TECHNOLOGY UTILIZATION IN A NON-URBAN REGION: THE FIRST FOUR YEARS OF AN EXPERIMENT

By
LEE B. ZINK, Ph. D.
Director

FINAL REPORT, NASr - 178
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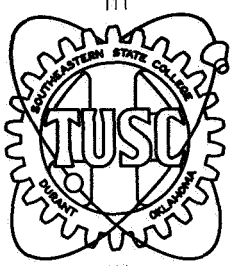
TECHNOLOGY USE STUDIES CENTER
SOUTHEASTERN STATE COLLEGE
DURANT, OKLAHOMA 74701

MAY 1968



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ACKNOWLEDGEMENTS

A report which describes activities of an organization for a period of over four years is the work of many persons. I would like to pay special tribute to my excellent staff without whose work there would be no report. They are a group of dedicated, professional, intelligent persons who have made my work a pleasant experience. Any success TUSC may have achieved is directly attributable to them. Additionally, my predecessor, Dr. W. N. Peach of the University of Oklahoma deserves my sincere thanks for his early guidance.

The actual preparation of this report has been a large undertaking. I have had significant assistance in this endeavor from the following members of the TUSC staff: Harold Warren, Assistant Director; A. M. Moore and Don Carpenter, Industrial Specialists; Mrs. Velma Dittmar, Administrative Assistant; Mrs. Debby Connely, Secretary; and Robert Klein, Statistical Assistant. Doyle Caton of the college's State Technical Services Program provided useful input for the report. Cecil Ray Sullivan, Manager of the College Duplicating Office, and his assistant, Mrs. Jane Brown, provided excellent services to TUSC in the printing of the report.

Two persons deserve special recognition. My good friend and counselor, Dr. Richard W. Poole, Dean of the College of Business at Oklahoma State University read the first draft of the report and provided many helpful suggestions for improvement. Throughout these four years, Dr. Poole's direction, counsel, and guidance have been at the foundation of many TUSC programs. Finally, my wife, Patty, who serves as my editor, deserves much credit for her faithful devotion.

Lee B. Zink

May 1968

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SUMMARY

Establishing the Base

The first work of the Technology Use Studies Center (TUSC) was the preparation of a detailed economic profile of each of the 17 counties of the TUSC primary experimental area. The profiles were to serve two major functions: first, to provide detailed information to be used as a base for future TUSC programs; second, to give a foundation for measurement of TUSC impact. These data were published in an eighteen volume series and were made available to the public.

In early attempts to identify opportunities to use NASA developed technology in the TUSC primary area, it was determined that much education regarding "technology transfer" was needed. Several procedures were devised to respond to that need. Among them were sponsorship of meetings, speeches before civic clubs, a TUSC newsletter, and a series of TUSC Bulletins. Personal contact with each chamber of commerce in the area was made, and their support for the TUSC program was gained.

Developing Effective Programs

The average TUSC client was a small firm. Of 235 manufacturing firms in the 17 county area, 194 had 19 or fewer employees. A basic problem solving mode of operation was developed to respond to the needs of these small firms. Personal contact between the TUSC field man and the client was the foundation of the program. Although the information provided by NASA was the base of the problem solving mechanism, additions, in the form of a less sophisticated technical library, were made. A group of faculty consultants was used as interpreters of problems and solutions.

Some efforts were made to anticipate problems by developing packages of information in selected fields. These were not

outstandingly successful.

In 1964, TUSC had 9 clients; in 1968, 150.

Specific Transfer Projects

TUSC developed some specific experiments to test various capabilities in its third year of operation. Firms outside the primary area were served by mail and telephone. It was determined that a certain amount of personal contact was essential. TUSC served a large firm and found that services designed for use by small firms were useful to the large firm. Technology utilization seminars were found to be somewhat ineffective in transferring technology to small business.

Evaluation of the Experiment

Obviously, a most difficult question was how to judge TUSC performance. The problem of obtaining adequate information regarding technology transfers was a major obstacle. Several clients were eager to indicate that TUSC service was invaluable to their operation and had contributed significantly to their growth. Special cases of TUSC impact were deemed quite important. Among them was the professional aviation program established at Southeastern State College.

CHAPTER I

ESTABLISHING THE BASE FOR EFFECTIVE TECHNOLOGY TRANSFER

> "The Contractor will provide the necessary personnel and facilities to construct a profile of the existing economic structure of the region surrounding the Southeastern State College. Identify opportunities to use locally, NASA developed technology. Disseminate this information in a manner calculated to assist the area to participate more fully in the space age and to contribute to the national needs." Statement of Work, NASr-178.

Introduction

Under the broad mandate stated above, the Technology Use Studies Center (TUSC) was founded in February 1964. Although the TUSC offices were located at Southeastern State College, the Center was an endeavor embodying significant cooperation among three institutions of higher education. The University of Oklahoma and Oklahoma State University joined with Southeastern State College in early planning and in the operation of the Center. The major portion of the senior staff in the early period was located at the two universities. Dr. W. N. Peach of the University of Oklahoma served as Director of the Center from February 1964 through August 1965. Dr. Richard W. Poole of Oklahoma State University served as Associate Director during the same period. The major committment of each of the three (3) institutions was of paramount importance. Without the spirit evidenced by genuine cooperation, TUSC could not have been successful.

The Statement of Work indicated that TUSC had at least two major areas of responsibility in fulfilling its mission. The first was the construction of an economic profile--gathering socio-economic data and presenting it in a meaningful format--for a specific geographic area in southeastern Oklahoma. Secondly, TUSC was to identify opportunities for use of NASA technology

and to disseminate it in southeastern Oklahoma. The first task, though formidable, was known to be one which could be accomplished. The second portion of the mission was known, even at this early stage, to contain many challenges. Moreover, few patterns of previously successful ventures of a like nature were available for guidance. Hence, predictions relating to accomplishment of this second task were of a tentative nature.

The geographic area to be used as the base for the socio-economic profile building was defined as seventeen (17) counties in southeastern Oklahoma (see map, Appendix A). Additionally, this area was designated as the primary one for the experimental program in use of NASA developed technology. Adjacent areas in Oklahoma, Arkansas, and Texas were also designated as potential areas for the technology utilization program.

With some exceptions, the standard of living in the seventeen (17) county primary area was relatively low. Per capita personal income in most counties was below the average for Oklahoma which, in turn, was below the average for the United States. Historically, the area had been heavily dependent upon agriculture, particularly cotton. As agricultural importance declined, no other economic activity had arisen to offset the decline; hence, the economy of the region had worsened. Still, it appeared that there was significant potential for development.

Any new public program requires significant effort to expose it to the public. The TUSC program was no exception; in fact, because of its unique character, more public educational activities were necessary than would normally be the case. Although the National Aeronautics and Space Administration was some six (6) years old at the time, it was not well known in southeastern Oklahoma. The idea of technology transfer from the space program to non-aerospace users was even more foreign. With this in mind, a number of public education programs were initiated.

In March of 1964, the first of these educational programs was held. Distinguished businessmen and educators from Oklahoma, Arkansas, and Texas attended. Mr. James E. Webb, NASA Administrator, was the speaker at one of the meetings of this event. His

address at this meeting was published as the first TUSC Bulletin (see appendix C). Presidents of major companies in the three states along with the presidents of the University of Oklahoma and Oklahoma State University and the Oklahoma Chancellor of Higher Education were participants. The impact of this introductory meeting was great, and the interest it generated was quite significant to TUSC's future work. Another meeting was held in October 1964 with Mr. Webb again enthusiastically leading the TUSC educational program.

Other educational ventures were undertaken during this early phase. An effort was made to gain rapport with all secondary schools in the primary area. This was accomplished, in part, by periodic mailings of NASA publications which would be useful in science classrooms. An intensive effort was made to personally contact each chamber of commerce in the seventeen (17) counties, to explain the program to their paid executive and board of directors, and to obtain their support. It was felt that the understanding and active support of chamber of commerce personnel would be vital to our future programs for the area.

Another program was progressing at this same time. Efforts were made to personally contact all federal, state, and local agencies whose activities had any bearing on economic development in the primary area. The purpose of this effort was two-fold; first, the TUSC staff needed to know details of these programs and, second, it was felt that the various agencies should know of the TUSC venture. As TUSC activity began to accelerate it became obvious that a switching mechanism was needed to assist in matching needs of the communities in the area with programs available to respond to these needs. After this early effort at contacting the various agencies and learning of their programs, TUSC was able to act in that switching capacity. (It should be pointed out that at that time there were no district organizations of the U. S. Economic Development Administration operating in the region.)

The Socio-Economic Profile

As previously mentioned, a first major effort of the TUSC staff was the preparation of the socio-economic profile data for the seventeen (17) counties. The first decision which was required related to the geographic unit to be utilized as the base for these data. The county was chosen as the appropriate unit for a number of reasons. The most important was that more data were available on a county basis than on any other local unit. Additionally, it appeared that data on a county basis would be adequate for necessary comparisons among counties at that time and in the future. Hence, it was determined that comparable data would be gathered and constructed for each of the seventeen (17) counties of the primary area.

The next step was to decide upon kinds of data to be included in the profiles. Data gathered by a TUSC census activity might have been desirable; however, such an activity was not feasible for a number of reasons. The most important of these was a limit to the resources which could be devoted to profile construction. Census taking is a very costly endeavor and was much beyond the scope of TUSC resources. Therefore, the decision was made to gather the majority of the data from secondary sources.

In order to provide background information on the development and growth of each county, many of the data series go back to the time of Statehood in 1907. Other series, such as those containing lists of manufacturing firms or financial institutions, were presented for only the most recent period. Although most of the profile data were gathered from official sources, some were compiled by TUSC staff members. Selection of data to be included was based on several aspects, the most important being availability of reliable data which would be adequate for TUSC needs and responsive to the needs of groups in the seventeen (17) county area.

Much painstaking activity was involved in preparation of these data for eventual inclusion in published volumes. Intensive work on this phase of the TUSC project began in March 1964. Publication of the first volumes was complete in August 1965.

During this period eight (8) professional economists and some twenty (20) statistical assistants were involved, on a part-time basis, in preparation of the data. This gives some idea of the magnitude of the undertaking. The volume of data which had to be gathered was one problem; another related and equally important problem was the painstaking care required to assure that all data were accurately recorded. The latter required much time and effort. Additionally, special care was given to making the volumes simple, clear and readable in order that they would be generally useful.

The culmination of all this activity was eighteen (18) published volumes, one for each of the seventeen (17) counties in the primary area, and one which described the sources and compilation procedures used for the county volumes. Each of the county volumes was entitled Human and Material Resources of Atoka (for example) County, A Profile for Growth and Development. The final volume was entitled Source Notes and Explanations for Human and Material Resources of (Atoka, Bryan, Carter, Choctaw, Coal, Haskell, Johnston, Latimer, LeFlore, Love, McCurtain, McIntosh, Marshall, Murray, Pittsburg, Pushmataha, and Sequoyah) County, A Profile for Growth and Development. This latter volume was completed in May of 1966. The eighteen (18) volume set contains 2,704 pages.

Each county volume contains forty-five (45) tables and forty-five (45) corresponding charts. There are also eleven (11) supplementary tables for each county for which there is no corresponding chart. The tables and charts are numbered uniformly for each county volume in order to facilitate comparisons between developments in one county and another. Thus, for example, Table 1 and Chart 1 for Atoka County provide information on population trends from Statehood through 1960. Table 1 and Chart 1 for each of the other 16 volumes provide similar information on population trends in their respective counties. The major subject categories of the forty-five (45) tables are: Population, Employment and Personal Income; Agriculture, Including Water and Weather; Industry, Trade and Finance; and Education, Housing and Voting Records. The eleven (11) supplementary tables contain information on such

subjects as population, lakes, minerals, coal reserves, financial institutions, manufacturing establishments, communication facilities, educational facilities, and others. Appendix B to this report contains a complete listing of all tables in the published volumes.

After publication of these volumes they were distributed to many groups and persons in the primary area as well as over the entire United States. Area users found the data quite useful in assisting in the analysis of their own problems. Users outside the area were interested in the volumes for a number of reasons. One of the most important of these was that these volumes established a pattern and a methodology for assembling similar data for other regions. To this writer's knowledge, at that time there had been no undertaking of comparable magnitude and detail accomplished for any other similar area of the United States. Thus, these volumes were on the forefront of a field which has become increasingly important during the past four years.

The brevity of this description of the preparation and publication of these data should not demean the monumental effort involved in the total project. The preparation of 765 separate charts and 952 separate tables is a mammoth undertaking. The work was evidently worth the effort. Prior to publication, data that had been collected were utilized by the city of Durant, Oklahoma, in the preparation of its new city plan. Use of these data allowed savings of $2,000 - $3,000 in that endeavor. Similar use of the data was made by a consultant working for the city of Ardmore, Oklahoma. Early work of the TUSC staff in making current the manufacturers listing for each county provided the TUSC field staff with ample information for its initial activities. Later, published profile data provided input for two "Overall Economic Development Programs" of district organizations formed under the Public Works and Economic Development Act of 1965. TUSC was informed that quite substantial savings were realized as a result.

Auxiliary Activities

Management Training

Early in the program it was recognized that one of the primary needs of area firms was assistance in applying adequate management methods. Providing this kind of assistance was not directly related to the TUSC program; however, adoption of better management techniques could well be a prelude to adoption of new technological techniques. In the hope of the latter, TUSC approached officials of the Small Business Administration and offered to jointly sponsor management training sessions aimed primarily at small businessmen. The first session was held in November of 1964 and was judged to be a success. Other sessions were then held with faculty members of Southeastern State College acting as instructors. All of these were presented at no direct cost to TUSC. Much good in the form of introductions to the TUSC technology transfer program has come through these presentations. Additionally, the practice of better management techniques has engendered consideration of the use of more advanced technology.

Involvement in Related Research Projects

TUSC professional economists soon became known as advisors and consultants on socio-economic data for Oklahoma. This occurred prior to the publication of the profile data partly because efforts were made to provide data to anyone who requested it as soon as it was compiled. Also, this effort allowed the professional staff to further their own knowledge of various details of generating and presenting data through intensive on-the-job training. This led to an increased awareness of needs for adequate data to analyze other problems of the economy. As a result, these professionals have initiated other important research projects stimulated by their early TUSC work. Several important projects now underway in the College of Business at Oklahoma State University and in the College of Business Administration at the University of Oklahoma have been generated in this manner. For example, at the University of Oklahoma several projects supervised by former TUSC professionals are progressing under sponsorship of the Ozarks Regional Commission. At Oklahoma State University TUSC consultants Drs. Robert Sandmeyer and Larkin Warner became

interested in labor force participation in Oklahoma as a result of their work on the TUSC economic profile data. A result of this was a study for the Manpower Administration, U. S. Department of Labor, entitled "The Determinants of Labor Force Participation Rates, with Special Reference to the Ozark Low-Income Area" (Contract #81-38-66-20). Drs. Sandmeyer and Warner were the principal investigators for this study. Also, these two (2) TUSC consultants along with Dr. Jack Robinson, TUSC consultant from the University of Oklahoma, were involved in a study prepared for the Office of Regional Economic Development, U. S. Department of Commerce, entitled "Bibliography and Evaluation of Publications on the Ozark Region." This study was a cooperative effort among the two Oklahoma institutions, the University of Arkansas, and the University of Missouri.

The idea for the Manpower Research and Training Center established in 1966 at Oklahoma State University was born in the minds of the TUSC Associate Director, Dr. R. W. Poole, and others at OSU during their work on TUSC projects. This center has become a nationally recognized institution. Evidence of this was a national conference sponsored by the group, along with the Ford Foundation and the Subcommittee on Government Research of the Committee on Government Operations, U. S. Senate in May of 1968. This conference was entitled "The Rural to Urban Population Shift--A National Problem."

In addition to the projects mentioned above, a number of M. A. and Ph. D. theses have been related to TUSC experiences. Dr. Warner supervised a master's thesis on the economic development of a county in Oklahoma directly adjacent to the TUSC primary area. Dr. Sandmeyer assisted in the supervision of a Ph. D. thesis relating to labor force participation rates.

The reputation as a reliable source of socio-economic data and of possessing a certain expertise in the field allowed TUSC staff members to become involved in a number of important activities. At the invitation of the Governor of Oklahoma, TUSC economists, along with officials of state government, represented the state in meetings which culminated in drawing of original boundary

lines for the Ozarks Economic Development Region. Several area cities were assisted with data while profile data volumes were being prepared. The data TUSC provided saved them considerable time and resources. Regional organizations under Department of Commerce programs were in their formative stages and TUSC data and expertise were quite useful to them.

Other TUSC Publications

The recognition of the need for educational programs which would reach a wide section of the populace led to the development of two (2) TUSC publication series. The first of these was "The TUSC News," a newsletter which contained general information about the TUSC program. The first issue of "The TUSC News" was published in July of 1964. There have been ten (10) more published at irregular intervals since then. The second TUSC publication which was developed was the TUSC Bulletin Series. This series was to serve two functions: one was to publish speeches or articles of general interest to the technology transfer endeavors of TUSC; the other was to publish selected scholarly work which had bearing on the problems of economic development in Oklahoma. The Bulletin Series has been a significant force in creating confidence in TUSC as a scholarly, trusted organization. Appendix C contains a listing of the five (5) TUSC Bulletins published to date.

Initial Efforts for Technology Transfer

The need for more understanding within the primary area regarding the benefits which could be derived through technology transfer led to a TUSC conference held 21 May 1964. The conference was titled "Commercial Applications of Space-Related Technology." Principal speaker for the event was Dr. George L. Simpson, Jr., Assistant Administrator for Technology Utilization and Policy Planning, NASA. Other speakers from NASA Headquarters and from TUSC's sister organization at Midwest Research Institute assisted with the program. After great effort by the TUSC staff, some 225 persons, primarily from the 17 county area, attended the meeting and were introduced to the TUSC program.

The technical staff began to make exploratory visits in the field and found that the educational effort which would be needed was even greater than originally estimated. Most small businessmen did not understand the fundamental concepts of technology transfer and apparently had little interest in learning about them. Breaking this barrier was to become one of TUSC's major objectives. Personal visitation--face-to-face confrontation--was soon judged to be the most successful method to be used in achieving that objective. Additionally, it was determined that the personality of the TUSC field man was of paramount importance. He had to be able to gain the confidence of the potential user or no effective interchange could occur.

Another problem which arose during this early phase was one of definition. What, exactly, was a "technology transfer"? How could one know when a transfer had been achieved? There were obvious cases which could be pointed out, but these were few in number. This definitional problem was to become more acute as the project grew older (see page 33).

CHAPTER II

DEVELOPING EFFECTIVE TECHNOLOGY TRANSFER MECHANISMS

> "...Identify opportunities to use locally, NASA developed technology. Disseminate this information in a manner calculated to assist the area to participate more fully in the space age and to contribute to the national needs." Statement of Work, NASA-178.

Introduction

One of the first steps in planning a program to reach firms in the seventeen (17) counties was to determine something about the nature of these firms. Information from the latest Federal census indicated that the area contained 235 manufacturing establishments. (This information was at that time six (6) years old; hence it was necessary that the TUSC staff gather additional data.) Of these 194 had nineteen (19) or fewer employees; thirty (30) had 99 or fewer employees, nine (9) had between 100 and 249 employees and only two (2) had more than 250. The largest numbers of all firms were in the lumber and wood products industry (78), the food and kindred products industry (65), and the printing and publishing industry (37). It was obvious that most of TUSC's clients would be small; i.e., fewer than twenty (20) employees.

