QUARTERLY STATUS REPORT NO. 34

October 1, 1973 - December 31, 1973

Contract Number NASW-2512

Southeastern State College

Durant, Oklahoma

Leon Hibbs

President

Chairman of TUSC

C. Henry Gold

Director of TUSC

TECHNOLOGY USE STUDIES CENTER

SOUTHEASTERN STATE COLLEGE

DURANT, OKLAHOMA 74701

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By
C. Henry Gold
A. M. Moore
Bill Dodd
Velma Dittmar

January 1974

TECHNOLOGY USE STUDIES CENTER

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PREFACE

For the purpose of providing a record of TUSC activities during the period of October 1, 1973 through December 31, 1973, this Quarterly Status Report (QSR #34) has been prepared and submitted in accordance with the terms of the Center's contract.

TUSC personnel who have made significant contributions toward the preparation of this report include: A. M. Moore, Senior Industrial Specialist; Bill Dodd, Industrial Specialist; Rick Billingsley, Bob Brewer, and Brent Martin, Information Retrieval Assistants; Veleta Coleman, Brenda Futrell, Barbara Miles, Judy Moseley, Clerical Assistants; Velma Dittmar, Administrative Assistant; and C. Henry Gold, Director.

C. Henry Gold

January 1974

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SUMMARY

Appendix A of this report contains the Summary Characteristics of TUSC technical searches completed during the quarter. Each year, during this time-period, there are three scheduled interruptions affecting the routine operation of the Center. They are: (1) the Thanksgiving Day holidays, (2) the Christmas holidays, and (3) the semester "break." TUSC relies heavily on the work and service provided by student employees who serve as Information Retrieval and/or Clerical Assistants. Thus, we estimate approximately 20% "down" time (work interruption) occurs at this time of the year--for all practical purposes, the activities of the Campus and the Center cease to function.

Looking at the brighter side, an outstanding team effort resulted in a record accomplishment of 54 searches completed--an increase of 25% over that of any previous corresponding quarter, i.e., October - December. A highly effective team effort by TUSC's student personnel is due recognition for the Center's accomplishment. Their work is not only affected by semester interruptions but also by the usual student stress/strain of final examinations.

The accomplishment even exceeds the TUSC estimate of the Center's maximum capability which is 50 searches per quarter. Even though search accomplishment, in a three-month period when production should be low, exceeds the Center's search capability

estimate, we do not consider it appropriate to increase our estimate. From a realistic viewpoint, the manual retrieval methods/techniques being used, the manpower availability and limited funds are facts that simply cannot be overlooked--an academic explanation would read "Center personnel overachieved." Credit, for the unusual accomplishment, is given to one of the finest, if not the best, information retrieval teams that the Center has ever had.

A highly significant point, relating to the above, is the fact that the Center has maintained a file copy of all searches accomplished since the establishment of TUSC. Thus, information retrieval is becoming more and more of an update process of searches previously made by the Center. Our search accomplishments, as reported herein, represents several instances wherein time or manpower spent on information retrieval was in fact an update of a previous search and/or searches relating closely to the subject of the search--meaning, of course, that the search processing time is decreased. A listing of the various searches processed during October, November, and December is set forth in the following section of this report--see pages 5-8.

Publication of a General Aviation News Letter was mentioned in TUSC's QSR #33 on page 4, and a copy of issue #1 as well as related correspondence was included in Appendix D of that report. Additional information is included in this report, see pages 25-44.

SPECIFIC REPORT RELATING TO STATEMENT
OF WORK IN NASW-2512

The following information provides information concerning TUSC performance of those work statements as set forth in Article I of the Center's NASA contract. A new item added to this Quarterly Report concerns TUSC's General Aviation News Letter, the background of which is covered in QSR #33.

Dissemination and Assistance

Transfers

Transfer 168--Electrostatic precipitator manufacture (Search 1012, as reported in QSR #33). The President of Filterlab Corporation, in a letter of November 12, 1973, states that technical data obtained through the SBA provided helpful assistance in developing a new electronic air filter to be marketed in 1974. The TUSC search mentioned above is cited by the SBA's TU Officer as data that contributed to the success of this transfer.

Transfer 169--Removing dissolved ammonia in waste water. Analyst Consulting Laboratories, Inc., gives documentation of a dual nature--TU information was not only of value to the firm, but it is being utilized by a client firm that manufacture's fertilizer. SBA's TU Officer provided TUSC with documentation of the transfers in a letter dated December 26, 1973. This transfer relates to TUSC Search 1069.

Searches and/or Assistance

Search 1052--This SBA search concerns communication systems research. The unique aspect of the search is that it could have been (and in effect was) four searches; i.e., (1) Delta Modulation, (2) Pulse Code Modulation, (3) Voice Signals, and (4) Voice Modulation. The TUSC retrieval team directed its efforts on reports accomplished in recent years--only eight reports are dated prior to 1971 (1967-2, 1968-2, 1969-3, 1970-1). The remaining 49 report abstracts sent to the SBA were dated 1971 - 1973--all were NASA-sponsored reports.

Search 1053--Search 1053 is also similar to Search 1052 from a multiplicity standpoint. The search involves eight areas of information: (1) Data Privacies Systems, (2) Voice Digitization, (3) Voice Privacy, (4) Voice Scramblers, (5) Data Scramblers, (6) Facsimile Scramblers, (7) Facsimile Privacy, and (8) Speech and Facsimile Scrambling and Decoding. Data bank information does not indicate that very much research has been done in the areas mentioned. However, it seems obvious that the search refers to matters relating to our national security and, if so, the information pertaining thereto is of a classified nature.

Search 1069--Transfer 169 mentioned above resulted from this search. It is a rare instance wherein information is provided and confirming documentation of technology utilization is also provided within the same quarterly time period.

Search 1074--There were 22 relevant reports retrieved for the University of Oklahoma that pertains to the request for information on oil spills and spread of oil on water.

Searches 1078, 1080, 1081, and 1095--The impact of the "energy question" is noticeable by TUSC's search effort during the quarter--four searches refer to the matter of energy. Some of the searches were made for the Southeastern State College debate team.

Search 1097--In terms of retrieval productivity, Search 1097 resulted in the largest number of reports and/or references (33) concerning a single subject, which is Reverse Osmosis Through Membrane filtration for Water Purification.

Search 1098--This search has good potential to develop into a significant transfer. The search stems from a faculty request for information on the state-of-the-art in electronic circuitry. Twenty-one relevant NASA Special Publications were provided. The information is being reviewed to determine the feasibility of updating course syllabi in the electronics curriculum.

TUSC completed searches 1008, 1016, and 1024 at the request of the SBA in support of their TU effort. The SBA TU representative forwarded their client's response relative to the information and the SBA TU program in general. The letter is from Frontier Enterprises, dated November 30, 1973, and is included in Appendix B of this report (see page 22). This letter is a strong testimonial of "spinoff benefits" of Government-sponsored research that emphasizes the particular problem with which the small firm deals on a day-to-day basis.

Assistance--Personnel of the Center participated in various meetings called for the purpose of developing graduate-level courses that are to be offered in the broad category of

Communications. A specific input by TUSC referred to a course proposal concerning the matter of information retrieval systems. Both manual retrieval and computer retrieval systems, for a graduate course, is being planned for the Fall Semester at SSC. The NASA/TUSC data bank will provide an excellent resource or "laboratory" for students.

Individual assistance to both students and faculty over and above formal searches, continue as a routine function of the Center in the form of "services." Since we have encouraged use of our NASA data bank holdings on a self-help basis, it is a bit cumbersome to provide a record of services rendered. A specific service was provided for two Associate Professors; it relates to information they needed for post-graduate work. Use of the Center by SSC students ranges from mere "brousing about" to actual use of reference material. To us, this practice is probably the best possible way to make known the benefits to be derived from NASA's Technology's Utilization Program. Students not only tell other students, but they tell the "folks back home" about TUSC. A cross section of SSC's student population is highly representative of the Southeastern Oklahoma and North Texas geographical area of which TUSC is assigned primary area responsibilities in the Contract Statement of Work. Also, the search assistance for Speech Debators, as mentioned on page 9 of QSR #33, brought about additional requests for information during this quarter also to be used by the debate team. The information concerns Solar Energy, Energy Dissipation, and Magnetohydro-dynamics (MHD).

