. This does not include the $45 million NASA refan program nor the DOT/FAA retrofit feasibility program, both of which had specified objectives and were completed in FY 1975. These two programs were designed to support the aircraft retrofit/replacement rule by demonstrating technology feasibility with full scale, flight-worthy hardware capable of being certificated. These programs were successful and also contributed to the development of Amendment 7 to Federal Aviation Regulation (FAR), Part 36, which reduces the maximum allowable levels of noise for new design aircraft developments. In addition to the base program of contracted effort, NASA supports an in-house aviation noise research program of approximately $11-12 million/year spread among its three major aeronautics research centers, the Lewis, Langley and Ames laboratories. The steady funding level in aviation noise research (Figure 2) actually represents a reduction in effort due to the inflationary effects indicated earlier. In this climate, the trend has been toward more emphasis on basic research and technology programs vis-a-vis the more expensive demonstration programs (Figure 3).

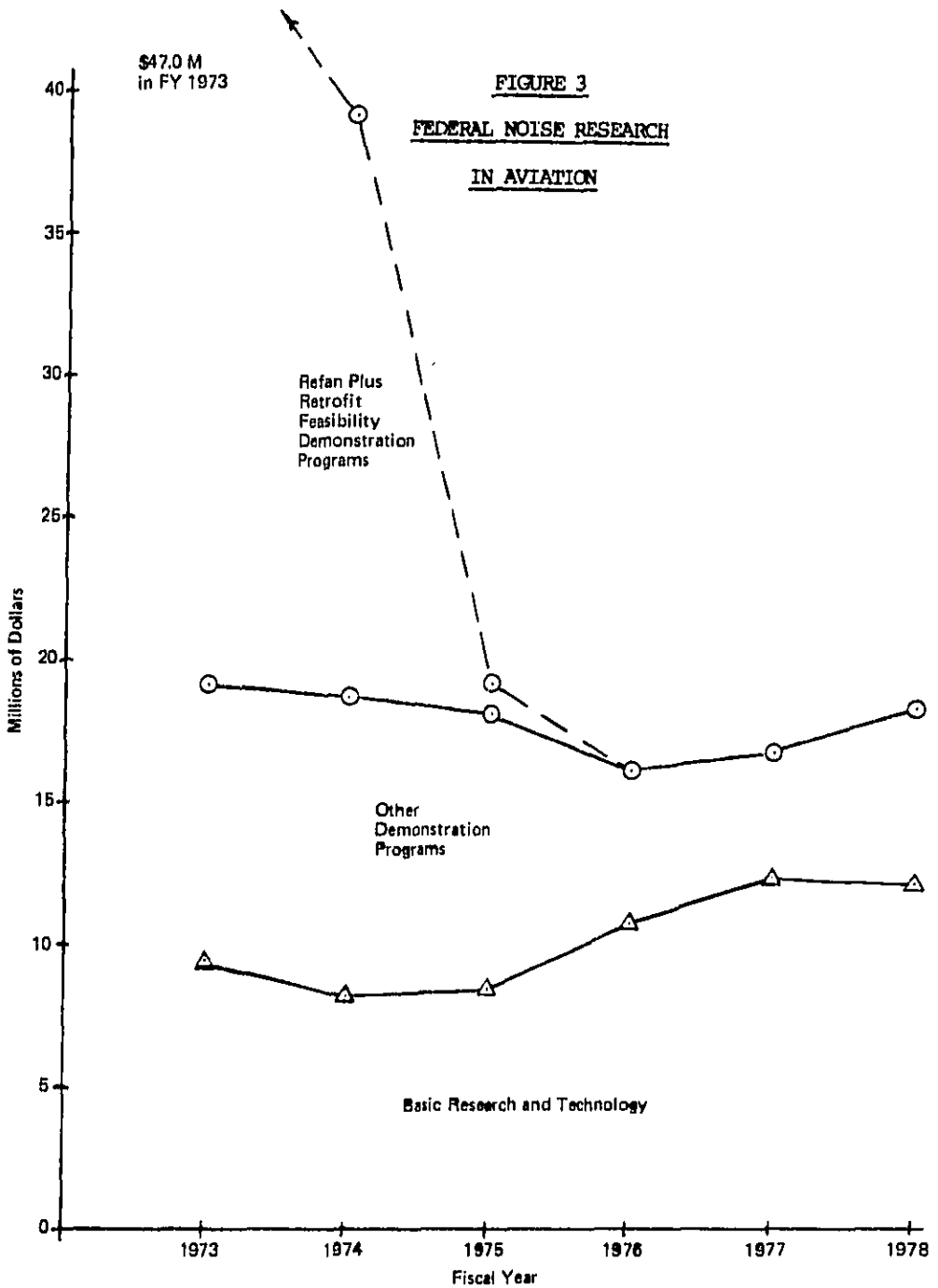
TABLE 2

FEDERAL NOISE EFFECTS RESEARCH FUNDING BY CATEGORY

(THOUSANDS OF DOLLARS)

Category	FY 73[a]	FY 74[a]	FY 75	FY 76	FY 77	EST. FY 78
Noise Induced Hearing Loss	1,084	1,366	2,300	3,563	3,385	4,116
Non-Auditory Health Effects	126	294	213	101	179	226
Psychological & Performance Effects[b]	381	361	776	1,143	1,344	1,127
Noise Effects on Sleep	217	254	81	117	130	130
Communication Interferernce	275	316	336	482	616	394
Community Collective Response	410	821	235	330	361	347
Domestic Animals & Wildlife	0	0	51	83	17	15
Noise Environment Determination[c]	1,073	1,344	261	445	330	655
Noise Concomitant with Vibration[d]	-	-	174	279	205	375
TOTALS	3,566	4,756	4,427	6,543	6,567	7,385

(a) From Ref 4
(b) Retitled (was "Individual Behavior Effects" in Ref 4)
(c) Retitled (was "Measurement Methodology and Calibration" in Ref 4)
(d) New category


$47.0 M
in FY 1973
FIGURE 3
FEDERAL NOISE RESEARCH
IN AVIATION
Refan Plus
Retrofit
Feasibility
Demonstration
Programs
Other
Demonstration
Programs
Basic Research and Technology
Millions of Dollars
Fiscal Year
0
5
10
15
20
25
30
35
40
1973
1974
1975
1976
1977
1978

Following the completion of the DOT Quiet Truck program in FY 1974, the program in surface transportation noise research dropped to a level of approximately $2 million/year during the FY 1975-77 time period. Current indications are that DOT participation in surface transportation noise research is expected to continue to lose emphasis, due to the dissolution of the Office of Noise Abatement in the Office of the Secretary of the Department of Transportation. However, in view of the need for continued reductions in surface transportation noise, EPA has initiated several technology development and demonstration projects in this area. (See Section III-E).

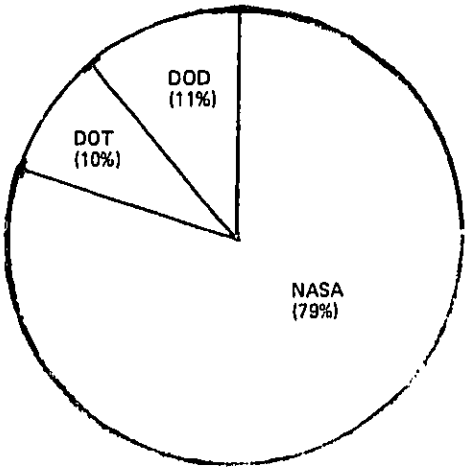
Federal funding for machinery and construction equipment noise research has increased since the earlier report and is currently over $3 million/yr. The Bureau of Mines is responsible for 50-60% of this effort. Most of this research is aimed at noise reduction at the source to reduce occupational exposures in accordance with health and safety requirements.

Figure 4 indicates the relative funding of each Agency in the area of interest of each panel for FY 77.

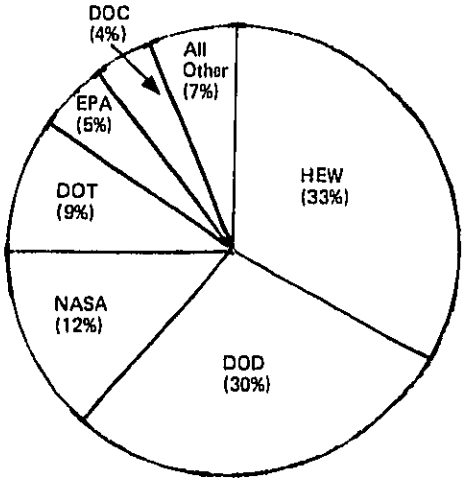
FIGURE 4

RELATIVE DISTRIBUTION OF FUNDS

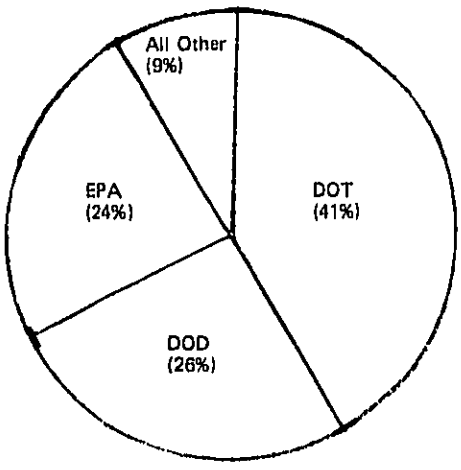
(FY 1977)



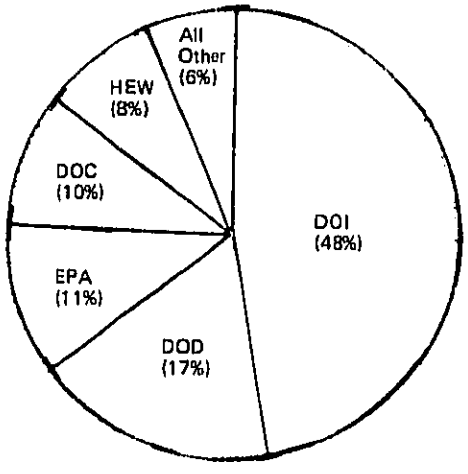
(a) AVIATION
($16.8 M)



(b) NOISE EFFECTS
($6.6 M)



(c) SURFACE TRANSPORTATION
($2.0 M)



(d) MACHINERY AND CONSTRUCTION EQUIPMENT
($3.1 M)

B. ASSESSMENT

The majority of Federal Agencies currently involved in research, development and demonstration (RD&D) activities related to noise abatement and control had active programs directed toward satisfaction of the individual Agency's statutory mandates, operational authorities, goals, and objectives prior to the passage of the Noise Control Act of 1972.

The Noise Control Act provided authority to the Administrator of the EPA to "...assess the contributions of those programs to the Federal Government's overall efforts to control noise."

In light of the above, any assessment of Federal noise programs must consider:

- o The specific mandates, goals and objectives of each Agency, and
- o The contributions of each Agency's noise programs to the National effort to control noise.

In order to provide some focus on the adequacy and needs of a Federal noise research program, several elements which contribute significantly to such a program assessment need to be addressed. These include:

- o Relevancy of objectives
- o The extent to which coordination/data exchange is being effected
- o The extent to which previous RD&D has been applied
- o Direction of current and on-going RD&D
- o Future needs (Recommendations)

1. Objectives

(a) National Noise Abatement Objectives

In October 1976, the EPA distributed a proposed National Strategy for Noise Abatement and Control. Comments were solicited and received from other

Federal Agencies, industry, and the public. A modified Strategy Document (Toward a National Strategy in Noise Control) was released by EPA in April 1977 (Ref 14). In brief, it suggested five specific goals for the National effort,

(1) Take all practical steps to eliminate hearing loss as a significant consequence of noise exposure

(2) Reduce environmental noise exposure of the population to an L_{dn} value of no more than 75 dB immediately

(3) Reduce environmental noise exposure levels to an L_{dn} of 65 dB or lower by vigorous regulatory and planning actions

(4) Aim for environmental noise exposure of no more than L_{dn} of 55 dB when planning future programs affecting the environment

(5) Encourage and assist Federal, State, and local agencies in the adoption and implementation of long-range noise control policies.