Attendance at area civic group meetings and field visits to selected firms assisted in further defining TUSC potential clients. A typical example was a small manufacturer of horse trailers employing sixteen men, all of whom were production workers. The owner was the manager, accountant, bookkeeper, personnel director, chief engineer (without formal training), etc. That this man was in business and making a profit was a tribute to his own drive and resourcefulness.

Some remarks from an early TUSC Quarterly Progress Report (#2) will summarize the findings of the TUSC staff relative to the then current situation.

> "Certain patterns are evident in our clientele. The 'lone' worker, who is mechanically inclined, and most likely engaged in a mechanical field, is a common recipient of our services. He will attempt to use the Center as a patent search facility.....A second type of client is one with perhaps a promising idea, but, when necessary production facilities are considered, his idea becomes impractical because of the equipment/facility cost..... A third type of client, and one to whom transfers most often occur, is the small businessman who is usually successful due to his drive and business acumen. He is producing a product that is marketable and is trying to 'beat' his competition with innovations, new designs and even new products in related fields. In our area, this type business will not likely have a formally trained engineer; therefore, there is usually considerable dialogue necessary to translate engineering terms into his laymen's language.....A fourth type of client is one who seeks market information. This type of client usually wants to know where he can find a market for his 'gadget' outside this area, or, how he can sell his 'know-how' to specific industries or government agencies.....A fifth type is one who is perhaps holding his own with the competition but whose equipment/facilities have put a ceiling on his production. His problem is in arranging his assets and bookkeeping to demonstrate that he is an acceptable risk to a lending institution."

It was recognized that to respond to these types of clients, TUSC should develop a basic problem solving mode of operation. However, another decision was necessary. Should TUSC staff members ask for the technical problems of the businessmen or should TUSC attempt to anticipate these problems in advance? After investigation, it was concluded that a mixture of these approaches was needed for an effective program. Obviously it would be impossible to anticipate all the needs of a variety of clients; however, certain problems were common to selected groups. The action program was built on this philosophy.

The Action Program

Contacts with Potential TUSC Clients

The personality of the TUSC field man was briefly referred to in Chapter I. Enough stress cannot be placed upon this point. The TUSC action program to bring about technology transfer was based almost entirely on personal contact. TUSC technical rep-

resentatives faced clients and potential clients more than half of their working hours. The ability to communicate effectively was paramount. The field man's education and prior experience were important; however, if he had some technical orientation and could communicate, he was adequately prepared to meet the challenge.

Most of the early personal contacts of the TUSC technical field staff were educational in nature. The concept of technology transfer had to be explained to a busy listener in a short period of time. If one assumed that the listener received and understood the message, when asked what his technical problems were, the usual answer was "money." In some cases the field man left in discouragement and the next day the potential client called with a technical problem to which TUSC could respond. This latter instance normally occurred only after the second or third face-to-face encounter. The some 15,134 square miles of the seventeen (17) county area was a formidable territory for two field men to cover; nevertheless, more than one (1) visit to each potential client was usually necessary to begin an effective interchange. This was to be expected for ours was, as previously stated, basically an educational endeavor. (It is interesting to note that the total number of miles driven by TUSC staff members from February 1964 through March 1968 was 236,503.)

TUSC had to have an adequate mechanism backing these field men to solve the problems they brought from clients. The major source of information for this purpose was that provided by the Scientific and Technical Information Facility of NASA. This information arose from the research and development efforts associated with the nation's space program. This information base was the foundation of the TUSC problem solving mechanism. However, it was soon determined that many of the problems of TUSC clients required a bridge between the problem and the NASA information bank. TUSC established such a bridge by constructing its own less sophisticated technical library. This library was primarily composed of many technical journals indexed in such a way as to make them useful in the problem solving process. Additionally, it was found that one span of that bridge had to be composed of

a group of interpreters — interpreters to work on defining problems and on simplifying answers to problems. These interpreters came from the faculties of Southeastern State College and the two universities. They often served TUSC in this capacity without compensation. Had they not been available, TUSC's mission would have been much more difficult, if not impossible.

To summarize, TUSC learned early that the business of technology transfer was primarily educational in nature. Potential clients had to be exposed to the program more than once on a face-to-face basis with the TUSC representative. A problem solving mode of operation had to be developed in order to respond to the needs of TUSC clientele. Although the information provided by NASA was the foundation of the evolving problem solving mechanism, additions were necessary to make the mechanism more effective. These additions were a TUSC technical library, less sophisticated than the NASA information bank, and a group of faculty consultants who served as interpreters of problems and solutions.

It was soon learned that for the technology transfer program to be effective, the TUSC field representative needed to be broadly educated. Before leaving for a field trip he needed to attempt to anticipate some of the problems his contacts might have. He should have had something with him from the NASA/TUSC files to respond to that problem. In order for him to be able to do this, he had to spend much of his time reading, or scanning, many documents which were added weekly to the information files. In addition to technical knowledge, he needed to possess broad knowledge regarding various Federal and state programs aimed at assisting small businessmen. If a client asked a question regarding manpower training or finance, the TUSC representative needed to be able to guide the client in the right direction. The early contacts made by the TUSC staff with various agencies paid dividends in this effort.

To this point, the description of the TUSC program has dealt largely with the problem solving mode of operation where the problems were given TUSC by clients. The following is a discussion of some of the efforts to anticipate problems.

Special Technical Information Programs

Efforts to establish some kind of "Selective Dissemination Service" of technical information have been made since early in the TUSC program. Careful analyses were made and the conclusion was reached that TUSC clients were so heterogeneous that few groups could be defined which would be interested in similar subjects. For that reason, use of a Selective Dissemination Program developed by one of TUSC's sister regional dissemination centers or by NASA was considered to be unwarranted. In place of this, TUSC developed an informal system oriented primarily toward updating retrospective searches. In other words, if a search had been made for a client, that search was updated at irregular time intervals and the results sent to the client. Additionally, the technical staff was well acquainted with the needs of the most active users of TUSC information and, on an informal basis, sent items that came to their attention to clients they felt would have an interest. Also, on an irregular basis, selected NASA Tech Briefs were mailed to a large group of TUSC clients.

During 1967 the Aerospace Research Applications Center (ARAC) at Indiana University conducted an experimental program to construct "Standard Interest Profiles" (SIP) aimed at providing selected information, in abstract form, from the NASA file in areas where their experience indicated a high index of interest. (Appendix D contains a sample SIP.) The information they developed through this program was disseminated to many potential users, among them TUSC. It appeared that this information would be useful to selected TUSC clients who had interests comparable with the standard profiles. Ten "most likely" candidates were selected from more than sixty (60) TUSC clients. They were sent an introductory mailing indicating the nature of the SIP program along with the first issue of the SIP in their area of interest. Future mailings of the SIP were made as they were issued by ARAC. The initial response from this effort was zero; no copies of documents were requested. TUSC attempted to stimulate interest by encouraging careful scrutiny of the material, and the result remained zero. These results were puzzling and remain so for ARAC has had good

results in their own distribution of like materials. It may be that TUSC did not stimulate a sufficient amount of interest in the program. When selected recipients were questioned about SIP's, their response indicated that they thought they were fine, but of little direct use to them. These results may also indicate that most companies with fewer than 500 employees and little in-house research and development activity simply do not use information until they have a problem.

Since so much has been written about problem solving, a selected list of problems which have been solved might be enlightening. Appendix E contains such a list. This list of problems (retrospective searches) was selected from the TUSC file.

Special Educational Endeavors

As the TUSC program progressed, the fact that it was largely educational was always apparent. Because of this, every opportunity to appear before public groups was accepted. From February 1964 through March of 1968, 61 such appearances had been made before audiences totalling some 4,450 persons. The impact of such endeavors is quite difficult to assess; however, knowledge of the NASA/TUSC program and the concept of technology transfer is a necessary first step in an effective transfer situation. In many cases, programs before such groups provided the opportunity to take that first step.

Another force of major assistance in the educational area was the TUSC Advisory Board. The Board was composed mainly of leaders in business and in education from the seventeen (17) county primary area. Its primary function was to assist in getting news of the TUSC mission to the public who could use it. It has proven to be very useful in that capacity.

TUSC Clients

Through these and other activities TUSC clients were developed. The first year, as would be expected, was most difficult and, as Table I shows, TUSC had only nine (9) clients at the end of the year. The pace has accelerated since that time. The TUSC definition of a client was broad. Any firm or individual with whom the TUSC staff had an effective interchange and/or to whom TUSC

supplied information was regarded as a client.

TABLE I

NUMBER OF TUSC CLIENTS BY CLASSIFICATION AND YEAR

Year	Firms	Special**	Individuals
1964	9	--	--
1965	21	--	8
1966	58	--	19
1967	77	--	29
1968* (15 May)	89	5	56

*In 1968, 4 institutions previously classed as firms were moved to the special category.

**The special category includes research organizations and government agencies.

Table II indicates the size of TUSC clients by numbers of employees. Table III describes clients by broad types of activities. Table IV gives number of clients by geographic location. Table V presents manufacturing firms by standard industrial code classifications. Appendix F contains a complete list of TUSC clients.

TABLE II

1968 TUSC CLIENT FIRMS, BY NUMBER OF EMPLOYEES

Number of Employees	Number of Firms
Below 25	45
25-49	10
50-99	14
100-249	9
250-499	7
500 and over	4
TOTAL	89

TABLE III

COMPOSITION OF TUSC CLIENT FIRMS, BY TYPE OF FIRM, 1968

Item	Number
Services	12
Mining	3
Manufacturing	74
Total Number of Firms	89

TABLE IV

1968 TUSC CLIENTS BY GEOGRAPHIC LOCATION

	Firms	Individuals	Special
Seventeen Counties	57	41	3
Remainder of Oklahoma	23	6	1
Arkansas	4	2	0
Texas	4	7	1
Florida	1	0	0
TOTAL	89	56	5

TABLE V

MANUFACTURING FIRMS BY SIC CLASSIFICATION*

Two Digit SIC Classification		Number of Clients
13	Crude Petroleum and Natural Gas	2
19	Ordnance and Accessories	0
20	Food and Kindred Products	4
22	Textile Mill Products	0
23	Apparel and Other Finished Products Made from Fabrics and Similar Materials	3
24	Lumber and Wood Products, except Furniture	3
25	Furniture and Fixtures	3
26	Paper and Allied Products	2
27	Printing, Publishing and Allied Industries	2
28	Chemicals and Allied Products	2
29	Petroleum Refining and Related Industries	4
30	Rubber and Miscellaneous Plastics Products	6
31	Leather and Leather Products	0
32	Stone, Clay and Glass Products	11
33	Primary Metal Industries	0
34	Fabricated Metal Products, except Ordnance, Machinery and Transportation Equipment	11
35	Machinery, except Electrical	20
36	Electrical Machinery, Equipment and Supplies	4
37	Transportation Equipment	7
38	Professional, Scientific and Controlling Instruments: Photographic and Optical Goods; Watches and Clocks	6
39	Miscellaneous Manufacturing Industries	4

*Total will not equal 74 because some firms have more than one classification.

Auxiliary Activities

Throughout the course of each major TUSC program a number of additional opportunities arose. Among the most important of these was the aviation training program TUSC personnel helped establish at Southeastern State College. The following information, taken mostly from Quarterly Progress Report No. 5, describes this program.

Southeastern State College Aviation Program

During the course of a series of visits by a TUSC representative to American Flyers, Inc., Ardmore, Oklahoma, the personnel situation for commercial aviation was discussed. American Flyers is an aviation training school which trains cockpit personnel for most of the major airlines. TUSC was supplying NASA technical information on some aerodynamic problems they had encountered.

It was generally recognized in the aviation industry in the summer of 1965 that an acute shortage of cockpit personnel for commercial aviation was imminent. American Flyers was preparing to receive additional students to meet this need. One of the greatest problems appeared to be that no schools were in operation which could grant college credit for aviation training. Young men who wished to follow flying as a career had to forego the advantages of college training in order to train themselves for a commercial aviation career.

This situation was brought to the attention of the Southeastern president who appointed a faculty committee to study the problem. The committee was to consider the feasibility of conducting an aviation training program in conjunction with American Flyers at Southeastern State College. Mr. A. M. Moore, TUSC Industrial Specialist, and Dr. Alvin White, TUSC part-time employee, were named to this committee. NASA information available through TUSC was to be utilized in the study.

An intensive study was conducted to determine if there was, in fact, a need for college-trained commercial aviation personnel. Members of the Air Line Transport Association, Air Line Pilots' Association, aircraft manufacturers, governmental agencies, and individual personnel managers of air lines were consulted. The committee found that the need did exist and that Southeastern,

in cooperation with American Flyers, could respond to that need. The basic flying and ground school could be conducted on the Southeastern campus. Advanced flying and ground school would be conducted at the American Flyers facility 45 miles from the SSC campus.

This idea first came to life during a conversation between Mr. Moore and American Flyers personnel in the middle of 1965. In April of 1966, the Oklahoma Board of Regents for Higher Education granted Southeastern the privilege of conducting a baccalaureate degree program in professional aviation. It was the second such program in the United States, the first being at Purdue University. Students were first enrolled in the fall of 1966. Sixty (60) students enrolled at that time. The program, under the direction of Dr. White, has grown to a current enrollment of 114 with 93 students listing aviation as their major. The first graduate received his Bachelor of Professional Aviation degree in January 1968. (He had transferred to Southeastern from Michigan State University because of the aviation program.) Three other persons are expected to graduate in 1968. Three have already left the program to accept jobs with air lines.

Oklahoma State Technical Services Program

Another important TUSC contribution was its impact on planning the Oklahoma State Technical Services Program under the Federal "State Technical Services Act of 1965." Dr. Poole, TUSC Consultant and former associate director, was named by the Governor to head the planning committee. Dr. Peach and Dr. Zink were members of the committee. The second meeting of the entire group was held in December of 1965 on the Southeastern campus. Dr. R. L. Lesher of NASA Headquarters led the TUSC staff in explaining the NASA Technology Utilization program. This meeting and subsequent contacts affected the course of the OSTS program and allowed it to utilize NASA/TUSC experience in formulating its own program.

Other Programs

Other auxiliary activities were the inception of a program to provide retrospective search facilities to faculties at various Oklahoma colleges and universities, a program to provide science

information and industrial arts information to secondary schools, and placement of trainees from Southeastern's specialized training courses with TUSC clients. This latter is an example of an unusual kind of "switching" function TUSC performed by meeting manpower needs with available manpower.

A final activity in this category was an experimental effort to utilize utility power salesmen as intermediaries in the transfer process. This endeavor was born in the mind of a TUSC Advisory Board member, Mr. W. M. Shepherd, vice president of Arkansas Power and Light Company. He felt that the industrial power salesmen working for his company should be very close to the problems of the power users and should be able to serve as a link in the switching mechanism between the NASA data bank and the user. TUSC had to develop special tools to use for this endeavor. One of these was the "TUSC Fact Brief," (see example in Appendix G) a brief publication aimed at general problems which might be encountered. This program is, at this time, not far enough along to be able to determine how effective it may be.

Importance of Ongoing Economics Program

The continuing program of economic research and data provision was significant to the technology transfer program. Often, it was the introductory tool which opened the door to a new area for TUSC endeavors. Chambers of Commerce in the seventeen (17) counties were in need of these data for their own programs; and when it was freely provided to them, along with professional assistance in interpretation, they felt kindly toward other TUSC programs. Provision of the data helped stimulate interest in all TUSC programs and allowed the time required for the educational process regarding technology transfer to be somewhat reduced.

CHAPTER III

THE NEXT PHASE -- SPECIFIC TRANSFER PROJECTS[1]

"The Contractor shall provide the personnel, services, materials, and facilities necessary to accomplish the program of work as set forth below:

1. The Contractor shall identify opportunities for the use of NASA generated new technology to the Oklahoma area and disseminate information with respect to such opportunities in a manner calculated to assist the area to benefit more fully from this information resource.

2. The Contractor shall conduct four technology utilization seminars in appropriate locations throughout the 17-county area primarily served by the Technology Use Studies Center. These seminars shall be oriented for the benefit of small business organizations.

3. The Contractor shall use its best efforts to establish liaison with at least two designated agencies of the State of Oklahoma State Technical Services Program. Subject to the establishment of such liaison, the Contractor shall conduct one or more seminars or other educational approaches oriented to small business in conjunction with each selected designated agency.

4. The Contractor shall conduct a telephone and mail service experiment outside the 17-county project area primarily served. Twenty business organizations believed to be potentially effective users of NASA generated information will be identified and contacted and the Contractor shall use its best efforts to establish a service relationship with that number of so selected organizations.

5. The Contractor shall use its best efforts to solicit one large business organization for an experimental program involving the provision of Technology Use Studies Center services of the kind previously provided for small business organizations. The so selected organization will not be charged for this service but the Contractor shall arrange, in consideration of service, for reasonable reporting on the utility of services by the recipient.

6. The Contractor shall use its best efforts to provide services to institutions operating under or in conjunction with the Oklahoma State Technical Services Program.

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[1]The contents of this chapter relate specifically to the Statement of Work in NSR 37-004-006. Numbers in headings refer to numbers in the work statement.

7. The Contractor shall provide information services to at least 15 selected faculty research personnel at Southeastern State College, Oklahoma State University, the University of Oklahoma, and other state colleges and universities. The Contractor shall use its best efforts to provide such services to faculty members involved in different technical disciplines.

8. The Contractor shall utilize the services of a graduate student at the Oklahoma State University for the collection and updating of the regional economic volumes developed under prior NASA contracts.

9. The Contractor shall provide information services to the Oklahoma State University Office of Engineering Research to accommodate that school's technology utilization contract to develop topical monographs for use in educational programs.

10. At its own discretion the Contractor may provide intermittent consulting services to personnel directing the Southeastern State College aviation program.

11. The Contractor shall use its best efforts to further develop cooperation with the organizations established under the Public Works and Economic Development Act of 1965." Statement of Work NSR 37-004-006.

Technology Utilization Seminars as a Transfer Mechanism (2)

Between September 1966 and March 1968, four seminars focused on the small businessman were held in, or immediately adjacent to, the TUSC primary area. Locations for these were McAlester, Oklahoma; Ardmore, Oklahoma; Sherman, Texas; and Fort Smith, Arkansas (Sherman and Fort Smith are on the fringe of the 17 counties).

Attendance at the McAlester seminar was approximately 45, Ardmore 42, Sherman 25, and Fort Smith 13. Obviously, the TUSC staff was disappointed, particularly with the latter figure. Fort Smith, a rapidly growing small city, was causing adjacent areas in Oklahoma to follow its growth pattern; and the potential was significant for an excellent project. However, the results of this initial seminar were quite discouraging.

A major problem of each seminar was attendance. In one case, even with a fair size group, the "right" people were not there. Even with the full cooperation of an active chamber of

commerce, it was very difficult to get the right people to attend. The businessmen TUSC wanted to reach were to busy to attend meetings.

The content of each of these programs was basically educational regarding the NASA technology utilization program. The term "seminar" may have been a misnomer for such an activity. TUSC planners felt that it would not be feasible to present formal technical papers to groups of small businessmen in a relatively underdeveloped region. The interests of such groups were far too diverse. Moreover, the technical paper presentation was considered to have little appeal for the anticipated audience. For these reasons, each program was designed to stimulate interest in the NASA/TUSC program. After that interest was stimulated collectively, it was to be pursued further on an individual basis.

