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A proposal for

**A FINANCIAL MODEL FOR
EDUCATIONAL PROBLEMS**

to

**Department of Model Cities
City of San Antonio**

March 5, 1970



SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO HOUSTON

March 5, 1970

A proposal for

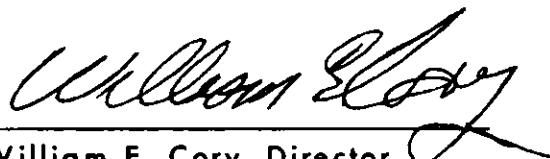
A FINANCIAL MODEL FOR EDUCATIONAL PROBLEMS

to

**Department of Model Cities
City of San Antonio**

Prepared by: T. E. Hawkins

Approved:

A handwritten signature in cursive script, reading "William E. Cory". The signature is written in black ink and is positioned above a horizontal line.

**William E. Cory, Director
Department of Electronic Systems Research**

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I. RESEARCH OBJECTIVES

A. Background

In recent years, the program of Southwest Research Institute has become increasingly concerned with the broad interfaces between technology and urban and social problems. While a number of our projects concern engineering research in environmental control, transportation systems, medical instrumentation, and water resources, we are also actively engaged in planning studies for state governments and municipalities. We believe that the modern techniques of mathematical modeling can be of assistance to municipal officials by assisting them to determine the quantitative effects of alternative policies and programs. The current situation involving the Model Cities Program and the Edgewood Independent School District is an excellent case in point.

B. Relationship Between MCP and EISD

According to recent articles in the local newspapers, the Model Cities Program recommended, and the City Council approved, the construction of multiple-unit housing in the Model Neighborhood area, which includes portions of the Edgewood Independent School District. Because of their feeling that this housing would adversely impact the already troubled financial structure of the Edgewood Independent School District, the citizens of that school district vehemently objected to the construction of multiple-unit housing, and recommended the development of a master plan. This master plan, according to the views of the citizens of the school district, should include the following: dispersement of multiple-unit housing throughout the City; alternatives for home ownership; alternatives for single-family living; replacement of substandard homes; and minimal impact on single school districts such as Edgewood. The City Council indicated that it had funds available for development of a Master Plan and placed a moratorium upon the housing projects.

However, as far as can be determined, none of the participants has available a planning tool capable of analyzing the economic impact of alternatives upon the financial structure of the Edgewood Independent School District. The availability of such an analytical tool seems to Southwest Research Institute to be a prerequisite to the development of a Master Plan, the plan which is quite properly prepared on the basis of both quantitative, numerical factors and qualitative, subjective judgements, would then have a firm foundation for those factors which can be quantified.



For the quantitative, numerical factors, we believe that the complexity of the program requires the development of a computer model as the planning tool. Our reason for this belief becomes clear when you consider the vast number of alternative programs and policies that must be included in a quantitative analysis. The factors, which are interrelated with one another, are:

1. Model City Housing Programs

Type Housing
 Number of Houses
 Cost of Housing
 Location of Housing

2. School District Revenues

School Tax Base
 School Tax Property Valuation
 School Tax Collections
 Impact of Additional Housing
 Impact of Additional Industry
 Impact of Additional Commercial Businesses

3. School District Costs

Teacher Costs
 Capital Plant Replacement, Modernization, and
 Maintenance Costs
 Inflationary Trends in Education Costs
 Site and Size Standards

4. Quality of Education Costs

Pupil-Teacher Ratios
 Teacher Degree Level
 Teacher Salary Scale
 Principal-Vice Principal Salary Scale
 Pupil-Counselor Ratios
 Counselor Salary Scale
 Teacher-Teacher Aide Ratios
 Impact of Change in Drop-Out Rate
 Special Education and Pupil Appraisal Programs
 Pre-School Programs
 Vocational Training Programs

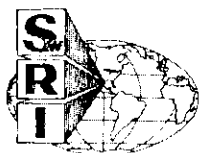


Bi-Lingual Programs
Library Programs
Medical Programs
Free-Food Programs

Ideally, we believe that the Model Cities Program should have an analytical planning tool for the entire area of San Antonio. However, because this would require a very extensive program of data collection and because of the current need for a planning tool specifically oriented toward the Edgewood Independent School District, we propose that this initial effort be limited to the interrelationships between the Model Cities Program and the Edgewood Independent School District.

C. Research Objectives

It is not the intent of Southwest Research Institute to develop a Master Plan, nor even to recommend the appropriate values for each of the Factors contained in the mathematical model. We believe that these are properly the responsibility of public administrators. The objective of our proposed research program is to design a mathematical model, which contains the interrelationships among the various factors and permits public administrators to calculate the economic impact of alternative programs and policies over a ten year period of time.



S O U T H W E S T R E S E A R C H I N S T I T U T E

II. RESEARCH PROGRAM

A. Overall Program

The proposed research will provide a planning tool that shows the economic impact, both revenue and cost, from alternative programs and policies over the next ten years.

The planning tool, which will be in the form of computer programs, will be developed through analysis of existing data and records of the Edgewood School District, nearby school districts, the Texas Education Agency, and the Model Cities Program. The analysis will consider historical changes in

- . population
- . socio-economic characteristics of the population
- . school age population
- . school district tax base
- . school district revenues
- . school district costs

Each of these areas will be thoroughly and systematically analyzed through a review of existing records and interviews with administrators in both the Edgewood Independent School District and the Model Cities Program, and with other school administrators. The analysis will identify the variables that are of significant importance in each area, and develop the mathematical and statistical formulas that define the relationships among these variables. These formulas will be expanded to encompass the relationships among the variables from alternative programs of the Model Cities, alternative levels of tax collection, and alternative levels of inflation in school costs. In addition, through discussions with the officials of the Edgewood Independent School District, and other nearby school districts and an examination of their official records, we will develop the alternative educational programs and their costs.

Thus, for each of the factors considered, we will develop a means of relating quantitatively the important variables and of the projected changes in yearly increments over the next ten years. For example, under the tax revenues we will show how monies collected are related to population size and distribution, real estate values, income levels, type of housing, industrial and commercial development, and effectiveness of the tax collection system.