TUSC had several contacts with an engineering-minded client in the project area who has a strong interest in better use of aerodynamic principles for streamlining road vehicles. He is experimenting with an airfoil device that would be a fairly simple, attachment-type component for pick-up trucks. He certainly has a sound theory; i.e., reduction of induced drag will reduce power requirements with an accompanied fuel savings. Search 986 completed last quarter concerns low-speed aerodynamics; the search was requested by TUSC's client to provide support for his experimentation.

A report concerning the TUSC General Aviation News Letter is included in Appendix C.

Searches Processed During October, November, and December

Search Number	Subject of Search
1045	A) State-of-the-art in Cable Television Transmission and Wire and B) Broadband TV Cable Communications--Coaxial Cable
1046	Machine Tooling
1047	Harrier Aircraft
1048	Apollo Moon Landings
1049	A) Electrical Discharge Machine, B) Numerical Control Machine, C) Electronic-Chemical Machine, and D) Chemical Machining
1050	Maximum Propagation of Pulses on Transients in Hydraulic Fluid in Long Lines at High Pressures
1051	Data Modems and High Speed Data Modems
1052	A) Delta Modulation, B) Pulse Code Modulation, C) Voice Signals, and D) Voice Signals or Voice Signal Modulation
1053	A) Data Privacies Systems, B) Voice Digitization, C) Voice Privacy, D) Voice Scramblers, E) Data

Search Number	Subject of Search
	Scramblers, F) Facsimile Scramblers, G) Facsimile Privacy, and H) Speech and Facsimile Scrambling and Decoding
1054	Population Census to Make Population Projections
1055	State-of-the-art on Fuel Cells
1056	Prevention of Corrosion and Corrosion Inhibitors
1057	Fluoride Content of Blue River and USHS Recommended Level for Fluoride in Human Drinking Water
1058	Replication Process of Circular Deoxyrebonucleic Acid Molecules (DNA)
1059	Solid Waste Disposal Systems for Cities of 10,000
1060	Trace Metal Analysis or Heavy Metal Analysis in Rainbow or German Brown Trout.
1061	Plastics Fabrication
1062	Chemicals Used for Water Treatment
1063	Disposal of Pickling Acid--Hot Dip Galvanizing and Metal Plating Acid Residues Are Difficult to Dispose of
1064	Manufacturing of a Hidden Field (On/Off Position Invisible) Illuminated Display
1065	How Industry Affects Adverse Weather Conditions
1066	Use of Activated Charcoal in: A) Purification of Air; B) Purification of Water; C) Purification of Other Gases; D) Removal of Heavy Hydrocarbons from Light Hydrocarbons; E) Removal of Color, Taste, and Odor from Hydrocarbons, Air and Water; and F) Any Other Related New Products
1067	Non-dispersive Infrared Detectors of Methane, Carbon Dioxide, and Other Gases with Absorption Bands in the Infrared Range
1068	Boring Precision Holes in Glass Tubing
1069	Methods Available for Determination of Dissolved Ammonia in Waste Waters, Analytical Metods for Same, and Measuring Dissolved Ammonia in Waste Waters
1070	Electronic Sensor for Detecting Hydrogen and Natural Gas

Search Number	Subject of Search
1071	Forming Stainless Steel Pipe Fittings, Especially Elbows and Tees. Interested in: 1) Hydraulic Forming, 2) Extrusion of these Fittings from Pipe, and 3) Forging of these Fittings
1072	New Methods of Non-destructive Testing, Expecially X-ray, Ultrasonics, and Magnetic Inspection--Availability of Training Manuals in any of these NDT areas
1073	Paint that is Fireproof after Application, Fireproof Coatings, Fire Resistant Surface Coatings, and Coatings that Retard or Prevent Fires
1074	Information on the Spread of Oil on Water, Either Under Calm Conditions or in Storms--Influence of Oil on Calming Waves During a Storm
1075	Ship Motion, Naval Hydrodynamics, Numerical Hydronautics, and Strip Theory of Ship Motion
1076	Frequency Standards--How to Attain Very Precise Control of Frequency
1077	Pickling of Steel Wastewater Recovery
1078	Hydrogen as an Energy Source
1079	Magnetohydrodynamics - MHD
1080	Energy Dissipation
1081	Solar Energy
1082	Printed Circuit Board Connectors, Card Edge Connectors, and Printed Circuit Board Card Edge Connectors
1083	Effect of Insecticides/Pesticides on the Growth of Crustaceons
1084	Integrated Circuit Sockets, Dual Inline Plastic (DIP) Sockets, DIP Integrated Circuit Sockets, and Other Sockets for Semiconductor Devices
1085	Plastic Molding or Injection Molding of Thermal Plastics into Electronic Connectors or Electronic Insulator Parts
1086	Sources of Silver, Platinum, and Gold
1087	Molded-on Plugs or Connectors Including Polyvinylchloride (PVC) and Molded Electronic Cable Plugs or Connectors

Search Number	Subject of Search
1088	Printed Circuit Board Wave Soldering, Board Pre-cleaning, Board Pre-fluxing, Post-Cleaning, Pollution Control for Printed Circuit Board Operation, Elimination of Flux Waste and Solvent Vapors in Printed Circuit Board Operation
1089	Design of Lock-In Amplifiers Used in Low Level Signal Amplification with High Noise Content
1090	Any Experimentation, Evaluation, Modification, Development, Design or Construction of an Ion Accelerator or Ion Injection with at least 1 Meg Electron Volts
1091	Constructing an Amplifier, Vacuum Tube
1092	55-Nitinal--The Alloy with a Memory
1093	Effects of the Chloride Salts, Lithium Chloride, on Living Organisms
1094	New Innovations or Products in the Use of the Blow-Molding of Plastics
1095	Conversion of Wind Energy
1096	Landing Field Surface Information
1097	Membrane Filtration for Use of Reverse Osmosis for Purification of Water
1098	Electronic Circuitry

Faculty Information Services

As mentioned earlier in this report, the Center's Information and Dissemination accomplishment was unusually high, considering the school calendar. The Faculty Information Services accomplishment of the Center was also above normal expectations. Requests for information in this category numbered eighteen searches during the quarter--fourteen student searches and four faculty searches were completed.

Our former Information Retireval Specialist, who now teaches in the Dallas Skyline (vocational) High School, is an active supporter of the NASA TU program. Three student requests (Searches 1055, 1091, and 1092) are results of his encouragement. His students correspond with TUSC on an individual basis; thus, they not only learn of the TU program, but also they put into practice written communications--a skill not yet mastered by many adults.

Search 1074, previously mentioned on page 2, is in support of a faculty request. The Oklahoma University Flame Dynamics Laboratory of the OU Research Institute requested the search. The "broad brush" aspect of the search is "spread of oil on water." Obviously, the University's research has national significance since it concerns an area related to the total energy problem. TUSC had several suggested avenues for information retrieval; i.e., rate of spread, flow patterns, oil slick thickness, oil evaporation losses from the slick, fires burning on oil spills under both calm and windy conditions, and extinguishing such fires. The reports recommended in our retrieval effort should cover most of the above mentioned areas of interest.

TUSC provided additional support to the Biological Science Department through Search 1083. It pertains to the State, Community and College Water Purification Project (using nature's ecology system). A previous reference to the project is noted on page 4 of QSR #32 in reference to Searches 893, 898, and 909.

Cooperation with Other Agencies

Although the State Education Advisory Committee is not an

agency in a strict sense of the term, TUSC, nonetheless, is fortunate to have the Director, Dr. C. Henry Gold, serve as Executive Secretary of the Oklahoma Commission on Education. It is certainly an important forum by which the NASA TU Program is made known through various contacts throughout this and other states by the TUSC Director.

Dr. Gold, likewise, was selected to serve as a board member of the Southern Oklahoma Development Association (SODA)--one of the Regional Economic Development Agencies with which TUSC has enjoyed a very favorable interface.