In addition, in early 1976, the Federal Aviation Administration (FAA) issued its 5 year environmental plan (Ref 15) re-affirming its noise mandate as expressed in the amended Section 611 of the Federal Aviation Act which established as an FAA goal, "---to afford present and future relief and protection to the public health and welfare from aircraft noise---". The FAA short and long range objectives are expressed as follows:

- Short range - "To confine severe aircraft noise exposure levels (i.e., Noise Exposure Forecast 40+)* around U.S. airports to those areas included in the airport boundary. To reduce, by 1980, to the extent possible (consistent with economic reasonableness and technological practicability) the NEF 40+ (or equivalent) areas outside existing airport boundaries or areas controlled by the airport proprietors, and assist neighboring communities in achieving compatible land use for the remaining areas."

*NOTE L_{dn} 75=NEF 40 and L_{dn} 65=NEF 30

The FAA's short range objective is consistent with the suggested National goals (1), (2), and (5) noted above.

- o Long range - "To reduce the noise exposure levels minimizing interference with human activities consistent with technological and economic consideration."

The FAA's long range goal is consistent with specific goals (3) and (5) noted above.

(b) Agency Noise Abatement Objectives

It has been suggested (Ref 5, 6) that the passage of the Noise Control Act, which provided specific authorities to the EPA, was interpreted by some of the other Agencies as a lessening of their responsibility to participate in a National program to achieve environmental noise reductions. This may explain why there appears to be a change in priorities occurring within the other Federal Agencies with respect to noise RD&D. This apparent slackening concern for the environmental noise problem may be inferred from the steady decrease in the "real" available funds and by the following Agency actions:

- o The recent reorganization of the Secretary's Office in the Department of Transportation disbanded the Office of Noise Abatement.
- o NSF, HUD, and DOA have reduced their efforts significantly in the area of noise control research.
- o In the area of machinery noise research, most of the activity is concentrated in the area of near term occupational noise reduction to meet existing requirements for personnel protection.

(c) Research Objectives

The objectives of a Federal technology program are to:

(1) Advance the state-of-the-art of technology to provide the basis for Federal, State, and local actions to limit the allowable noise of products identified as requiring noise control.

(2) Encourage industry to undertake noise reduction programs.

(3) Ensure the availability of technology to permit the reduction of allowable source noise on a timely basis.

It is generally accepted that the most cost-effective method of reducing noise is to control it at the source. In other words, noise reduction should be an intrinsic criterion in the design and development phase of any new product. The lack of technological means of adequately controlling noise from many products is proving to be a constraint in establishing National source standards required for the protection of the public health and welfare. The noise reduction benefits to be derived from technological developments are directly related to the speed with which they can be incorporated into production hardware.

While the primary responsibility for developing this technology may rest with industry, investment by the Federal Government in technology development, particularly in the demonstration stage, in many cases may nevertheless be needed for the reasons cited earlier (Section IB). This Federal initiative could also serve to permit establishment of noise targets for future products or equipment. These targets would be based upon demonstrations of components or systems that are not yet in production.

Federally sponsored noise effects research programs are necessary to establish noise exposure criteria, and to document the effects of various

types of noise on the population in order to support the need for noise standards and regulations as well as hearing conservation programs, and to provide personal noise control information to the public.

2. Coordination

The re-establishment of the Federal Noise Research Panels has provided a format for expanded interagency dialogue among the various participating Agencies. Some of the expected benefits to be derived from this technical interchange should include:

- o Identification of joint problem areas or common needs which may be beyond the capability of any one Agency to resolve but which could lead to jointly sponsored projects.
- o Opportunity for technology transfer based upon another Agency's research progress.
- o Elimination of unnecessary duplication of effort which could occur as a result of inadequate or incomplete knowledge or awareness.
- o "Piggy-backing" of existing or planned programs to provide supplementary data more quickly and at an overall lower cost to the Federal Government.

Based upon inputs to the panels' reports, the full measure of benefit has not been realized due to possible agency or budgetary constraints. The vast majority of project data provided in the panel reports represent recently completed or on-going funded projects. Some projects which are in the contract negotiation stage are identified, but relatively few planned projects were reported. This is reflected in the Panel reports as "incomplete data" for FY 1978.

Since most of the reported activities are already in being, it is extremely difficult to introduce supplementary supportive work to be incorporated under these contracts for other Agencies with differing objectives. No planned FY 1979 initiatives, which would allow for complementary program actions, were identified by the Panel members, despite the fact that FY 1979 budget planning, including Zero Base Budget (ZBB) exercises, were in process during the period in which the Panels were developing the data inputs to the reports.

3. Application of Previous RD&D

The "bottom line" objective for justifying RD&D activity is to see the results implemented. This is the principal goal for industry-sponsored research and development and the same criterion should pertain to Federally sponsored research and development. However, there also is a need for a continuing program of basic research that is not results-oriented but rather explores various physical laws and phenomena associated with technical and scientific events to better understand the cause/effect relationship of these phenomena in the hope that they may be practically applied in the future. In aviation, a base technology program has been maintained, but with recent budgetary restrictions, demonstration program activity has been drastically curtailed.

The implementation process can be voluntary or legally effected through ordinances and/or regulations. Roy Jackson, the Associate Administrator of NASA's Office of Aeronautics and Space Technology during the 1970-73 time period made the following observation in this regard:

> "It is clear to me that there is only one way to keep the industry equally competitive and still reduce noise as much as we want as fast as we can, and this is by regulation.

> The regulations must be timely and precede the commitment to a new design by industry. And the regulations must be bold in demanding noise levels on the forward edge of technology to force technologists to fashion economically acceptable solutions."

While the results of previous RD&D have not been fully implemented, there has been some progress in temporarily halting the escalation of noise based upon selective utilization of previous research and technology programs. Some examples are:

- As a direct result of the Sound Absorbent Material (SAM) demonstration program conducted during the 60's and early 70's, the FAA modified or amended two (2) Federal Aviation Regulations (FAR) to require all aircraft (in production or in current operational use) not previously covered by FAR Part 36 to comply with the stage 2 noise limits (1969 FAR 36 levels). While these two actions bring older aircraft into compliance with the initial noise regulations, it does not reflect the technology developments that could be incorporated in new type aircraft for future development and production.
- In March of 1977, the FAA promulgated Amendment 7 to FAR 36 which reduced the permissible maximum level of noise for new-design aircraft produced after 1975. This lowering of the "lid" reflects the noise emission characteristics of currently produced aircraft and therefore eliminates the possibility of future aircraft being noisier than those currently being produced. Notwithstanding that the FAA must consider safety, cost and appropriateness factors in the development of their regulations, EPA

believes that the FAA, in promulgating the new levels, has not encouraged industry to utilize more of the technology that has been developed and demonstrated. As Russell Train, former Administrator of the U.S. EPA, stated in 1976:

> "Significant improvement in technology will be possible in the future, and the Federal Government must project these improvements and codify society's expectations into mandatory standards with sufficient lead times. The practice of waiting until the new technology is being used by some manufacturers, and then legislating its use by all, has not provided the environmental protection which we have needed; and it has not given the aircraft manufacturers firm design targets."

The EPA proposed rule for future production aircraft, submitted to the FAA in Oct. 1976, does, in fact, reflect the R&D accomplishments of previous and on-going NASA & FAA programs which EPA believes are economically reasonable and appropriate to the types of aircraft considered.

- Regulations delineating maximum permissible noise levels for surface vehicles have been promulgated (for new medium & heavy trucks) and proposed (for new buses), based in part on the technology demonstrated in the DOT Quiet Truck Program. This program also demonstrated the technology to retrofit operational trucks and buses to meet the existing Interstate Motor Carrier Regulation.
- Noise effects research into hearing loss criteria has established, and reinforced, the identification of L_{eq} (24) of 70 dB or L_{eq} (8) of 75 dB as the levels of noise that could affect one's hearing capability as a result of extended exposure to such levels.

- o The Bureau of Mines' noise research and development activity has led to retrofit programs on specialized mining equipment which have significantly reduced the occupational noise exposure of miners.
- o Outputs of previous R&D efforts have resulted in the development of a variety of manuals and guidelines for evaluating noise environments for use by state & local environmental planning agencies.
- o Additionally, methods for reducing noise exposures by retrofit, use of barriers or other noise control devices have been developed. These have been most applicable in reducing occupational noise exposure due to machinery as well as exposure to surface vehicle noise.

4. Current and On-Going RD&D

This assessment of the on-going Federal Noise RD&D program is restricted to EPA's appraisal of the various Agency activities as they pertain to the National environmental, or community, needs. How these projects contribute to the individual Agency's needs is addressed in the Panel reports (Ref. 5-8).

(a) Aviation Noise

Both the FAA and the EPA have identified similar aviation noise objectives, both short and long range (Sec. II B(1)(a)). For purposes of this EPA assessment, short range refers to 1985 and long range relates to the year 2000, as initial benchmarks.

Due to the length of time required to fully implement the results of technology developments, the 1985 aviation noise environment can be reasonably predicted since it will be controlled by Federal actions that have already been taken. Specifically, the retrofit/replacement rule requires that all commercial jet aircraft, serving U.S. airports, conform to the FAR 36, Stage 2 noise levels (1969 FAR 36) by 1985. Therefore, the 1985 fleet will reflect the application of previously demonstrated technology. It has been estimated that a reduction of approximately 40% in the NEF 40 (L_{dn} 75) exposure area will be realized due to this regulatory action (Ref. 7). While it is possible that some new design aircraft utilizing the results of recently completed (or near completed) technology development or demonstration programs may begin to enter the fleet in the early 80's, they would not be introduced in sufficient quantities by 1985 to influence the environment significantly.

Therefore, if the short range goal is to be achieved by 1985, complementary Federal, State or local actions are required in addition to source control. Although there now is some local airport noise abatement planning taking place at a few airports, we see little likelihood that the 1985 goal could even be approached, much less achieved without significantly more airport noise abatement planning, and implementation of these plans.

The assessment of the Federal Government's programs in aviation noise RD&D relative to the long range goals must reflect the following considerations:

- With the forecasted increase in number of aircraft, operations, and aircraft size in the civil aircraft fleet, and with few,

if any, new airport construction programs planned, the reduction in cumulative noise exposure around the nation's airports resulting from existing FAA regulations will be offset in the future by the increased activity if no further abatement actions or controls are implemented.

- The recent Amendment to FAR 36 (Amendment 7), which reduces the maximum allowable noise limits for future new type design aircraft, is not expected to result in meeting the long range National objective of containing the L_{dn} 65 (NEF 30) contour within the control of the airport proprietor by source control alone.
- While it is generally accepted that source control (through technology) is the most cost-effective means of providing noise relief, the constraints are severe. For example, studies by the EPA (Ref 16) indicate that even if the technology were available to reduce the commercial air carrier aircraft noise to 10 dB below the 1969 FAR 36 limits (Stage 2), and assuming this technology could be incorporated in all aircraft in the year 2000 fleet, approximately 200 square miles of land area would still be exposed to cumulative noise levels of L_{dn} 65 (NEF 30) or above. The exposure to L_{dn} 75 (NEF 40) however would be essentially eliminated.