Results of these efforts have been difficult to assess. TUSC gained nine (9) new clients as a direct result of these seminars. Four (4) of these have been among the most active TUSC contacts during the past year. Some of these firms would have become clients without the seminar and with no TUSC initial encouragement; others would not have. Considering all problems involved, this particular transfer mechanism was not as effective as was desired. Much time and effort went into each one of these and each bore relatively penurious results. Hence, as a general rule, the TUSC staff considered other forms of transfer mechanisms to be superior.

Cooperation with Oklahoma State Technical Services (3, 6)

The designated agency for operating the State Technical Services program was Oklahoma State University. TUSC had excellent relations with the designated agency since the early planning stages of the program. Other institutions which participated in the state program were the University of Oklahoma, Oklahoma City University, Langston University, Tulsa University, Southwestern State College, and Southeastern State College. Most of the programs the first year, 1964-1965, were oriented toward business administration with the exception of Oklahoma State

University and Southeastern. Southeastern started its program by employing a full time information specialist who was to work with TUSC in serving a twelve (12) county area outside the seventeen (17) county TUSC area. Oklahoma State began a program of field work for all of the state except those twenty-nine (29) counties. Southwestern State College's proposal included a small action program to contact businessmen and seek to solve their technical problems.

TUSC cooperated actively with Southeastern's program. The Southeastern information specialist was the most active in the state. He made a number of mailings to different types of firms in his area. TUSC supplied all of the technical information for the mailings. Also, TUSC supplied retrospective search services to the Oklahoma State, Southwestern, and Southeastern projects. TUSC supplied the program for a seminar conducted under the auspices of the Southwestern State College program. A similar program was planned by the Southeastern representative but did not materialize due to lack of support by a local sponsoring organization.

TUSC interaction with this program was severely hampered by the STS program's lack of funds. Plans were made to carry out a substantial field operation which would have required considerable assistance from TUSC. Sufficient STS resources were not available to carry out these plans.

Serving Distant Firms by Mail and Telephone (4)

The project to serve client firms primarily by mail and telephone was initiated with a Tulsa meeting in January 1967. The Tulsa Chamber of Commerce co-sponsored the meeting with TUSC. Some fifty (50) firms were selected to receive invitations because it was felt that they could benefit from use of the TUSC information bank. After much prodding by the Chamber of Commerce, fourteen (14) firms sent representatives. Of these fourteen, ten (10) became active TUSC clients.

Additional clients for this program came through other regular and special TUSC activities. Firms from Arkansas who attended the Fort Smith meeting and became active TUSC clients were serviced under this program. An active TUSC client contacted routinely in Wewoka was counted here. A TUSC field representative was sent to Oklahoma City to make personal calls on selected firms and encourage them to enter this program. Five (5) firms did so. As a result of all of these endeavors, TUSC served twenty (20) firms under this project. Numbers from various cities were as follows: Sherman, 2; Oklahoma City, 5; Tulsa, 10; Wewoka, 1; Fort Smith, 2. The results of thirty-five (35) retrospective searches were supplied to these firms from 1 September 1966 through 31 March 1968.

During the early phase of the dialogue with each firm, TUSC staff members made explicit requests to each client to let us know how they used the information TUSC supplied. All agreed that this would be done. However, obtaining this information was very difficult in most cases. First, letters were written and when no response came, the clients were phoned to encourage them further. Next, personal visits were made by staff members to selected firms. Finally, as part of a TUSC self-evaluation effort, questionnaires were sent to selected firms. The total information obtained through all these efforts was not enough for an adequate evaluation to be made. Therefore, it was necessary to come to the following tentative conclusions.

A mail and telephone service would be useful to firms if it were preceded by an intensive personal, educational interchange. The objective of this interchange would be to assure that the potential user knew how to utilize the services available. Personal contact by TUSC representatives semi-annually would be desirable. The main purpose of this contact would be two-fold. First, a joint review of the use of the service would be made between the TUSC representative and the firm's management. Second, the TUSC representative would attempt to elicit explicit examples of transfers from the client.

During the TUSC experimental period, a modification of this procedure was followed even though it was not a part of the

original design of the experiment. The TUSC staff was discouraged with the inability to obtain an adequate evaluation of the service, and this colored the analysis of the experiment. It was correct to indicate that a mail and telephone service, unsupplemented by personal contact, was probably not effective. However, when personal contact was used judiciously, the project became effective.

Serving a Large Firm (5)

From the beginning, TUSC services were structured to serve very small business organizations. During the early history of the TUSC, some firms with 500 or more employees were served on an irregular basis; however, no concerted effort was directed to this audience prior to the beginning of this experimental project.

In an effort to test the services developed for small businesses against the needs of a large firm, TUSC established a client relationship with a firm with approximately 500 employees in Tulsa, Oklahoma. This relationship was engendered late in the contract year due to a previous campaign to develop relations with another firm which declined the invitation.

The dialogue with the client began with a meeting between the TUSC director and the president of the company. The latter was very enthusiastic about the TUSC proposal and agreed to report future use of the service in great detail. In three days, another meeting was held involving TUSC technical staff and the engineering staff of the firm. The TUSC staff made an effort to have available some information which would appeal to the client. This was in the form of particular SIP's from ARAC, selected NASA Tech Briefs, and some NASA Special Publications. The room overflowed with enthusiasm coming from the client's engineering staff. At the end of this meeting the client's director of engineering was designated as the TUSC contact point.

Some two months passed with no word from the client. Finally, telephone conversations indicated that the engineering staff was still attempting to absorb the initial information provided by TUSC. The TUSC contact encouraged the firm to ask problem

solving or state-of-the-art questions in order that they might interact with the file. The firm contact indicated that he would do so, soon.

During approximately six (6) months of service to this client, TUSC processed five (5) retrospective searches for the firm. The firm ordered copies of seventeen (17) reports resulting from these searches. They reported that a new product was developed, partially as a result of this information. The product will be placed on the market in the summer of 1968. They indicated that the TUSC information saved a significant number of engineering man-hours. That was the extent of the information, even after considerable TUSC encouragement.

One of the major problems of evaluation in this experiment was that it has not been in progress long enough. This was due to the initial, unavoidable delays in making effective contact with the firm. Additionally, it was difficult to obtain explicit information from the firm about their use of TUSC information. This was unfortunate, but predictable. Other organizations similar to TUSC have encountered like problems. The TUSC staff has no doubt that the service developed for small firms is equally applicable to large firms. Different kinds of problems are encountered, but the basic provision of information is the same.

Provision of Information Services to Faculty Users (7)

During the contract period, twenty-three (23) faculty users availed themselves of TUSC information services. These users were located at the following institutions: seven (7) at Southeastern State College; two (2) at the University of Oklahoma; one (1) at the University of Tulsa; five (5) at Southwestern State College; five (5) at Oklahoma State University; one (1) at the Graduate Research Center of the Southwest; one (1) at Kansas State College of Pittsburg; and one (1) at Grayson County Junior College. The disciplines covered included chemistry, physics, business administration, electronics, biology, industrial arts, engineering design, aerospace engineering, thermodynamics, mechanical engineering, and chemical engineering.

The TUSC experience proved that faculty users are even more reluctant than businessmen to divulge their use of information. TUSC found that it had been used in their own research, in their writing, and in the classroom. These broad answers were not entirely satisfactory, but were the best that were obtained.

Miscellaneous Related Efforts

Updating the Socio-Economic Data Volumes (8)

During the contract, a continuing effort to update the socio-economic data publications of the Center was carried out. This was done by a research associate of the Center working under the supervision of the TUSC assistant director. This project culminated in publication of a single volume which made the previously published volumes as current as possible.

The introductory sections of the original volumes required many changes to render current the information regarding available assistance in economic development activities. Thirteen (13) tables were brought up-to-date. The directory of manufacturing establishments for each county (Supplementary Table E) was made current. Finally, the source notes were amended to include these revisions and additions.

This volume was distributed to all holders of the original volumes.

Support of Oklahoma State University College of Engineering Project (9)

TUSC provided search services and abstract, microfiche, and document copies to a pilot project at Oklahoma State University. The purpose of this project, supported by the Technology Utilization Division, National Aeronautics and Space Administration, was to develop monographs, to be used in college engineering classes, based on the NASA TU file. A quotation from the Statement of Work for this project will be illuminating.

> "The Contractor shall provide the necessary personnel, equipment and facilities to review technical reports and related material supplied by NASA and Technology Use Studies Center at Southeastern State College in Durant, Oklahoma —

> with the objective of selecting information that would be of significant benefit to graduate and undergraduate engineering educational programs — in specialized technical areas selected by mutual agreement between the Office of Engineering Research at Oklahoma State University and the Office of Technology Utilization at NASA Headquarters.
>
> From the selected information, the Contractor shall prepare instructional materials (i.e. topical monographs) as appropriate for use in graduate and undergraduate engineering educational programs. Recognized textbook authors or educational authorities in each of the specialized technical areas selected, are either to prepare these materials or to direct their preparation." Statement of Work, NSR 37-002-045.

During the contract year, 27 microfiche and 104 copies of reports were provided. The pilot project's director indicated that TUSC service was satisfactory.

Southeastern Professional Aviation Program (10)

Upon request, TUSC provided information which was utilized in the professional aviation program of Southeastern State College. There were a few occasions when the aviation director needed assistance in problems of contacting sources within state and Federal government agencies. TUSC provided this assistance. Additionally, consideration was given to establishment of an air traffic controllers course. TUSC provided technical information to this endeavor. Other than additional moral support due to pride in parenthood, no further contribution was made to the aviation program.

Cooperation with Economic Development Administration (11)

The TUSC staff had excellent cooperative working arrangements with the state agency supervising EDA projects. Further, the same kind of relations existed between TUSC and the two (2) economic planning districts in the seventeen (17) counties; i.e., the Southern Oklahoma Development Association and the Kiamichi Economic Development District of Oklahoma (KEDDO).

The most significant event in this area of cooperation was the assistance the TUSC staff provided the KEDDO staff in preparation of their Overall Economic Development Plan. By reference to the TUSC socio-economic profile data and through

professional advice from the TUSC staff, the KEDDO staff estimated a saving of approximately $9,000 on preparation costs for this document.

CHAPTER IV

TENTATIVE EVALUATION OF THE EXPERIMENT

Problems of Evaluation

A major problem in any evaluation procedure is the standard by which performance is to be judged. Selecting an unambiguous standard for the TUSC experiment was difficult. Although similar ventures were operating in other areas of the United States concurrently with the TUSC operation, they had too many dissimilarities to allow valid comparison of total operations.

At the end of this phase of the TUSC experiment, the definition of a "technology transfer" remained somewhat of a problem. The TUSC staff and director finally agreed that any activity accomplished with clients which responded to their problem was called a technology transfer. Appendix H to this report lists all transfer cases recorded by the TUSC staff. Appendix I contains reports of selected transfer cases which were deemed worthy of special attention. Actually, the transfers recorded in these appendices are not all the TUSC staff has effected; they are the only ones of which the staff has knowledge. Undoubtedly many more occurred during the four year period--perhaps more significant than those which were recorded. The problem was to determine how the information TUSC supplied its clients was used. This was particularly acute in some of the special experiments conducted with firms located some distance from TUSC facilities. It was also the case with other groups of users; i.e., faculty at colleges and universities. These various individuals were apparently eager to secure the information; but it was difficult in many instances to determine how it was utilized, if at all. This particular problem appears to be universal among all organizations with functions similar to TUSC. In fact, due to the relatively small size of TUSC clients, it may be that the TUSC staff was able to obtain more data regarding use of TUSC-supplied information than were many similar organizations.

Even though a transfer was recorded, the total effects of that transfer were difficult to assess. Sometimes the effects within the firm were apparent but effects outside the firm were usually not. Because of the difficulties of assessing the impact of transfers outside the firm, very little of this was attempted except in special cases.

Self-Evaluation Project

TUSC recently completed the first phase of an on-going self-evaluation project. This endeavor is being conducted under arrangements with consultants at Oklahoma State University. A small sample of eleven (11) representative TUSC clients was chosen to receive the initial trial questionnaire. A copy of this questionnaire is presented in Appendix J. Also, some preliminary information about TUSC services has been developed from this initial sample.

Seventy (70) percent of the sample felt the TUSC service to be useful and desired to continue to avail themselves of the service. Seventy (70) percent of the firms would like for TUSC to provide additional special services based on periodical information. Fifty (50) percent of those questioned use TUSC to keep abreast of new technology developed under auspices of the Federal government. Information provided by TUSC resulted primarily in a saving of time and funds which would otherwise have been spent on research. The major barriers encountered by clients in using TUSC-supplied information were: too time consuming (60 percent); difficult to identify specific problem (40 percent); and, information too general (40 percent).

Some comments made on the questionnaires are enlightening. (1) "A great deal of time was saved on one particular program due to information furnished by TUSC." (2) "I probably am not utilizing the TUSC service to maximum advantage since much of the data I receive is not at all applicable." (3) "Survey of electroluminescent lighting information convinced me not to devote time and money for R & D at this time." (4) "Because of our mission, we feel that TUSC is of limited <u>practical</u> use in our particular case." (5) "Affords a service to both small

and large industry that if used could make firms competitive with larger businesses that have research and development departments and that are also better strategically located to research libraries and facilities." Learning more about why there are such differences in the way TUSC clients view the Center is among the next steps of this evaluation process.

Finally, a somewhat simplified and shortened questionnaire is being developed to be sent to all TUSC clients. It is hoped that a more complete evaluation of TUSC services can be made through analyzing the results of that questionnaire and through additional activities.

TUSC Impact

Although at this time quantitative analyses would be somewhat tentative, TUSC has had an impact on the economic development of the seventeen (17) county region. There is little doubt that TUSC has contributed significantly to the ability of a number of firms to grow. In some instances, provision of technical information was all that was required. In other situations, total resources of TUSC facilities, along with others at Southeastern State College, were necessary.

Several TUSC clients would, if solicited, make statements that without TUSC information available to them, they could not be in the favorable position they now enjoy. Solicitation of such statements to be included in a document of this type was deemed unwise. A spontaneous response (to the questionnaire contained in Appendix J) by one of the most active clients is given below:

> Thank you for your letter of 28 February 1968 regarding evaluation of the work of The Technology Use Studies Center at Southeastern State College. The questionnaire which you requested is enclosed herewith.
>
> A brief comment on Item (11) regarding dollar saving resulting from information received from TUSC: This is an extremely difficult figure to approximate. In the first place, it is highly dubious that a small company located as we are could have obtained the information and assistance which we received from TUSC with any

> expenditure of money within reason, hence, it is difficult to establish a bench mark for calculation of dollar saving.
>
> The assistance which we have received and are receiving from TUSC is of vital importance to two separate development programs which we have currently underway. I question if either of these programs could have been carried through without this assistance, and one of these in particular will, I believe, form the basis for a major segment of our production in the period two years to six years from now.
>
> Obviously then, I am an enthusiastic supporter of this program and I am hoping that it will be continued and expanded in the future.

The TUSC program aimed at providing general assistance in economic development endeavors has borne fruit. As described in previous chapters, the program was designed to provide answers to problems in a variety of fields. By adding existing college programs to the capabilities of TUSC, a significant mechanism for assistance to individuals, firms, quasi-governmental bodies, and governmental bodies had been developed. Problems relating to the latest technical information, socio-economic data regarding resources and deficiencies of the area, trained manpower, and education could be directly attacked through the TUSC vehicle. That kind of assistance had not previously been available in one place in the seventeen (17) counties.

Special Cases of TUSC Impact

Special cases of TUSC impact are important. The professional aviation training program described in Chapter II holds promise of having significant impact, not only on the college, but upon the region. One example is the tremendous increase in private flying at Durant's municipal airport, not only directly resulting from the college activity, but through increased interest in private flying due to availability of college-leased planes for other uses. The philosophy regarding the maintenance of this airfield has changed from negative to positive. This change will save taxpayers money in the future and protects a previous (during World War II) investment of tax monies. Although this increased interest in general aviation and maintenance is not considered of great magnitude on a national basis, it is significant. And,

without the college aviation program, it would not be present, at least in the same degree. The benefits to the college of bringing nation-wide attention and more students to its doors are great. Bringing students from all over the country to mingle with those from southeastern Oklahoma may have salutary effects on both groups.

The attempt to join the peanut producers and the aerospace engineers described in Appendix I could have far reaching effects, not only in this region and other peanut growing regions of the United States, but in the entire world. The peanut is a very nutritious food and many more pounds could be produced if drying methods were improved. It appears that such improvements, of some magnitude, are now within reach; TUSC helped stimulate the action required by both parties.

Another special case of impact of much less immediate importance than the two previously described was that of the assistance TUSC rendered to the establishment of the Kiamichi Economic Development District of Oklahoma. This organization had to be formed in order for a seven (7) county region in the Center's primary area to be eligible for a large number of economic development programs of the U. S. Department of Commerce. TUSC joined forces with others in the area to see that this organization was established. It, too, will be a force to speed the economic development of the area.

TUSC brought about another case of genuine cooperation between the two major state supported universities in Oklahoma. Those who are not associated with higher education may not realize the importance of that feat. As is the case in most states, the universities are rivals in many areas. However, the spirit of cooperation with which they joined in the TUSC venture has been exemplary. Further, it has probably led to efforts at cooperation in other activities.

Finally, a significant case of impact of the Center has been its impact upon Southeastern State College. The presence of TUSC has immeasurably strengthened the service function of the college. It has made the college a more important force in regional and state affairs. The national attention accorded the college because

of TUSC's presence on the campus has undoubtedly affected the image of the college in the potential student's eye. The quality of teaching at the college has been upgraded, not only by TUSC staff members engaging in some teaching activities, but by allowing the scientists on the faculty to interact with the TUSC information bank. And, quite importantly, the presence of TUSC has led to other joint activities with the business community. The aviation program is the most significant example of this.

Overall Evaluation

It is difficult, if not impossible, to indicate today what TUSC's most important contribution has been. It may very well be that in the future an economic historian could look back and indicate that the establishment of TUSC coincided with the serious beginning of change in southeastern Oklahoma. That change was from an almost totally agrarian society to one populated with a number of small, technically sophisticated manufacturing establishments. The work of TUSC had broken down some of the barriers which impede such change and had assisted in providing a climate in which that change could occur in a more orderly fashion. An important element in this climate is pride. The existence of TUSC has caused some people to look up to what might be done if they have pride in themselves and in their region.

The Next Step

The obvious next step in the evolution of the TUSC program is to incorporate what has been learned during these four years into the program and to proceed. In review, the most important things that have been learned are these: (1) Effective communication regarding the benefits of externally generated information to the single firm is a paramount problem. The answer to this educational problem probably requires national attention. (2) The best way to reach and communicate with any client is face-to-face, personal contact. This is particularly true with the small businessman. It is an expensive, but a necessary ingredient of success. (3) Seminars, at least as structured by TUSC,

are probably not a good method of transferring technology to small businessmen. (4) For most firms with 500 or fewer employees, a technical problem solving service is most appealing. They seem to have little use for a selective dissemination of information service, at least as TUSC has structured it.