The Small Business Administration (SBA) was by far the most frequent agency in contact with the Center on behalf of their clients. Slightly more than 50% of our search activity provided support to the SBA TU program. Certainly, the ultimate goal of the Technology Utilization Program is to provide access to government-sponsored research to taxpayers--the TUSC/SBA partnership is helping to do this and TUSC maintains a file of documented evidence such as Transfers 168 and 169 (page 1). Probably one of the best examples of documentation is the letter in Appendix B from Mr. F. T. Williams of the Frontier Enterprises, Inc.

General Center Functions

The General Aviation News Letter Editor and Senior Industrial Specialist, Mr. A. M. Moore, visited the West Coast for the purpose of obtaining information about apporpriate items to be featured in the News Letter. A former associate, who is now a Project Supervisor at the B-1 Division of Rockwell International, extended an invitation to Mr. Moore to tour the manufacturing

area of B-1 Bomber #1. This afforded an unusual opportunity for TUSC to receive first-hand information about the unclassified engineering innovations being used and built into this newest of new aircraft. Mr. Moore also visited the NASA Flight Research Center at Edwards, California. The NASA TU Representative was most helpful to Mr. Moore in introducing him to various engineers working on projects applicable to general aviation news items. NASA's publication, Basic Research Review (August 1971), provided a guide as to the research projects to inquire about. Valuable information was obtained on subjects such as Fly-by-Wire, Composite Materials, Remote Piloted Vehicles, Civilian Aircraft Research, etc.

TUSC Director, Dr. Gold, served as UF General Chairman Bryan County. The goal established for the County was met and exceeded. He also presided at the Second Annual Symposium sponsored jointly by the Oklahoma Education Commission and the State Chamber of Commerce. (He has served for three years as Chairman of the Education Committee of the Oklahoma State Chamber of Commerce.) Dr. Gold attended a two-day meeting of the Oklahoma Higher Education Alumni Council. Thus, the TUSC Director has been in highly favorable situations in helping to make known the NASA TU program and benefits to be derived therefrom.

Mr. Bill Dodd, Industrial Specialist, attended a meeting wherein Talkback Television capabilities were utilized in presenting information concerning the Equal Employment Opportunity Act of 1972 (EEO). As a service to clients, TUSC has made an

attempt to stay abreast of such legislation as EEO and the Occupational Safety and Health Act of 1970 (OSHA).

TUSC STAFF

In each quarterly report, we include names of the TUSC staff as a part of the report preface. Work-study assistance by students help, in a large measure, to render services for which the Center has contract responsibilities. Some student help is funded directly from TUSC resources, some is funded through the College Student Aid (work-study) program, some is funded through the Vocational Aid Programs, etc. Obviously, there is a relatively high student employee "turnover" which is not always noted is this section of the QSR. For example, Information Retrieval Assistants Tommy Marvell, Bob Frederick, Dan Gandy, Bennie Oulds, and Brent Martin have either graduated or terminated their TUSC employment for personal reasons; the same is true for Kathy Hayes, Kay Parker, and Laura Elix, student clerical assistants, who are not on the TUSC team.

Bob Brewer, an electronics major, replaced Bennie Oulds. His knowledge of electronics is a valuable asset since many search requests relate to this subject in one form or another. Other student employment additions are: Rick Billingsley, Donita Duke, Jeran Binnings, and Byron Wallace, Information Retrieval Assistants.

APPENDIX A

SUMMARY OF CHARACTERISTICS OF TUSC TECHNICAL SEARCHES

TABLE 1

SUMMARY CHARACTERISTICS OF TUSC TECHNICAL SEARCHES BY CATEGORIES,

Search Number	Abstracts Sent	Reports Ordered	SIC Code	STAR - IAA Categories																																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1045	53	--	I-T							13		24	4	2			1	1				1			3	2	1	1									
1046	--	4	I-S																																			
1047	--	--	I-S																																			
1048	--	16	I-S																																			
1049	6	2	I-S			1			1				1					2		1																		
1050	11	--	I-T			3				1			1		4	1				1																		
1051	9	--	I-T							8	1																											
1052	57	--	I-T						3	46	4			2																		1	1					
1053	10	--	I-T							1	7	2																										
1054	--	--	I-T																																			
1055	--	--	I-S																																			
1056	--	--	I-T	(89 Pages from STAR and IAA Indexes)																																		
1057	--	--	I-P																																			
1058	9	6	I-S				8		1																													
1059	19	4	I-T				2								1	13												1								1	1

TABLE 1

SUMMARY CHARACTERISTICS OF TUSC TECHNICAL SEARCHES BY CATEGORIES,

Search Number	Abstracts Sent	Reports Ordered	SIC Code	STAR - IAA Categories																																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1060	--	--	I-T	(Information not available)																																		
1061	--	--	I-T																																			
1062	--	--	I-T																																			
1063	4	--	I-T							1						3																						
1064	19	1	I-T					1			1	6	2				3							2					4									
1065	9	1	I-C				1								3								4														1	
1066	7	--	I-S					1	2												1				3													
1067	8	--	I-T						4								2				1						1											
1068	22	--	I-T									1					2	7	7		2	1													1		1	
1069	8	--	I-T							5						3																						
1070	9	1	I-T														6	1	1	1																		
1071	7	--	I-T											1		1		2	1	1																		1
1072	--	--	I-T																																			
1073	7	--	I-T	1																1	4															1		
1074	22	--	I-F								2				2	15								3														

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SUMMARY CHARACTERISTICS OF TUSC TECHNICAL SEARCHES BY CATEGORIES,

Search Number	Abstracts Sent	Reports Ordered	SIC Code	STAR - IAA Categories 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1075	16	--	I-T	1										2	5	5							1			1											1
1076	26	--	I-T									9					7	1	5							1			3								
1077	--	--	33																																		
1078	--	--	I-S									(23 Pages from STAR Index)																									
1079	--	--	I-S									(18 Pages from STAR Index)																									
1080	--	--	I-S										(23 Pages from STAR Index)																								
1081	--	--	I-S										(8 Pages from STAR Index)																								
1082	14	2	I-T									9	1					2	1	1																
1083	6	--	I-F						2	1						3																				
1084	5	--	I-T									4																1								
1085	12	--	I-T						1			4						4			3															
1086	--	--	I-T																																		
1087	8	2	I-T									4						1		1	2															
1088	15	3	I-T					1				3	2	1				4	1	2	1															
1089	18	--	I-T									15	1			1				1																

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Search Number	Abstracts Sent	Reports Ordered	SIC Code	STAR - IAA Categories																																		
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
1090	15	--	I-S											5	3												4	3									
1091	--	--	I-S																																			
1092	3	--	I-S																	3																		
1093	10	--	I-S				8		1																				1									
1094	--	--	I-T																																			
1095	7	--	I-T			2			1					1										3														
1096	17	--	I-O		4	1	1						2	7				1																				1
1097	21	--	I-T					1	1		12					4					2														1			
1098	--	--	I-F																																			
Total	89	42		1	5	7	20	4	17	88	15	81	14	21	18	49	21	26	16	13	16	2	5	8	6	4	6	6	8	0	0	0	1	1	2	2	6

TABLE 2

SUMMARY CHARACTERISTICS OF TUSC TECHNICAL SEARCHES BY DATA SOURCE

Search Number	Federal R & D Reports	Library of Congress	McGraw - Hill	TUSC Library	SSC Library	Tech Briefs	Contractor Reports	Technical Notes	Special Publications	Aerospace Technology	American Aviation	Aviation Week	Business Week	Electronics	Engineering News Record	Food Engineering	Forest Industries	Industrial Research	Instruments & Control Systems	International Science & Tech.	Iron Age	Materials Engineering	Modern Plastics	Oil & Gas Journal	Research & Development	Science	Technology Week	Welding Journal	Sales Management	Business Automation	Thomas Register	AD Abstracts	Combustion	Products Finishing	JWPCF	Power
1045						13																														
1046									4																											
1047												4																								
1048									16																											
1049																																				
1050																																				
1051																																				
1052																																				
1053																																				
1054				1																																
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1059						3																														