As a frame of reference, the allowable noise limits of Amendment 7 to FAR 36 (Stage 3) approximates 5 dB below the Stage 2 (1969) FAR

36 levels when averaged across the fleet. The reductions range from 1-9 dB on takeoff and 3-4 dB on approach, depending upon aircraft type.

It is difficult, if not impossible, to assess the contributions of basic research and technology projects to meeting overall National objectives. These projects are aimed at reducing the noise contribution of individual components or sub-elements of a system at least cost and with minimum effects on performance. Not until all of the elements are combined into an overall system and analyzed (e.g., airframe or engine) can the results be appraised. For example, a 10 dB reduction in compressor generated noise may not yield a significant reduction in total engine noise if it is not the primary source of noise in the engine. Therefore, research needs to be applied to all elements of the system concurrently with emphasis applied to the most critical noise source first. This emphasis may change as component noise levels are reduced.

There are several demonstration programs nearing completion or underway that could significantly alter the future noise environment around airports if adopted voluntarily by the industry or required by Federal regulation.

o QCSEE (Quiet, Clean, Short Haul Experimental Engine) - The design, development and demonstration testing of the QCSEE engine is nearing completion. The engine has demonstrated dramatic noise reduction characteristics by incorporating many features developed in the basic research and technology program. These include:

- o Acoustically designed composite nacelle
- o Near sonic inlet
- o Low fan tip speed and pressure ratio

- o High bypass ratio
- o Multiple thickness wall treatment in inlet and exhaust
- o Acoustically treated splitter and guide vanes

The basic core of the engine derives from the developed B-1 engine (which is also the core of the advanced design CFM56 engine). The sideline noise level of a QCSEE-powered STOL aircraft is reported by NASA to be 12 EPNdB below that of a contemporary quiet aircraft such as the DC-10. While not all of the characteristics of the QCSEE engine may be applicable to long range aircraft such as the DC-10, NASA indicates, "Although directed toward short haul commercial application, it is evident that QCSEE technology has a potentially broad range of application" (Ref. 7). Since the QCSEE engine has been developed using flight-weight hardware, with appropriate modifications it can be evaluated under flight operational conditions, although there apparently are no current plans to do so.

o QCGAT (Quiet, Clean, General Aviation Turbofan) - This project was initiated to demonstrate the applicability of large turbofan engine technology to small turbofan engines. Some of the features to be demonstrated include:

- o Medium-to-high bypass ratio
- o Mixer nozzles
- o Acoustic treatment
- o Low fan tip speeds and pressure ratio

Two engine companies have completed the design of these engines which are now being fabricated. Testing is to begin in 1978. Analysis, based upon the final engine designs indicates that both engines will meet the program noise goals. These engines would result in future aircraft noise

levels 6-9 EPNdB lower on takeoff and 3-5 EPNdB quieter on approach compared with the Cessna Citation which is the quietest turbofan powered aircraft currently in production.

These two (2) major technology demonstration programs should be the basis for future aircraft design and development. The EPA-proposed rule for future new-type design aircraft produced after 1985, (which has not yet been acted upon by the FAA), reflects the results of these as well as other accomplishments of NASA's research and technology development activities.

o Another significant demonstration program, initiated in FY 1977 by the FAA, will develop and demonstrate an exhaust mixer for existing JT8D engines. The objective of the project is to demonstrate a reduction in sideline and take-off noise of about 4 EPNdB. Jet exhaust noise reductions of this magnitude are significant since they would result in a reduction of approximately 50% in an aircraft's takeoff noise footprint area.

However, assuming the demonstration program is successful, there is little compelling incentive for incorporating the technology in existing operational aircraft. New production of early design DC-9's, 727's and 737's (which utilize this engine) already meet the Stage 2 requirements of FAR 36. The non-conforming operational aircraft can meet the retrofit requirements without the addition of the mixer.

One way to encourage implementation of these results would be through a further lowering of the noise level requirements for new production of old aircraft or as a further retrofit to existing aircraft. However, no information has been furnished on FAA's intentions for the use of the results of this costly development/demonstration program.

Development of a technology base for possible application to future civil supersonic aircraft represents a continuing significant investment in time and money. The attainable noise levels currently estimated by NASA and the FAA are levels at, or slightly below, the Stage 2 limits (1969 FAR 36). EPA is concerned that advanced SST noise objectives appear to be compromised with respect to other performance of operational considerations. If future SST aircraft are not required to meet the noise levels of contemporary subsonic aircraft, they could dominate the noise environment around the airports from which they operate, thereby cancelling the benefits of previously applied aviation noise technology developments.

The Department of Defense, has publicly affirmed its intent to meet civil aircraft noise standards where such action would not impact on strategic or tactical combat missions. However, in procurement of trainer or transport aircraft, the Air Force has not adopted the noise reduction technology available in civil versions of these aircraft despite the fact that DOD has supported research in noise reduction technology through its Independent Research and Development program (IR&D).

(b) Surface Transportation Noise

Noise from surface vehicles is the most pervasive source of noise in the Nation, affecting populations of urban, suburban and rural areas. This contrasts with aircraft noise where the individual vehicle noise and cumulative exposure may be at a higher level but is more restricted geographically.

Progress has been made in preventing the escalation of noise from heavy trucks (the major source of noise from surface vehicles). EPA regulations governing the allowable levels of future production heavy (and medium) trucks,

and the Interstate Motor Carrier regulation which limits the allowable noise for operational trucks and buses engaged in interstate commerce, will provide some near term relief for urban residents and those living adjacent to highways. These regulations were based, in part, on the DOT Quiet Truck research, development and demonstration program. The recently proposed noise regulation for new production buses was also based in part on the DOT program.

Federal research into path control technology has led to limited installations of physical barriers along isolated sections of heavily traveled highways. This alternative to source control is relatively expensive and in many cases, unsightly. It should be noted that the FHWA has developed a manual on barrier aesthetics to provide guidelines for future barrier design and construction.

Recent studies by both DOT and EPA (Refs. 18 & 19) indicate that the noise problem due to surface vehicles (including automobiles and light trucks) is likely to be exacerbated in the future due to population shifts, increased numbers of vehicles in the fleet, along with possible increases in noise from new vehicles resulting from efforts to conserve fuel. Some of the suggested energy conservative scenarios of the future could work in opposition to noise reduction, if equal consideration is not given to noise constraints in these early deliberations.

Despite this trend, funding for Federal programs in surface vehicle noise research, development and demonstration have been insufficient and decreasing. The Department of Transportation, which has the primary responsibility and authority to "...undertake research and development relating to transportation, including noise abatement..." has reduced its activities in surface vehicle noise RD&D by more than 65% since 1974 (Table 6).

In light of this cutback, EPA has initiated several technology demonstration programs covering:

a. Internal Combustion Engines

b. Heavy, Medium and Light Trucks

c. Tires

However, the funding is minimal, and the time scale for results is extended due to the limitation on the availability of funds from the existing EPA noise budget.

(c) Machinery and Construction Equipment

Although there has been a moderately increasing level of funding in this area for noise RD&D, there has been very little Federal effort aimed at reducing new machinery source noise or, in general, reducing community exposure to machinery or construction equipment noise.

The principal effort has been to respond to near term occupational requirements and hearing conservation programs, by modifying existing equipment. While this activity has led to significant reductions in noise for a few isolated pieces of specialized equipment, particularly mining equipment, even the resulting reduced levels are excessive, particularly in the industrial environment. There has been limited research or technology developments undertaken that would lead to quieter new equipment.

(d) Noise Effects

One of the primary reasons for the Federal Government to be involved in a program of noise effects research is to be able to provide defensible evidence for the need and degree of noise abatement and noise control actions. Previous research efforts provided information which resulted in

publication of the Criteria Document (Ref 20) and the Levels Document (Ref 21). These two references furnished the information available at the time relating to the health and welfare effects of noise and identified maximum levels of environmental noise requisite to protect the public health and welfare with an adequate margin of safety.

Most of the effects research to date has concentrated on determining the effects of exposure to continuous high levels of noise and the related potential for hearing loss in various occupational situations. Recently, concerns have been raised regarding hearing loss potential with respect to intermittant exposure to excessively high levels of noise. Research activity has been increased in this area. More than 50% of the total Federal noise effects program is in the category of noise induced hearing loss. This is appropriate since noise induced hearing loss is the nation's number one occupationally-induced disease.

While annoyance effects of exposure to different levels of noise is well documented, the underlying physiological and psychological effects are still unclear. There are indications that noise may induce or exacerbate cardiovascular, neurological and other stress-related diseases. Although this category of research (non-auditory health effects) was identified as a high priority need in the previous panel's deliberation (Ref 4), it remains one of the lowest funded items in the current program. The effects of noise on sleep disruption and its consequences with respect to overall general health is another area of high concern but low priority research activity.

In summary, the Federal noise RD&D program, as presently structured, does not meet the needs for successful implementation of a National noise abatement strategy. The composite Federal noise research program still reflects multiple agency objectives rather than a cohesive unified direction. Priorities are generally based upon individual agency objectives and needs which is to be expected with restrictive noise budgets.

C. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and recommendations have been developed by EPA after considering the on-going noise research programs of the Federal Government in relation to the National needs for noise abatement and control.

While current programs do contribute to the National goals, specific program actions are required in order to accelerate the achievement of these objectives in a reasonable time frame. In addition, supplementary administrative and legislative actions are needed to help implement a cohesive National Noise Research Program.

o 1973 was the year of peak Federal activity bolstered by the infusion of special funds for new technology demonstrations for noise reduction. The programs underway at that time, while in support of the needs expressed in the Noise Control Act, were initiated under the mandates of the individual Agencies. Since 1973, Federal activity (in terms of "real" dollars and effort) has decreased, despite the needs expressed in the Noise Control Act. Progress in developing the technology for future noise abatement and control has been constrained by this apparent diminishing interest in the environmental noise problem. As indicated earlier, this may have been due, in many cases, to the mistaken impression that, with the passage of the Noise Control Act, EPA would undertake the necessary research.

While the 1972 Noise Control Act established a National policy objective for noise abatement and control, more recently, energy efficiency has become a high priority National policy objective as well. In meeting the goals for reduced energy consumption, particularly as applied to transportation vehicles, it appears that noise reduction efforts may suffer (e.g., use of diesel

engines in place of quieter gasoline engines in automobiles). Concurrent with the increase in research funding for development of energy efficient systems, there has been a steady decline in noise research support in the Federal government.

RECOMMENDATION 1

Both the President and the Congress should re-affirm the Nation's commitment to noise abatement and control and take appropriate action to assure a balanced program for meeting the objectives of both noise control and energy efficiency.

RECOMMENDATION 2

Noise research funding should be immediately restored to the 1973 equivalent level. In current dollars, this would require an annual budget of approximately $45 million. This increased funding should be ear-marked for high priority research, development and demonstration programs aimed at accelerating progress towards meeting the objectives of the National noise control effort.

o The Federal Government has made a commitment in the form of a law (Noise Control Act), and in terms of dollars and time expended by the various Federal Agencies to develop noise abatement technology for reducing the noise imposed upon the citizens of this Nation. In order for these actions to be more than mere window dressing, the Executive and Legislative Branches of Government should encourage the rapid implementation of successful technological developments, even if marginal incremental costs are involved. Full scale technology demonstration programs are expensive to conduct, but necessary for justifying technology availability. If successful and feasible R&D programs are not implemented, then one may wonder why they were undertaken in the first place.

Specific program recommendations have been identified by EPA in each of the panels' area of interest.