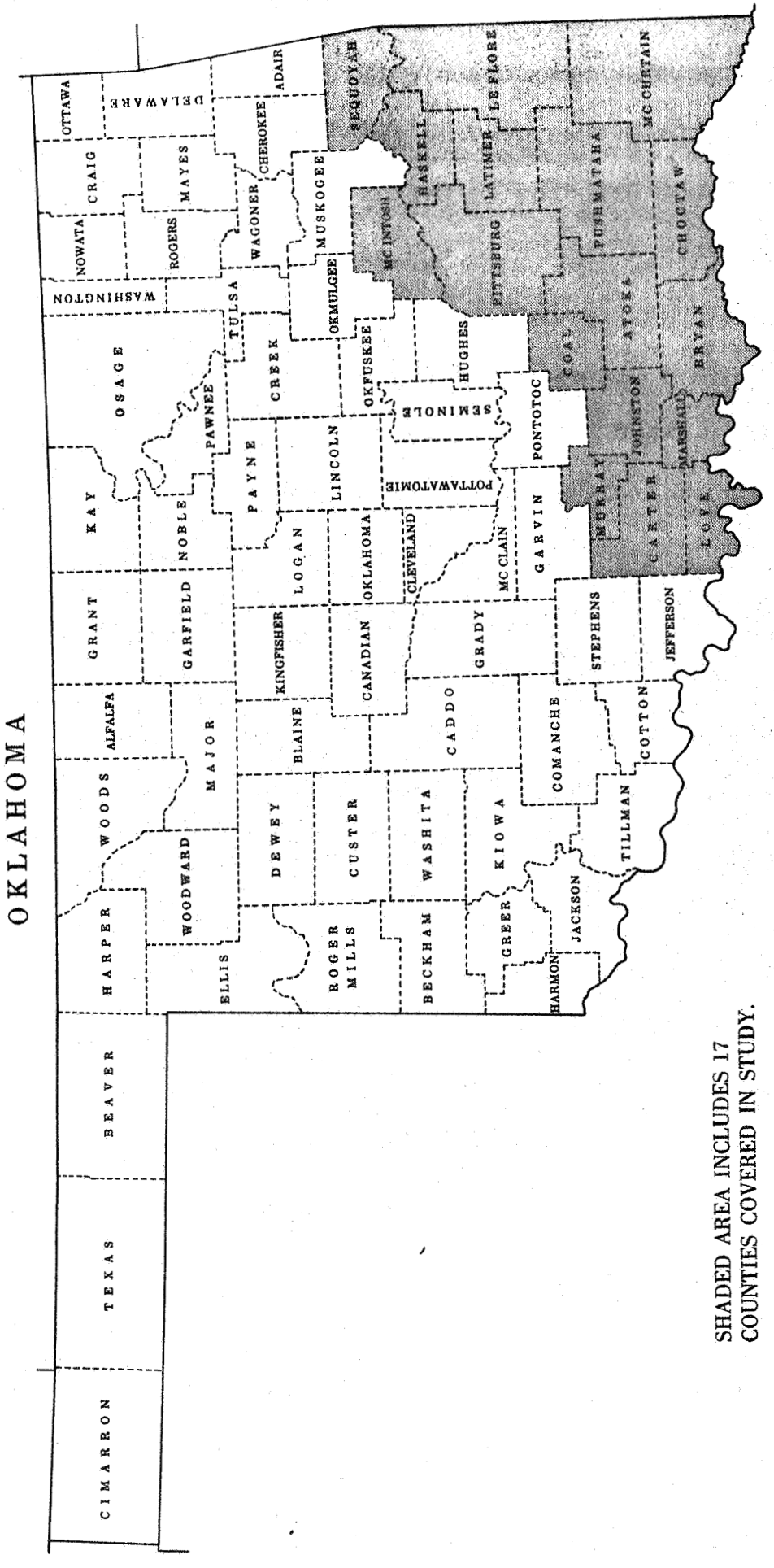
Further, detailed evaluation of TUSC efforts to date needs to be made. Plans for this are currently underway. It will include an in-depth analysis of total impact. This analysis will include explicit examination of how and why technology transfers occur.

Finally, it would be advantageous for TUSC to expand the geographic area in which it works and change its mode of operation, somewhat. With the expertise that has been developed within the staff, a considerably larger geographic area could be served. Experience gained under the specific transfer experiments mentioned in Chapter III will be favorable to new experimentation in a larger area.

TUSC does not aspire to become a large, multi-state organization. It is felt, however, that previous experience should be built upon and that TUSC could make a significant contribution to the national program of technology transfer and to this region in the future.

APPENDIX A

MAP



SHADED AREA INCLUDES 17
COUNTIES COVERED IN STUDY.

APPENDIX B

LIST OF TABLES IN PROFILE DATA

APPENDIX B

LIST OF TABLES IN PROFILE DATA

POPULATION, EMPLOYMENT AND PERSONAL INCOME

Population, by Census Year, 1907-1960

Population of Incorporated and Unincorporated Places of 1,000 or More in 1960, by Decade, 1919-1960

Urban and Rural Population, by Decade, 1919-1960

Per Cent Distribution of Population, by Age Group, by Decade, 1930-1960

Racial Composition of the Population, by Sex, by Decade, 1930-1960

Years of School Completed by Persons 25 Years Old and Over, 1940, 1950, and 1960

Population 14 Years Old and Older, and Labor Force, by Age and Sex, 1960

Employment by Industry, 1940, 1950, and 1960

Employment by Occupation, 1940, 1950, and 1960

Selected Payroll and Employment Data, Local Government, 1957 and 1962

Local Government Employment, by Function, 1962

Federal Civilian Employment, by Agency or Department 1950 and 1960

Personal Income, by Major Component, Annually, 1950-1962

Personal Income, by Broad Industrial Source, Annually, 1950-1962

Wages and Salaries, by Major Industrial Source, Annually, 1950-1962

Public Assistance Payments, by Type, Annually, 1950-1963

AGRICULTURE, INCLUDING WATER AND WEATHER

Number of Farms, Land in Farms, Average Size of Farms, Value of Land and Buildings, Selected Years, 1925-1959

Land Use, by Type, 1958

Number of Farms, by Size, 1954 and 1959

Automobiles, Trucks, and Tractors on Farms, Selected Years, 1925-1959

Selected Equipment on Farms, 1950, 1954, and 1959

Livestock on Farms, 1950, 1954, and 1959

Livestock Sold from Farms, 1949, 1954, and 1959

Production of Selected Crops, Annually, 1950-1963

Value of Farm Products Sold, 1949, 1954, and 1959

Off-Farm Work of Farm Operators, 1949, 1954, and 1959

Average Monthly Temperature and Precipitation, Period of Record, 1931-1960

Annual Precipitation, Period of Record, 1931-1963

INDUSTRY, TRADE AND FINANCE

Value of Mineral Production, Available Years, 1952-1962

Oil and Gas Wells Drilled, 1953-1962

Number of Manufacturing Establishments, Value Added by Manufacturing, and Capital Expenditures, 1947, 1954, and 1958

Number of Retail Trade Establishments, Sales and Payrolls, Selected Years, 1929-1958

Number of Retail Trade Establishments and Sales, by Kind of Business, Selected Years, 1929-1958

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Number of Wholesale Trade Establishments, Sales and Payroll, Selected Years, 1929-1958

Deposits of All Banks, Selected Dates, 1950-1962

Road Mileage, by Type of Surface, Annually, 1950-1963

Motor Vehicle Registration, Annually, 1950-1962

EDUCATION, HOUSING AND VOTING RECORDS

Revenue Available for Expenditures by Common Schools, Fiscal Years 1951-1962

Average Daily Attendance at Common Schools by School Year, 1951-1962

Housing Tenure and Vacancy Status, 1940, 1950 and 1960

Age of Houses

Selected Housing Facilities: Toilet, Bathing, and Water Supply, by Decade, 1940-1960

Condition of Housing Units, 1950 and 1960

Votes Cast, by Party: Presidential Elections, 1948-1964, and Gubernatorial Elections, 1950-1962

SUPPLEMENTARY TABLES

Distribution of the Population, by Age Group, by Decade, 1930-1960

Federal and Other Lakes, 1963

Production and Value of Selected Minerals, Available Years, 1953-1963

Coal Reserves, by Seam Thickness, January 1, 1953

Name and Address of Manufacturing Establishments, 1964

Name and Address of Commercial Banks and Savings and Loan Institutions, 1964

Railroads, Bus Lines, Truck Lines and Airports, 1964

Newspapers, Radio Stations, and Television Stations, 1964

Name and Address of Electric, Gas and Telephone Companies, 1964

Health Services, 1964

Elementary Schools, High Schools and Colleges, 1963-1964

APPENDIX C

LIST OF TUSC BULLETIN SERIES

APPENDIX C

LIST OF TUSC BULLETIN SERIES

Bulletin 1: The United States Space Effort, by The Honorable James E. Webb, Administrator, National Aeronautics and Space Administration

Bulletin 2: Implications of the Space Effort for Science and Technology (November 1964), by George L. Simpson, Jr., Assistant Administrator for Technology Utilization and Policy Planning, National Aeronautics and Space Administration

Bulletin 3: State-Local Taxes and Industrial Location: A Logical Frame of Reference (February 1965), by Richard W. Poole, Oklahoma State University

Bulletin 4: Estimates of Electricity Sales by Utilities, by County and Class of Service, Oklahoma, 1950 and 1960 (July 1966), by Larkin B. Warner, Oklahoma State University

Bulletin 5: Employment Changes by Industry in Oklahoma from 1940-1960 (November 1967), by Harold Warren, TUSC Regional Economist and Assistant Director

APPENDIX D

AEROSPACE RESEARCH APPLICATIONS CENTER

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N67-30477# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

NEW TEST TECHNIQUE FOR SHEAR MODULUS AND OTHER ELASTIC CONSTANTS OF FILAMENTARY COMPOSITES

L. B. Greszczuk 1967 28 p refs Presented at the ASTM Symp. on Standards for Filament Reinforced Plastics, Dayton, Ohio, 21-23 Sep. 1966

(Douglas Paper-3670; AD-651920) CFSTI: HC $3.00/MF $0.65

A new test technique is presented for measuring the five principal elastic constants of filamentary composites: two moduli of elasticity, two Poissons ratios, and a shear modulus. The technique employs strain rosette-instrumented tensile specimens containing oriented filaments. Transformation equations for orthotropic materials are used to develop pertinent equations for the elastic constants evaluation. Given one of the Poissons ratios of a laminate (experimental or theoretical value) and using Maxwells Reciprocity Theorem, principal elastic properties can be obtained from data corresponding to one tensile test. Otherwise, two tests are required to obtain those properties. The shear modulus, which is independent of the Poissons ratio, can be obtained from tensile test data on a specimen having filaments oriented at any angle 0 < alpha < 90 degrees. The validity and consequences of using theoretical values of Poissons ratio to compute properties other than shear modulus are discussed. Author (TAB)

N67-30497# Naval Research Lab., Washington, D. C.

MICROVOIDS IN GLASS-FILAMENT-WOUND STRUCTURES: THEIR MEASUREMENT, MINIMIZATION, AND CORRELATION WITH INTERLAMINAR SHEAR STRENGTH Interim Report

A. G. Sands, R. C. Clark, and E. J. Kohn 31 Mar. 1967 28 p refs

(NRL-6498; AD-651294) CFSTI: HC $3.00/MF $0.65

A statistical point-count method adapted from petrographic modal analysis was studied as a quantitative means of measuring void content in filament wound composites and tentatively appears to be a more precise, rapid, and versatile method than other techniques presently being used, especially at low-void-content levels (< 1 vol-%). Low-void-content (< 1 vol-%) filament-wound NOL rings were fabricated by a continuous single-strand-winding process and resin impregnation at reduced pressure with the vacuum applied only to the resin bath. Working of the strand during the resin impregnation step by various configurations of guide rolls and strand vibrating devices either at atmospheric or reduced pressure was relatively ineffective in decreasing void content as compared with vacuum resin impregnation alone. Regression correlation analysis studies have shown that a linear inverse relationship exists between the interlaminar shear strength and the void content of NOL rings and that void content is the primary factor influencing interlaminar shear strength. The high degree of correlation between interlaminar shear strength and void content derived from the statistical regression correlation analysis is indirect supporting evidence that the point-count method for the quantitative measurement of the void content of composite structures has a relatively high degree of precision. Author (TAB)

N67-30650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.

GRAPHITE FIBER REINFORCED COMPOSITES Technical Report, Nov. 1965-Jul. 1966

R. G. Spain Jan. 1967 24 p refs

(AFML-TR-66-384; AD-651652) CFSTI: HC $3.00/MF $0.65

Several types of graphite fibers were used in the fabrication and evaluation of epoxy resin matrix composites. The fibers covered a large mechanical property range and were of various constructions. From the composite data obtained, the potential of graphite fibers as a composite reinforcing agent is discussed. Author (TAB)

N67-30810*# Stanford Research Inst., Menlo Park, Calif.
STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTICS—EXTENDED WORK
Quarterly Progress Report, 1 Jan.–31 Mar. 1967
David L. Chamberlin, Jr., Mark V. Christensen, and Michael D. Bertolucci 9 May 1967 11 p refs
(Contract NASr-49(14); SRI Proj. FRU-4525)
(NASA-CR-84865; QPR-10; Rept.-12) CFSTI: HC $3.00/MF $0.65 CSCL 09I

Procedures for the fluorination and alkylation of glass fabric for subsequent use in the production of laminates have been established. Several test specimens were made from untreated glass fabric in order to perfect a technique for the production of laminates. The lay-up procedure for the specimens to be used in the evaluation studies has been chosen. A detailed study of the effect of surface modification on the position of the Si–O fundamental stretching frequency was made. The study required attenuated total reflection spectral techniques for the attainment of highly resolved spectra. Author

N67-31181* Harvey Aluminum, Torrance, Calif. Engineering Labs
DEVELOPMENT OF ULTRAHIGH STRENGTH, LOW DENSITY ALUMINUM SHEET AND PLATE COMPOSITES
Final Report, 1 Jul. 1965–30 Jun. 1966
E. V. Sumner Jul. 1966 91 p refs
(Contract NAS8-11508)
(NASA-CR-85863; HA-2263) CSCL 11F

Development of a composite material of aluminum alloy matrix reinforced with fine steel wires is described. Progress in scaling up the 2024 aluminum-NS355 steel wire composite in sheet and plate form to sizes of 12 in. × 96 in. is reported. The highest UTS achieved in 12 in. × 96 in. size was 170 ksi. Limited tests for impact strength, notched strength, and thermal cycling were conducted at temperatures from −320°F to 10°F. Partial success was achieved in joining by diffusion bonding and liquid infiltration. Aluminum matrix composites using B, SiC, and Be as reinforcement were successfully produced. Author

A67-31931

FIBERGLASS-REINFORCED THERMOPLASTICS.

Rudolph D. Deanin (DeBell and Richardson, Inc., Hazardville, Conn.).

SPE Journal, vol. 23, June 1967, p. 87-90. 11 refs.

Description of new processes used in producing fiberglass-reinforced thermoplastics, generally based on Fiberfil's patented technique. Using this technique, continuous glass roving is first sized to increase interfacial adhesion between glass and resin, then impregnated and coated with thermoplastic resin, and finally chopped into pellets, which contain core bundles of parallel glass fibers impregnated and surrounded by a sheath of thermoplastic resin. Some producers have simply mixed shorter glass fibers randomly into the thermoplastic resin in the molding pellet. These materials are processed primarily by injection molding. Perhaps the most significant effect in thermoplastics is the retention of impact strength down to very low temperatures. Deflection temperature is improved most markedly with nylon, less so in most other thermoplastics.

P.v.T.

A67-33387 #

STRESSES IN FIBRE-REINFORCED MATERIALS.

I. M. Allison (London, University, University College, Dept. of Civil and Municipal Engineering, London, England) and L. C. Hollaway (Surrey, University, Dept. of Civil Engineering, London, England).

British Journal of Applied Physics, vol. 18, July 1967, p. 979-989. 6 refs.

A relatively detailed knowledge of the stress distribution around the fibers in a composite material is required in order to predict the mode of failure. Idealized models of a reinforced material, consisting of an isolated fiber embedded in a brittle matrix, have been analyzed by the photoelastic technique. Complete stress distributions have been obtained in the vicinity of both square- and semicircular-ended fibers with the composite subjected to uniaxial tension. It is interesting to find that the maximum tensile and shear stresses induced at the tip of the semicircular fiber are significantly greater than the corresponding values for the square-ended fiber. This apparent anomaly is explained by the mechanism controlling the load transfer from the matrix to the fiber. (Author)

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APPENDIX E

SELECTED LIST OF RETROSPECTIVE SEARCH TITLES

APPENDIX E

SELECTED LIST OF RETROSPECTIVE SEARCH TITLES

1. SEARCH TITLE: Chemical Milling of #304 Stainless Steel
   COMPANY OR INDIVIDUAL: Systems Engineering Electronics, Inc.
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 15
   OTHER: 0

2. SEARCH TITLE: How can Particles Smaller than 10 Microns be Separated According to Size?
   COMPANY OR INDIVIDUAL: Lobaris Co.
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 7
   OTHER: 0

3. SEARCH TITLE: Servo System Velocity Lock for Handling Computer Tape
   COMPANY OR INDIVIDUAL: Midwestern Instruments, Inc.
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 10
   OTHER: 0

4. SEARCH TITLE: Electroplating; State-of-the-art
   COMPANY OR INDIVIDUAL: Oklahoma Aerotronics, Inc.
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 11
   OTHER: 0

5. SEARCH TITLE: Separation of Liquids from Solids in Human Waste
   COMPANY OR INDIVIDUAL: Mar-Jean
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 11
   OTHER: 0

6. SEARCH TITLE: Semipermeable Membranes Pertaining to Liquids; State-of-the-art
   COMPANY OR INDIVIDUAL: W. L. Hale
   NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
   NASA: 16
   OTHER: 0

7. SEARCH TITLE: Radiation (low level) Detection
COMPANY OR INDIVIDUAL: Hal Cochran, KTEN-TV
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 26
OTHER: 0

8. SEARCH TITLE: Maximum Noise Level (Decibles) Under Which Men Can Do Useful Work
COMPANY OR INDIVIDUAL: Seismograph Service Corporation
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 7
OTHER: 0

9. SEARCH TITLE: Fiber Optics; State-of-the-art
COMPANY OR INDIVIDUAL: Systems Engineering Electronics, Inc.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 13
OTHER: 0

10. SEARCH TITLE: Types of Metals that Will Withstand Temperatures Greater than 3000° F.
COMPANY OR INDIVIDUAL: Mar-Jean
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 7
OTHER: 0

11. SEARCH TITLE: Vapor Purification from Burning Waste
COMPANY OR INDIVIDUAL: Mar-Jean
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 6
OTHER: 0

12. SEARCH TITLE: Zirconium Chloride; General Characteristics
COMPANY OR INDIVIDUAL: Arnold Walker
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 24
OTHER: 0

13. SEARCH TITLE: Electroluminescence; State-of-the-art
COMPANY OR INDIVIDUAL: Systems Engineering Electronics, Inc.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 11

OTHER: 0

14. SEARCH TITLE: Cybernetics in Relation to Business and Secretarial Work

COMPANY OR INDIVIDUAL: Gregg Lynn

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 55

OTHER: 0

15. SEARCH TITLE: Aluminum Brazing; State-of-the-art

COMPANY OR INDIVIDUAL: Mar-Jean

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 19

OTHER: 3

16. SEARCH TITLE: Flight Simulators; State-of-the-art

COMPANY OR INDIVIDUAL: American Flyers, Inc.

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 7

OTHER: 4

17. SEARCH TITLE: What is the Post Load Efficiency of a Small Gas-Fired Boiler

COMPANY OR INDIVIDUAL: Arkansas Power and Light Co.

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 6

OTHER: 5

18. SEARCH TITLE: Post Crash Fires in Aircraft

COMPANY OR INDIVIDUAL: University of Oklahoma Research Institute

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 24

OTHER: 2

19. SEARCH TITLE: Phenolic Joining Material

COMPANY OR INDIVIDUAL: Major Engineering Co.

NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 9

OTHER: 7

20. SEARCH TITLE: Kiln-Drying Lumber; State-of-the-art
COMPANY OR INDIVIDUAL: Wal-Zac Manufacturing Co., Inc.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 4

21. SEARCH TITLE: By-Products of Coal
COMPANY OR INDIVIDUAL: Wes Watkins, KEDDO
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 8

22. SEARCH TITLE: Conductor to Carry 16,000 V AC Immersed in Oil
COMPANY OR INDIVIDUAL: Sauder Tank Co., Inc.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 6

23. SEARCH TITLE: Plastic Thermoforming
COMPANY OR INDIVIDUAL: Midwestern Instruments, Inc.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 9

24. SEARCH TITLE: Building Material for Prefab Construction
COMPANY OR INDIVIDUAL: Robert Duffield
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 7

25. SEARCH TITLE: Corrosion Control
COMPANY OR INDIVIDUAL: Carpenter Machine Shop
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 53

26. SEARCH TITLE: Oil Recovery from Tar Sand; State-of-the-art
COMPANY OR INDIVIDUAL: Signal Oil and Gas Co.
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:
NASA: 0
OTHER: 3

27. SEARCH TITLE: Reinforced Plastic Fabricator; State-of-the-art
COMPANY OR INDIVIDUAL: W. W. Trailers
NUMBER OF ABSTRACTS AND/OR ARTICLES RETRIEVED:

NASA: 0
OTHER: 2

APPENDIX F

TUSC CLIENTS

APPENDIX F

TUSC CLIENTS

Firms

	Name	Location
1.	Amercoat Corporation	Ardmore, Oklahoma
2.	American Flyers, Inc.	Ardmore, Oklahoma
3.	Anderson Clayton & Co.	Sherman, Texas
4.	Arbuckle Supply, Inc.	Ardmore, Oklahoma
5.	Ardmore Plastics Co.	Ardmore, Oklahoma
6.	Ardmore Transformer and Motor Co.	Ardmore, Oklahoma
7.	Arkansas Power and Light Co.	Little Rock, Arkansas
8.	B.O.R.C.O., Inc.	Sapulpa, Oklahoma
9.	Carpenter Machine Shop	Durant, Oklahoma
10.	Cecil Body Shop	Harrison, Arkansas
11.	Cherry-Burrell Corporation	Dallas, Texas
12.	Coin-Operated Equipment Manufacturing Co.	Ardmore, Oklahoma
13.	Cordray Die Casting Co.	Sallisaw, Oklahoma
14.	Corken Pump Co.	Oklahoma City, Oklahoma
15.	Creamer's Machine Supply and Metal Works	Durant, Oklahoma
16.	Data-Tronic, Inc.	Ardmore, Oklahoma
17.	Davis Trailers	Boswell, Oklahoma
18.	Delta Mining Corporation	Mill Creek, Oklahoma
19.	Dierks Lumber Co.	Broken Bow, Oklahoma
20.	Durant Animal Hospital	Durant, Oklahoma
21.	Durant Concrete Block Co.	Durant, Oklahoma
22.	Durant Electronics Co.	Durant, Oklahoma
23.	Fibre Reduction Co., Inc.	Ardmore, Oklahoma
24.	Fife Manufacturing Co.	Oklahoma City, Oklahoma
25.	Fourco Glass Co.	Fort Smith, Arkansas
26.	Frank Wheatly Industries	Tulsa, Oklahoma
27.	Gaither Machine Shop	Poteau, Oklahoma
28.	Garland Coal and Mining	Fort Smith, Arkansas
29.	Graphics, Inc.	Poteau, Oklahoma

	Name	Location
30.	Graphic Engineering, Inc.	Tulsa, Oklahoma
31.	Halliburton Co.	Duncan, Oklahoma
32.	Hasco Manufacturing Co.	Sapulpa, Oklahoma
33.	Herron Industries, Inc.	Idabel, Oklahoma
34.	Hicks Photography Studio	Antlers, Oklahoma
35.	Hugo Milling Co.	Hugo, Oklahoma
36.	Hydro-Jet Sales Co.	Ardmore, Oklahoma
37.	Johnston Fagg, Inc.	Tulsa, Oklahoma
38.	Kellwood Co.	Clinton, Oklahoma
39.	Kimray Inc.	Oklahoma City, Oklahoma
40.	Land Davidson Manufacturing Co.	Ardmore, Oklahoma
41.	Little Giant Pump Co.	Oklahoma City, Oklahoma
42.	Lobaris Co.	Mangum, Oklahoma
43.	Lockheed Aircraft Co.	McAlester, Oklahoma
44.	Major Engineering Co.	Tulsa, Oklahoma
45.	Marine Engineering & Equipment Co.	McAlester, Oklahoma
46.	Mar-Jean	Ardmore, Oklahoma
47.	McAlester Fuel Co.	McAlester, Oklahoma
48.	McGraw Edison	Sherman, Texas
49.	Midwest Oil Corporation	Poteau, Oklahoma
50.	Midwestern Instruments, Inc.	Tulsa, Oklahoma
51.	Mitchell Furniture Co.	Durant, Oklahoma
52.	Noble Drilling Co.	Seiling, Oklahoma
53.	Oklahoma Aerotronics, Inc.	Hartshorne, Oklahoma
54.	Pennsylvania Glass Sand Co.	Mill Creek, Oklahoma
55.	Pete's Place	Krebs, Oklahoma
56.	Phil-Good Products, Inc.	Oklahoma City, Oklahoma
57.	The Pillsbury Co.	Denison, Texas
58.	Poteau Trucking Co.	Poteau, Oklahoma
59.	Ravia Sawmill	Ravia, Oklahoma
60.	Red River Research & Manufacturing Co.	Ardmore, Oklahoma
61.	Research Instruments	Norman, Oklahoma
62.	Roland Construction Co.	McAlester, Oklahoma
63.	Sallisaw Glass Co.	Sallisaw, Oklahoma
64.	Samedan Oil Co.	Ardmore, Oklahoma

	Name	Location
65.	Sauder Tank Co., Inc.	Tulsa, Oklahoma
66.	Seismograph Service Corporation	Tulsa, Oklahoma
67.	Sequoyah Concrete Co.	Sallisaw, Oklahoma
68.	Shi-Maid Manufacturing Co.	Sulphur, Oklahoma
69.	Signal Oil & Gas Co.	Healdton, Oklahoma
70.	Southwest Stone Co.	Stringtown, Oklahoma
71.	Stahl Metal Products, Inc.	Durant, Oklahoma
72.	St. Claire Lime Co.	Sallisaw, Oklahoma
73.	Stromberg-Carlson	Ardmore, Oklahoma
74.	Strong Enterprises	Ardmore, Oklahoma
75.	Sunkist Peanut Co.	Durant, Oklahoma
76.	Sunray D-X Oil Co.	Tulsa, Oklahoma
77.	Systems Engineering Electronics, Inc.	Wewoka, Oklahoma
78.	Taylor Oil Well Servicing	Mead, Oklahoma
79.	T.E.S.C.O. Engineering Co.	Ardmore, Oklahoma
80.	Universal Dynamic Co.	Oklahoma City, Oklahoma
81.	Vail & Son Concrete Co.	Durant, Oklahoma
82.	Video Electronics Systems, Inc.	Tulsa, Oklahoma
83.	W. W. Trailers	Madill, Oklahoma
84.	Wal-Zac Manufacturing Co., Inc.	Marietta, Oklahoma
85.	Water Bonnet Corporation	Orlando, Florida
86.	Water Engineering Co.	McAlester, Oklahoma
87.	Wells-Lamont Corporation	Hugo, Oklahoma
88.	Williams Construction Equipment Co.	Atoka, Oklahoma
89.	Yuba Heat Transfer Corporation	Tulsa, Oklahoma

Individuals

	Name and Occupation	Location
1.	Mark Alford Warden, State Sub Prison	Stringtown, Oklahoma
2.	Jack Bain & Associates Inventor - Tractor and Implement Dealer	Idabel, Oklahoma
3.	Glen Burke KSEO	Durant, Oklahoma

Name and Occupation	Location
4. Roy A. Carr Anderson Clayton & Co.	Sherman, Texas
5. Bill Clifton	Oklahoma City, Oklahoma
6. Hal Cochran Engineer for KTEN-TV	Ardmore, Oklahoma
7. Marvin Cochran Trucking Contractor	Atoka, Oklahoma
8. Jerry Dalton Plastics Technician	Coalgate, Oklahoma
9. W. L. DeLay Inventor	Sulphur, Oklahoma
10. Roland Descans	Ardmore, Oklahoma
11. Robert Duffield Unemployed - Trying to start new business	Tulsa, Oklahoma
12. Jack Dye Business Professor	Durant, Oklahoma
13. Bill Flagg Student	Denison, Texas
14. Glen Foster Student	Denison, Texas
15. Dr. Harold Fristoe Engineering Staff at O.S.U.	Stillwater, Oklahoma
16. David Gentry Student	Durant, Oklahoma
17. Edwin L. Golden	Durant, Oklahoma
18. W. L. Hale Industrial Engineer	Caddo, Oklahoma
19. Walter B. Hall Oklahoma Highway Department	Antlers, Oklahoma
20. J. L. Harris Photographer	Sulphur, Oklahoma

Name and Occupation	Location
21. Ronnie Harwood Student	Durant, Oklahoma
22. Lanie Hudson Student	Durant, Oklahoma
23. Lynn Johnson Student	Denison, Texas
24. Janie L. Jones Business Professor	Durant, Oklahoma
25. Bruce Ketch Chairman, Aerospace School at Tulsa University	Tulsa, Oklahoma
26. James Keyker Works with Manpower Training, SSC	Durant, Oklahoma
27. Robert Klein Student	Durant, Oklahoma
28. Hobart F. Landreth Professor	Weatherford, Oklahoma
29. Gregg Lynn Student	Durant, Oklahoma
30. Harold Lynn Professor	Durant, Oklahoma
31. Rev. Bill McFatridge Preacher	Idabel, Oklahoma
32. Phil McGehee Student	Calera, Oklahoma
33. Gerald Morris Student	Durant, Oklahoma
34. Hal Myers	Durant, Oklahoma
35. Norwood Brothers Funeral Directors (Inventors)	Idabel, Oklahoma
36. James Posey Sales Representative	El Dorado, Arkansas
37. Father Patrick Quirk Lease Broker	Durant, Oklahoma

Name and Occupation	Location
38. E. M. Richison Inventor	Stigler, Oklahoma
39. Jack L. Robinson Science Professor	Durant, Oklahoma
40. Jack Smith Formerly Director of Industrial Airpark	Ardmore, Oklahoma
41. Mike Snapp Vice President of First Nat'l Bank	Sulphur, Oklahoma
42. Bill Squires	Durant, Oklahoma
43. E. V. Stair Farmer	Caddo, Oklahoma
44. Dan Stone	Dallas, Texas
45. Murel Talley Dirt Contractor	Durant, Oklahoma
46. Dr. John Taylor Science Professor	Durant, Oklahoma
47. Joe Tidwell Educator of the Deaf	Sulphur, Oklahoma
48. Gabriel Utz Petroleum Engineer	Dallas, Texas
49. James Vanoy Inventor	Healdton, Oklahoma
50. R. J. Wagner Field Representative	El Dorado, Arkansas
51. Arnold Walker Science Professor	Durant, Oklahoma
52. Fred Ward	Stigler, Oklahoma
53. Wes Watkins Director KEDDO	Wilburton, Oklahoma
54. David Westbrook Student	Denison, Texas

Name and Occupation	Location
55. Dr. Alvin White Aviation and Industrial Arts Professor	Durant, Oklahoma
56. Bryce Wilde	Choctaw, Oklahoma

Special

Name	Location
1. Federal Aviation Agency	McAlester, Oklahoma
2. Graduate Research Center of the Southwest	Dallas, Texas
3. Noble Foundation	Ardmore, Oklahoma
4. Oklahoma Peanut Commission	Madill, Oklahoma
5. University of Oklahoma Research Institute	Norman, Oklahoma

APPENDIX G

TUSC FACT BRIEF

TECHNOLOGY USE STUDIES CENTER

AREA CODE 405 / 924-5452 SOUTHEASTERN STATE COLLEGE DURANT, OKLAHOMA 74701

TUSC FACT BRIEF

To speed the use of knowledge, a cooperative effort of the University of Oklahoma, Oklahoma State University, and Southeastern State College.

THE LASER--- BEAM OF THE FUTURE

THE TERM LASER IS AN ACRONYM DERIVED FROM THE PHRASE "Light Amplification by Stimulated Emission of Radiation." A beam of this amplified light is produced by certain materials when they are subjected to strong light or electrical charges. The beam of light when generated under these conditions is monochromatic, (of a single wavelength or color) and coherent. Coherent in this case simply means that all the light waves are in phase and pursue parallel paths, thus creating an extremely narrow, intense beam which does not spread with increased distance as normal white light does. The color of the beam may vary from near infra-red to near ultra-violet depending on the material used and changing techniques employed.

From a standpoint of materials used, lasers may be divided into two general categories. These are solid state and gas lasers. Among solid state laser materials, the much publicized ruby crystals, and such rare compounds as lithium flouride, yttruim-iron garnet and gallium are finding use. Gas lasers may use such gases as helium-neon, carbon dioxide, argon and even water vapor.

A FORERUNNER OF THE LASER WAS THE MASER. Maser is an acronym meaning "Microwave amplification by Stimulated Emission of Radiation." The term maser has been extended to cover all wavelengths below the visible part of the spectrum and not just the microwave portion as originally intended. Thus there are masers operating all the way from the audio to the infra-red portion of the spectrum. Atomic clocks, the most accurate of all clocks with an error rating of less than .01 seconds per year, use a maser oscillator. The first maser was developed by Gordon, Zeiger and Townes (1954-55) and opened the way for Charles Townes to continue work in cooperation with Arthur L. Schawlaw toward development of the laser during the years 1958-60.

LASERS ARE FINDING PRACTICAL APPLICATION in numerous areas. One rather unusual field in which lasers are being used is meteorology. The laser is applied to the remote detection of extremely small particles and cloud droplets. Sensitive photometers have been developed to pick up the faint "returns"—the laser light scattered and reflected back from microscopic bits of dust, cloud droplets and other atmospheric particles. The Lidar (a laser plus light receiving device) promises a much sharper picture of the structure and growth of individual clouds.

Although enormously powerful laser pulses are leading to applications in laser beam welding and interplanetary radar, continuous, rather than pulsed, coherent beams are needed for most communications purposes. A major step forward was taken with the announcement of ionized gas lasers by Eugene I. Gordon and Edward F. Labud of Bell Telephone Laboratories and William Bridges of Hughes Research Laboratories. Continuous laser action at more than 60 new wave lengths overlapping the entire visible portion of the spectrum, was obtained in ionized argon, krypton, xenon and neon. Powers in excess of one watt were obtained.

The development of continuously tunable laser beams allows the researcher to select the frequency or wave length of the laser light. This advance is second only in importance to the conception and development of the laser itself.

MUCH EXCITEMENT HAS BEEN GENERATED BY experiments in holographic (three dimensional) photography. Scientists at the University of Michigan Institute of Science and Technology have attempted to produce holographic movies. They made multiple exposures on a photographic emulsion and rotated the plate in front of a laser beam to produce animation. X-Ray microscopy and television have also undergone experimentation.

In operation, twin laser beams can provide a straight line of sight for aligning everything from small precision dies to huge milling machines. The Transcontinental Gas Pipeline Company is currently utilizing to extent a laser beam to line up a 34-mile ocean pipeline between Long Island and Morgan, N.J. A laser mounted on a tower in the ocean permits the contractor to lay the pipe with a speed and accuracy that would not be possible with the traditional method of alignment by buoys set by triangulation. Setting buoys is slow and difficult work.

Holding them on line is impossible because of currents and tidal variations. But the laser, once set, provides a perfect red light beam that spreads less than 6 in. in width for each mile of distance. By keeping the beam in sight, the operator is able to maintain an almost perfect line.

CONSIDERABLE MATERIAL IS AVAILABLE on lasers. Among books recently published are two which are recommended by the American Association for the Advancement of Science. The Story of the Laser, by John Carroll is a simple and non-mathematical explanation of the workings of lasers. Masers and Lasers: How They Work, What They Do, by Manfred Brotherton is an explanation of physical principles and details of operation.

The May 1967 issue of Science and Technology magazine contains a comprehensive article by Robert A. Myers entitled "Scanning with Lasers." Another magazine which frequently carries the latest developments in laser applications is Industrial Research Magazine.

For industrial, field and laboratory use, University Laboratories of Berkely, California has produced two unique portable lasers. The Model

240 HE-NE Gas Laser sells for $295 and the Model 200 HE-NE Gas Laser is priced at $195.

Some applications for these low priced lasers are lab type communications and chemical analysis tests, and surveying and alignment in field and industrial projects.

The following complete reports are available through our office for a nominal charge. When ordering, list both the stock number and title. For additional information please phone or write the Technology Use Studies Center.

N67-17362-- LASERS, National Bureau of Standards, Boulder, Colo., 1966, 11 pages.... Summaries are presented of conference papers which cover the state of the art and possible applications of lasers. Specific topics include: (1) aspects of fringe counting in laser interferometers, (2) interferometric measurements on diffuse surfaces by holographic techniques, (3) noise in lasers and laser detectors, (4) radiometric measurement of laser output, (5) calorimetric measurement of pulsed laser output energy, (6) a laser microcalorimeter, and (7) frequency stabilization of gas lasers.

N6716725-- HYDROGEN MASER RESEARCH ACHIEVEMENTS AT MSFC, John G. Gregory, National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala., 1966, 8 pages.... The Basic principles and the construction of a hydrogen maser and its potential as a highly stable frequency reference for precision tracking systems are discussed. Improvements in stability and size are presented and future improvements are proposed. Results of measurements of relative frequency stability of two masers and the comparison of a hydrogen maser and a cesium beam are discussed. Also presented is the status of the hydrogen maser program and possible areas of application.

N66-39840-- SOME CONSIDERATIONS ON EYE HAZARDS WITH LASERS, J.J. Vos, Institute for Perception RVO-TMO, Soesterberg (Netherlands), 1966, 26 pages.. Eye hazards by laser radiation are described and discussed on the basis of experimental data on animals, theoretical consideration on head dissipation, and recent data on ocular imagery. Critical doses are determined and thicknesses calculated for protective filters. Tentative safety precautions, on this basis, concludes the report.

A67-36639-- LASER LIGHT, C.C. Eaglesfield, International Telephone and Telegraph Corp., Standard Telecommunications Labs., Harlow, Essex, England, 1967, 197 pages (this book is available at a cost of $6.00).... The three main types of laser—the ruby laser, gas laser, and semiconductor laser-are described, and laser applications in the communications field are reviewed. The reflection of radiation by polished surfaces and various visual effects of laser light are examined. The text contains numerous line and halftone illustrations and extensive references on the subject.