When the analysis of each factor has been completed, the mathematical and statistical relationships will be synthesized into appropriate computer programs. Upon completion of the development and debugging of the computer programs, there will be calculated the impact of alternative programs and alternative sensitivities of the important variables.

The last step in the research program will be the preparation of a final report which will present the results of the critical analysis of historical data, the examination of new programs, the mathematical and statistical relationships among the variables, the computer program, and the results of the consideration of a limited number of alternatives. The debugged computer program will be furnished with the final report. This will enable the City to consider at some later point in time any number of alternatives that appear appropriate to them.

B. Research Phases

There are three interrelated phases for the proposed research: Systems Analysis, Model Development, and Test Design and Interpretation.

The Systems Analysis phase requires the identification of all of the important variables, and the development of the data base for these variables. Once the data base has been developed it will be necessary to design the algorithms which explicitly state the quantitative relationships among the various variables for alternative programs of the Model Cities, revenue factors, and educational programs.

The Model Development phase requires the basic logic design of the computer model, and its programming, testing, and debugging. So that the computer model can be used by public administrators in San Antonio for the calculations of alternative economic impacts, there will be presented extensive documentation on the design and operation of the model.

The final phase of the research involves the design of tests to insure the validity of the computer model, and for the design of tests to develop the sensitivity of each of the variables. In this regard, in addition to our liaison during the earlier phases of the research, we plan to meet with representatives of the Model Cities program during the tenth week of the program so that we may jointly review our specific plans for the conduct of the sensitivity analyses.



Upon completion of the sensitivity analyses, the documentation of the systems analysis, model design, and interpretation of the tests will be combined into a draft final report.

C. Time-Phasing and Report Schedule

Monthly progress reports will be submitted. These reports will include information on accomplishments during the previous month, status of the expenditure of funds on the project, outstanding problem areas, and plans for the subsequent month.

The final draft report will be submitted within twelve weeks from the contract award date. The final report, in one reproducible master and five copies, will be submitted within 5 working days after completion of your review of the draft final report. The final report will include the computer program for the mathematical model, together with the documentation of the data collection and analysis, computer programs, and the test data on the analysis of alternatives.

The time-phasing for the various tasks and reports is shown below.

		TIME-PHASING (WEEKS)														
PHASE	TASK	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
I	Data Collection	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Data Analysis				x	x	x	x	x	x	x	x	x	x	x	x
	Data Documentation				x	x	x	x	x	x	x	x	x	x	x	x
II	Logic Formulation				x	x	x	x	x	x						
	Programming, Test, DeBug						x	x	x	x	x	x	x	x	x	x
	Program Documentation									x	x	x	x	x	x	x
III	Model Test Design								x	x	x	x	x	x	x	x
	Interpret Test Results											x	x	x	x	x
	Test Data Documentation													x	x	x
REPORTS																
	Monthly Progress						x				x					x
	Draft Final Report													x		
	Final Report															x



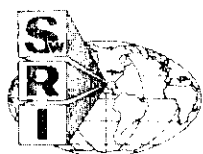
D. Project Organization and Staffing

It is generally accepted that the most successful method of handling interdisciplinary problems is by means of a functional project organization. At SwRI, project organizations are under the direct supervision of a project manager. The project manager is selected from the senior professional staff to organize, direct, and coordinate all project activities. He is an experienced individual who has a good combination of technical and administrative abilities.

A functional organization is established solely to conduct a specific project, and, following completion of the project, it is abolished. Project members are then free to undertake other project efforts through the coordination of their permanent Section organization. Staff members comprising the project organization are drawn from the various departments as required to handle the program requirements. This ability to form a functional project organization, staffed with interdisciplinary specialists, makes it possible for SwRI to undertake and solve, rapidly and economically, complex scientific and engineering problems. For this specific research, the team will consist of members from five departments within Southwest Research Institute.

Leadership in developing the planning tool for the analysis of alternatives will be provided by Mr. Thomas E. Hawkins, Senior Research Analyst, Operations Research Section. Mr. Hawkins is an experienced systems analyst with academic training in both engineering and administration. He has extensive experience in the conduct of analytical studies, and in the design of models for the analysis of alternatives by computer simulation.

For the data collection and analysis phases of the project, Mr. Hawkins will be assisted by an interdisciplinary team of analysts, economists, and psychologists. Mr. R. John Prevost, Senior Research Analyst, Operations Research Section, is an operations research analyst with academic training in Physics. He has experience in the use of operations research techniques for the analysis of problems in military and social sciences. Dr. David F. Culclasure, Ph.D., Senior Research Psychologist, Department of Bioengineering, has experience in the areas of human learning and motivation, perception, and psychometrics. His recent areas of activities include the development of new training techniques for the educationally and culturally disadvantaged. Mr. Delmar A. Thibodeau, Senior Economist, Department of Applied Economics, has had extensive professional experience with industry, government, and educational institutions.



For the design of the simulation model, Mr. Hawkins will be assisted primarily by Dr. W. R. Brian Caruth. Dr. Caruth, Manager of the Operations Research Section at Southwest Research Institute, is an operations research scientist with academic training in civil engineering. His employment experience has been largely in the application of analytical techniques to resource management problems in government and industry. These have included an information and control system for a transport and work equipment fleet, an economic replacement policy for transport equipment, a simulation of water data acquisition system, an evaluation of a global buoy information system for marine meteorological and oceanographic data, design of a comprehensive health planning management information system, and the development of management systems for forecasting operating equipment needs of the Post Office Department. Through participation in and direction of these and other studies, Dr. Caruth has gained extensive knowledge of computer simulation, cost-effectiveness and cost-benefit analyses, mathematical and statistical modeling, and the design of management information systems.

The personal data sheets for these key participants and for other supporting professionals are contained in Appendix A.

In addition to these professionals from Southwest Research Institute, we have given consideration to the use of a consultant experienced in the field of educational planning, and have made provision in the cost estimate for such an individual. The extent of his required participation in the research project can be developed during contract negotiation or during the conduct of the research.