Aviation

While progress has been made in containing the escalation of aviation noise and providing some near term relief through application of previously demonstrated technology, this trend will reverse if additional noise control actions are not implemented. These future actions are strongly dependent upon current research and demonstration programs. NASA reports that results from both the QCSEE AND QCGAT engine technology demonstration programs indicate significant noise reduction benefits for future civil aircraft.

RECOMMENDATION 3

> $6M should be set aside immediately to initiate flight test programs, with industry cooperation and participation, for both the QCSEE and QCGAT engines to demonstrate their noise emission performance in an operational environment. It is recognized that additional funding for these programs will be required in future years, as was the case for the SAM and the Refan demonstration programs.

RECOMMENDATION 4

> NASA and the Congress should formally set the noise objectives for the NASA supersonic technology program to at least meet Stage 3 subsonic aircraft noise limits (1975 FAR 36). Such levels are necessary for future SST aircraft to be compatible with airport operations in the 1980's and 1990's and NASA should direct its research efforts to search for alternative solutions accordingly. This action now will also provide the necessary guidance for industry planning and development activities.

Surface Transportation

EPA & DOT studies have shown that environmental exposure to surface vehicle noise will decrease over the short term as the new medium and heavy truck popu-

lation begins to conform to the current noise regulatory requirement. However, these same studies show that if no further noise abatement or control actions are taken, the population exposure levels will begin to increase again, thereby cancelling the temporary benefits that were previously achieved, because of projected increases in vehicle fleet size, changes in vehicle characteristics due to energy conservation criteria, and urban population growth.

RECOMMENDATION 5

A comprehensive tire noise research program is imperative. Development of a "quiet" tire is necessary if noise from high speed vehicles, operating on the Nation's highways and freeways, is to be significantly reduced. Concomitantly, road surface/tire interaction criteria need to be developed so that the noise due to tire-surface interaction is minimized and road surfaces are compatible with the needs of specific local traffic demands.

RECOMMENDATION 6

Research, technology development and demonstration programs on components of light, medium and heavy trucks must be expanded and accelerated to assure future reductions in noise generation for these type vehicles.

$3 million of supplementary funding should be set aside or re-programmed for these activities (Recommendations 5 and 6).

Machinery and Construction Equipment

Machinery noise probably affects more people, for a longer period of time, on a continuing basis due to occupational exposure, than all other sources of noise. Most of the Federal (and industry) research activity has been in developing "fixes" to existing equipment or evaluating ear protectors in order to meet the near term OSHA noise exposure requirements.

The current 90 dB requirement has been challenged by EPA, NIOSH and DOD as not being fully protective of the workers' health or welfare. Industry claims that 90 dB is adequately protective and that technology is unavailable to do better. NIOSH has the authority to conduct the necessary research but has experienced severe budgetary cutbacks in their noise program, particularly in the area of technology development.

RECOMMENDATION 7

An expanded program in industrial machinery research, development and demonstration is required. Initial investigations should be restricted to those pieces of equipment that are common to several industries or for which there may be a common technological approach to noise reduction. $1 million should be earmarked to initiate this research.

Noise Effects

There are indications that excessive noise may induce or aggravate physiological and/or neurological disorders. Unfortunately, the relatively low level of research funding in this area has not provided the necessary evidence to confirm these indications. However, if true, a large percentage of the population may be unknowingly adversely affected.

RECOMMENDATION 8

$2 million should be set aside immediately for high priority non-auditory health effects research.

o EPA has identified in the previous recommendations the need for $12M of supplementary funding for high priority noise research, development and demonstration programs to support a National Noise Abatement Program.

These programs would extend our knowledge beyond existing technology to provide for future progress in noise abatement and control. Although Section 14 of the Noise Control Act provides EPA with the authority to conduct research, the Agency has not applied for a research budget for technology development or demonstration. It has, until recently, depended upon the results of the research programs of other agencies to support its regulatory activities. However, we recognize that environmental noise may not have high priority or visibility within some Agencies and their noise activities are oftentimes directed primarily at meeting their individual agency mandates or may be reprogrammed for "higher priority" agency programs.

RECOMMENDATION 9

> Serious consideration should be given to providing a research budget to EPA to be used for the development and demonstration of noise abatement technology for future products and to undertake identified programs in noise effects research. This would assure that priority National noise programs, in response to the intent of the Noise Control Act, would be maintained. These funds could be transferred to other agencies for program implementation or used by EPA directly, as appropriate.

o Section 4 of the Noise Control Act authorizes the Administrator of the EPA "...to coordinate the programs of all Federal agencies relating to noise research and noise control" and to "...publish, from time to time, a report on the status and progress of Federal activities relating to noise research and noise control."

This report is in response to that authorization. The four (4) panel reports provide the details of the on-going Federal noise research programs. While the cataloging and dissemination of this information can provide a data base from which research needs can be identified, it represents only one

element of an effective coordination program. The expertise represented on the panels should be utilized in improving the planning and budgeting for noise research on a continuing basis.

RECOMMENDATION 10

> The panels, in conjunction with EPA and OMB, should participate in the systematic development of high priority research needs and programs as a normal part of the program planning and budget development cycle to facilitate implementation of the National noise objectives identified in the strategy document (Ref. 14). To be effective this process may well need to be codified in an OMB circular or an Executive Order.

EPA'S preliminary conception of the necessary process is as follows:

- o January - Panels identify 4-6 high priority programs that should be included in specific Agency budget submittals
- o March-April - Confirm that identified programs are included in Agency plans. (if not, panels recommend alternate approach to accomplish needed research)
- o June-July - EPA check to assure that programs are still in planned budget submissions.
- o September 1 - Comfirming letter to EPA on final program status in budget submittal. (in-out-cut back, etc.)
- o September 20 - EPA submit a letter report to OMB to describe the high priority items identified in January, their inclusion or non-inclusion in the Agency budgets and the programmatic implications of these budget proposals.

III. OVERVIEW OF AGENCY PROGRAMS

Noise research programs conducted or sponsored by each Agency, while contributing to the national objectives of noise reduction in general, are primarily focused on the specific Agency's needs for complying with its legislative mandates. The noise RD&D activities are directly related to their civilian or military constituency needs.

This section of the report addresses the legislative authorities for conducting noise research as well as a brief summary of the overall program activity for each participating Federal Agency.

More comprehensive and detailed discussions of each Agency's mandates, objectives, programs and project descriptions are provided in the four Panel reports (ref 5-8).

A. DEPARTMENT OF COMMERCE (DOC)

The Department of Commerce noise RD&D effort is conducted through the National Bureau of Standards (NBS). NBS activities in environmental noise measurement are undertaken to support the Congressional mandate for developing and maintaining standards of measurement used in scientific investigations, engineering, manufacturing and commerce, (P.L. 56-117 Amended By P.L. 81-619) as well as in support of Section 14 of the Noise Control Act of 1972. The Noise Control Act authorizes and encourages a cooperative relationship between NBS and the EPA in regard to developing measurement methodologies and standards.

Approximately 35-40% of the research conducted by NBS is through interagency agreements with other Federal Agencies with the program funding provided by the supporting Agency. Although NBS's internally funded research is primarily reported in the areas of noise effects and machinery noise, the development of measurement procedures and the design and calibration of instrumentation is important to all noise programs.

Table 3 and Figure 5 illustrate the breakout of NBS effort in noise research. As indicated therein, interagency cooperative programs represent a significant percentage of the total activity. This would appear to be a positive implication that the results of the research are more likely to be utilized due to the joint interest in the programs.

The Bureau's emphasis, in accordance with their legislative mandates, is in research on improved noise measurements procedures and methodologies. The results of NBS studies are applicable to each of the four Panels' area of interest.

TABLE 3

DEPARTMENT OF COMMERCE (NBS)

NOISE RESEARCH FUNDING

(Thousands of Dollars)

	FISCAL YEAR										
	1973		1974		1975		1976		1977		19
	NBS	IAG**	NBS	IAG	NBS	IAG	NBS	IAG	NBS	IAG	NBS
AVIATION	-	-	-	-	-	-	-	-	-	-	-
NOISE EFFECTS	98	N/A	117	N/A	202	25	335	236	258	288	247
SURFACE TRANSPORTATION	-	N/A	-	110	-	162	-	252	150	153	-
MACHINERY and CONSTRUCTION EQUIPMENT	138	N/A	264	N/A	353	50	360	65	319	40	306
TOTAL	236	N/A	381	110*	555	237	695	553	727	481	553

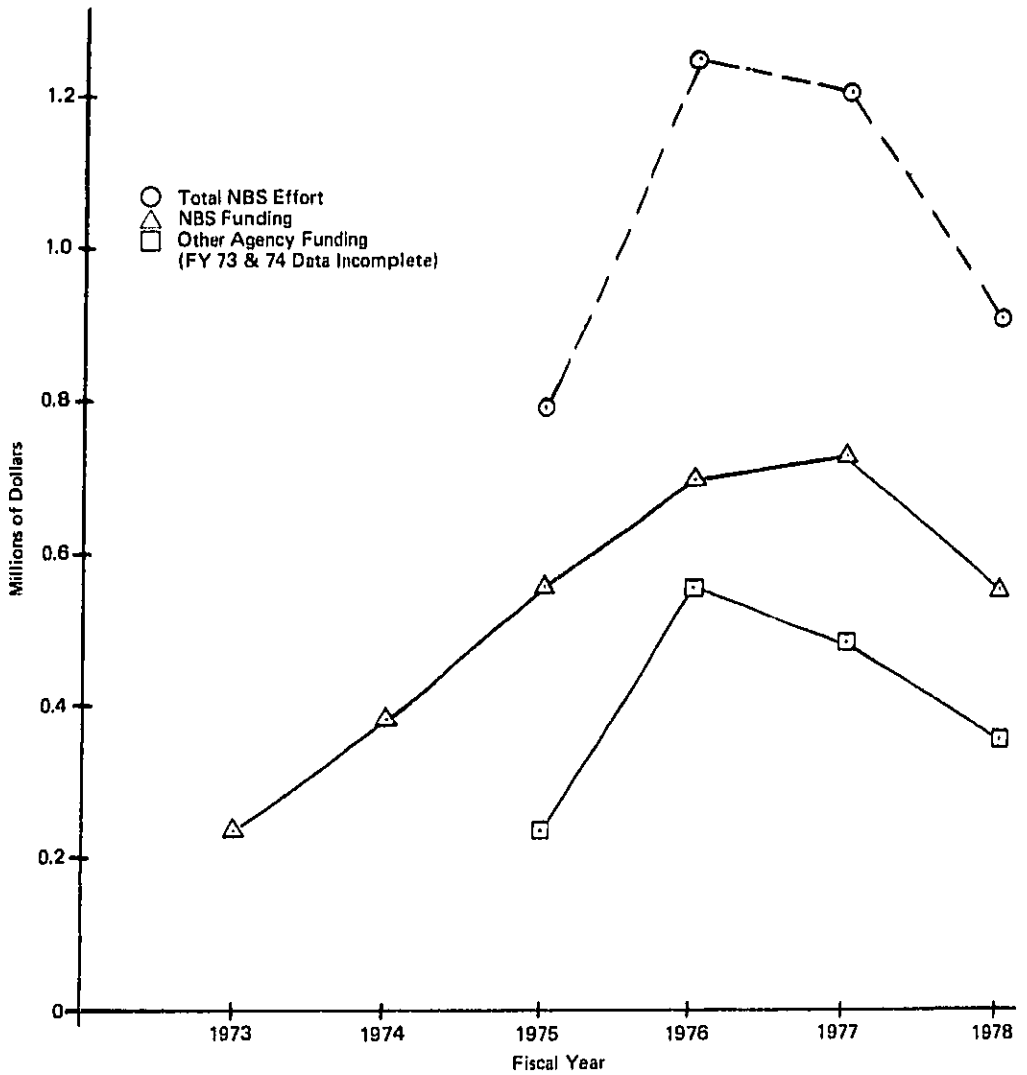
*Incomplete Data

**Interagency Agreement (Funds Supplied By Sponsoring Agency)

FIGURE 5

DEPARTMENT OF COMMERCE (NBS)

NOISE RESEARCH FUNDING



B. DEPARTMENT OF DEFENSE (DOD)

Although DOD does not have specific legislative authorization to conduct noise research programs, there are 3 compelling reasons for them to do so:

- o Military personnel hearing and health protection
- o Survivability in combat environments (low-detectability)
- o Reduce noise exposure of adjacent communities due to military facility operations.