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Search Number	Federal R & D Reports	Library of Congress	McGraw - Hill	TUSC Library	SSC Library	Tech Briefs	Contractor Reports	Technical Notes	Special Publications	Aerospace Technology	American Aviation	Aviation Week	Business Week	Electronics	Engineering News Record	Food Engineering	Forest Industries	Industrial Research	Instruments & Control Systems	International Science & Tech.	Iron Age	Materials Engineering	Modern Plastics	Oil & Gas Journal	Research & Development	Science	Technology Week	Welding Journal	Sales Management	Business Automation	Thomas Register	AD Abstracts	Combustion	Products Finishing	JWPCF	Power
1060																																				
1061																							2													
1062																																	7			
1063																																	1	5		
1064									1																											
1065									1																											
1066																																				
1067						3																														
1068																																				
1069				2																																
1070						2			1																											
1071																																				
1072									2																											
1073						9																														
1074																																				

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Search Number	Federal R & D Reports	Library of Congress	McGraw - Hill	TUSC Library	SSC Library	Tech Briefs	Contractor Reports	Technical Notes	Special Publications	Aerospace Technology	American Aviation	Aviation Week	Business Week	Electronics	Engineering News Record	Food Engineering	Forest Industries	Industrial Research	Instruments & Control Systems	International Science & Tech.	Iron Age	Materials Engineering	Modern Plastics	Oil & Gas Journal	Research & Development	Science	Technology Week	Welding Journal	Sales Management	Business Automation	Thomas Regulator	AD Abstracts	Combustion	Products Finishing	JWPCF	Power
1075				1																															
1076				2																															
1077																																			
1078																																			
1079																																			
1080																																			
1081																																			
1082						3			2					3																						
1083																																			
1084														10																					
1085						3																	2												
1086				1																															
1087						3			2					1																						
1088									3																										
1089																																			

TABLE 2

SUMMARY CHARACTERISTICS OF TUSC TECHNICAL SEARCHES BY DATA SOURCE

Search Number	Federal R & D Reports	Library of Congress	McGraw - Hill	TUSC Library	SSC Library	Tech Briefs	Contractor Reports	Technical Notes	Special Publications	Aerospace Technology	American Aviation	Aviation Week	Business Week	Electronics	Engineering News Record	Food Engineering	Forest Industries	Industrial Research
1090																		
1091				8														
1092							2		1									
1093																		
1094																		
1095																		
1096								5	2									
1097						3												
1098									21									

Search Number	Instruments & Control Systems	International Science & Tech.	Iron Age	Materials Engineering	Modern Plastics	Oil & Gas Journal	Research & Development	Science	Technology Week	Welding Journal	Sales Management	Business Automation	Thomas Register	AD Abstracts	Combustion	Products Finishing	JWPCF	Power
1090																		
1091																		
1092																		
1093																		
1094					8													
1095														1				
1096																		
1097														6			2	1
1098																		

APPENDIX B

SELECTED TRANSFER AND IMPACT REPORTS OF SIGNIFICANT IMPORTANCE

FRONTIER ENTERPRISES

November 30, 1973

Mr. S. Charles Pierce
Technology Utilization Office
Small Business Administration
Region VI - PMA
1100 Commerce Street
Dallas, Texas 75202

Dear Mr. Pierce,

Earlier this year, as you undoubtedly recall, I requested information on several vital areas of technological interest to my company, Scientific Dimensions, Inc. and another company for whom I was consulting, Frontier Enterprises, Inc. Since that time I have changed to full time employment at Frontier Enterprises as Director of Applied Sciences. I cite this change so you will not develop mass confusion over the letterhead on this communication.

I would like to take this time to make a few comments on your program and the effectiveness of the information supplied. First, the information searches are of tremendous importance in addressing our specific problems in the development and manufacture of aerosol generation and measuring equipment. The larger data base computer searches certainly provide a better overview of progress being made in government research and development projects. However, I do find that while I thought the key words were rather specific, the searches in general returned approximately 60 per cent non-applicable topics. In spite of the fact that some of the searches returned a majority of information which, at this time, is not useful they all had a significant portion which has had substantial impact upon our program. As an example, a NASA scattering chamber may very well be, in modified form, a part of our new product line to be announced in May, 1974. Exchange of technology is the only way we, as a small company, can keep from re-inventing the wheel and these information searches have taught me to look first at the available technology prior to putting on the inventor's cap.

Secondly, the response of people who are personally contacted to provide technical assistance on specific problems has been over-

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whelming. I particularly mention Mr. Filmer Ruegg at the National Bureau of Standards for his kind assistance on flow measurement. Here is a man at the head of his field whom I would never have known had it not been for your tireless efforts and seemingly infinite contacts. Through his comments and recommendations we now have a strong capability and knowledge in our specific flow measurement problem.

Finally, I would like to speak to your specific program. For over 15 years I have been aware of a certain negative attitude on the part of the business community toward the Small Business Administration. This attitude primarily centers itself on the financial portion of the SBA program which for some time, I might add, I shared with the community. Also earlier technology utilization programs such as the NASA Computer Retrieval, e.g. Technology Applications Center at the University of New Mexico, provided a search at a prohibitive cost to the small businessman. When I say small I allude to the person like myself who may be doing well to draw enough money from the company to pay the rent at home. $250 for an information search would be totally out of the question unless substantial sales could be guaranteed which can never be the case. Your office is the first contact that I have ever developed which genuinely helps at, I am sure, considerable expense and for which I have never been forced to expend any money save the price of applicable documents beyond that which you could supply. Your efforts have changed my attitude and I proudly proclaim your service and accomplishments to my colleagues.

Your program is in fact a vital portion of the Small Business Administration program and furthermore is the only avenue at my disposal for reaching the answers to so many questions. If the federal government can bail out Lockheed Corporation from bankruptcy and cost plus fund the major corporations in all manner of joyful pursuits of knowledge and profit, it can certainly afford the relative pittance it spends on your program as one of the most cost effective investments this country can make.

Thank you again for your support.

Very truly yours,

F.T. WILLIAMS
FRONTIER ENTERPRISES, INC.

FTW/jp

cc: Frank G. Mitchell, Chief
SBA, Region VI - PMA

APPENDIX C

TUSC GENERAL AVIATION NEWS LETTER

TUSC GENERAL AVIATION NEWS LETTER

In Quarterly Status Report No. 30 (pages 4-5), TUSC reported that coordination between the Center, NASA's General Aviation Technology Office, and the NASA's TU Office has resulted in formal approval for publication of a TUSC General Aviation News Letter. A reproduced copy of the first issue was included in QSR #33.

A survey of individuals, organizations, agencies, etc., known to be general aviation enthusiasts has been made. Approximately 300 written inquiries were mailed to prospects. Insofar as valid addressed could be established, inquiries were mailed to the various State Aeronautics Commissions. Furthermore, personal contact was made with members of the University Aviation Association (UAA) and the National Business Aircraft Association (NBAA) at their annual meeting and convention; also, SSC Aviation Department faculty personnel informed attendees of a recent symposium for airport managers about the News Letter. The UAA and NBAA offer a fertile field for significant growth in future mailings of our publication. Thus far the results of our "scatter-gun" type mailing have been most encouraging due to an unusually good response to the News Letter. As a matter of general interest, a topic which has been most often repeated, as an item of interest, concerns sound; i.e., noise tolerance levels, noise suppressors, noise measurement, etc.

TUSC believes that a bountiful field of harvest, relative to TU benefits and spinoffs, is available from coast to coast in and through our publication by presenting aviation information that is couched in terms appropriate to the reader's level. We recognize that some information viewed from the standpoint of a current and knowledgeable aeronautical engineer may seem to be elementary data. However, the reader for which the News Letter intends to reach are persons who do not have the technical expertise of an aeronautical engineer. Despite all-out efforts of the FAA, there are licensed pilots that do not fully understand some of the basic principles of flight, aircraft systems, and/or aircraft performance expectations or calculations.

Topics in the News Letter may or may not directly touch upon one or more of the specifics mentioned above, but it will contain articles of interest to the typical, general aviation-type individual. Reproduced copies of each News Letter published to date are included in the pages to follow.

The TUSC News

GENERAL AVIATION - TECHNICAL EDITION

Published by TECHNOLOGY USE STUDIES CENTER
Southeastern State College, Durant, Oklahoma 74701
(405) 924-0121 Extension 2517

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CONTRACT NASW 2512

Volume I, Number 1 September 1, 1973

COMPOSITES

Many advancements made in aerospace have been closely associated with the progress made in metallurgy. Basically, metallurgy is that branch of science which deals with the separation of metals from the ore and prepares the metal for use. Many metallurgists believe that a point of diminishing returns has been reached in alloys for structural members and for hot environment applications.