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SOUTHWEST RESEARCH INSTITUTE
 COST ESTIMATE
 Proposal No. 14-7135

<u>Direct Labor Cost</u>	<u>Hour</u>	<u>Rate</u>	<u>Amount</u>
Senior Research Analysts	880	\$8.10	\$ 7,128
Senior Research Psychologists	120	8.25	990
Senior/Research Economists	240	6.75	1,620
Senior/Research Mathematicians	360	5.55	1,998
Research Assistant	140	2.00	<u>280</u>
Total Salaries & Wages			\$12,016
Provision for Vacation, Holiday, & Sickness - 12%			<u>1,441</u>
Total Direct Labor Cost			<u>\$13,457</u>
 <u>Provisional Overhead Rate - 110%</u>			 14,803
 <u>Other Direct Costs</u>			
Report Preparation and Reproduction		\$ 50	
Computer Use Charge 2 hrs. @ \$1,000/hr.		<u>2,000</u>	2,050
 <u>Travel Expense:</u> Local plus 1 man trips to Austin, Texas			 130
 <u>Outside Consultants</u>			
15 man days @ \$150/day			<u>2,250</u>
 <u>Total Estimated Cost</u>			 \$32,690
 <u>Fixed Fee</u>			 <u>2,300</u>
 <u>Total Estimated Cost and Fixed Fee</u>			 <u>\$34,990</u>

SOUTHWEST RESEARCH INSTITUTE
CONTRACTUAL INFORMATION
COST-PLUS-FIXED-FEE PROPOSAL

SwRI Proposal No. 14-7135
Purchase Request No. _____

Southwest Research Institute is a nonprofit corporation organized in the public interest and existing under the laws of the State of Texas, with its general offices at 8500 Culebra Road, San Antonio, Texas 78228. Laboratories are maintained at San Antonio, 3600 Yoakum Boulevard, Houston, Texas 77006, and 1901 N. Shoreline Drive East, Corpus Christi, Texas 78403. The Institute presently employs approximately 1000 full-time scientists, engineers, technicians, and service personnel.

The Defense Supply Agency, Defense Contract Administration Services Office, 7071B San Pedro, San Antonio, Texas 78216 has been assigned responsibility for administration of Department of Defense contracts. The agency having cost cognizance on all Government contracts awarded this Contractor is the Defense Contract Audit Agency, San Antonio, 7077 San Pedro, San Antonio, Texas 78216.

Contractor's current financial statements are filed quarterly with the Defense Supply Agency, the audit agency, and the Directorate of Procurement, Headquarters, Air Force Systems Command, Andrews Air Force Base, Washington, D. C. 20331, who has been assigned cognizance under the program for the coordinated negotiation of overhead rates.

The accounting policies and procedures of the Institute and employee salary rates and ranges are reviewed and approved on a current basis as acceptable for Government cost-type contracts.

It is desired that a cost-plus-fixed-fee contract be provided with costs determined in accordance with the Armed Services Procurement Regulations, Section XV, Part 2. In accordance with current approved procedures, direct labor cost includes provision for vacation, holiday, and sickness costs at 12% of the cost of direct salaries and wages. A final negotiated overhead rate of 100.28% of regular staff direct labor cost has been established for fiscal year ended September 30, 1967 on the basis of actual cost by the cognizant audit agency. The overhead rate for fiscal year ended September 28, 1968 has not been established. The Government approved provisional overhead billing rate based on audit of current cost incurred and projections is 110% of direct labor cost. However, cost projections are made by the Institute on a periodic basis, and any expected variation from the approved provisional rate is reflected in the cost estimate.

The approved policy of the Institute with regard to reimbursement for transportation and other travel expenses is limited to the actual reasonable cost incurred. Subsistence expenses are limited to the actual cost of lodging and related tips plus the actual cost, not to exceed an average of \$12.00 per day, for meals, related tips and other subsistence expenses. Transportation by personal and/or Institute-owned automobiles is reimbursed at \$.10 per mile as representing the actual cost of such transportation.

Government financing to the extent of current payments on account of allowable costs as provided in the clause entitled "Allowable Cost, Fee and Payment" in accordance with Paragraph 203.4 of Section VII of the Armed Services Procurement Regulations is requested.

The fixed fee, in the case of the Institute is paid not only for the "know-how", which it is in a position to furnish, but for the growth and expansion of the organization which has been set up primarily for the public good through scientific progress and as a specific service to the Government, industry and the public generally. The Institute, a nonprofit organization, does not have the capital structure to provide for expansion outside of the fee received for work performed, and nominal contributions from interested individuals and organizations. Experience has proven that funds must be available to expand facilities, and also procure new and replace obsolete equipment, in order for the Institute to keep abreast with the latest in scientific development. The fixed fee proposed in this instance has been determined with due consideration given to factors set forth in ASPR, Section III, Par. 808.

This proposal shall remain in effect not longer than 90 days from date of presentation. This proposal constitutes an offer and, if accepted by a Notice of Award placed in the mail addressed to Southwest Research Institute, will form a binding contract on the terms covered by this proposal. It is agreed that any such Notice of Award will be replaced at a later date by a definitive contract bearing the same date as the Notice of Award and containing the details of the agreement between the parties.

Personnel to be contacted for any negotiations required on this procurement:

Contractual:

Mr. S. H. Birgel, Sr. Contract Administrator, Area Code 512, 684-2000, Ext. 755,
Mr. D. D. Belto, Assistant Treasurer, Area Code 512, 684-2000, Ext. 231,
Mr. A. C. Hulen, Secretary-Treasurer, Area Code 512, 684-2000, Ext. 233

Technical:

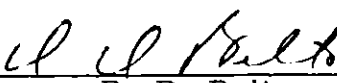
Mr. T. E. Hawkins, Senior Analyst, Operations Research Section, Area Code 512, 684-2000, Ext. 780
Mr. W. E. Cory, Director, Department of Electronic Systems Research, Area Code 512, 684-2000, Ext. 319

Contractual Information - continued

Contingent Fee Statement

Bidder represents: (a) That he has not employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and (b) that he has not paid or agreed to pay to any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating to (a) and (b) above as requested by the Contracting Officer. (For interpretation of the representation, including the term "bona fide employee, " see Code of Federal Regulations, Title 41, subpart 1-1.5 (April 1966)(August 1967)

SOUTHWEST RESEARCH INSTITUTE

By 
D. D. Belto
Title Assistant Treasurer
Date: March 4, 1970

IV. ORGANIZATION AND CAPABILITIES OF SOUTHWEST RESEARCH INSTITUTE RELATED TO THE RESEARCH

A. General Description

Southwest Research Institute is a nonprofit corporation organized to serve industry, government, and individuals in science and technology. Founded in 1947, the organization is now comprised of one major laboratory complex located in San Antonio, and two smaller laboratories, one located in Houston and the other in Corpus Christi. The major portion of SwRI's R&D work is conducted in the main laboratory complex.