N66-29552--PROSPECTS FOR LASER AND OPTICAL COMMUNICATIONS, R. Svoren, Joint Publications Research Service, Washington, D.C., June 1966, 25 pages.... Technological developments and future prospects for lasers and their applications, particularly as radio receivers and transmitters, in optical communications are discussed in a very general way. Among the advantages cited for lasers are: (1) The spatial coherence of the laser beam facilitates electromagnetic radiation in only one direction and this property permits a large number of lasers to operate on the same frequency. (2) Lasers generate waves in the optical range of frequencies, (infrared, light and ultraviolet), and operate on an unlimited frequency band. (3) The sharp laser beam can be achieved with relatively small emitters, and the ability to emit sinusoidal electromagnetic waves makes it possible to load the laser beam with information as in radio transmition. Thus, although utilized to a limited extent now, a single, multi-channel laser beam could carry all television and radio programs, radar signals, remote control, and telemetering.

N66-39441--HEATING OF A BILAYER SHEET IN WELDING WITH A LASER BEAM, N.W. Rykalin, A.A. Uglov, and N.I. Makarov, Joint Publications Research Services, Washington, D.C., Sept. 27, 1966, 12 pages.... The temperature distribution in a bilayer sheet subjected to a heat source located on its surface is considered as one of the problem areas in the application of lasers for use in welding. The equations which describe this problem are provided, and solutions for these equations are given.

N66-39473--A STUDY OF LIGHT MODULATION AND SCANNING TECHNIQUES FOR APPLICATION TO SIMULATION DISPLAY GENERATION, W.L. Foley, Aerospace Medical Div., Aerospace Medical Research Labs, March, 1966, 58 pages.... Various techniques for modulation and scanning of coherent light are analyzed for application to the generation of high resolution high contrast displays for simulation. A number of possible techniques are discussed in the main body of the report. The individual discussions include a brief description of the principles of operation together with capabilities relative to bandwidth, contrast ratio, deflection angle, alignment, sensitivity, ease of fabrication, and handling. This is based somewhat upon voltage and power requirements over range of operation.

N66-33411--AN EVALUATION OF THE OPTICAL MASER PHOTON RATE GYROSCOPE, C.V. Heer, Ohio State Univ., Columbus. Dept. of Physics, Nov. 1964, 39 pages....Equations of motion are used for single and degenerate modes and for calculating the polorization of an optical maser medium. The optical maser photon rate gyroscope is evaluated. Schematic designs of the photon rate gyroscope and other typical cavities are given, along with various curves obtained from equations occuring in the series of calculations.

APPENDIX H

ALL REPORTED TECHNOLOGY TRANSFER CASES

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ALL REPORTED TECHNOLOGY TRANSFER CASES

All transfer cases previously reported in Quarterly Status Reports from 1 July 1965 through 31 March 1968 are reported in this Appendix. It will be noted that the definition given a "technology transfer" has changed from time to time. Details regarding these changes can be obtained from the Quarterly Status Reports.

1. (Reported in detail in Appendix I)

2. BENDING TUBING - September 1965; Coin-Operated Equipment Manufacturing Co.

   Problem - Making sharp bends in tubing without collapsing the tubing.

   Solution - The Ames Research Center "Frozen Water" method of bending tubing was directly applied. The company found this useful but has given no indication of cost savings to them.

3. ELECTRICAL CONNECTIONS - September 1965; Graphics, Inc.

   Problem - Electrical Connections.

   Materials Provided - Back-up package to Tech Brief 63-101174, "Modular Chassis Simplifies Packaging and Interconnecting of Circuit Boards."

   Solution - The information provided proved to be a partial solution to the company's problem.

4. INTERPLANETARY SPACE COMPUTER - September 1965.

   Opportunity - Manufacture of the JPL/NASA-developed "Interplanetary Space Computer" for commercial use.

   Assistance Provided - TUSC has worked closely with the company in exploring the potential market for this product as a teaching device to be used in classroom situations. ARAC performed a market survey for the company.

Results - The California Institute of Technology had secured a waiver from NASA for the patents on the five different computers and for the copyrights on data describing the use of the computers. An exclusive license has been granted to the company by CIT to manufacture and market these computers. The company is currently planning to establish an entirely new operation to carry out this program. This should bring considerable new investment and employment to one of the cities in our area.

Current status on the manufacture of the JPL/NASA-developed "Interplanetary Space Computer."—The company is dealing with a distributor who is making his own market analysis for sales of the product. Production will start soon if favorable word is received from the distributor.

Unfortunately, at the present time prospects for the eventual manufacture of the JPL/NASA-developed "Interplanetary Space Computer" are somewhat diminished. The distributor who made the market analysis covering one area of the United States determined that the product would not be feasible for use in secondary schools. The potential manufacturer is disappointed, but it is hoped that the TUSC staff, with important assistance

from NASA Headquarters, can encourage him to pursue other potential markets. Due to other heavy commitments, the project is currently not receiving much attention from the manufacturer.

The company with whom TUSC was working who hoped to manufacture the JPL/NASA-developed "Interplanetary Space Computer" has lost its license due to inactivity. This is unfortunate in many respects, not the least of which is loss of the possibility for establishment of a new industry. In assessing the situation from an ex post facto position, no blame can be placed on TUSC, any NASA facility, or the company involved. Events led to a situation requiring more time and effort on the part of the company than they could give and the idea was dropped. It continues to be a good idea for someone else to explore.

5. CORROSION FROM WATER - September 1965; Marine Engineering and Equipment Co.

Problem - Corrosion involving the use of cold galvanizing on welded galvanized materials and using cold galvanizing on non-galvanized iron.

Solution - A NASA special publication suggested a partial solution to the problem. Use of the "Langley Spray Nozzle" to apply an overcoat of epoxy over the cold-galvanizing paint after the base metal had been sand-blasted to the bare surface has proven beneficial.

The company has given us no estimate of savings from use of this process.

6. WELDING TECHNIQUES SEMINAR - September 1965.

Problem - Improved Welding Techniques.

Solution - Two welding seminars were held on the campus for all industries in the area having an interest in welding. NASA literature on "Selected Welding Techniques" was used and some of these techniques were demonstrated by those conducting the seminar. At least two of the firms attending indicated an interest in purchasing the necessary equipment to enable them to use these new techniques. One of these firms has since purchased the equipment.

7. SHRINKAGE OF PLASTICS - September 1965.

Problem - Shrinkage of Plastics.

Materials Provided - Results of a retrospective search on the subject.

Solution - The company has indicated that some use has been made of the materials sent. However, they have not gone in to depth as to what savings will arise from this use.

8. NEW ELECTRIC CIRCUIT - September 1965; Airtronics Instruments, Inc.

Opportunity - Utilization of a new Electrical Circuit.

Solution - The company has adopted a circuit described in NASA Document TMX-52013, "Recent Developments in Semiconductor Circuits," and has found it to be superior to their previous circuit. The company has not indicated the dollar savings to us.

9. SECONDARY OIL RECOVERY - September 1965.

Problem - Secondary oil recovery in an abandoned field. A small oil field servicing company is trying to develop a highly proprietary process for recovering oil which is too thick to pump with standard equipment. Their plans involve heating air, increasing its

mass and forcing it into the oil-bearing strata.

Solution - Valve Technology (NASA SP-5019) was received with enthusiasm by these people. They are in need of a flexible joint which will provide for approximately three feet of expansion in the casing leading from the surface to the oil-bearing strata. The dialogue is continuing with this client. He is "going for broke" on the project. If he succeeds, we may be able to accept part of the credit for his success. If he fails, we will have contributed technology to which he was entitled.

10. FIBERGLASS IN THE PRODUCTION OF HORSE TRAILERS - September 1965; W. W. Trailers.

Opportunity - "Build a better mouse trap." A professional cowboy and his friend were not satisfied with their horse trailer. One of the men designed and built a trailer under the shade of a tree, five years ago. He is now turning out trailers at the rate of twelve per day and is four months behind with the orders. He is considering a second production line and extensive use of fiberglass in an improved model. He asked if TUSC "could smarten him up" on fiberglass. We provided him with 22 abstracts. Reports N64-10587, N64-10646, N64-11596, and N64-10641 have been ordered for him. Numerous brochures from commercial firms were delivered to him. These provided him with price and delivery information. It is possible that this transfer can double his employment; however, there is no way to evaluate it at this time.

11. JET ENGINE IMPROVEMENT - September 1965; American Flyers, Inc.

Opportunity - An airline employee has invested a considerable amount of time and money into the investigation of an interest that he has had for several years. The flow patterns in aerodynamics vortices suggested a means for improving the efficiency of the gas flow within a jet engine.

Results - TUSC has supplied him with 83 abstracts and has ordered seven hard copies of technical reports. Some of these reports have been A65-20232, NASA TN D-2696, A64-17832 and N64-25006. We have also submitted a formal search request to ARAC for this client.

The recipient is continuing his investigation and we are continuing our dialogue. If his engine improvement is valid and practical, our contribution is immeasurable.

12. GAMMA RAY TRACERS - September 1965; Coin-Operated Equipment Manufacturing Co.

Problem - Gamma Ray Tracers.

Solution - This concern had its birth as a result of the inventiveness of the owner. He had a unique application for a gamma tracer. In the light of the information furnished by a bibliography on isotopes, plus the consultation of the SSC Physics Department, he determined that he could find a better method of achieving his objective than through the use of gamma ray tracers.

13. WORK-SCHOOL PROGRAM - September 1965; Bethel Industries.

Opportunity - Bethel Industries is a project sponsored by a church group for high school graduates who might not be financially able to continue schooling at the college level. The project envisions a work-school program. Their plan involves the establishment of a group of small industries, the chief asset of which would be skilled hand labor.

Results - We have been asked to compile a profile of reports covering plastic assembly, electronics subassemblies and metal forming for this client. We feel that significant transfers have already been made to this infant organization in the form of providing them the most current information available.

14. PROTECTIVE COATING ON OVENS - September 1965; Hugo Milling Co.

Problem - Keeping a protective coat on unprotected ovens. An alfalfa pelleting plant has two large cylindrical ovens which are used to dehydrate green alfalfa. Keeping a coat of paint on these ovens, which are outside, has proven to be an expensive and repetitive job.

Solution - This client was given a copy of NASA Tech Brief No. 65-10156 which recommends a paint for high-temperature application. Although this application was reported as satisfactory to the owners at first, a visit to the plant by TUSC personnel disclosed that the recommended paint mixture had not been given a fair trial. The company had not used all the necessary ingredients in the paint. TUSC is attempting to procure the materials recommended in Brief No. 65-10156 and allow the pelleting concern to try the mixture as recommended.

15. PLASTIC GRAVE COVER - December 1965; Jo-Ray Corporation.

Problem - The best available material and finish for a plastic cemetery accessory.

Solution - TUSC provided information on non-metallic materials and on finishes to the client.

Results - The client has made a model of the grave cover and is currently planning to go into production. If successful, this will mean a totally new industry for a town that is in dire need of new life. (This problem was brought to our attention through the local Chamber of Commerce.)

This client is now established for limited production in expanded quarters. Additional models of the grave cover have been fabricated. Preliminary arrangements are underway to obtain a loan from the Small Business Administration to further expand the production facilities. Potential marketers have been contacted and prospects appear very favorable for sale of the items. Another TUSC client who is a pro-

fessional photographer has been recommended to the grave marker manufacturer to work on the design of the monument.

16. ECONOMIC FEASIBILITY ON INVESTMENT IN PURE JETS - December 1965; American Flyers, Inc.

Problem - A study of the economic feasibility of making a $20,000,000 investment in pure jets for use in charter service.

Solution - TUSC provided some thirty abstracts through retrospective search. Of these, eight were deemed highly useful by the firm in their study.

Results - No concrete results will be apparent until the decision about purchase of the aircraft is made. (This problem came to our attention through our continuing dialogue with this client.)

After additional study and assistance from TUSC, this company ordered one 8-1/2 million dollar "707" type jet transport to be delivered in October 1966. An additional major problem which arose during the study by the company was the selection of the most accurate and reliable type of navigational system for long range transport aircraft. A decision in this area had to be made in conjunction with the decision to purchase the jet transport. TUSC provided the following specific information: N64-10127, "Low-Cost Inertial Navigation Systems for Aircraft," N65-11759, "Inertial Navigational Systems," N65-12766, "Evaluation of Inertial Sensors and Systems for Aircraft Applications," N65-29006, "Inertial Navigation Study for Civil Air Transport, Phase I," N65-27996, "Behavior of Inertial Systems of Navigation for High Speed Flight," N65-23642, "Application of Inertial Locator Concepts to FAA Basic Flight Inspection, Vol. I," N65-19050, "Use of Self-Contained Navigation Aids in Domestic Airspace," N65-17736, "Aircraft Testing of Inertial Navigation Systems: Approach and Analytical Evaluation,"

N65-20718, "Application of Inertial Locator Concepts to FAA Basic Flight Inspection, Vol. I," N65-28714, "Operation Accordion: Navigational Accuracies of Civil Jet Aircraft Over the North Atlantic, February, 1962-September, 1963, Vol. I." The client stated that this material helped him satisfactorily solve the navigational questions.

17. INFORMATION ON VORTEX DISTURBANCE - December 1965; American Flyers, Inc.

Problem - Obtaining current information on the problem of vortex disturbance during critical phases of flight.

Solution - TUSC supplied the client with NASA literature containing the most current information regarding control problems in relation to vortex disturbance.

Results - No tangible value can be given this transfer; however, increased knowledge of newly trained pilots could have significant bearing on flight safety. (This problem came to our attention through our continuing dialogue with this client.)

18. ELECTROMAGNETIC METAL FORMING IN AUTO BODY REPAIR - December 1965; Cecil Body Shop.

Problem - Development of an electromagnetic metal forming device to be used in auto body repair.

Solution - TUSC has provided the client with literature which relates to the problem.

Results - Since all of the contact has been by mail and since the client has not directly indicated what use he has made of the information, no definite statement

can be made at this time. However, the client has been generous in his praise for our assistance. (This problem came to us through mail from an Arkansas client.)

19. IMPROVED POWER SOURCE AT REMOTE OIL FIELD INSTALLATIONS - December 1965; Arkansas Power and Light Co.

Problem - A better power source at remote oil field installations.

Solution - Through a retrospective search on solar batteries and by other "in-house" mechanisms, we supplied the client with 12 abstracts and eight (8) NASA reports. Partially as a result of these, his original study of electrical power storage has now branched into chemical fuel cells.

Results - No tangible results are yet available. However, a letter from the client dated 22 December 1965 states, in part, "I, first of all, want to thank you for the excellent response given to my request. I want to assure you that the information I have received thus far has been very well in line with the data which I have presented." If this study comes to a successful conclusion, it could have wide adaptability in this area. (This problem came by mail from an Arkansas client.)

20. LOW FREQUENCY OSCILLATOR - December 1965; Oklahoma Aerotronics, Inc.

Problem - Availability of a low frequency, (LOKC), oscillator.

Solution - Through both a retrospective computer search and an "in-house" search, the client was provided 49 abstracts. He ordered three reports which he described as containing the exact information he needed.

Results - The client felt that the NASA reports he received were the result of two man-years of work directly related to his problem. The client is negotiating with the U. S. Navy on a contract to produce several items he was able to develop as a result of combining NASA information with information he developed himself. If successful, his operation may expand and more jobs will be provided for a relatively depressed area. (An active client brought this problem to us.)

21. PLASTIC PORTABLE WATER CONTAINER - December 1965; Shi-Maid Manufacturing Co.

Problem - Replacing an outmoded metal portable water container with a similar product made of a new material.

Solution - TUSC supplied technical information regarding fabrication methods and cost estimates for building similar containers from modern plastic.

Results - During the period of time required for TUSC to assemble the data from NASA and non-NASA sources, the client secured subcontracts for building sheet metal ducting for air conditioning. He does now have the necessary information upon which to base his decision regarding the manufacture of water cans. (This problem was brought to our attention through the local Chamber of Commerce.)

22. ESTABLISHMENT OF A MODERN PRECISION MACHINE SHOP - December 1965; Marvin Cochran.

Problem - Establishment of a modern precision machine shop.

Solution - A search was conducted and material supplied to the individual who was interested in said shop. Also, the NASA publication, "Selected Shop Techniques," was given to him.

Results - This man is now considering an investment of some $50,000 in equipment for a new facility in the area. Having this capability available in this geographic area whould be significant in itself.

23. (This is Transfer Case Number 4 - erroneously reported as Number 23 in Quarterly Status Report Number 3.)

24. IMPROVEMENT OF COLOR ENLARGING BY COMPUTER - March 1966; Hicks Photography Studio.

Problem - The measurement of exposure time for color photography printing and enlarging. Color enlarging is an expensive process and a few failures can be very costly. An analog computer is currently in use and the client desires to improve his exposure/success record.

Solution - TUSC provided the following reports for the client: N63-36016, "Computers--Analog, Digital or Hybrid?" N65-33035, "Analog Computer Using Fourier Series for Optical Spectrometry," N65-31025, "Analog Computer Methods for Parameter Optimization," N65-11667, "An Analog Computer Mechanization of the Hodgkin-Huxley Equations," N65-17346, "Design Considerations and Use of Analog Power Spectral Density Analyzers," N65-19668, "Time-Variable Time Delay for Analog Computer Simulations," N65-13586, "An Analog Solution to Viscoelastic Structural Problems," N65-13853, "An Analog Computer with Iterative Computing Facilities," N65-26751, "New Device for the Measurement of the Rate of Watches," N65-26972, "Simple Analog Computer for Solving the Abel Integral Equation," N65-25055, "Development of an Analog Memory Device Using a Magnetostrictive Delay Line."

Results - The client is currently in process of utilizing the information supplied by TUSC to develop a better

computer for his purposes. He feels that his expected success can be largely attributed to the support received from TUSC. If he does attain this new competency, his monetary saving will be significant. Although located in a rather remote area, this business is one of very few color photography laboratories in Oklahoma and a significant portion of his business comes from outside this geographic area. (This problem came to our attention after initial introduction to the client through a local Chamber of Commerce.)

25. WATER CORROSION - March 1966; Marine Engineering and Equipment Co.

Problem - Preventing corrosion of mild steel in the presence of water. The company is manufacturing styrafoam boat docks for fresh and salt water use. The structural forms that hold the styrafoam in place are subject to corrosion. At present, the company is using a hot dip galvanizing process which imposes a delay in production and a logistics problem due to the distance between the plant and the galvanizing facility.

Solution - TUSC supplied the following information: N64-30758, "Polyurethane Coatings Use and Performance;" A63-12008, "Coatings to Prevent Corrosion;" AD-261 549, "State of the Art of Bonding Fluorocarbon Plastics to Structural Materials."

Results - The company has adopted some of the technology learned from the reports; no estimate of monetary savings can be definitely made at this time, but it could run into thousands of dollars over a few years. (An active client brought this problem to us.)

26. BRAZING TITANIUM TO OTHER METALS - March 1966; Carpenter Machine Shop.

Problem - Most effective method of brazing titanium to other metals.

Solution - TUSC supplied the client with N65-20204,

"Investigation of Diffusion Processed in the Brazing of Titanium Alloys."

Results - The client indicated that by adopting methods described in the report he had been able to solve his problem. This client operates a machine shop and the monetary savings, though small, will be significant to him.

27. LIGHTWEIGHT PORTABLE SHELTER - March 1966; Marine Engineering and Equipment Co.

Problem - Locating a lightweight, hand laid structural material which can be formed without heat and nested for shipment.

Solution - TUSC supplied AD-621 522, "Strength Properties and Relationships Associated with Various Types of Fiberglass Reinforced Facing Sandwich Structure" from the Federal Clearinghouse.

Results - The client is continuing his study which involves plans for a lightweight, portable shelter. He indicated to us that the report will save them much effort which might otherwise have been wasted. (This problem came to us from an active client.)