In the areas of surface transportation and machinery/construction equipment noise, the vast majority of noise research activity (that is reportable) is conducted by various components of the Army. The Navy has a significant program for reducing underwater machinery noise but has not provided specific program/or funding information because of security limitations.

Table 4 and Figure 6 provide the distribution of effort within the components of the DOD. The funding indicated represents, in large part, in-house research activities, related to unique military problems, conducted by the various Service laboratories and facilities.

During FY 1976 and 1977, research in the area of noise effects comprises a large part of the DOD noise research activity with increased emphasis applied within the Air Force and the Army. Of the total noise effects research funding during this period, 55-60% addresses the category of "noise induced hearing loss." This activity is directly supportive of the DOD's hearing conservation program. A major increase in noise effects research is planned by the Army in FY 1978 although no program details are reported in Ref 8.

Starting in FY 1977, the Army has expanded its program in helicopter noise research to better understand the noise generating mechanism of helicopter rotors.

TABLE 4
DEPARTMENT OF DEFENSE
NOISE RESEARCH FUNDING
(Thousands of Dollars)

	FISCAL YEAR					
	1973	1974	1975	1976	1977	1978
AVIATION	2051	2286	1595	1506	1907	1619
ARMY	N.A.	N.A.	(0)	(46)	(926)	(868)
NAVY			(1195)	(818)	(470)	(295)
AIR FORCE			(400)	(642)	(511)	(456)
NOISE EFFECTS	984	930	1182	1911	1948	3434
ARMY	N.A.	N.A.	(345)	(676)	(825)	(2210)
NAVY			(504)	(605)	(429)	(429)
AIR FORCE			(333)	(630)	(694)	(795)
SURFACE TRANSPORTATION*	404	412	202	374	518	650
MACHINERY and CONSTRUCTION EQUIP'T*	458	750	265	450	516	472
TOTAL	3897	4378	3244	4241	4889	6175
(ARMY)	N.A.	N.A.	(812)	(1546)	(2785)	(4200)
(NAVY			(1699)	(1422)	(899)	(724)
(AF)			(733)	(1272)	(1205)	(1251)

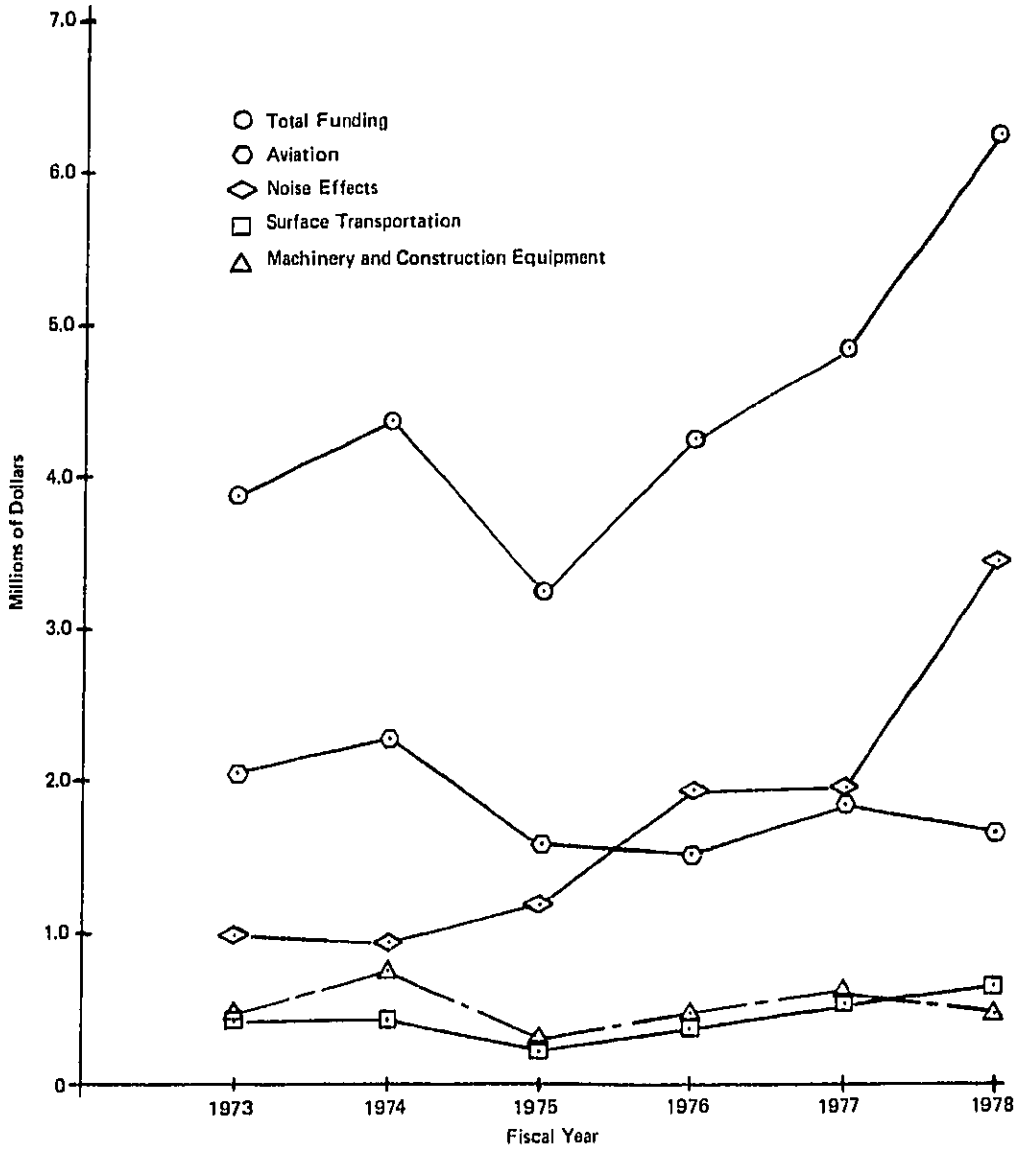
N.A. = Not Available

*Primarily Army

FIGURE 6

DEPARTMENT OF DEFENSE

NOISE RESEARCH FUNDING



C. DEPARTMENT OF INTERIOR (DOI)

Noise research, development, and control activities within the Department of the Interior are carried out by the Bureau of Mines (BOM) and the Mining Enforcement and Safety Administration (MESA)* under several legislative mandates. The overall goal is prevention of occupational hearing loss by reducing noise exposures below the 90 dB(A) occupational exposure limit.

The Bureau of Mines' objectives with respect to noise are accomplished through development and implementation of engineering noise control techniques and measuring instrumentation. MESA conducts its noise reduction development and control projects by defining the noise problem and providing early solutions with existing technology. The thrust of the noise abatement effort is directed toward identifying the sources of noise and reducing the noise at these sources. Additional projects are related to noise instrumentation, exploratory studies, and standards development. Instrumentation work is devoted to development of more precise, easier to use noise instruments to facilitate monitoring of the miner's noise environment.

In addition, DOI maintains a relatively low level of effort in noise effects research, mainly devoted to the evaluation of ear protective devices and personal dosimeter calibration techniques.

Table 5 presents the historical funding level for DOI noise research.

*Effective March 9, 1978, the Mining Enforcement and Safety Administration was transferred to the Department of Labor and renamed the Mine Safety and Health Administration.

TABLE 5

DEPARTMENT OF INTERIOR (BU MINES/MESA)

NOISE RESEARCH FUNDING

(Thousands of Dollars)

	FISCAL YEAR					
	1973	1974	1975	1976	1977	
MACHINERY AND CONSTRUCTION EQUIPMENT	337	528	1463	2076	1481	
NOISE EFFECTS	72	23	109	56	31	
TOTAL	409	551	1572	2132	1512	

D. DEPARTMENT OF TRANSPORTATION (DOT)

The Department of Transportation has many diverse responsibilities and authorities through a number of legislative mandates covering the various Administrations contained within the Department.

The Federal Aviation Administration (FAA), Federal Highway Administration (FHWA), Urban Mass Transportation Administration (UMTA), and the Federal Railroad Administration (FRA), each have the responsibility and authority to "... undertake research and development relating to transportation, including noise abatement with particular attention to aircraft noise." This authorization was provided to the Sec'y of Transportation in Sec. 4 (a) of the Department of Transportation Act of 1966 (P.L. 89-670).

The U.S. Coast Guard, also a component of the DOT, has had only minor involvement in noise research or analysis.

Table 6 indicates the distribution of noise research funding within DOT by organization and panel area of interest. Trends are plotted in Figure 7 which highlight two significant points.

- During the FY 1973-77 period approximately 65% of the DOT noise research budget has been directed to the problem of aviation noise. The sound absorbent material (SAM) demonstration program (in conjunction with the NASA refan demonstration program) provided the technological and economic justification to permit the FAA to amend Part 91 (General Operating and Flight Rules) of the Federal Aviation Regulations which requires the fleet of existing noisy aircraft to comply with the FAR 36, Stage 2 noise levels. (Note: Stage 2 noise levels refers to the limits of 1969 FAR 36).

- o Funding for surface transportation noise research has been steadily decreasing and with the recent dissolution of the Office of Noise Abatement, this trend is expected to continue.

In addition to the FAA's noise research and technology demonstration programs in aviation, the Office of Noise Abatement in the Secretary's office (OST), and the FAA, have conducted complementary technology and cost benefit studies in support of aircraft certification and regulatory programs. These projects were not addressed in the Aviation Panel report since they were considered outside the frame of reference established by the chairman. The results of these studies and technology assessments, can be useful in identifying research needs for the future. These projects, (to the extent provided by the DOT/FAA), are listed in Appendix A herein in order to provide a more complete picture of noise-related research activities. The funding levels associated with these studies are not included in the summary data on total Federal funding nor in Table 6 and Figure 7.