The staff of SwRI currently numbers approximately 1100. About one-third of this number are professional scientists and engineers, about one-third are technical support personnel, and the remaining one-third are engaged in administrative and other non-technical work. Among the professional staff, 50 have doctoral degrees, and 287 have degrees beyond the baccalaureate.

Southwest Research Institute is organized to fully utilize the interdisciplinary approach to solving scientific and engineering problems. This is achieved by the organization arrangement shown in Figure 1. Staff members comprising the project organization are drawn from the various departments, listed in Figure 1, as required to handle the program requirements. This ability to form a functional project organization, staffed with interdisciplinary specialists, makes it possible for SwRI to undertake and solve, rapidly and economically, complex scientific and engineering problems.

B. Operations Research/Systems Analysis

The Operations Research Section at Southwest Research Institute is concerned with the application of modern management techniques and information systems to business, science, and government activities. In practice, teams composed of individuals with expertise in computer technology and the technical areas are formed to apply analytical techniques to the solution of problems in a wide variety of areas, including: management information systems for health care, education, and traffic safety; evaluation and analysis of technology transfer; models for management and planning of water resource systems; management analysis of banking operations; systems analysis of postal operations; and analysis of the dynamics of estuarine areas.



S O U T H W E S T R E S E A R C H I N S T I T U T E

SOUTHWEST RESEARCH INSTITUTE
SAN ANTONIO, TEXAS
ORGANIZATION CHART

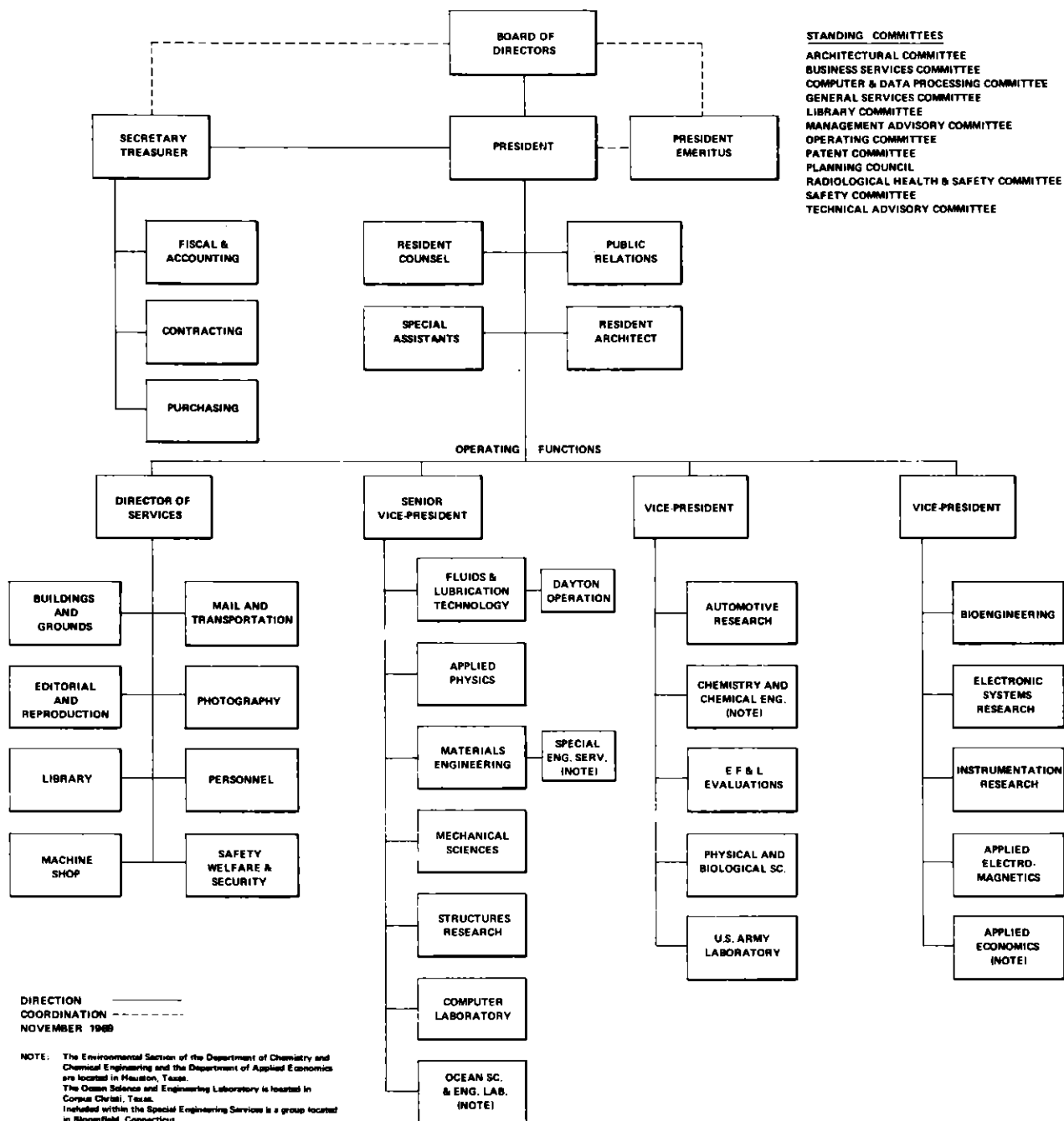


FIGURE 1

The Operations Research Section recently completed a study for the Interagency Health Council of the State of Texas to design a health planning information system to provide integrated and coordinated comprehensive health planning data. The study included (1) the development of a health index and reference system to identify basic health data available in the state and (2) the design of data collection, processing storage and retrieval procedures to utilize the available basic data to develop information for comprehensive health planning.