"Composites" have received a great deal of attention from the metallurgists since Sputnik. These scientists have experimented with varying combinations of man-made fibers, ceramics, plastics, metals and metal alloys, seeking a combination that would exhibit an increase in strength-to-weight ratio and a tolerance for high temperature.

Development of man-made fibers has presented a promise for better aerospace materials. The fibers, sometimes called "whiskers," are not to be confused with the man-made fibers used in the textile industry. Fibers can be "grown" from silicate, iron, carbon, graphite and many other metals and semi-metals. They can be grown in lengths measured in feet and in diameter from submicron (less than a millionth of an inch) up to several microns. In short lengths and in bulk, they appear as a powder to the naked eye. The high degree of crystal perfection and orientation are believed to be the source of their great strength. Some of the more promising composites use these fibers for reinforcement similar to the use of steel for reinforcing concrete.

The bulk form of graphite has tensile strength of approximately 2,000 pounds per square inch while the fibers from graphite have a tensile strength of about 3½ million PSI.[1] Alumina has a bulk strength of 30,000 PSI and fibers from the same material have 2,200,000 PSI. Some fibers retain 80% of their strength at 3500°F[2]--in comparison, stainless steel melts at approximately 2700°F.

Manufacturing and fabricating structural shapes from composites has been and continues to be a great problem. How does one machine a composite material that is reinforced with fibers which have a tensile

strength of 3½ million PSI? Rolls-Royce Ltd. believed that it had found a way to fabricate turbine blades from a composite. Rolls originally sold the RB.211 engine with carbon fiber composite blades to Lockheed for its L-1011 transport. The composite blades would not retain their integrity under engine test and Rolls declared bankruptcy while trying to improve its manufacturing technique so that the blades would meet the specifications. Lockheed then ran into difficulty when it found itself with a ramp full of expensive, engineless airframes which were not saleable.

Experimental composite parts have been in use for some time on late military aircraft. Secondary structural parts, farings and skin sections are compiling an acceptable history for composites to date. The parts are largely "one-of-a-kind" and laboriously made, due to the primitive methods employed in fabricating the material.

Limited use of the fibers has not promoted the expenditure of funds necessary for the equipment to mass produce the material. The high cost of the "pilot plant" output imposes constraints upon the designing for use of the fibers. This situation in the introduction of new material is not unique. Aluminum cost $545.00 per pound in 1859. With the development of smelting knowledge and fabricating know-how mass production has brought the price down to approximately $.30 per pound. Requirements for lightweight, yet strong and temperature-tolerant structures in the NASA Shuttle program may provide the impetus for further development in usage of composites in general aircraft. It is believed that an increase in performance, a longer life span and a savings in maintenance will result from the employment of this new material in aircraft.

SUPERCRITICAL WING

When a situation is described as critical, immediate remedial action is in order. If the situation is SUPERCRITICAL, one would normally expect that catastrophic events were imminent. However, when aerodynamics is the subject under discussion, the definition of SUPERCRITICAL is changed considerably. The SUPERCRITICAL wing is proving in flight what it promised in the windtunnel. Aeronautical engineers expect that the supercritical airfoil will provide significant improvements in the performance of the next generation of transport aircraft. General aviation aircraft will probably reap benefits from this aerodynamic advancement during this decade. SUPERCRITICAL airfoils will be a subject discussed in one of the Fall letters of this series.

HEAD-UP INSTRUMENT DISPLAY

Head-up instrument display systems have received considerable attention recently. Giles Lay and Jack Tucker are trying to adapt the system for use in automobile driver education for the Oklahoma School of the Deaf, Sulphur, Oklahoma. An explanation of the head-up system will appear in a later issue of this letter.

FLY BY WIRE

"Fly-by-wire" systems which do away with bellcranks, push-pull rods and cables for moving flight control surfaces are coming closer to application to general aircraft. There is a significant weight-saving between small electrical leads going to actuators and all of the mechanical rods, etc. "Fly-by-wire" technology will be discussed in detail in one of the Fall editions of this letter.

METRIC SYSTEM CONVERSION CHART

NASA and many other technically orientated organizations have adapted the SI (metric) system of weights and measures. It appears that the system may be adapted by all segments of aerospace over the next decade or so. A chart is attached which might be useful as a reference on the change-over. The chart was developed by the Small Business Administration.

STUDY OF AIRCRAFT IN SHORT HAUL TRANSPORTATION SYSTEMS.
(N67-38582, 225 pages, $3.00, NTIS)

The Boeing Company contract study for NASA dated 1967 suggests that among other improvements in aircraft these major improvements from current levels are postulated by 1985:

> Profile drag reduced by 10%, placard speed increased by 20% with same comfort level, usable lift coefficient for STOL approach increased by 100%, powerplant weight reduced by 30-50%, increase of avionics reliability 2,000 fold.

Further on in the report they say, "Based on extrapolation of statistical information, an engine thrust-to-weight ratio of 40:1 can be expected by 1980." (Lift engine)

CHEMICALLY INDUCED IGNITION IN AIRCRAFT AND SPACECRAFT ELECTRICAL CIRCUITRY BY GLYCOL/WATER SOLUTION.
(TN D-4327, 15 pages, $1.50, TUSC)

Some old-time armament types think they know why JATO systems malfunctioned even AFTER thorough cleaning with a glycol cleaner.

NASA found, as reported in the above Technical Note, that silver-coated copper wire will ignite if exposed to glycol/water solutions. In the third reported experiment, "The first drop of solution (water/glycol) in both instances produced ignition in less than one minute with a sustained current flow." Glycol will cause stray current in an electrical system which has silver-coated wire. Anti-ice fluids and cleaning fluids containing glycol are not compatable with commonly used silver-coated, electrical aircraft wiring.

OPTIMUM RUNWAY ORIENTATION RELATIVE TO CROSSWINDS.
(N72-30250, 19 pages, $1.90, TUSC)

If you are planning an airport or modifying an existing facility, the above numbered report may be helpful. The abstract of the report contains this statement, "Two procedures for obtaining the optimum runway orientation relative to minimizing a specific crosswind speed are described and illustrated with examples. The empirical procedure requires only hand calculations on an ordinary windrose."

THE EFFECT OF VARIATIONS IN LOCAL GRAVITY AND OF AIRCRAFT SPEED ON THE EFFECTIVE WEIGHT OF AIRCRAFT IN HIGH PERFORMANCE CRUISE.
(N72-31024, 16 pages, $1.60, TUSC)

This report states, "For Concorde in cruise there is a reduction in effective weight of approximately 0.5% in westward flight and this increases to more than 2% in eastbound flight." (Let's quit talking about the maneuver used by a fly to light on the ceiling and talk about this one for awhile.)

SERVICE TO SMALL COMMUNITIES.
(Part 1, 114 pages, deals with local service carrier costs and subsidy need requirements; Part 2, 150 pages, Small Aircraft and Small Communities: A History and Economic Analysis)

Both of these reports were developed by the Civil Aeronautics Board. N72-31016 costs $7.75 for hard copy and N72-31017 costs $9.50 for hard copy. Each report is on microfiche for $0.95 each. NTIS.

SATELLITE AIR NAVIGATION And Other Systems.

The NEWNAV Symposium was held in Frankfort am Main, Germany, Oct. 5-7, 1971, and sponsored by the International Federation of Airline Pilots' Associations. Twenty-three reports eminated from this meeting. The reports cover: Satellite Navigations Systems, Doppler Systems, Area Coverage Nav Systems, Characteristics and Prospects for a New Landing Guidance System, Aircraft Collision Avoidance Systems, and similar subjects. TUSC can provide abstracts of all of the titles. The reports come from Frankfort am Main, Vereinigung.

REMOVAL OF BAKED-ON ALUMINIZED SILICONE PAINT. (from R1820 engines)

N72-31174, 11 pages, TUSC. A safe and practical method for removing baked-on aluminized silicone engine paint is outlined in this report.

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[1]NASA SP-5060, SOME NEW MATERIAL AND METAL-CERAMIC COMPOSITES, p.13.

[2]NASA SP-5055, NON-GLASSY INORGANIC FIBERS AND COMPOSITES, Table I, p. 14.