28. FEASIBILITY OF OPERATING A MIXED FLEET OF TRANSPORT AIRCRAFT - March 1966; American Flyers, Inc.

Problem - Feasibility study of operating a mixed fleet of transport aircraft (jet and propeller).

Solution - TUSC supplied N64-12880, "An Advanced Method for Airborn Simulation" and A64-10349, "The Future of the Aeroplane in Civil and Military Fields."

Results - The main result was reported in transfer #16--the client decided he could operate a mixed fleet and ordered a "707" type transport plane. His present fleet consists of prop-driven, both reciprocating and turbojet aircraft. In order to remain competitive, he is faced with the necessity of modernizing his fleet. He obviously expects a fair return on an 8-1/2 million

dollar investment but it would be very difficult to access TUSC's contribution in monetary terms. The client has indicated to us that our information has saved his staff many hours of work. (This problem came to us from an active client.)

29. SAND-PAINT MIXTURE FOR HIGHWAY SURFACE MARKERS - March 1966; W. L. DeLay.

Problem - Perfection of a sand-paint mixture for use as highway surface markers which would have high durability.

Solution - TUSC provided Tech Brief 65-10156 with the back-up package and other information developed in the Center.

Results - Sand for making reflective materials for highways and for reflective tape is produced near one of our area cities. Our client would like to combine this natural sand with a carrier of the inorganic paint and thus make a very durable product. If he is successful, this could be a highly significant transfer. It is too early to assess tangible results at this time. (This problem came to our attention through another active client.)

30. MAINTAINING CONSTANT VISCOSITY OF HYDRAULIC FLUIDS - March 1966; Coin-Operated Equipment Manufacturing Co.

Problem - Maintaining a constant viscosity of hydraulic fluids in outside temperatures of from 120 degrees F to minus 20 degrees F.

Solution - TUSC provided A64-22568, "What's Hot in Hydraulic Fluids?"

Results - This client is engaged in research on a future operation which is certain to present this problem. The assistance we provided enabled them to solve the problem before it actually arose and will allow them to save time and effort which would have been expended in solving the problem. No monetary saving can be assigned this solution at present. (The problem came to us from an active client.)

31. STRESSES ON UNDERGROUND FIBERGLASS PIPE - March 1966.

Problem - Evaluation of stresses on underground fiberglass pipe.

Solution - TUSC provided Technical Note D-3177, "Experimental and Analytical Studies of Cryogenic Propellant Tank Pressurant Requirements."

Results - The company has been quite proprietary in its dialogue with TUSC. They have indicated that our assistance did help solve their problem; however, we have absolutely no way of assessing the value of this assistance. (This problem came to our attention as the result of an initial visit to the firm by an Industrial Specialist.)

32. WARPAGE OF ALUMINUM ASSEMBLY DURING WELDING - March 1966; Stromberg-Carlson (formerly General Dynamics).

Problem - Warpage of aluminum assembly during welding.

Solution - TUSC provided SP 5024, "Bibliography on Welding Methods," and Midwest Research Institute's publication, "What's New in Welding."

Results - The client found the literature helpful in increasing his technical capability. He has not yet solved this specific problem and we are continuing to work with him. TUSC counts this as a transfer in that we have increased his level of technical competency. (This problem came from an active client.)

33. FABRICATION, STRUCTURAL ANALYSIS, AND THERMAL QUALITIES OF "FOAM PLASTIC" - March 1966; Jo-Ray Corporation.

Problem - Information was needed regarding fabrication, structural analysis, and thermal qualities of "foam plastic" for a client considering the expansion of his product line.

Solution - TUSC provided the following information: N64-22626, "Foamed Plastics on a Base of Organosilicon Resins and Their Combinations with Organic Polymers," N64-23719, "Expandable Foam-In-Place Shelters and

Related Terms," N64-17143, "Investigation of Mechanical Properties of Foam-In-Place Sandwich at Elevated Temperatures," N64-16412, "Structures with Foam Plastic Fillers," N64-12920, "Bonding of Foam Plastics by Means of High-Frequency Heating," N65-11840, "Feasibility of Monolithic Foam Radomes," N65-24656, "Development of Flexible Foamed Filled Structures, Phase I," N65-21426, "Development of Low Density Rigid Polyurethane Foam for Use of S-1C Flight Vehicles," N65-28944, "Low-Cost Plastic Foam Molds for Laminated Plastics," N65-27012, "State of the Art in Plastics," A66-12769, "Strength of Sandwich Panels with Thin-Film Facings and Foam Cores," N65-27639, "Development of a Predistributed Azide Base Polyurethane Foam for Rigidization of Solar Concentrations in Space."

Results - The company has made no final decision as of this report. However, it has indicated that the information supplied by TUSC has given a complete basis for making this decision. Should a positive decision be made, a small business in a struggling community will be strengthened, partially through TUSC efforts. (This problem came to us from an active client.)

34. (Reported in detail in Appendix I.)

35. ELECTRETS - March 1966; Harold Fristoe.

Problem - A researcher is doing work on electrets and needed to have current NASA-generated information on the subject.

Solution - TUSC provided our own retrospective search capabilities and those of ARAC to this researcher. The searches produced 12 pertinent abstracts.

Results - This researcher is located at Oklahoma State University. This is reported as a transfer because TUSC feels that cooperation between the two institutions in this form is indeed a transfer in an important sense. TUSC provided this researcher with capabilities previously unavailable.

36. INORGANIC PAINT - June 1966; W. L. DeLay.

Problem - The client has been working with the paint formula as outlined in NASA Tech Brief #65-10156 for some two months. He has formulated approximately thirty-five different mixtures using the Tech Brief and back-up materials as a guide. He has not been satisfied with the results of his experiments because the resulting product did not have the appearance of "paint." On June 6, 1966, the client was introduced to R. Hunter Kemmet, Quality Engineer for United States Gypsum Company, Southard, Oklahoma. Mr. Kemmet has successfully formulated a high temperature coating using the basis of Tech Brief #64-10226 with notes GSFC-165B attached. After examining Mr. Kemmet's work and seeing samples of his mixture in use, our client concluded that he had formulated about the same product himself. He is carefully examining inorganic paint with the intention of going into commercial production. He believes that he can improve on some of the characteristics of the material and make a marketable product of use to the oil refining industry.

Solution - The tangible benefits to the client in this transfer are not readily measurable at this time. He, himself, has contributed well over one hundred hours (the writer's estimate) in the laboratory and library examining the chemical aspect of the paint. He has probably spent many hours thinking about the methods of production and his approach on sales. TUSC personnel have discussed all of these aspects with the client. TUSC has transferred the paint production idea, the basic chemical process for making the product, ideas on production, and has suggested marketing ideas. The client has access to sufficient capital to give the product a trial. He states that he will enter the oil refinery market on a test basis. If this entry meets his expectations, he will attempt to enter a wider market.

37. TEFLON COATING FOR PORTABLE OUTDOOR BARBEQUE GRILL - June 1966; James Vanoy.

Problem - The client has invented and patented a portable outdoor barbeque grill. This grill is designed to be carried in the trunk of an automobile. The construction of the grill is sheet metal with insulation material used within the paneling to attain greater efficiency in utilizing heat from the charcoal. The client thought of using Teflon coating on the 1/16" expanded metal grill as a sales attraction for simplicity of cleaning, since this grill was designed to be portable. Since the first TUSC contact was made, he has installed $8,000.00 worth of sheet metal equipment such as a 72-inch metal brake, a spot welder, a crimper, a 72-inch shear and numerous hand tools.

Solution - After searching our files, and submitting a search request to ARAC on coating of Teflon to steel, we provided N65-17427, "Fluidization Bed Coating Organic and Inorganic Materials," to him. He has used the information in this report to prepare the coating for his product. The client has recently started manufacturing the product. For the time being, he is going to build these units himself, in his spare time. He had checked with three other manufacturers in our 17-county area before he made the decision to manufacture the grill himself. This client's portable charcoal grill is now being marketed commercially on a substantial scale.

38. CUTTING STANDARDS FOR MACHINE TOOL WORK - June 1966; Red River Research and Manufacturing Co.

Problem - The client is presently doing machine work for General Dynamics Corporation, Amercoat Corporation, Collins Radio Company, Tinker Air Force Base, and several other concerns. The problem was to increase his efficiency level.

Solution - During a preliminary hand search, we noticed a NASA report, #N66-11907, entitled "Metal Cutting Standards - Turning and Boring." This report provides metal cutting standards data for turning and boring operations covering a wide range of feeds, speeds, and depths of cut based on an eight-hour tool life. Information is included on surface finish and power requirements to aid in the selection of data from these tables. Although these standards were set up primarily for use on numerically controlled equipment, they will work just as well on conventional machine tools. After the client had studied the report for several weeks, an Industrial Specialist called on him to see if the report was beneficial. The client told the Industrial Specialist that his future plans were to expand his plant to twice its present size, and employ several more machinists. This report will be used as a basis for all of his machine tool setup work. The client is well acquainted with TUSC and had used our services several times. The Industrial Specialist also introduced him to buyers of Collins Radio Company, Dallas, Texas. As a result of this, he is doing subcontract work for them at this time. The client also learned through TUSC of the Manpower courses that were in operation at Southeastern State College. As a result of this, he hired five of the machine tool operators, and is well satisfied with the quality workmanship that they are producing. As stated previously, he has planned an expansion of his facilities, and has on order approximately $150,000.00 worth of precision machine tools.

39. SALVAGE OF POTTED CONNECTORS - June 1966; Stromberg-Carlson (formerly General Dynamics).

Problem - The client had a subcontract for fabricating multi-circuit electrical cables for NASA's launch activities at Cape Kennedy, Florida. They were having difficulties meeting the "no failure" criteria

set for this product.

Solution - Among the twenty-seven abstracts we went, they found information contained in reports #A65-11166, "A New Concept - Low Density Elastomer for Missile and Space Systems," and #A64-22285, "An Evaluation of Inorganic Potting Compounds," contributed to the final solution of their potting difficulties. They were able to innovate with the information gained from these reports and through the innovation, salvage many potted connectors. For example, they learned to detect and fill voids with a medical hypodermic needle. The tangible benefit to the client is measurable in that his reject rate has almost reached the zero level. The intangible result is that by combining his "in shop" capability with the experience recorded in the mentioned reports, he has been able to advance the state of the art in potted connections. The client has benefited technically; however, they are unable to determine the exact portion of the benefits which came from the cited reports. The actual transfer is as much a stimulation through suggestion as it is a transfer of "bolts and nuts know-how."

40. MATERIAL FOR TREE CUTTER BLADE - June 1966; Jack Bain and Associates.

Problem - The client invented a new type tree-cutter blade that can be used on a "brush hog" type mower. His first material used for the blades was a mild steel plate. He cut this plate with a cutting torch and hand shaped the cutter blades to the proper angle. The mild steel was easily worked by hand, but was too low in carbon content to give the desired toughness that it would need to be desirable for this use. The client is not equipped with sophisticated machine tools and this makes his requirements harder to fill.

Solution - Through abstracts that we sent him, and by reference to commercial steel companies, the client decided that there were several good materials that

would be feasible for this use, but that the cost for the space age exotic steels would be prohibitive. We recommended, after talking with several steel companies, that a T-1 material, manufactured by Sheffield Steel Co., could be used, and also a SSS-100, manufactured by United States Steel, could be used. These materials have the workability, the strength and ability to hold a cutting edge. Also, they are relatively inexpensive materials. The tangible benefits to the client cannot be measured at this time, since he is not in actual production. The client has spent several months in perfecting the blades, and also has spent a considerable amount of money. His first problem, which was very time-consuming, was in perfecting the proper tooth design for the cutting edge. TUSC considers this a transfer in the sense that we found that new materials developed through the space program would work; however, due to the expense involved, others were utilized.

41. TEFLON COATING FOR PORTABLE OUTDOOR BARBEQUE GRILL - June 1966.

Problem - Another client operating independently, has devised a portable outdoor barbeque grill. He feels that a Teflon coating on the actual grill would be a sales attraction, as it would make the grill easy to clean.

Solution - A copy of NASA report #N65-17427, "Fluidization Bed Coating Organic and Inorganic Materials," was provided. A search request concerning Teflon was submitted to ARAC, and the abstracts resulting from this search were mailed to the client. We have also mailed some technical reports and application material received from DuPont to him. We hope this transfer will result in a new line for an area manufacturer.

42. MATERIALS FOR NEW TYPE FOOTBALL LINE YARD MARKER - June 1966; Norwood Brothers.

Problem - Our client has invented a more efficient football

line yard marker. He was seeking advice on materials to be used for the marker.

Solution - Several calls and visits were made to plastic companies and plastic tubing manufacturers before a suitable plastic could be found. The material required would have to be 1 1/32" I.D. and 1 3/4" O.D. This material would also have to withstand hard jolts without breaking, and would also have to be flexible enough to bend and return straight. The companies that we contacted were primarily in manufacturing oil field corrosion-resistant line pipe. We finally located a suitable plastic tubing that met the requirements from a steel and plastic company. The material they suggested is under the brand name of Omicron. This is a chloride having only the minimum additions of stabilizers, pigments and lubricants necessary to produce extrusions or moldings of the highest quality. The company sent us samples which we gave to the client with recommendations on processing the rest of the marker. The bottom of the marker has a 6" steel spike to be driven into the ground. There is a 5/16" eye bolt pin to secure the spike to the plastic tubing. At the top will be a flashing light which will be purchased on the commercial market. This transfer may result in a new industry for the area.

43. (Reported in detail in Appendix I)

44. FEEDBACK IN AUDIO EQUIPMENT - June 1966; McAlester Federal Aviation Station.

Problem - A Federal Aviation Station located at one of our area airports was experiencing difficulty with feedback in some of their audio equipment. They had attempted to solve the problem themselves with little success.

Solution - A TUSC engineer made a routine call on the facility and was able to correct the problem for them in a very simple manner. Changing the position of

several inputs was all that was necessary. This is a unique kind of "transfer" of knowledge, but one which TUSC feels is important.

45. IMPROVING CURRICULUM OF SOUTHEASTERN STATE COLLEGE INDUSTRIAL EDUCATION DEPARTMENT - June 1966.

Problem - Updating the Southeastern State College Industrial Education Department with regard to cutting speeds and feeds and cutting tool design for use on all metals.

Solution - NASA report N66-11907, "Metal Cutting Standards - Turning and Boring" is being used to update the curricula of both college courses and Manpower Development and Training Act courses operated by the college. The benefits are obvious.

46. (Reported in detail in Appendix I)

47. CANCER RESEARCH - September 1966; Noble Foundation.

Problem - A research foundation is presently engaged in cancer research. They desire bio-medical information from the NASA program which might benefit their research.

Solution - TUSC provided a state-of-the-art awareness to this foundation. Researchers indicate that information supplied will keep them from duplicating some experiments which had previously been accomplished, thus saving considerable time, energy, and money.

48. INDUCTION BRAZING FOR SUBSTRUCTURES OF ELECTRONIC COMPONENTS - September 1966; Oklahoma Aerotronics, Inc.

Problem - The use of induction brazing for substructures of electronic components. Problems have been encountered previously with discoloration of anodized aluminum during welding and with distortion and warping due to other high heat processes.

Solution - Little information has been written on induction brazing since this is a new field of welding. However, most work that has been done is in the space program. The information provided by TUSC has allowed the client to continue his experimentation with the process which

he hopes will prove successful.

49. INSULATION MATERIAL FOR USE BETWEEN THIN GAUGE METAL - September 1966; Coin-Operated Equipment Manufacturing Co.

Problem - To find a suitable insulation material for use between two pieces of thin gauge metal. This is for use in a portable building, similar to a house trailer, to house a coin-operated laundry.

Solution - TUSC supplied much NASA and non-NASA information on the subject. The client is still in the developmental stage of this project; however, he has indicated that the information we have supplied could speed his efforts and assist in cutting labor and material costs. The potential impact of this transfer is quite significant due primarily to the innovational traits of the client. An example of this is his prior development of the pressurized auto wash.

50. TRANSPORTING HEAVY, PORTABLE COIN-OPERATED LAUNDRY - September 1966; Coin-Operated Equipment Manufacturing Co.

Problem - This same client needed information relating to movement of the heavy, portable coin-operated laundry.

Solution - The NASA literature contained information relating to spacecraft surface transportation which has bearing on the client's problem.

51. IMPROVED MATERIAL FOR WALKWAYS BETWEEN BOATHOUSES AND BOATDOCKS - September 1966; Marine Engineering and Equipment Co.

Problem - Finding a better material to use for walkways between floating styrafoam boathouses and boatdocks.

Solution - TUSC provided information which the client is using in his continuing experiment to find such a material. At present, it appears that he may be able to effect a considerable savings in manpower if the experiment is successful.

52. IMPROVED PRODUCT TO USE IN FRACTURE TREATING OIL WELL SAND FORMATIONS - September 1966; Fibre Reduction, Inc.

Problem - The need for a better product to use in fracture treating oil well sand formations.

Solution - Although still very much in the experimental stage, it appears that, with assistance from ARAC, a suitable material has been found. It should be much cheaper than the previously used material, and, if successful, will effect significant savings to the oil industry.

53. WELDING TECHNIQUES - September 1966; Stromberg-Carlson (formerly General Dynamics).

Problem - Warpage and leaks developing around welds due to different thicknesses of metals to be welded.

Solution - Although still in the experimental stage, it appears that some of the NASA developed welding techniques will prove useful to the solution of this problem.

54. UPGRADING TECHNICAL TRAINING AT OKLAHOMA SCHOOL FOR THE DEAF - September 1966.

Opportunity - To assist the Oklahoma School for the Deaf in its technical training efforts. The vocational courses offered include printing, carpentry, dry cleaning, laundry work, electronics, photography, drafting, and cooking.

Response - TUSC has provided much information, primarily in the form of Tech Briefs and Special Publications. The benefits which could be derived from upgrading the educational opportunities available to handicapped persons are very significant.

55. UPGRADING TECHNICAL SKILLS OF OKLAHOMA STATE HIGHWAY DEPARTMENT ENGINEERS - September 1966.

Opportunity - To assist in upgrading the technical skills of a portion of the Oklahoma State Highway Department.

Response - One of TUSC's Industrial Specialists had seen a series of reports published by the Department of

Commerce which he felt would be very useful to highway engineers. The engineer involved was unaware of these reports and indicated that they would be of much use to his department.

56. MACHINE TEACHING OF AIRCRAFT MECHANICS - September 1966; American Flyers, Inc.

Opportunity - Application of an "informational package" on Machine Teaching. The shortage of mechanics was brought to the attention of training personnel in the Department of Labor by the aircraft machinist strike during this summer.

Response - Through the suggestion of TUSC, a dialogue developed between American Flyers and the Department of Labor on the subject of training aircraft mechanics. Negotiations were entered into between the Department of Labor and American Flyers. The negotiations are held up at this date by corporate level studies of the training proposition in American Flyers. During the development of the proposal, the corporate decision machinery decided that American Flyers would include contract aircraft maintenance as a part of their total program. This is a new venture for American Flyers since they have never trained ground crewmen before. The decision was made to train 350 aircraft mechanics for the contract maintenance program. A fallout of the aviation training study program (as reported in the TUSC Quarterly Report dated 30 June 1966) was the accumulation of considerable machine training information within TUSC. American Flyers personnel responsible for training the 350 mechanics realized the enormity of their task and requested help from TUSC in developing "training aids." TUSC provided an internally-developed package on machine teaching.