Another current study is being undertaken for the United States Post Office Department to develop management systems for forecasting operating equipment needs. The objective of the study is to develop and implement a system and associated procedures to project future operating equipment requirements for first, second and third class offices from one to five years in the future. The system, which will be programmed for computer operation, will generate output for use in preparation of budget submissions and procurement funding. Reports will be generated on a quarterly basis for: overdue orders, quantity of items received, year to date expenditures, requirements by quarter compared with previous quarters, and unexpected balances per item per region.

Operations Research Section personnel have participated in the following studies which are also relevant to the proposed work:

- . A study for the Water Resources Division, Geological Survey, to develop a computer event simulation model to analyze and evaluate the effectiveness of alternative configuration for a national water data system, composed of the data monitoring, communication, processing, storing and dissemination components.
- . A feasibility study for the United States Coast Guard of a system (monitoring, data communication, and data handling components) to collect, process and disseminate marine, oceanographic and meteorological data.
- . A study to apply electronic data processing (EDP) to two facets of the operation required for evacuation of patients through the United States Air Force Aero-medical Evacuation Command. One phase of the study considered the possibility of applying EDP techniques



to (a) account for the movement of the several thousand patient population in the Aeromedical Evacuation System and (b) to schedule and plan patient transfers in accordance with medical requirements, and aircraft capacity and availability. Patients were divided into routine, priority, and urgent categories with associated time priorities for delivery two weeks for routine, twenty-four hours for priority and one hour for urgent. The second phase of the study involved the calculation of flight plans in consideration of aircraft speed, origin, destination, weather and winds, fuel available and altitude constraints dictated by the medical condition of the patients.

- . A study to develop a computer based data system for use in search and rescue operations in Southeast Asia. The system was designed to provide search and rescue coordinators with the information required for mounting operations to rescue and recover United States and allied personnel in distress. The scope of the study included operations in both hostile and safe areas for airmen shot down, ground troops cut off from their units, and naval and coast guard personnel. The information provided by the system included (a) the location of distressed persons, (b) location of the enemy, (c) location of suitable recovery vehicles, (d) location of ground and air battle units and (e) other battle situation characteristics.

The following are examples of recent and active research activities conducted by the Institute. The listing is included to demonstrate the scope and diversity of the Institute's capabilities and to focus attention upon the emphasis given to interdisciplinary cooperation in resolution of research problems. This interdisciplinary approach, in which researchers from a variety of appropriate disciplines are merged into a cohesive research team constitutes the hall mark of Institute investigative effort.

- . Conducting a study of urban renewal areas to determine the extent and timing of requirements for replacement homes. The primary method used was the personal interview, with particular attention given to residents of low-income/minority group residential areas.



- . Developing an action oriented program to enhance the capability of low-income/minority group residents of Model Cities Areas to participate more effectively in programs designated for the Model Neighborhood Areas by presenting target area residents with diversified experience designed to produce greater capability of the disadvantaged to participate in local planning processes and to foster integration of organization and function of community action and city development agencies, with the aim of eventual consolidation of resident participation organizations into the Model Neighborhood Areas.
- . Conducting a comprehensive analysis of a potential industrial opportunities which can be integrated with training programs for unskilled workers as part of an overall effort to reduce poverty levels.
- . Providing the professional staff and consultation necessary for implementing a series of technical assistance projects sponsored by the Economic Development Administration.
- . Conducting an economic analysis of a proposed triple-purpose plant featuring power generation, desalination, and ammonia production.
- . Conducting a planning study for an Upper level college in Corpus Christi, Texas.
- . Studying dynamics involved in family dwelling fires. Available data indicate that more than one-half of the annual death toll in the United States from fires occurs in one- and two-family dwellings. To establish the life safety hazard of various interior finishes, a completely furnished three-room house has been built, burned, and rebuilt four times for further testing. Among the parameters monitored are temperatures, oxygen levels, smoke density, carbon monoxide levels, and carbon dioxide levels in the various rooms. The test program is being augmented by a comprehensive statistical survey of the records available for actual fires.



- . Utilizing a systems analysis approach to study the maximum operating capabilities of fire departments under emergency situations. While the study was concerned with problems of civil defense, much of the knowledge gained was equally applicable to emergencies arising from conflagration, hurricanes, or other disasters.
- . Conducting a marketing strategy analysis employing operations research techniques to aid in the location of new manufacturing and warehouse facilities for a lubricants producer. Final site selections were based on an integrated analysis of the market structure, the nature of the manufacturing operations, transportation factors, and company policies.
- . Conducting an analysis of the locational factors which enter into the determination of land values in the city of Houston, Texas. These factors were then correlated through a multiple regression approach to arrive at a theoretical model which can be used to predict future land values in specific locations. Among the parameters taken into account were distance from the downtown area, proximity to major shopping centers and freeways, and population density. To provide a reasonable basis for future extrapolations, historical data covering land sales over the past 20 years were incorporated in the analysis.

These studies represent but a small sampling of the diverse research activities conducted by the Institute. In these and other research projects, the varied backgrounds of the SwRI professional staff are brought to bear upon given problems to the maximum extent, thus permitting the cross-fertilization of ideas which has proven so efficient in promoting solutions to complex problems.

C. Other Supporting Facilities

1. Computer Laboratory

The Southwest Research Institute Computer Laboratory functions as a service and consulting organization throughout the Institute and thus is called upon to solve an extremely wide range of technical,



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scientific, and management information problems. The scientific applications staff have capabilities in statistics, numerical analysis, information theory, mechanics and physics. The non-numerical applications staff have abilities in business management, systems development, computer systems evaluation, indexing, and information retrieval. The staff members have an average of 8 years experience in the area of computer sciences.