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Volume I, Number 1 -5- September 1, 1973

Comparing the Commonest Measurement Units

Approximate conversions from customary to metric and vice versa.

	When you know:	You can find:	If you multiply by:
LENGTH	inches	millimeters	25
	feet	centimeters	30
	yards	meters	0.9
	miles	kilometers	1.6
	millimeters	inches	0.04
	centimeters	inches	0.4
	meters	yards	1.1
	kilometers	miles	0.6
AREA	square inches	square centimeters	6.5
	square feet	square meters	0.09
	square yards	square meters	0.8
	square miles	square kilometers	2.6
	acres	square hectometers (hectares)	0.4
	square centimeters	square inches	0.16
	square meters	square yards	1.2
	square kilometers	square miles	0.4
	square hectometers (hectares)	acres	2.5
MASS	ounces	grams	28
	pounds	kilograms	0.45
	short tons	megagrams (metric tons)	0.9
	grams	ounces	0.035
	kilograms	pounds	2.2
	megagrams (metric tons)	short tons	1.1
LIQUID VOLUME	ounces	milliliters	30
	pints	liters	0.47
	quarts	liters	0.95
	gallons	liters	3.8
	milliliters	ounces	0.034
	liters	pints	2.1
	liters	quarts	1.06
	liters	gallons	0.26

(Over)

THESE PREFIXES MAY BE APPLIED TO ALL SI UNITS

Multiples and submultiples	Prefixes	Symbols
1 000 000 000 000 = 10^{12}	tera	T
1 000 000 000 = 10^{9}	giga	G
*1 000 000 = 10^{6}	mega	M
*1000 = 10^{3}	kilo	k
100 = 10^{2}	hecto	h
10 = 10	deka	da
0.1 = 10^{-1}	deci	d
*0.01 = 10^{-2}	centi	c
*0.001 = 10^{-3}	milli	m
*0.000 001 = 10^{-6}	micro	μ
0.000 000 001 = 10^{-9}	nano	n
0.000 000 000 001 = 10^{-12}	pico	p
0.000 000 000 000 001 = 10^{-15}	femto	f
0.000 000 000 000 000 001 = 10^{-18}	atto	a

*Most commonly used

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Volume I, Number 2 October 1973

NASA GENERAL AVIATION TECHNOLOGY PROGRAM

Roger L. Winblade has been appointed Manager of the National Aeronautics and Space Administration General Aviation Technology Office. His work involves implementation and management of NASA's general aviation research program and review and coordination of NASA's general aviation effort with other government agencies and private industry. Winblade has been an active general aviation pilot since '52, received a BS in Engineering in '59 and did flight test engineering for Douglas before joining NASA. Since joining NASA he has worked on the X-15 program at Edwards (where he developed an energy management system for which he holds the patent), and he logged more than 200 jet fighter missions with the ANG in Southeast Asia.

Winblade's office has generated a "General Aviation Technology Program Fact Sheet" which lists some of the general aviation research which has been done, research which is under way and that which is planned.

Among the research projects where work has been done and where research is continuing are these:

1. Stall/spin characteristics of general aircraft and remedial measures to keep stall/spins from contributing to so many accidents.

2. Aerodynamic spoilers both on primary and secondary airfoils for more responsive controls.

3. Development of airfoil shapes to give higher lift/drag ratios and more docile stall characteristics.

4. Noise reduction, engine and propellers.

5. Realistic design techniques for crashworthiness (jointly with FAA).

6. Piloting procedures and traffic flow around general aviation airports and uncontrolled airspace.

7. Low cost advanced avionics and flight control technology to better utilize VFR and IFR airspace.

8. Special general aviation life training, simulation studies computer aided training.

9. Development of runway and guideslope visual aides.

A complete copy of the "Fact Sheet" may be secured by addressing your request to Roger Winblade, Manager, General Aviation Technology Office, Code RAG, NASA, Washington, D.C. 20546.

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The complete documents referenced in these News Letters may be purchased from this office or from National Technical Information Service (NTIS), U. S. Department of Commerce, Springfield, VA 22151. Paper copies are $3.00 each and microfiche copies are $1.45.

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ACLS (Air Cushion Landing System)

"Ground loads transmitted through conventional landing gear play a major role in the design of an airframe in as much as these loads are concentrated at discrete points on the aircraft structure. Similarly, pavement design (runway, taxiway, ramps, etc.) is based upon the loadings in the tire-pavement interface. With the current trend of larger and heavier aircraft, efforts to maintain acceptable loadings both in the airframe and on the ground have resulted in a multiplicity of gears. The expense in volume and weight for such systems, which serve no useful purpose when the aircraft is airborne, is high." The above quote is from NASA TN D-7295 which is entitled, LANDING PERFORMANCE OF AN AIR-CUSHIONED LANDING SYSTEM INSTALLED ON A 1/10 SCALE DYNAMIC MODEL OF THE C-8 BUFFALO AIRPLANE. Among the concluding remarks these statements are found: "The model behavior for all landings in rough water was considered satisfactory." "Hard surface landings were generally smooth. There was a small bounce after initial impact followed by small oscillations. A maximum acceleration of about 3g developed." "Taxi runs across a simulated tree stump and ditch generally caused no difficulty." Ground pressure imposed by this 1/10 scale model is in the order of 1/10 to 2/10 PSIG. IF the scale up to the actual aircraft is lineal, the ground pressure would thus be from 1 to 2 PSIG for the C-8 Buffalo airplane.

****

"Cement must be cheap in America" is a remark attributed to the French pilot of the Concorde when he looked down on the Dallas/Fort Worth Regional Airport. Although cement is not cheap in America, it is more attainable generally than the cooperation demonstrated in the development of the D/FW Airport. Approximately twenty entities of government ranging from precinct to the Federal level have had inputs as well as constraints to lodge against the project. The faith in air transportation which supported the leaders of the project and the many levels of government leadership over the years of development ranks with the technical excellence as outstanding in this D/FW project. A view of the Concorde, the C-5A and the 747 on the ramps during the

dedication ceremonies lends credence to their faith. During the final minutes of the dedication, Congressman Wilson made an observation as a sort of an afterthought regarding ancillary fallouts from the project. He observed that the project had created in both Dallas and Fort Worth an interest in the neighboring city's welfare. "If you have co-signed a $430 million note with a neighbor, you have more than a passing interest in his welfare."

****

ANGLE-OF-ATTACK INDICATING SYSTEM

The NASA Flight Research Center at Edwards, California, tested a commercially available angle-of-attack indicator system in a light twin general aviation airplane. The concluding remarks from the 22-page report, TN D-6210, follow:

"An investigation of the use of angle-of-attack information for the pilot's display in a light, twin-engine, general-aviation aircraft resulted in exposing certain fundamental complications which tended to negate some expected advantages of this parameter. As a result, the improvement in performance and flight safety was thought to be insignificant for the following reasons:

(1) The pilot was required to compensate for the nonstabilizing nature of angle of attack because it was not a reasonable control parameter except in combination with airspeed, attitude, or other information.

(2) The low-speed directional-control capability of the test airplane limited the advantages of using angle-of-attack information in that portion of the flight envelope, which led to undesirably low approach velocities (below minimum control speed) under low-weight conditions.

(3) The maximum performance curves for the test airplane were so flat near optimum values that expected climb performance gains were insignificant.

(4) Angle of attack was of no value as a cue when the correct speed for takeoff was reached.

Pilot acceptance of angle of attack was found to be highly dependent on a clear understanding of its meaning and limitations and the degree to which he combined it with other types of information. This understanding became important when angle of attack was used as a primary control parameter rather than as a stall margin displayed parameter.

Some of the characteristics of the angle-of-attack system were not adversely affected by vehicle aerodynamics and were considered to be desirable by the pilots. These were:

(1) The visual indication of stall margin.

(2) A single display point for straight-in approaches regardless of flap setting and gross weight, except for extremely lightweight conditions.

(3) The ease of obtaining trim and power settings when using the angle-of-attack indicator as a reference."