TABLE 6

DEPARTMENT OF TRANSPORTATION

NOISE RESEARCH FUNDING

(Thousands of Dollars)

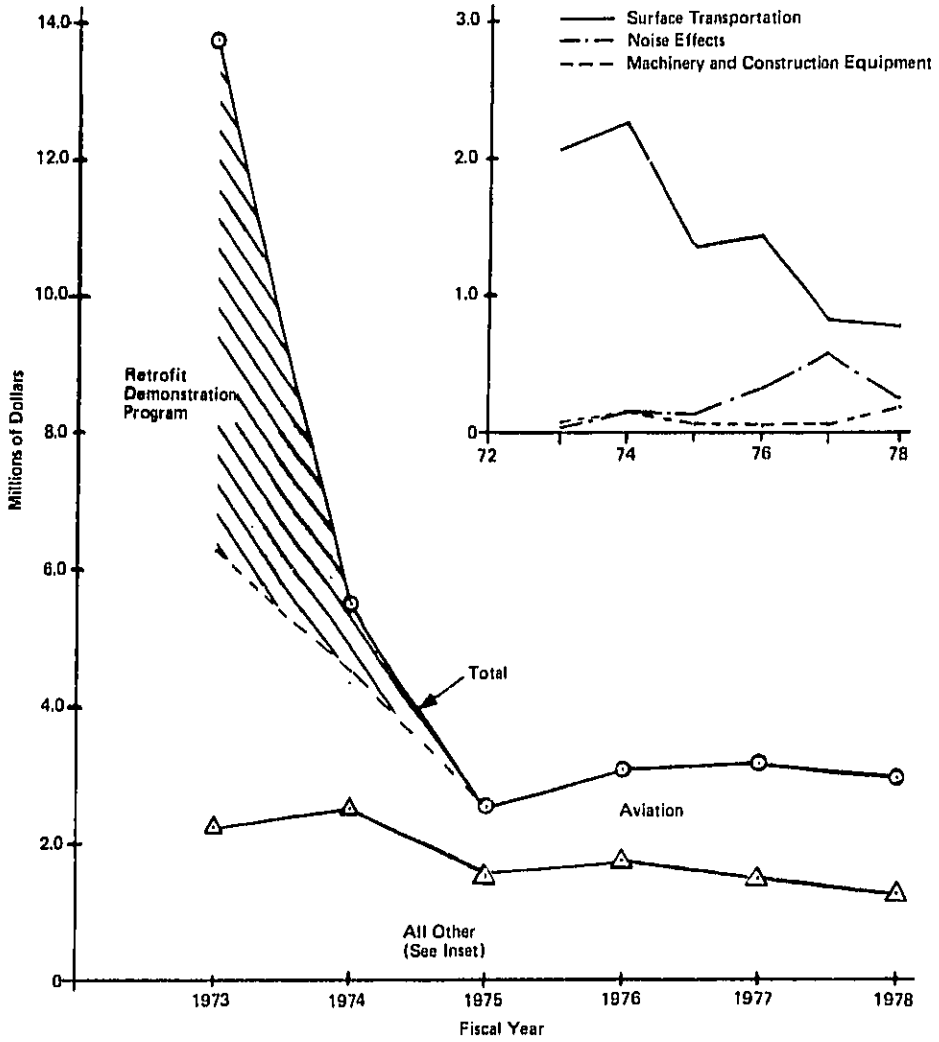
		FISCAL YEAR					
		1973*	1974	1975	1976	1977	19
OST	Surface Transportation	N.A.	1317	625	593	128	
	Machinery and Const. Equip't.	N.A.	N.A.	5	-	-	
	Noise Effects	-	130	-	-	-	
	Aviation	-	-	-	-	-	
		N.A.	1447	630	593	128	
FAA	Aviation	11563	2983	959	1253	1720	1
	Noise Effects	45	-	35	112	396	
		11608	2983	994	1365	2116	1
FHWA	Surface Transportation	N.A.	264	341	699	501	
	Machinery and Const. Equip't.	N.A.	N.A.	71	42	60	
	Noise Effects	-	-	76	201	125	
		N.A.	264	488	942	686	
UMTA	Surface Transportation	N.A.	637	401	108	-	
	Noise Effects	N.A.	N.A.	9	-	-	
		N.A.	637	410	108	-	
FRA	Surface Transportation	N.A.	49	-	17	175	
CG	Noise Effects	5	-	-	-	50	
TOTALS	Aviation	11563	2983	959	1253	1720	1
	Surface Transportation	2064	2267	1367	1417	804	
	Machinery and Const. Equip't.	90	130	76	42	60	
	Noise Effects	50	130	120	313	571	
GRAND TOTAL		13767	5510	2522	3025	3155	2

*From Ref. 1-4

FIGURE 7

DEPARTMENT OF TRANSPORTATION

NOISE RESEARCH FUNDING



E. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Section 14 of the Noise Control Act authorizes the EPA Administrator to:

> "Conduct research, and finance research by contract with any person, on the effects, measurement, and control of noise, including but not limited to
>
> > (A) investigation of the psychological and physiological effects of noise on humans and the effects of noise on domestic animals, wildlife, and property, and determination of acceptable levels of noise on the basis of such effects;
> >
> > (B) development of improved methods and standards for measurement and monitoring of noise, in cooperation with the National Bureau of Standards, Department of Commerce; and
> >
> > (C) determination of the most effective and practicable means of controlling noise emission."

This research authority was to "--complement, as necessary, the noise research programs of other Federal Agencies".

Until recently, EPA's noise research activity was primarily focused in the area of noise effects in accordance with (A) above.

Technology assessment studies to identify the state-of-the-art of available technology were undertaken in support of planned regulatory actions. These studies are not considered "research" in the sense that they do not contribute directly to the advancement of technology. However, they are significant in that they identify the current technology base and help to point out the areas of future research needs. These EPA projects, related to surface transportation and machinery and construction equipment noise were reported in the respective panel reports. As in the case of the FAA, the EPA technology assessment studies in aviation in support of proposed regulatory actions were not identified in the Aviation Panel report. These studies and analyses are reported in Appendix A herein.

Since 1976, the Office of Noise Abatement and Control has initiated several technology demonstration projects, particularly in the area of surface vehicle noise. Reduced efforts by DOT in this area despite the continued pervasiveness of the surface transportation noise problem stimulated the need for continued technology development and demonstration programs by EPA. The elements of the EPA surface transportation technology program includes

- o Truck noise reduction
- o Tire noise reduction
- o Internal combustion engine noise reduction

In addition, EPA has initiated a significant research study of the cardiovascular effects of noise with co-sponsorship from the National Institute of Environmental Health Sciences (NIEHS).

Table 7 and Figure 8 provide the EPA research funding levels by area of interest as well as the technology assessment studies in support of regulatory actions which are not included as part of the total Federal Noise "research" funding summary.

TABLE 7

EPA NOISE RESEARCH

& REGULATORY SUPPORT FUNDING

(Thousands of Dollars)

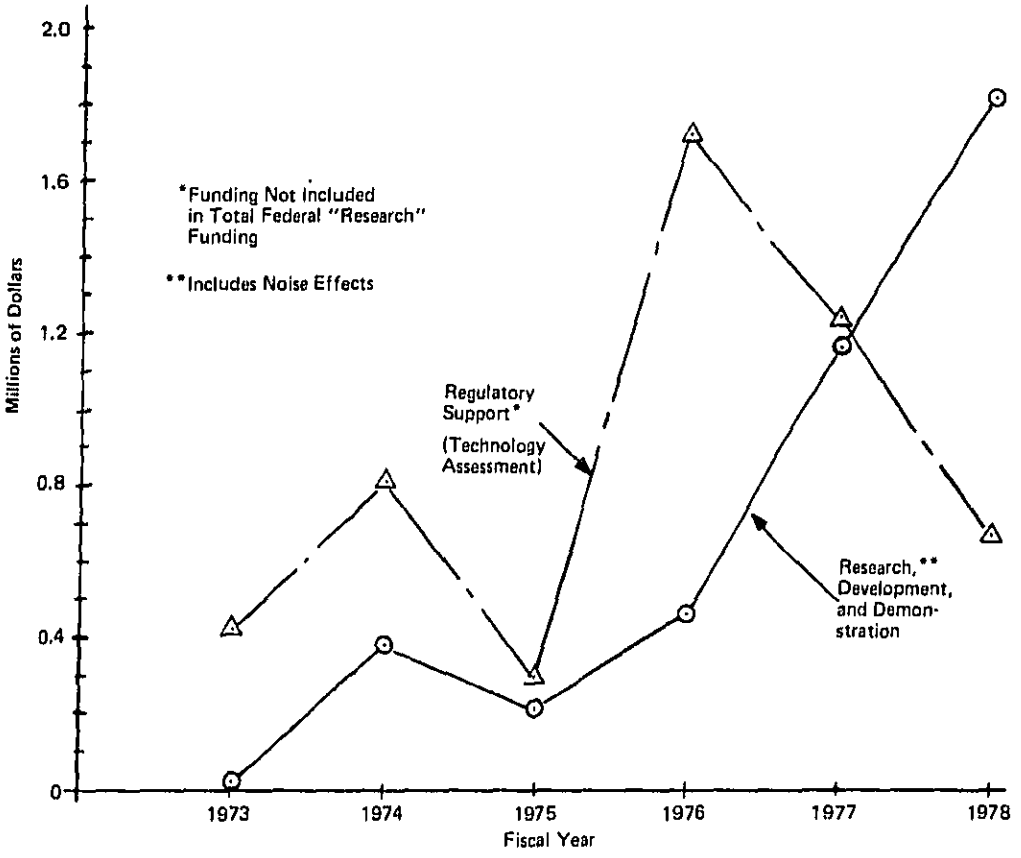
	FISCAL YEAR											
	1973		1974		1975		1976		1977		1978	
	RD&D	REG. SUPPORT*	RD&D	REG. SUPPORT*	RD&D	REG. SUPPORT*	R&D	REG. SUPPORT*	RD&D	REG. SUPPORT*	R&D	REG. SUPPO
Aviation	-	-	-	404	-	1150	-	90	-	1151	100	250
Noise Effects	24	-	377	-	190	-	230	-	349	-	350	-
Surface Transp.	-	369	-	178	18	-	162	978	476	680	1224	280
Machinery and Const. Eqt.	-	60	-	230	9	145	74	657	343	415	141	140
TOTAL	24	429	377	812	217	295	466	1725	1168	1246	1815	670

* Funding not included in total Federal "Research" Funding

FIGURE 8

ENVIRONMENTAL PROTECTION AGENCY

NOISE RESEARCH & REGULATORY SUPPORT FUNDING



F. DEPARTMENT OF HEALTH, EDUCATION & WELFARE (HEW)

The noise related activities of the various organizational elements within HEW have two major thrusts:

- By the Occupational Safety and Health Act of 1970 (P.L. 91-596) and the Federal Coal Mine Health and Safety Act of 1969 (P.L. 91173), the National Institute of Occupational Safety and Health (NIOSH) is charged with undertaking research and related activities to assure safe and healthful work-place conditions.
- The National Institutes of Health have the responsibility for improving the health of the American people through biomedical research, including studies related to the development of a better understanding of the efffects of noise on individuals.

During the FY 1973-78 time period, the major emphasis within HEW, including NIOSH activity, has been in noise effects research rather than technology related noise control.

The National Institute of Neurological and Communicative Diseases and Stroke (NINCDS) accounts for approximately 1 to 1½ million dollars per year or 55-60% of the HEW noise research effort. Practically all of their efforts are studies related to noise-induced hearing loss. As indicated earlier, this research activity has shown a significant increase in funding since 1973. The NINCDS effort alone in hearing loss studies has increased from approximately ½ million dollars in FY 1973 to 1½ million dollars in the FY 1976-77 period.

Table 8 provides the FY 1973-78 funding data for the National Institutes of Health of HEW.

TABLE 8

DEPARTMENT OF HEALTH, EDUCATION & WELFARE

NOISE RESEARCH FUNDING

(Thousands of Dollars)

	FISCAL YEAR					
	1973	1974	1975	1976	1977	1978
Mach'y and Construction Equipment	16	226	139	179	247	135
NIOSH	(16)	(226)	(139)	(179)	(247)	(135)
Noise Effects	1074	1387	1901	2315	2135	1875
NIOSH	(395)	(507)	(606)	(470)	(328)	(247)
NINCDS	(526)	(622)	(1150)	1559)	(1427)	(1426)
NIEHS	(153)	(258)	(145)	(203)	(319)	(202)
NICHHD	-	-	-	(48)	(61)	-
NIMH	-	-	-	(35)	-	-
TOTAL	1090	1613	2040	2494	2382	2010

G. NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

The National Aeronautics and Space Administration (NASA) was established by the National Aeronautics and Space Act of 1958 which provided NASA with responsibilities to conduct aeronautical research and technology activities including aircraft noise research and technology development.