The equipment available to the Laboratory is the most flexible and economical for the broad range of problems solved. The high speed (40,800 baud) terminal remote to a CDC 6400 gives the staff immediate access to one of the most powerful computer systems available anywhere. Numerous teletype terminals throughout the Institute enable the staff to use conversational techniques on several different computer systems having on-line time-sharing.

The program library available to all staff members covers many areas. The biomedical programs developed at the University of California and converted to the CDC 6400 have procedures for data description, histograms, plotting, correlation, multivariate analysis, regression analysis, time series analysis, and analysis of variance. The IBM system 360 scientific subroutine package, a collection of over 250 FORTRAN subroutines, has been converted to the CDC 6400 system. This library enables the staff to use FORTRAN programs written for the 360 system. The Computer Lab staff also has access to many user group libraries: VIM, a group of CDC 6600 users, maintains a library which has many large special purpose scientific programs; FOCUS is an organization of CDC 3000 and smaller system users whose library contains many FORTRAN programs which can be converted when necessary to the CDC 6400. Each time-sharing system has its own large collection of general purpose programs which are very convenient for the scientific user.

2. Library Facilities

The Institute library contains approximately 19,000 volumes of books, 19,000 volumes of periodicals, and 50,000 documents and technical reports pertaining to all major fields of engineering, mathematics, chemistry, and physics. About 1500 books are added annually, and about 750 volumes of periodicals are bound each year.

Documents are received on automatic distribution from the Atomic Energy Commission, U. S. Public Health Service,



National Aeronautics and Space Administration, U. S. Bureau of Mines, Air Force Cambridge Research Center, Air Force Materials Laboratory, Air Force Flight Dynamics Laboratory, Air Force School of Aerospace Medicine, U. S. Department of Agriculture, Advisory Group for Aeronautical Research and Development, Electronic Properties Information Center, Jet Propulsion Laboratory (Cal Tech, Defense Metals Information Center, and U. S. Office of Civil Defense).

The Librarian is registered with the Atomic Energy Commission, National Aeronautics and Space Administration, and Defense Documentation Center. Through these sources, other documents may be ordered as needed.

Among the major elements of the Abstract and Index collection are:

- . ASM Review of Metal Literature
- . Aluminum Abstracts
- . Analytical Abstracts
- . Index Aeronautics
- . Applied Mechanics Reviews
- . Applied Science and Technology Index
- . Bibliographical Bulletin for Welding and Allied Processes
- . Bibliography of Agriculture
- . International Aerospace Abstracts
- . Engineering Index
- . Geophysical Abstracts
- . Highway Research Abstracts
- . International Abstracts in Operations Research
- . Mathematical Reviews
- . Metallurgical Abstracts
- . NASA Scientific and Technical Aerospace Reports
- . Nuclear Science Abstracts
- . Psychological Abstracts
- . Biological and Agricultural Index
- . Chemical Abstracts
- . Computing Reviews
- . Dissertation Abstracts
- . Science Abstracts, Series A, Physics Abstracts
- . Science Abstracts, Series B, Electrical and Electronics Abstracts
- . Technical Translations
- . Textile Institute Journal, Abstracts



Interlibrary borrowing is fairly heavy, amounting to approximately 1500 items annually. Main source of borrowing is the library of the School of Aerospace Medicine, a 75,000-volume library exceptionally strong in chemistry and physics. The next source is the Linda Hall Library which contains over 300,000 volumes, specializing in technical material. Other excellent sources include The University of Texas (over 1,700,000 volumes), Texas A & M University (500,000 volumes), Southern Methodist University (800,000 volumes), and North Texas State University (500,000 volumes).



S O U T H W E S T R E S E A R C H I N S T I T U T E

APPENDIX A
PERSONNEL DATA SHEETS



S O U T H W E S T R E S E A R C H I N S T I T U T E

THOMAS E. HAWKINS
Senior Research Analyst
Department of Electronic Systems Research

B.S. in Engineering, U.S. Coast Guard Academy, 1949
M.A. in Government, George Washington University, 1964
Graduate Study in Public Administration,
George Washington University, 1965-

Mr. Hawkins is an experienced systems analyst with academic training in both engineering and administration and has held the rank of Commander in the U.S. Coast Guard. Twenty years of experience as an active commissioned officer has provided Mr. Hawkins with a broad background in systems analysis, including specialized experience in program planning and control, system requirements and effectiveness analysis, operations research, and management information systems. His major fields of graduate study are administrative theory and practice, financial management, computer technology, and political science. Mr. Hawkins is currently a dissertation candidate for the professional degree of Doctor of Public Administration. At Southwest Research Institute, Mr. Hawkins will be involved in the application of quantitative techniques and computer technology to the solution of complex problems of government and industry.

PROFESSIONAL CHRONOLOGY: Commissioned officer, U.S. Coast Guard, 1949-69 (junior officer assigned to duties entailing oceanographic and meteorological data collection, maritime safety, and aids to navigation, 1949-58; electronic aids to navigation, 1958-62; commanding officer, 1962-3; full-time graduate student, 1963-4; long range planning and program analysis, 1964-9); Southwest Research Institute, 1969-(senior research analyst, department of electronic systems research, 1969-).

Memberships: Operations Research Society of America; American Society for Public Administration.

Sep/69



S O U T H W E S T R E S E A R C H I N S T I T U T E

W. R. BRIAN CARUTH
Manager, Operations Research
Department of Electronic Systems Research

B. A. , Liberal Arts (Major Studies: English, French, and Geography),
Dublin University, Ireland, 1961

B. A. I. , Civil Engineering, Dublin University, Ireland, 1961

Ph. D. , Civil Engineering (Major Field: Marine Hydraulic Modeling),
Dublin University, Ireland, 1964

Post Doctorate Studies in Probability and Statistics,
University of Toronto, 1965-6

Dr. Caruth is an operations research scientist with academic training in civil engineering. His employment experience has been largely in the application of analytical techniques to resource management problems in government and industry. These have included an information and control system for a transport and work equipment fleet, an economic replacement policy for transport equipment, a simulation of water data acquisition system and an evaluation of a global buoy information system for marine, meteorological and oceanographic data. Through participation in and direction of these and other studies, Dr. Caruth has experience and knowledge of computer simulation, cost-effectiveness and cost-benefit analyses and mathematical and statistical modeling. Dr. Caruth is also familiar with the application of system analysis and operations research techniques in such diverse areas as health care, law enforcement, transportation and urban development. His Ph.D. thesis was entitled, "Wave Effects in Harbours, with Special Reference to Howeth and Kilmore."