****

NASA TN D-7371

"Ornithologists have known for a long time that owls fly very quietly in pursuit of their prey." Thus the introductory paragraph of NASA report TN D-7371 begins. According to references cited in the report, owls can fly more quietly than other birds because the owl's wing has serrations on the leading edge. NASA and the Army Air Mobility R & D Laboratory attached serrated strips to lift blades to test the noise reduction. One of the strips tried has "teeth" 1/10" long similar to hacksaw blade teeth. The strip was fastened just back of the LE on the high pressure side of the rotor blade. "Noise level reductions from 4 to 8dB overall sound pressure level and from 3 to 17dB in the higher frequency octave bands were achieved with 0.25-cm(0.1-in.) serrated brass strips attached to the small scale rotor leading edge." The strip did not cause a deterioration of the blade performance...it did cut out some noise. The theory advanced for the effectiveness of the strips is that each "tooth" causes a small vortex on the low pressure side and a small area of turbulent flow on the high pressure side of the rotor. "This effect reduces separated flow regions..."

****

NATIONAL BUSINESS AIRCRAFT ASSOCIATION ANNUAL CONVENTION (SEPT. 24-27, 1973)

"Let George do it," has special meaning when one observes what George Haddaway and Al Harting did for the NBAA this year: the expression can be changed to "Let George and Al do it." The variety and quality of the exhibits and the symposium presentations were outstanding. The exhibits had an ancillary benefit to NBAA members besides that of demonstrating the state-of-the-art in structures, instrumentation ground service equipment, etc. The proselyting of ideas and the cross fertilizing of engineering functions among the equipment manufacturers augured well for the purchaser/user of such equipment in the future.

****

UAA FALL MEETING

The University Aviation Association met August 2 and 3 on the campus of Lawrence University, Appleton, Wisconsin. Elizabeth Murphy of the Southeastern State College Aviation Department reported that the agenda kept expanding until a second meeting was necessary. The second meeting was held in conjunction with the Dallas meeting of the NBAA, September 26. Gene Seibert of Southern Illinois University was elected president and Dr. Oliver H. Laine of the FFA Washington Office was selected as president elect. One of the problems the UAA has addressed itself to is that of standardization. College/University course descriptions have not been adequate for transferring aviation credits from one institution to another. Marion Stevens heads a committee which is working with Regional/college accrediting agencies to eliminate problems of transferring college aviation credits.

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Volume I, Number 3 December 1973

ONE WAY TO SAVE FUEL

NASA Contractor Report CR-2315 was prepared by the Massachusetts Institute of Technology on the subject, "Motorless Flight Research," November 1973. An interesting section of this report relates to the BUMPAS (Biplane Ultralight Man-Powered Aircraft Systems) group. They have in mind the $24,000 offered by the Royal Aeronautical Society of England to anyone who can make a MAN-POWERED flight over a closed course. The prize is offered for flying approximately a figure "8" pattern around pylons set 1/2 mile apart. Some of the things this MIT group found to be best for this "airplane" do not necessarily agree with generally accepted aerodynamic ideas.

Power/weight constraints called for a .66 lb/ft^2 wing loading. Among the first wing plans abandoned was a cantilever which would have had a span of 125 ft. They determined that a BIPLANE configuration was the only feasible approach. The traditional DOWN LOAD on the aft-mounted horizontal stabilizer gave way to a forward-mounted canard surface which can ADD TO the total lift. The canard is an "all flying" surface for pitch control. Roll control is provided by SPOILERS instead of ailerons. Ailerons on the TE of the wing impose a twisting force on the wing which can only be overcome by adding structure and weight to the wing. The spoiler attached directly to the spar was found to be the best means for roll control as well as to give yaw in the down wing direction.

Groups in England, Canada, and Japan are working in the same "man-powered" aircraft area. Puffin II has made a 180 degree turn while airborne and Jupiter flew 1172 yards straight away. We're pulling for the MIT BUMPAS group who will start their flight experiments this winter.

****

TIRE CHARACTERISTICS

Wheel well size has been a limiting factor in the amount of braking effect that can be built into a wheel brake system. A "cantilever" tire (the sidewalls overhang the rim) can carry more load than a "standard"

tire for the same wheel size. A larger diameter wheel using a "cantilever" tire will provide room for a greater braking capacity and still carry the same load.

"Cantilever" tires, which were called "Donut" tires in the Thirties are receiving considerable attention for the reason given above. Langley Research Center has recently published a TN D-7351 which compares the cornering characteristics of "cantilever" tires and "standard" aircraft tires. Cornering-force, drag-force friction coefficients and self-aligning torque were obtained for the two tires on dry runways, damp runways and flooded runways. They found the "cantilever" to be a bit better on dry runways but not quite as good as the standard tire on wet runways. The "standard" tire develops a higher drag-force friction coefficient at 100 knots. There doesn't appear to be a significant difference between the two types of tires in the areas tested.

****

JET ENGINE COSTS

The Lewis Research Center at Cleveland, Ohio, is the National Aeronautics and Space Administration's principle field installation for research and development of propulsion and power generating systems. The Center held a conference on "Aircraft Propulsion" and issued a report numbered NASA SP-259. One section of the report covers "Low-cost Engines for Aircraft." Two of the twenty pages of this report are quoted:

> Gas turbine engines have now almost completely taken over the field of large aircraft propulsion. Their small size and weight also make them very attractive for light aircraft. A major obstacle, not technical but economic, is the very high cost of current gas turbine engines which substantially restricts their use. The approximate cost of several current general aviation engines are shown in the following table:
>
> Turbocharged piston engines and prop:
> - Direct-drive 285-hp engine $10 200
> - Direct-drive 290-hp engine 11 300
> - Geared 425-hp engine 17 400
>
> Turbine engines:
> - Low pressure ratio 1025-lbf thrust turbojet. . . 22 200
> - Turboshaft 605-shp engine. 35 300
> - Turbojet 2850-lbf thrust engine. 65 500
> - Fanjet 200-lbf thrust engine 65 000
>
> It should be kept in mind that the general aviation light plane must be suitable for a retail sales price of around $30 000 for a single-engine aircraft and $45 000 for a light twin-engine aircraft. The turbocharged piston engines are themselves quite costly. For the high flight speeds that we will consider, a 425-horsepower engine would be

required, but the price of over $17 000 is already too high. The currently available turbojet, turboshaft, and fanjet engines are much too costly, with prices ranging from $22 000 to over $65 000.

Looking at these prices, we can now understand the competitive impact of a really low-cost gas turbine engine with a 1000-pound static sea level thrust having a total manufacturing price of $5000, or $5 per pound of thrust. Such an engine would provide important performance gains for light aircraft and also have a very important price advantage over either current piston engines or current jet engines. In order to sell at 1/5 the price per pound of thrust of current jet engines, however, this engine would require really major design simplifications and manufacturing cost reduction.

The foregoing has briefly summarized and described the major aspects of this low-cost-engine program. At this time, major results and conclusions cannot be made because the program is at an intermediate point.

For the future, it is planned to continue the fabrication development program on sheet-metal axial stages and the control development and its application to the turbojet and the fanjet engines. Design work on the fanjet engine will continue and also the final design will be completed on the Navy Ordnance engine. Fabrication of prototype Ordnance engines will then begin. This engine will be built so as to simulate production engine fully, and it will be tested at its full design operating conditions.

In connection with our overall interest in low-cost aircraft engines, it is instructive to examine the estimates that have been made on the production prices of the components of this engine. These are shown in table VII-1 and are based on production rates of 2000 units per year where the tooling writeoff costs may be neglected.

It is not the purpose of this paper to discuss these prices completely. The total cost of just over $3000 for the 650-pound-thrust engine, clearly indicates, however, that we can expect to provide the advantages of turbojet propulsion to missiles and drones at a price that is competitive with any other form of propulsion. Similar price estimates were previously made for the 1000-pound-thrust level turbojets, which indicated that manufacturing costs of about $5.00 per pound of thrust has, therefore, been indicated for both thrust levels. We are not concluding that $5.00 per pound of thrust would be a final manufacturer's selling price since there are a number of indirect costs which would affect the selling price. For example, the costs for calibration runs, the writeoff of qualification expenses, sales, and field engineering, and the distributor's markup. It is possible that these items could actually double the price at which the engines would be finally sold to the user.