The various elements of the aviation noise research activity includes reduction of noise at the source, alternative operational procedures, and human factors. Human factor studies at NASA are particularly concerned with community annoyance and the related adverse subjective responses to aircraft noise.

Noise technology research is being undertaken to extend the understanding of the fundamental mechanisms of noise generation, propagation, and suppression of noise from all component noise sources (basic R&T program) as well as to develop and demonstrate the feasibility and effectiveness of potential technological applications for noise reduction.

The NASA aviation noise research and technology program represents 80-85% of the Federally-sponsored aviation noise research activity and 50-60% of the total Federal noise research program.

The primary thrust of the NASA effort is to extend the technology base through conceptual analyses, scale model and component development and test and full scale technology feasibility demonstration testing. Between FY 1975 and FY 1977 the full-scale demonstration portion of the overall NASA noise program has decreased significantly, while the basic research and technology funding, after allowing for inflation, has increased by approximately 40%. (Table 9 and Figure 9).

As indicated earlier, the NASA refan program has been separately identified since this was a special, Congressionally-approved, add-on to the basic NASA RD&D program. The funding for this effort alone in FY 1973 and FY 1974 was more than the total NASA aviation program funding today, including inflation effects.

TABLE 9

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

NOISE RESEARCH FUNDING

(Thousands of Dollars)

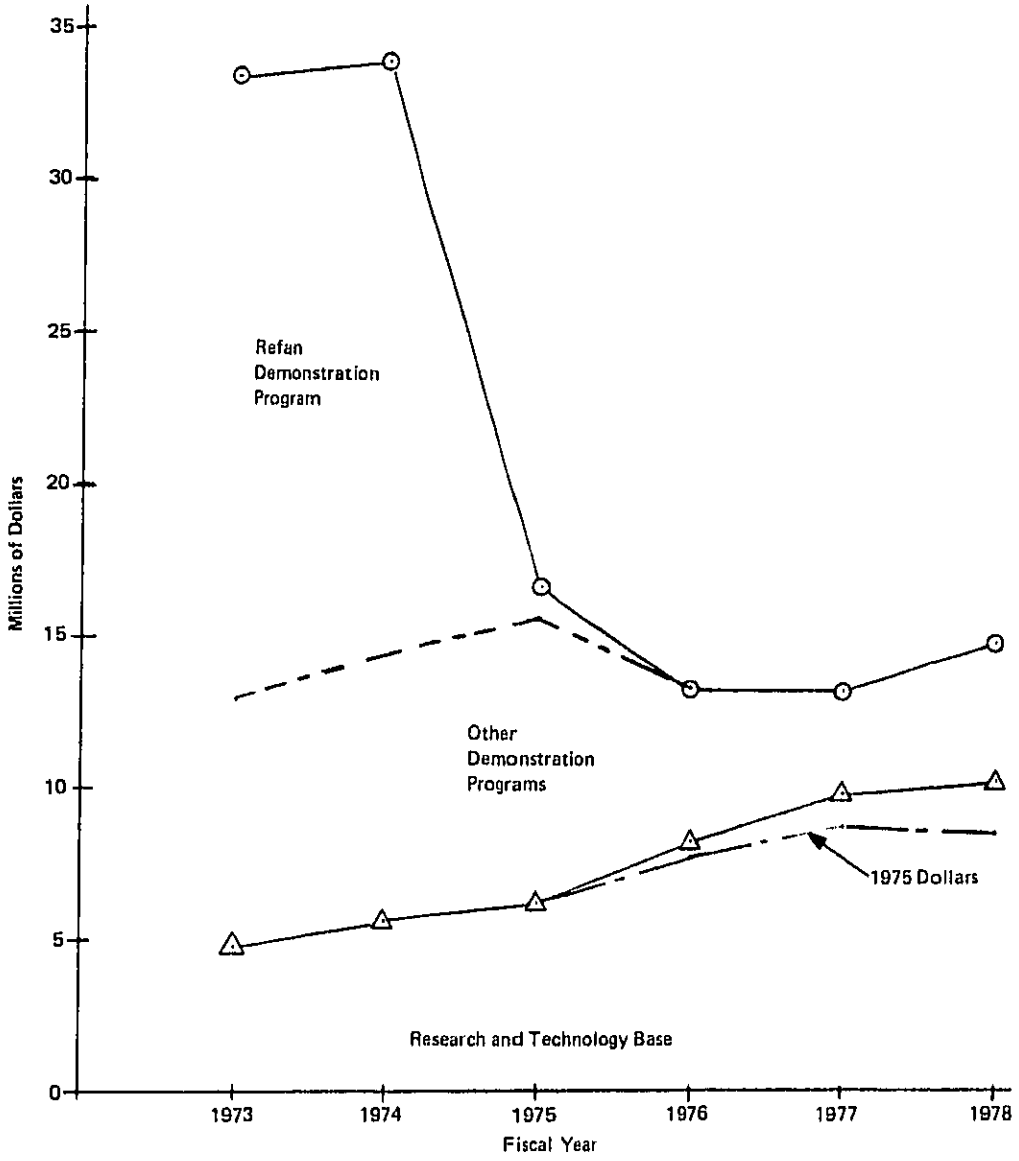
	FISCAL YEAR					
	1973	1974	1975	1976	1977	1978
AVIATION	33352*	33964	16600	13359	13213	14909
Basic R&T	(4844)*	(5589)	(6100)	(8260)	(9802)	(10257)
Demonstration Programs	(28508)*	(28375)	(10500)	(5099)	(3411)	4652)
NOISE EFFECTS	1127	1154	514	825	814	740
TOTAL	34479	35118	17114	14184	14027	15649

* Estimated from data in Ref 2.

FIGURE 9

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

AVIATION NOISE RESEARCH FUNDING



H. OTHER FEDERAL AGENCIES

There are approximately eight other Federal agencies that have implemented noise research projects intermittently over the past 6 years. These include:

- o Department of Housing & Urban Development (HUD)
- o Department of Agriculture (DOA)
- o Consumer Product Safety Commission (CPSC)
- o Energy Research and Development Administration (now Department of Energy (DOE))
- o National Academy of Science (NAS)*
- o National Science Foundation (NSF)
- o Veterans Administration (VA)
- o Department of Justice (DOJ)

Table 10 provides the funding levels and area of interest for each of these Agency activities.

During the 6 year period of FY 1973-78 these 8 agencies collectively funded approximately $4-1/2 million of noise research activity. During the last 3 years however a marked drop in technology research has occurred. Over 80% of the noise research funding since FY 1975 has been in the area of noise effects with only ERDA (DOE), VA and NSF maintaining a continuing program.

One of the more distressing developments since passage of the NCA of 1972 has been the decision by the NSF to withdraw its considerable expertise in noise technology research and also its ability to influence the academic community.

* Quasi-Official Agency - Established by an act of Congress

TABLE 10

OTHER FEDERAL AGENCIES

NOISE RESEARCH FUNDING

(Thousands of Dollars)

	CPSC	DOA	DOJ	ERDA	HUD	NAS	NSF	VA	TO
Noise Effects									
FY 73	-	-		-	117	-	20	-	1
74	-	-		-	638	-	-	-	6
75	-	10		45	-	100	-	54	2
76	36	100		165	-	-	49	208	5
77	-	2		143	-	-	125	191	4
78		-		143		-	72	185	4
									24
Surface Transportation									
FY 73		4	-		-		-		
74		73	-		-		302		3
75		9	-		548		-		5
76		16	78		-		-		9
77		8	5		-		-		1
78		26	-		-		-		2
									10
Machinery and Constr. Eq't.									
FY 73	-	-					243		2
74	70	20					356		4
75	-	100					-		10
76	-	265					-		26
77	-	118					-		11
78	-	123					-		12
									12

IV. REFERENCES

IV. REFERENCES

1. Federal Surface Vehicle Noise Research, Development and Demonstration Programs FY 73-FY 75, EPA 600/2-75-002, U.S. Environmental Protection Agency, March 1975, NTIS Document # PB - 241887/LK

2. Federal Aircraft Noise Research, Development and Demonstration Programs: FY 73-FY 75 EPA 600/2-75-003, U.S. Environmental Protection Agency, March 1975. NTIS Document # PB - 244904/LK

3. Federal Machinery Noise Research, Development and Demonstration Programs: FY 73 - FY 75, EPA 600/2-75-008, U.S. Environmental Protection Agency, May 1975. NTIS Document # PB - 243523/LK

4. Federal Noise Effects Research: FY 73-FY 75 EPA 600/1-75-001, U.S. Environmental Protection Agency, March 1975. NTIS Document # PB - 241751/LK

5. Federal Research, Development and Demonstration Programs in Surface Transportation Noise. EPA 550/9-78-305. U.S. Environmental Protection Agency, February 1978

6. Federal Research, Development and Demonstration Programs in Machinery and Construction Noise. EPA 550/9-78-306. U.S. Environmental Protection Agency, February 1978

7. Federal Research, Technology and Demonstration Programs in Aviation Noise. EPA 550/9-78-307. U.S. Environmental Protection Agency, March 1978.

8. Federal Noise Research in Noise Effects. EPA 550/9-78-102. U.S. Environmental Protection Agency, February 1978

9. University Noise Research-Proceedings of the EPA-University Noise Seminar. EPA 550/9-77-300. U.S. Environmental Protection Agency, October 18-20, 1976, NTIS Document # PB - 265114

10. Foreign Noise Research in Surface Transportation. EPA 550/9-78-301. U.S. Environmental Protection Agency, December 1977

11. Foreign Noise Research in Machinery/Construction Equipment. EPA 550/9-78-302. U.S. Environmental Protection Agency, December 1977

12. Foreign Noise Research in Aviation. EPA 550/9-78-303. U.S. Environmental Protection Agency, December 1977

13. Foreign Noise Research in Noise Effects. EPA 550/9-78-101. U.S. Environmental Protection Agency, January 1978

14. Toward a National Strategy for Noise Control. U.S. Environmental Protection Agency, April 1977

15. The Federal Aviation Administration Five-Year Environmental Plan 1976-1980. Department of Transportation, Federal Aviation Administration, January 1976

16. National Measure of Aircraft Noise Impact Through the Year 2000. EPA 550/9-75-024. U.S. Environmental Protection Agency, June 1975

17. Advanced Supersonic Technology. Hearings before the Subcommittee on Aeronautics and Space Technology, Committee on Science and Astronautics, U.S. House of Representatives, February 22, 1974. House Document #39

18. National Exposure to Highway Noise to the Year 2000. Unpublished Draft Report.

19. Draft Interagency Study of Post-1980 Goals for Commercial Motor Vehicles. Department of Transportation, June 1976

20. Public Health and Welfare Criteria for Noise. 550/9-73-002. U.S. Environmental Protection Agency, July 27, 1973. NTIS Document # PB-241000/AS

21. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare With an Adequate Margin of Safety. 550/9-74-004. U.S. Environmental Protection Agency, March 1974. NTIS Document # PB-239429/AS

V. APPENDIX

AVIATION NOISE

REGULATORY & CERTIFICATION

SUPPORT PROJECTS

FUNDING SUMMARY

AVIATION NOISE REGULATORY & CERTIFICATION

SUPPORT PROJECTS

(Thousands of Dollars)

	FISCAL YEAR			
	1975	1976	1977	1978
EPA	150	90	151	250
FAA*	N/A	2070	2414	2440

N/A - Not provided

*NOTE: FAA provided total budget submission data. The funding level indicated above represents the total annual noise budget less the technology and noise effects research activities provided in the panel reports (Ref 7 and 8)

EPA

AVIATION NOISE

REGULATORY SUPPORT

PROJECTS

Abatement of Community Noise Exposure Resulting From General Aviation Operations

There are today approximately 6500 public use airports in the United States that are served exclusively by about 150,000 general aviation aircraft conducting about 130 million operations per year. The FAA estimates that within ten years, the GA fleet will grow to greater than 240,000 aircraft conducting over 220 million annual operations. The existing FAR 36 noise rules only serve to limit or "cap" the noise levels of current types of GA airplanes and do not provide guidelines nor incentives for advancements in noise control technology to be incorporated in new type designs. Consequently, as the GA fleet grows, noise exposure will grow as well, unless progressively more stringent noise regulations are prescribed or other means are devised to encourage applications of noise control technology flight procedures.