PROFESSIONAL CHRONOLOGY: Lecturer in mathematics, Dublin University, 1961-2; engineer, Lurgan Borough Council, 1963-4; engineer, Montreal Engineering Company, 1964; operations research engineer, Hydro Electric Power Commission of Ontario, 1964-6; operations research scientist, Travelers Research Center, 1966-7; (acting) director, resource systems division, Travelers Research Center, 1967-8; Southwest Research Institute, 1968-(senior research scientist, department of electronic systems research, 1968-9; manager, operations research, department of electronic systems research, 1969-).

Memberships: Institution of Civil Engineers (Great Britain), The Institute of Management Sciences, The Operations Research Society of America.

Rev Apr/69

DAVID F. CULCLASURE
Senior Research Psychologist
Department of Bioengineering

B.S. in Psychology, Trinity University, 1959
M.S. in Psychology, Trinity University, 1960
Ph.D. in Psychology, University of Texas, 1963

As a research psychologist with the Army Medical Department, Dr. Culclasure served in a variety of assignments affording unique opportunities for professional growth in the areas of human learning and motivation, perception, and psychometrics. During this period, he designed specialized instrumentation for the experimental investigation of the reinforcement parameters involved in auto-instruction and in the perception of subliminally presented stimulus sequences. He also gained extensive experience in the design and validation of psychometric instruments and scaling devices used to measure the various behavioral dimensions involved in job performance of technical medical personnel. Additional areas of professional interest included intra-individual analysis of behavioral phenomena; discriminative (perceptual) learning; and memory function. Recent areas of activity include utilizing the dynamics of form perception to devise a test for measuring mechanical ability among the educationally and culturally disadvantaged and development of new training techniques which capitalize upon advances being made in learning theory and educational technology.

PROFESSIONAL CHRONOLOGY: Active military service with Army Medical Department, U. S. Army, 1946-68, with primary assignments involving education and training activities; member, Federal Advisory Council on Medical Training Aids, 1965-8; executive editor, Robert J. Brady Company, a Subsidiary of Prentice-Hall, Inc., Washington, D. C., 1968-9; Southwest Research Institute, 1969-(senior research psychologist, 1969-).

Memberships: American Psychological Association, Society of Sigma Xi.

Rev Aug/69



S O U T H W E S T R E S E A R C H I N S T I T U T E

JOHN W. EBERT
Research Economist
Department of Applied Economics

B.S., University of Houston, 1964
Indiana University, 1946-52
Major Subjects - Chemistry, Industrial Psychology

Mr. Ebert has had extensive experience in the petroleum and petrochemical industry, and management responsibilities in the field of engineering. As personnel manager of Bovay Engineers, Inc., he had overall responsibility for the administration of personnel policies and procedures at the corporate level. In this capacity, Mr. Ebert adapted all personnel records to an EDP management information system which integrated the many diverse sub-functional activities of personnel management such as compensation, wage and salary analysis, performance, organization structure, and supplemental benefits into one system. As manager of EDP systems and applications, he determined those areas in design engineering where EDP could be utilized efficiently and economically. Such applications included structural analysis, water distribution network analysis, critical path and job progress reports. Programs selected were revised or rewritten in FORTRAN IV as required. Mr. Ebert has served as a member of the Texas Society of Professional Engineers, Region IV, Continuing Education Committee, teaching General Electric time-sharing computer language.

Economic studies or surveys which Mr. Ebert participated in at Southwest Research Institute include production costs of modified gasolines for the West Coast; recreational and leisure activities at former world fair sites; cost-calculation procedures at various desalting complexes; and computerized analysis and graphic presentation of questionnaire data. He has served as consultant to engineering organizations in computerized project and personnel management information systems.

PROFESSIONAL CHRONOLOGY: U. S. Navy, 1945-6; package engineer, Inland Container Corporation and St. Regis Paper Company (Cleveland and Toledo, Ohio), 1952-7; chemist, Sinclair Petrochemicals (Channelview, Texas), 1957-8; corrosion engineer, Amercoat Corporation (Houston), 1958-9; senior chemist, Goodyear Chemicals (Houston), 1959-66; personnel manager, Fletcher Emerson Company and Bovay Engineers, Inc. (Houston), 1966-9; Southwest Research Institute (Houston), 1969-(research economist, department of applied economics, 1969-).

Dec/69

ROBERT GONZALES
Mathematician, Computations Laboratory
Department of Mechanical Sciences

B.S. in Mathematics, St. Mary's University, 1956

Experienced in data processing, scientific programming, Mr. Gonzales has experience with Burroughs E102, NCR 102A, IBM 704, IBM 709, and GE-225 computers. His computer applications include mathematical subroutines for digital computers, scientific problems in hydrodynamics and aerodynamics.

PROFESSIONAL CHRONOLOGY: Mathematician, Southwest Research Institute, 1956-).



S O U T H W E S T R E S E A R C H I N S T I T U T E

ARTHUR F. MULLER
Senior Research Mathematician
Computer Laboratory

A. B. in Mathematics, St. Benedict's College, 1958
M. S. in Mathematics, Kansas State University, 1960
Graduate Work in Mathematics, University of Wichita, 1960
Graduate Work in Mathematics, University of Dayton, 1962

Serving as an applied mathematician, Mr. Muller has experience in the applications of computers to problems in engineering and the physical sciences. He has experience on digital computers which include IBM 1620, 709, 7090, 7094; Philco 2000; CDC 3600 and 6600 utilizing SOS, FAP, MAP, and TAC assemblers; and FORTRAN, ALGOL and ALTAC compilers; and he has performed studies on the application of special and general purpose analog computers. He was responsible for a comprehensive program for the prediction of ocular effects resulting from nuclear detonations. This program included the responsibility for the design and implementation of laboratory experiments and the analysis of field and laboratory data related to thermal energy effects in animal eyes. His experience related to aeronautical problems includes analysis of engine-to-wing configurations using mission profiles and design criteria analysis for aeronautical loads.