From the estimates made in the program, however, it is evident that gas turbine engines of the type here considered will be attractive and cost competitive for general aviation,

for missiles and drones, for additional services uses (such as reconnaisance airplanes), and possibly for the smaller business category aircraft. If the obstacle of high cost can be eliminated, gas turbine engines will make major performance improvements available for these purposes.

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NEW AIRCRAFT

General aviation aircraft reap long-time benefits from advanced military aircraft. The benefits usually occur in the form of better materials, improvements in subsystems, etc. The B-1 bomber program may make contributions to general aviation, but they will be a bit different in nature from those made by such programs in the past. Research performed for the X-15 in the mid-fifties and the lessons learned in operating the aircraft have not been utilized. The advancements made by building and operating the XB-70, a triple sonic bomber type aircraft, have not been put into usage. The studies made for the development of the SST have been gathering dust. Many directly applicable advancements in fly-by-wire and associated systems were made in the Apollo program. Operational experience with the YF-12 high performance aircraft must be expanding the capabilities in maintaining and in using new materials and systems.

An examination of the assemblying of the first B-1 bomber was a satisfying experience. All of the technology and know-how developed in the above mentioned programs are wrapped into the B-1. There are no great gaps in technology which have to be filled in for this aircraft. True, there is a great amount of adaptation and of making systems compatable and great efforts are required in the manufacuturing phase of the program.

The bustle, noise, traffic, odors and apparent confusion which are usual on an assembly floor are not found around the B-1. Strikingly small groups surround the sub-assemblies and the assemblies themselves are hidden by "the high rear ends and flying elbows" of the workers at their jobs.

There appears to be less technical risk in the B-1 than there has been in similar programs for many years. If the powers that be determine that such a vehicle belongs in our inventory, the B-1 will be there.

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FLY-BY-WIRE

Fly-by-Wire (FBW) is the terminology used for a flight control system which uses electrical energy for energizing flight control surfaces rather than the traditional cables, bellcranks, push-pull rods, etc. Many advantages are attributed to FBW, some of which include lighter weight, less workload for the pilot, better control in transitional regions such as transonic and even re-entry from space into the

atmosphere. Pitch and yaw dampers may be a part of the system, as well as a flutter suppression system which has received some attention.

Sensing devices such as gyros and accelerometers are employed to detect an undesirable movement in an aircraft or even a part of an aircraft much more quickly than a human can sense the movement. Electronic networks can then work from the detected signal and correct for the undesired movement without input from the pilot or even his knowledge. Aerodynamic and structural limits of a vehicle are programmed into a computer. Pilot commands as historically transmitted by stick or control column are routed to the computer. The computer modifies the pilot commands in relation to what is being fed into the computer by the sensing devices. A skid or slip in a turn would be impossible and stall/spins would be a very rare occurrence. Small trim-tablike control surfaces on the leading and trailing edge of the wings can aerodynamically prevent twist and bending in the wing and thus make less stringent the requirement for stiffness in the structure. Canard surfaces might be employed to keep long fuselages in line without the present entire dependence upon structural stiffness.

Turbojet engines provided power for performance that required new aerodynamics and methods of control. The forces involved in moving the control surfaces prompted the use of hydraulic power for flight controls in high performance aircraft. Hydraulic actuators at the control surfaces lent themselves to piggy-back yaw and pitch dampers.

The dampers were needed because of aerodynamic problems associated with operations in the transonic and supersonic regions. The sensing devices mentioned earlier were tied into the hydraulic flight controls through an electronic network. The damper systems were imposed upon the existing flight control actuators system "piggy back."

Success in the damper technology probably pointed the way to FBW. Precise and timely increments of fluid were used for wiping out pitch/yaw. Why not port ALL of the fluid to the actuators through the networks and thus Fly-by-Wire?

FBW systems feed pilot-generated electrical signals to hydraulic valves on or adjacent to the actuators themselves. These signals have been processed by the computer, for example, so that at near stall speed and with an inadequate power setting it is impossible to get the nose high enough to stall the airplane. Complete utilization of FBW might even obviate the necessity for designing stability into an aircraft.

One line of thinking on the system envisions an electrically powered pump at each actuator. The pump and its reservoir would be independent of any aircraft engine driven hydraulic system. Redundant power leads and control leads would render the system less prone to battle damage and other types of failure inherent to a central pump with hydraulic lines threading throughout the structure.

Two programs which have advanced the state-of-the-art are mentioned in NASA's TN D-7420. The first two paragraphs of the report are quoted:

Structural flexibility must be considered in the design of large, high performance aircraft. Aeroelastic affects not only basic flight characteristics such as performance, controllability, handling, and ride qualities; it also increases structural loads and fatigue. The problems associated with flexible aircraft are not new; however, the technology required to control structural dynamics behavior was first developed for the inherently aerodynamically unstable launch vehicles. The success of the launch vehicle systems prompted the development of similar systems for aircraft, including systems for the control of structural mode response (ref. 1).

Two flight-test programs sponsored by the United States Government were initiated to achieve elastic mode control in large, flexible aircraft. The first program, which was conducted by the Boeing Company and Honeywell, Inc., was devoted to the development of a load alleviation and mode stabilization (LAMS) system for the B-52 airplane. Extensive analytical and simulator studies were used to define the details of the system and also to demonstrate the system's potential (ref. 2).

NASA used an F-8 airplane at Edwards FTC for establishing base lines for FBW performance. The airplane has ALL mechanical linkage removed and flies strictly by "wire."

FBW will contribute to the advancement of large aircraft and high performance aircraft as the state-of-the-art now exists. Fall-outs from FBW may be found in general aircraft during the next decade but a complete FBW system for general aircraft appears to be a remote possibility.

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HOW HIGH, HOW FAST, HOW!?

Predicting the performance of light aircraft is an area that is quite limited in comparison to high performance and/or heavy transport aircraft. General aviation pilots, for example, have been introduced to the "Crosswind Component" chart only in recent years. Typically, an aircraft owner's manual provides only performance charts for Take-Off and Landing Distance, Stall Speed, and Maximum Rate-of-Climb--for cruise performance, usually a generalized statement is made to the effect that normal cruise will vary from 60% to 80% of maximum power. Thus, optimum altitude, power, and/or speed to be used is somewhat of a guessing proposition for a typical general aviation pilot because the so-called "Cruise Performance Chart" merely sets forth fuel consumption data and TAS predictions based on the horsepower output of aircraft engine/s at various altitudes.

A June 1973, NASA Contractor Report (CR-2272) provides new insight and valuable information pertinent hereto. The title of the report is Point and Path Performance of Light Aircraft--A Review and Analysis. The report was the result of research and work of the Department of Mechanical and Aerospace Engineering, North Carolina State University at

Raleigh. One of the report's literature references (Ref. 9: "The Pilots Cruising Dilemma--How High and How Fast," by William D. Thompson in the Technical Review, Society of Experimental Test Pilots, Vol. 9, No. 1, 1968) gives a special significance with reference to the cruising dilemma mentioned above. As a means of helping to solve the what-to-do or how-high-to-fly questions relative to level flight with a light airplane, normally operating engine, and constant speed propeller, the NASA report reference suggests that:

(1) The high speed dash should be made at near sea level at maximum power.
(2) Normal cruising at 65-75% power should be made at the highest altitude at which these powers are available using full throttle and normal cruising RPM.
(3) Maximum range airspeed should be 1.4 to 2.0 times the flaps up stall speed depending on aerodynamic cleanness.
(4) Range is independent of altitude if airspeed is maintained at correct best range speed for each altitude.
(5) For best range at higher airspeeds, the optimum altitude is progressively higher.
(6) In moderate headwinds, the speed for maximum range should be increased about 10%.
(7) For maximum endurance, the airplane should be flown between 20 and 30 percent above flaps up stall speed, depending upon where minimum power is required to sustain level flight.

The suggestions given by Thompson are generally in good agreement with the results obtained from a point performance analysis of the Cessna 182 (see the section on Examples of Point Performance Calculation). Similar agreement was also found using a path performance analysis when flying near the angle of attack for best lift to drag ratio. These analyses were made using the point and path performance programs presented in Appendices C and D respectively.

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A very high percent of our readers have indicated an interest in "Noise Pollution Around Airports." We are trying to extract the needed information from a tremendous volume of literature. Our next issue will be largely devoted to this subject.

A. M. Moore
Editor