The purpose of this study is: to predict the noise exposure caused by GA aircraft through the year 2000 assuming several fleet growth and noise reduction scenarios; assess noise control technology development; demonstrate a noise control planning concept for GA airports; and classify the noise problems and possible methods of solution at the GA airport level.

Investigators: Not yet determined

Fiscal Year Funding ($1000):	1975	1976	1977	1978
				240

Comparative Study of Aircraft Noise Prediction Procedures

There are a number of computational procedures in use today for predicting cumulative noise exposure in the vicinity of airports resulting from aircraft operations. Although the various procedures may yield significantly different results, any one may be used in support of activities such as environmental impact stgatements and lawsuits which can result in critical decisions involving the nation's health and welfare and economy. The purpose of this study is to identify the aircraft/airport noise prediction procedures most used today and to define the principal computational components common to all. The differences in assumptions and methods inherent in the components for each of the noise prediction procedures shall be described and estimates made for the influence on noise exposure that could result from those differences.

Investigator: Dytec Engineering, Inc.

Fiscal Year Funding ($1000):	1975	1976	1977	1978
				10

Noise Exposure of Civil Aircarrier Airplanes Through The Year 2000

This study updates and supplements the previous study sponsored by the EPA. The purpose is to predict the nationwide community exposure to aircraft noise in the vicinity of aircarrier airports. The assumptions are based upon several aircraft fleet and noise reduction time phased scenarios as well as various options for aircraft departure and arrival fight procedures and the influence of supersonic transports. The baseline year is 1975 and the national aircraft noise exposure shall be estimated thereafter for five equal time periods beginning with 1980

and ending with 2000. The scenarios and options are chosen such that the extremes of the predicted noise exposure will represent an envelope within which the actual noise exposure for the years investigated can reasonably be expected to lie.

Investigator: Wyle Laboratories

Fiscal Year Funding ($1000):	1975	1976	1977	1978
			86	

Effectiveness of Various Takeoff Procedures for Aircraft Noise Control

The purpose of this study is to supplement the analysis already conducted in house by the EPA on the effectiveness of various takeoff procedures for the control of aircraft noise. The EPA analysis has predicted the noise levels along the flight track which are necessary but may not be sufficient to make a definitive judgement as to which of the procedures results in minimum noise exposure. The scope of this study is to determine the areas enclosed by a specified number of single event noise level contours whose closure points are indicated by the noise levels along the flight track.

Investigator: Wyle Laboratories

Fiscal Year Funding ($1000):	1975	1976	1977	1978
			15	

GENERAL AVIATION AIRCRAFT NOISE

The purpose of this study is to collect information on the noise exposure produced by general aviation aircraft. Surveys consist of examining a particular set of FAA's regional files on general aviation airports

and correlating the available results of noise studies conducted relative to to the Airport Development Act Program (ADAP), Environmental Impact Statements (EIS), airport master plans, and any other sources as appropriate.

Investigator: Georgia Institute of Technology

Fiscal Year Funding ($1000):	1975	1976	1977	1978
			10	

Military/Civil Aircraft Noise at Joint-Use Airports

As a result of aircraft noise regulatory actions, noise exposure in the vicinity of civil airports due to the civil fleet is anticipated to decrease in the coming years. However, as the noise exposure resulting from the civil fleet diminishes, there may remain a significant component in the total aircraft noise exposure due to military aircraft operations at joint-use civil airports. Therefore, this study has been initiated to determine the aggregate national noise exposure of military operations at joint-use civil airports as the noise of the civil fleet is diminished with time.

Investigator: Wyle Laboratories

Fiscal Year Funding ($1000):	1975	1976	1977	1978
			40	

Dynamic Preferential Runway System at JFK

The performance of the Dynamic Preferential Runway System (DPRS), which was installed at JFK International Airport in 1971, was analyzed. The DPRS is used by the FAA control tower staff as an aid in selecting

runway combinations from the standpoint of minimal noise impact in surrounding communities. A report of this analysis was published in May 1975.

Investigator: Tracor

Fiscal Year Funding ($1000):	1975	1976	1977	1978
	9			

Airport Operating Modes at JFK

Studies of airport operating modes at JFK International Airport are being conducted for use in conjunction with the operation of the Dynamic Preferential Runway System (DPRS). The DPRS is used by the FAA control tower staff as an aid in selecting optimum runway combinations from the standpoint of minimizing noise. Its success depends on the flexibility of airport operations and thus the range of choices of operating modes.

Alternative operating modes and typical wind patterns at JFK have been identified, and work has been begun to determine the incremental aircraft impact (IAI) for comparison with the operating modes. Based on an EPA methodology, the IAI identifies the incremental noise levels contributed by aircraft flyovers beyond the indigenous noise level of the community.

Investigator: Tracor

Fiscal Year Funding ($1000):	1975	1976	1977	1978
		10	37	

Field Support for a Pilot Project to Test a Draft Regulation on Airport Noise

The EPA has developed an environmental assessment methodology for determining aircraft noise impact on people living around the nation's airports. This assessment technique is known as the Airport Noise Evaluation

Process (ANEP). Characteristic of this process and the attendant methodology is a means to measure the relative effectivensss of noise abatement actions and convey the results in terms understandable to both technical and lay personnel. This project was to conduct field tests at a number of U.S. airports in order to provide EPA with "hands on" experience in the ANEP.

Investigator: PRC Systems Sciences Company and Arthur D. Little, Inc.

Fiscal Year Funding ($1000):	1975	1976	1977	1978
	130	40		

Aircraft Noise Impact Through the Year 2000

The nationwide community impact of aircraft noise through the year 2000 was evaluated, considering a number of aircraft/airport noise reduction alternatives. The study was based on the evaluation of operations at three airports - Los Angeles International, St. Louis, and Washington's Dulles International. A report was issued in June 1975. (Ref 18)

Investigator: Wyle Laboratories

Fiscal Year Funding ($1000):	1975	1976	1977	1978
	11			

Modeling Techniques

A method for calculating values of Day/Night Levels (L_{dn}) at a point due to aircraft operations from civil airports was determined. A report was published in January 1977 that described two levels of sophistication. At the basic level, such factors are type of takeoff and landing procedures

are considered. A more detailed method also considers aircraft range and nonstandard approach glide slopes.

Investigator: Bolt Beranek and Newman, Inc.

Fiscal Year Funding ($1000)	1975	1976	1977	1978
		40		

DOT/FAA

AVIATION NOISE

REGULATORY AND CERTIFICATION

SUPPORT PROJECTS

In the DOT Congressional budget submittal the noise programs are broken out in various categories as follows:

Noise Control Systems Analysis

One of the principal programs under this category is to define a framework for long-range regulatory goals. This program was initiated in FY 76 and includes: predictions of the types and quantities of air transportation vehicles forecasted to be in service through the year 2000; a regulatory classification system defined as a function of aircraft type, operation and noise abatement technology; and a technology assessment program.

Noise Reduction at the Source

Some of this activity was reported in the aviation panel report (Ref 7), in particular, the core noise and jet noise suppression programs.

Noise Monitoring and Noise Reduction Through Aircraft Operational Procedures

Noise abatement operational procedures designed to provide lower noise levels in the communities in the vicinity of airports have been developed for the takeoff and departure and the approach and landing portion of flight, as well as air traffic routing.

Analysis of alternative approach procedures for noise abatement were concluded in FY 1976 and similar studies for alternative takeoff and departure procedures were completed in FY 1977.

The noise monitoring system, in place at Dulles, was expanded to include Washington National Airport during FY 1977 to provide information on noise related to aircraft and ATC operating procedures. These activities will continue in FY 1978 in order to develop modified

procedures to further reduce noise, to provide data for other noise reduction research and regulatory support, and to serve as a model for airport noise monitoring systems.

Noise Reduction Through Airport Use Restrictions

During FY 1977 work proceeded on the development of methodologies to estimate the total system costs and benefits associated with airport use restrictions. A limited study was undertaken in FY 1977 at JFK Airport for this purpose. Consistent with the issuance of the Aviation Noise Abatement Policy Statement, it is expected that use restrictions will be implemented at many airports in a similar fashion as was done by the Massachusetts Port Authority at Logan Airport. FAA must be in a position to evaluate these actions by proprietors. Therefore, during FY 1978, the FAA will continue these studies and implement a policy and procedure for considering airport use restrictions for noise abatement.

Land Use Planning

During FY 1977 a program to develop land use criteria based upon performance standards for interior acceptability relative to the exterior noise levels was initiated. This work will be completed during FY 1978. Guidance on land use compatibility with aircraft operations will be developed and used in conjunction with models for aviation noise/land use compatibility planning. Information will be developed and systematized regarding state and local aviation land use and noise related programs. Only through the application of land use planning activities by local authorities can the actions taken by the Federal Government regarding

source noise reduction be supplemented so as to maximize benefits in the area of aircraft noise abatement to the Nation's citizens.

Environmental Assessment

The objective of this program is to provide policies and procedures for considering all relevant environmental impacts or proposed FAA actions significantly affecting the quality of the human environment and to assure that FAA environmental assessments are consistent with national environmental goals.

Identification by the FAA of specific project objectives, timing and funding were not made available although much of the effort can probably help identify future research needs. For example, a cursory review of Commerce Business Daily contract citations over the past few years provides the following FAA contract information:

> AIRFRAME NOISE REDUCTION STUDY. Contract DOT-FA76WA-3821 (LGR-6-5184) for $43,404 to United Technologies Research Center, East Hartford, CT.
>
> BUSINESS EXECUTIVE JET NOISE REDUCTION PROGRAM. Contr. DOT-FA75WA-3668 (WA5R-5219) for - $63,900 - to Bolt Beranek & Newman, Inc., Cambridge, MA.
>
> V/STOL, NOISE PREDICTION AND REDUCTION, STOL AND VTOL AIRCRAFT NOISE PREDICTION STUDY - RFP WA5R 5213 - Anticipated date of issuance o/a 19 Mar 75.

STUDY OF COST/BENEFIT TRADEOFFS avail in acft noise technology applications in the 1980's. Cont. DOT-WA77WA-4037 (LGS-7-3767) - 22 Sep 77 - $79,205 - Bolt, Beranek, and Newman, 21120 Vanowen St., Chicago Park, CA.

AIRCRAFT NOISE/EMMISION TRADE-OFF STUDY. Requirement will include Identification and Summarization of Reduction controls related to turbofan, turbojet and turboprop engines, development of methods for relating and presenting trade-off considerations; and cataloging of reduction controls-Job-RFP LGR-6-5175-Anticipated date of issuance o/a 24 Nov 75.

DEVELOPMENT OF A GUIDANCE DOCUMENT on aviation noise control plans, techniques, and procedures, Contract DOT-FA78WA-4105 (RFP LGR-7-3714) 28 Dec 77 to Bolt, Beranek and Newman, Cambridge, MA., 02138 for - $40,284.