PROFESSIONAL CHRONOLOGY: Instructor, mathematics department, St. Benedict's College, 1958; associate research engineer, The Boeing Company, 1960-1; Technology Incorporated, 1961-7 (research mathematician, 1961-3; senior research mathematician, 1963-7); Southwest Research Institute, 1967-(senior research mathematician, computer laboratory, 1967-),

Memberships: Association for Computing Machinery and Society for Industrial and Applied Mathematics.

Apr/68



S O U T H W E S T R E S E A R C H I N S T I T U T E

R. JOHN PREVOST
Senior Research Analyst
Department of Electronic Systems Research

B.S., Physics, Lamar State College of Technology, 1962
M.S., Physics, Texas A&M University, 1965
Graduate Studies, Texas Christian University, 1965

John Prevost is an operations research analyst with academic training in physics. His experience as a nuclear physicist includes nuclear shield analysis techniques and particle transport theory. He has participated in evaluating alternative designs for radiologically armored vehicles and in analyzing shielding materials against nuclear reactor radiation sources. Mr. Prevost has more recently applied operations research techniques to analyze problems in military and social sciences. Included are analyses of vulnerability, survivability and cost effectiveness of aircraft in hypothetical operational scenarios involving nuclear and conventional threats, and, currently, analyses of management decision problems for banking institutions and for the United States Post Office. Participation in and direction of such studies has provided Mr. Prevost with knowledge in the areas of computer simulation and mathematical and statistical modeling.

PROFESSIONAL CHRONOLOGY: Teaching assistant, Texas A&M University, 1962-3; research assistant, Texas A&M University, 1963-4; nuclear physicist, General Dynamics Corporation, 1964-6; operations research analyst, General Dynamics Corporation, 1966-9; Southwest Research Institute, 1969-(senior research analyst, department of electronic systems research, 1969-).

Memberships: National Management Association, North Texas Operations Research Society, Dallas/Fort Worth Metropolitan Philosophical Society.

Aug /69



S O U T H W E S T R E S E A R C H I N S T I T U T E

DELMAR A. THIBODEAU
Senior Economist
Department of Applied Economics

B.S. in Economics, Georgetown University, 1955
M.A. in Management
(Emphasis on Labor Economics and Personnel Administration)
George Washington University, 1958

Mr. Thibodeau has had extensive professional experience with industry, government, and educational institutions. As liaison man for A.T.&T. on Department of Defense accounts, he assisted in the planning of private line systems to meet their organizational and operational needs.

While with the State of Maine, Mr. Thibodeau researched and published a number of reports pertaining to the socioeconomic development of the State and its municipalities. These projects involved close liaison with many public and private institutions and required an understanding of their intra- and interrelationships. His work at Bowdoin College involved the same general areas of interest, with additional research on the informational needs of small business establishments to enable them to compete successfully in today's business society. He also researched and wrote the business publication, "Maine Business Indicators."

Mr. Thibodeau has also been involved in marketing and sales, education and administration. He served in communications in the U.S. Navy during World War II and Korean War, and was employed by electronics industries between the wars.

PROFESSIONAL CHRONOLOGY: Commercial representative, American Telephone and Telegraph Co., 1955-9; regional sales representative (Washington D.C. area), Foley Electronics Co. and Radiation Counter Laboratory, 1960-2; administrator, Congo-American Institute (US/AID Program), Leopoldville, Congo, 1962-4; research and planning associate, Maine Department of Economics Development, 1964-6; administrator, Maine Satellite Station (Communication Satellite Corp.), 1966-8; staff associate (research), Public Affairs Research Center (Bowdoin College), 1968-9; Southwest Research Institute, 1969-(senior economist, department of applied economics, 1969-).

Memberships: American Economic Association, Northeastern Research Foundation, Industrial Development Council of Maine, Smaller Business Association of New England.

Dec/69

VELNA RAE THURMAN
Research Mathematician
Department of Automotive Research

B. A. In Mathematics, University of Texas, 1965

Graduate Work in Math, University of Texas, 1965-6

Post Graduate Study in Computer Programming, San Antonio College, 1969

Computer Mapping of Information, Harvard Graduate School of Design, 1969

Since Miss Thurman's employment by the Institute on December 30, 1968, she has been engaged with the GATE Operations Center revising the GATE Energy Analysis Programs for GATE Members, and processed programming of job requests for GATE clients. Institute work has included system analysis and selection of computer equipment to automate and computerize the Engines, Fuels, and Lubricants Test Lab. She has devised a computer program to determine air-fuel ratio run control on the Ford Sequence V-B Engine Test. She is presently involved in the construction of a prototype computerized engine test lab. Her other endeavors have been statistical analysis using the computer on vehicle emissions data, gas chromatography data, and highway safety data.

Prior to joining the staff of SwRI, she was a Research Scientist at Defense Research Laboratory in Austin. Her computer applications in underwater acoustics included sonar simulation problems with target tracking, identification, and acquisition. In conjunction with her sonar work, other responsibilities included analyzing and plotting positional coordinate data and programming underwater signal processing and beam forming problems. She has also had experience in teaching college mathematics and computer programming.

Miss Thurman's computer hardware experience has been on the CDC 3200, CDC 6600, IBM 360/30, IBM 360/50, and IBM 1130 computers along with the Calcomp 565 digital plotter. She has used FORTRAN IV and COBOL compiler languages primarily.

PROFESSIONAL CHRONOLOGY: Teaching assistant in math, University of Texas, Austin, Texas, 1965; mathematics instructor, Cameron State College, Lawton, Oklahoma, 1966; research scientist associate, Defense Research Laboratory, Austin, Texas, January 1967-September 1968; Southwest Research Institute, 1968-(research mathematician, department of automotive research, instructor in data processing, San Antonio College, 1969-).

Memberships: National Council of Teachers of Mathematics, Gamma Alpha Chi, National Advertising Fraternity for Women, San Antonio Professor's Society.

Rev Jan/70



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