The client attaches considerable importance to this venture. It marks a distinct turn of the 26-year old firm's area of interest. Where there is a need for perhaps 2,000 new cockpit personnel each year, there

is a requirement for approximately 4,000 maintenance specialists. The client has presently enrolled approximately 250 cockpit students. Should this program develop, their student enrollment would double immediately. It would require the employment of approximately 12 instructors and 2 clerical personnel.

A dollar value of TUSC's contribution would be extremely difficult to ascertain. American Flyers would have gone into the program without aid from TUSC, but they express their appreciation for the information this organization has furnished which gives them an entry level into this training field which has not been attained to date by some of the junior colleges which have been in the business a decade or more.

57. ETCHING STAINLESS STEEL - December 1966; Systems Engineering Electronics, Inc.

Problem - A client who fabricates instrument dials, clock faces, etc., had a need to use stainless steel in this application. The problem was how to etch stainless steel.

Solution - TUSC retrieved 15 abstracts from STAR and IAA and the client stated that five of these reports furnished more information pertinent to his problem than he had been able to find in a previous four-month search. A "package of information" pertaining to this subject was assembled from open literature and forwarded to the client. He indicated that he was highly pleased with our service. Since this initial contact with this client, we have received by mail requests for searches on six additional subjects. The only indication we have of the rating we have earned with this firm is the volume of work they are requesting.

58. DEVIATION FROM IDEALITY OF A PERFECT GAS - December 1966; Sunray D-X Oil Co.

Problem - A client is conducting a study toward utilizing natural gas from a reservoir under 22,000 PSI pressure

and 400° temperature. He requested information on "the deviation from ideality of a perfect gas."

Solution - Seven abstracts which appeared to be pertinent to the problem were forwarded; however, no direct appraisal of these abstracts by the client has been given. He did indicate that we provided significant assistance. (This is a large company we are working with on an experimental basis.)

59. DUST DETECTION EQUIPMENT - December 1966; Pennsylvania Glass Sand Co.

Problem - To find possible dust detection equipment to be used by a company that processes glass sand beads. The processing technique emits minute particles of sand into the air creating a health hazard to the employees.

Solution - TUSC supplied the firm with NASA literature which relates to the problem. By using a method to detect the dust particles a serious health problem could be avoided.

60. BRANDING IRON FOR COLD BURNING ANIMALS - December 1966; Noble Foundation.

Problem - A research foundation is looking for a suitable material, preferably plastic, to experiment with a new kind of branding iron. They have considered using cryogenic liquids to cold burn the hide of the animal. The problem has been in finding a material for the cryogenics to penetrate.

Solution - Both NASA and non-NASA information was supplied by TUSC to the client. He indicated that it was useful.

61. THERMOSETTING AND THERMOFORMING PLASTIC TECHNIQUES - December 1966; Fibre Reduction Co., Inc.

Problem - A client is studying the possibility of entering either the thermosetting or the thermoforming plastic business. Information on these technologically sophisticated processes was requested.

Solution - TUSC supplied materials from the trade journals relating to these techniques.

62. ELECTRONIC WATER FILTERING IN SAWMILL STEAM BOILER - December 1966; Herron Industries, Inc.

Problem - A client requested information on electronic filtering processes for water to be used in a steam boiler for powering sawmill machinery. A city water supply, containing various chemicals for health purposes, is the power source. These chemicals need to be removed before the water enters the gas-fired steam boiler in order to avoid build up of an alkali formation.

Solution - The TUSC Industrial Specialist put the client in contact with a company which recently became the Southwest distributor for electronic water filtering processes. They solved the problem.

63. EUTECTIC EUTALOY PROCESS FOR REPAIR OF PLASTIC INJECTION MOLDS - December 1966; Durant Electronics Co.

Problem - A toy manufacturer was experiencing problems with machinery used in the manufacturing process. The small edges of the plastic injection molds were chipping and breaking. Use of standard electric welding procedures proved unsatisfactory in making repairs.

Solution - The Industrial Specialist was familiar with and demonstrated a new type powdered metal process known as Eutectic Eutaloy. The firm decided to try the new technique and can possibly save several thousand dollars a year as a result. One plastic injection mold costs approximately $6,000 and when damaged may have to be discarded. The new welding process can be used for repairing molds and for other applications in the factory.

64. EXPERIMENTAL ELECTRIC WHEEL CHAIR - December 1966; E. M. Richison.

Problem - Slippage in the drive mechanism of an experimental electric wheel chair.

Solution - The TUSC Industrial Specialist was aware of a

new type rubber gear belt and pulley assembly which would completely eliminate the problem. The client believes that use of the suggested mechanism will greatly improve performance of the wheel chair.

65. TEFLON COATING ON PRODUCTION MOLD - December 1966; Taylor Granite Works.

Problem - Polyester resin sticking to the mold in the production of novelty items. The finished product emerges with its surface marred.

Solution - An interest profile report using non-NASA monthly publications and a search on Teflon Coatings was implemented. The client had very good results with Teflon coating; therefore, an aerosol Teflon application was ordered for test purposes.

66. TEFLON TAPE FOR PACKAGING PRODUCT - December 1966; Pennsylvania Glass Sand Co.

Problem - A client has been experiencing difficulty in the packaging of his product for shipment. Small quantities of the sand are sometimes shipped in paper bags which have a plastic filler hole that is self-sealing as the bag is filled. The temperature of the sand flowing through the filler nozzle tends to melt the plastic sealer. A plastic that will not deteriorate under the temperature generated is needed for the filler openings.

Solution - After some investigation we recommended using a Teflon tape wrapping on the filler tube to avoid contact with the plastic bag. This apparently solved the problem.

67. AIRPORT PLANNING AND CONSTRUCTION - December 1966; Ardmore Industrial Airpark.

Problem - The city of Ardmore, Oklahoma, is considering extending concrete runways at the Ardmore Industrial Airpark in order to accommodate a Boeing 707. City officials desired basic information about runway

planning and construction.

Solution - A search yielded some NASA literature in this area which was provided for the city engineer. Although the FAA will supervise construction, the city engineer needed this information.

68. WARPAGE OF FRAMEWORK FOR FOLD-UP QUONSET TYPE TENTS - December 1966; Stromberg-Carlson (formerly General Dynamics).

Problem - Twisting and warping around welded joints on the framework for fold-up Quonset type tents. This results in many frames not meeting required specifications.

Solution - Information was provided which appears to be responsive to the solution of the problem.

69. MEASURING RELATIVE HUMIDITY - March 1967; Oklahoma Peanut Commission.

Problem - A client stated that he needed a means for determining the relative humidity of air after it was heated for conventional peanut drying.

Solution - TUSC provided him with a psychrometric chart and instructions for employing the chart.

70. ETCHING STAINLESS STEEL FOR ORTHODONIC DEVICE - March 1967; Systems Engineering Electronics, Inc.

Problem - How to etch stainless steel.

Solution - The client states that the information he received through report N66-13249 saved him at least sixty days work. He would not have had time to do the work saved by this report; consequently, his company is able to move into the civilian market with an orthodonic device which costs, under present technology, approximately $600.00. The etching technique they use with stainless #304 allows them to fabricate a better item that will retail at approximately one-tenth of the present cost. They believe their innovation will be applicable to other civilian usage.

The firm was supplied with fifteen abstracts covering the subject of "chemical milling of #304 stainless steel." We also called the client's attention to five articles in the 1966 issues of Materials in Design Engineering. He requested and received five reports outlined by these abstracts. He said that several of the reports and articles gave him much needed background information. He attributes the success of his project to the report N66-13249, and to Part II of report N66-26277. He foresees $100,000 worth of civilian business over the next few years resulting from this technology transfer.

71. INTERSTITIAL ATOM DIFFUSION IN FACE-CENTERED CUBIC METAL - March 1967; Don Harper.

Problem - What is the latest information on interstitial atom diffusion in face-centered cubic metal?

Solution - Fifty-nine abstracts were retrieved in a combined hand and computer search. This was one of the most difficult searches TUSC has conducted. Our hand-retrieved abstracts were mailed 7 November, and the computer search results were mailed 16 January. As yet, we have no indication from the client as to the pertinence of the abstracts.

72. REPORT OBTAINED - March 1967.

Problem - A client noticed a report in a weekly newsletter which he wanted. The letter did not give an accession number. The client gave us the name of the author and the subject matter covered in the report.

Solution - In the "author index" we found a reference to the report and the contract number. Through the contract number we were able to trace the originator to the Naval Avionics Facility, Indianapolis. We got the report to the client within ten days.

73. FIRE AND THEFT DETECTION BY MEANS OF INFRARED LIGHT SOURCES - March 1967; Coin-Operated Equipment Manufacturing Co.

Problem - To explore different methods of fire and theft detection by means of infrared light sources.

Solution - A client asked that TUSC search for information

on infrared that would pertain to theft and fire detection. He owns a chain of open front grocery stores, and is in the process of opening a coin-operated popular item grocery. He anticipates the theft rate to be exceptionally high in this type operation because no attendants will be used after 10:00 p.m. or before 7:00 a.m. The equipment would be well marked as theft detection equipment to discourage any vandalism or burglary.

The client was supplied with an Edmund Catalog #665 from Edmund Scientific Company, Barrington, New Jersey, and a copy of NASA report N66-29387, "An Expansion of the E. V. System."

74. ECONOMICAL PROCESS TO MAKE NUMBERS FOR BRANDING IRON - March 1967; Durant Animal Hospital.

Problem - To find an economical process and material to make numbers for branding cattle.

Solution - The Durant Animal Hospital asked TUSC to find an economical process to make numbers for branding. The numbers on the commercial branding iron are priced at $7.00 to $10.00 each and they felt this was too expensive for the average farmer or rancher. A complete set of numbers would cost $90.00 to $100.00. The process to be used would be a super-cooled iron cooled with liquid nitrogen which would give the animal a cold burn instead of the hot burn that has resulted in the past. The cold burn has many advantages over the hot burn, one being that the cold burn does not leave rawness that is likely to become infected. The Industrial Specialist involved had used a technique developed by trial and error which he thought would prove effective and would be easy to work. By using a commercial modeling clay and mixing asbestos particles, the material can be worked easily and is fireproof. The metal used is a babbit material which is also easy to work. Babbit is a lead-tin-zinc material that has a melting point of about 600° F. and can be melted and poured. After the material sets up in the clay mold,

it will be tough and stable.

The firm also asked for information on other metal materials that could possibly be used. These were aluminum, copper, and steel; however, the melting point of these materials is too high and it cannot be worked without special equipment.

75. CHEMICAL TO DISSOLVE CALCIUM SULPHATE DEPOSITS IN OIL WELLS - March 1967; Taylor Oil Well Servicing.

Problem - To find a chemical that will dissolve calcium sulphate deposits in oil wells.

Solution - This company is seeking a chemical that can be used in oil well pumps to dissolve slag formations that build up on pump parts in oil wells. The chemical would have to be pumped down the casing to the working barrel where the formation is most prominent. The chemical desired would also have to be non-corrosive to mild steel, brass, and chrome. An "in-house" search was conducted by TUSC and a computer search was conducted by ARAC but neither produced any new chemical of this type. Calls were made to DuPont Company in Dallas and Houston. The Houston office referred us to the Visco Division of the Nalco Chemical Company in Houston. This company is in the business of water treatment for the oil industry and has done quite a bit of work in this field. They told us of their product, Visco 900. This product is a specially prepared formula of an inorganic dry acid containing an inhibitor against attack on ferrous metals. It is principally used for the removal of sulphate and iron deposits in equipment, producing oil wells and water injection wells. This information, plus results of a search of The Oil and Gas Journal for this type product, was sent to the client.

76. MACHINE SHOP CONVERTS TO MANUFACTURING WORK - March 1967; Gaither Machine Shop.

Problem - Making a decision whether to stay in the

machine shop business as a job shop or change to a subcontracting facility.

Solution - At the time of the initial contact, this machine shop was doing job work. The owner was not satisfied with this type work. After an explanation of TUSC, he asked if we had any information regarding subcontract possibilities.

The Information Specialist left NASA SP-5010, "Selected Shop Techniques," and MRI report, "What's New in Welding." We also sent a list of NASA prime contractors which was secured through the Manned Spacecraft Center in Houston.

The owner contacted several companies that were doing prime contracting for NASA in regard to subcontract work. He found that this field was wide-open and decided to close his job shop and tool up for production work. He has bought three automatic screw machines, three radial drills, and several other pieces of machine tool equipment. He is now making parachute hardware for a major aircraft company. The client gave TUSC credit for helping him make the decision to go into manufacturing work.

TUSC also sent him report N66-11907, "Metal Cutting Standards - Turning and Boring." He said this report was invaluable to his shop employees in setting up cutting speeds for automatic machines.

77. METAL SUITABLE FOR BULLDOZER POWERED TREE SAWS - March 1967; Jack Bain and Associates.

Problem - To find the specifications of a metal with characteristics which would make it suitable for bulldozer powered tree saws.

Solution - The information already provided another client in the development of his stump cutter was equally applicable to this usage. The client was provided with the metallurgical number and the supplier's name and address.

78. CONTRACTING FOR RESEARCH - March 1967; Oklahoma Peanut Commission.

Problem - How to contract for research.

Solution - A six-page article in the February, 1967, issue of Research and Development magazine entitled, "Your Money's Worth from Outside Research," by Paul J. Lovewell, a recognized expert in research consulting service, was forwarded to each member of the Oklahoma Peanut Commission's Technical Committee. This was an educational effort on our part which should reap future rewards.

79. METAL AND TUNGSTEN INERT GAS WELDING - March 1967; Stromberg-Carlson (formerly General Dynamics).

Problem - To find state-of-the-art reports on Metal Inert Gas Welding and Tungsten Inert Gas Welding.

Solution - Many improvements on the old standard ways of welding have been made in the past few years. Modifications of conventional methods have produced many benefits in the welding field. Distortion,

warpage, and speed of welding operations are just a few of the advantages of the new processes. This company asked for these reports not specifically to solve a problem, but to educate the operators.

80. KILN-DRYING PROCESS FOR SAWMILL OPERATIONS - March 1967; Ravia Sawmill.

Problem - To set up a kiln-drying process for sawmill operations.

Solution - The owner of an area sawmill is considering the possibilities of installing a kiln dryer at his sawmill. He asked TUSC to provide information on kiln-drying processes, temperatures that should be used, equipment needed, and acceptable moisture content in lumber. The owner is rapidly expanding his operation and in order to best utilize his equipment and provide a top-grade lumber, he feels a kiln would be necessary.

A search was made in the college library and copies of pertinent articles on kiln-drying were sent to this client.

81. IMPROVED INK TO STAMP ELECTRONIC PARTS - March 1967.

Problem - To find a better ink to stamp electronic parts.

Solution - After electronic components are manufactured and finished, government requirements state that these parts must be stamped with a number in ink so that the parts may be identified. This is done to simplify parts identification in case of repairs. These parts are subjected to handling, heat, and other abuses which tend to eradicate and smear the numbers. Government inspectors have not been satisfied with the ink the company is presently using. The ink they use now is an epoxy ink.

A search request was submitted to ARAC and a hand search was done by TUSC. Neither revealed any information in this field.

A search was done in Material in Design Engineering, and Modern Plastics, and quite a bit of information was found on commercial inks for the purpose of marking metal parts. The company is in the process of contacting suppliers of commercial inks. The company appreciated the services TUSC had rendered because they had neither the publications to search, nor the time.

82. HIGH RESOLUTION PHOTOGRAPHY - March 1967; J. L. Harris.

Problem - To locate information on high resolution photography.

Solution - A client is in the photography business specializing in high resolution photography. He has developed and patented a machine for the development of large photographs. He has also asked that we contact NASA officials for the possibilities of his doing work for NASA.

A search was done on high resolution photography and fifteen abstracts were sent to the client.

83. STRONG EPOXY ADHESIVES - March 1967; Hasco Manufacturing Co.

Problem - To find strong epoxy adhesives.

Solution - During oil well drilling operations, it is necessary to set casing in order to seal off undesirable elements from the hole. The casing also serves as a guide for the drill pipe during drilling operations. After the initial hole is drilled, the hole must be reamed to the size of the casing. The casing is then screwed together and at the present time must be welded before it can be lowered into the hole.

An epoxy cement that would be durable and strong enough could be used in the threads to block them together permanently and eliminate welding the joints together. A search was made in STAR and IAA and the company was sent twenty-seven abstracts. They ordered three reports, SP-5066, "Adhesives, Sealants, and Gaskets," N66-21445, "Epoxy Compounds and Their Appli-

cations," N66-31240, "Locking of Threaded Fasteners."

84. FIREPROOF AND DURABLE THREAD FOR SEWING WORK GLOVES - March 1967; Wells-Lamont Corporation.

Problem - To find a better thread to sew work gloves.

Solution - A thorough search was made in STAR and IAA plus the auxiliary library. Very few abstracts were found and only one seemed to be of a useful nature. The company is having a problem finding a suitable thread which is fireproof and also durable enough for heavy work glove construction. NASA report N66-36227, "Development of Revised Simplex Fabric for Summer Flying Gloves," came to our attention as a result of the search and was sent to the company. This report deals with a knitted fabric which was developed for use in flying gloves which would give better protection in the event of exposure to flames or extreme heat. This report was in the exact area of the company's interest.

85. IMPROVED METHOD OF BRAZING ELECTRONIC PARTS - March 1967.

Problem - To find a better method of brazing electronic parts.

Solution - This company is constantly looking for better methods of brazing small electronic parts. NASA report N67-12705, "Induction Brazing," came to our attention through an Industrial Application Report, and a copy of the abstract was sent to them. Induction brazing is a process which utilizes the capillary flow to insure greater surface area and additional strength, resulting in a better weld. This process has the advantage of low temperature which minimizes warpage and prevents destruction of electronic parts. The company indicated that they are interested in any reports of this type that can be supplied and plan to utilize the information.

86. COMPUTER PROGRAMMING TECHNIQUES - March 1967; Gabriel Utz.

Problem - To find better methods of linear and mathematical computer programming.

Solution - The client asked us to find information on the latest techniques of computer programming. This type program is designed to improve the efficiency of scientific computing and system programming by automatic techniques. Thirty-one abstracts were sent by TUSC and 102 abstracts were sent as a result of the ARAC search. As yet, no assessment of these reports has been given.

87. SPRAY NOZZLES - March 1967; Gabriel Utz.

Problem - To locate information on spray nozzles which mix plastic resins and additives with conventional spray guns.

Solution - NASA Tech Brief 63-10318 was located. This Brief completely illustrates a new type nozzle. Also a search was made in Modern Plastics which revealed several types of spray guns now on the commercial market.

88. UPGRADING ELECTRONICS INSTRUCTION AT THE OKLAHOMA SCHOOL FOR THE DEAF - March 1967.

Problem - To find suitable study material for electronics students at the Oklahoma School for the Deaf.

Solution - As a result of the Ardmore Chamber of Commerce-TUSC meeting in Ardmore, instructors at the Oklahoma School for the Deaf noticed electronics material published by NASA. NASA SP-5002, "Reliable Electrical Connections," was especially noticed since it is very thorough. It was brought out that deaf students are much harder to teach than normal students and the SP was well illustrated and comprehensive. The school was given twelve copies of the SP and they plan to use it as a textbook. We also secured a NASA training film through Marshall Space Flight Center. The film will also be used as a training aid.

89. ALUMINUM BRAZING - March 1967; Mar-Jean.

Problem - To find state-of-the-art material on aluminum brazing.

Solution - This company is currently engaged in metal fabricating and welding. They are one of few shops in the area equipped for welding aluminum. There are several methods of welding aluminum, and the method used depends on the type aluminum that is being welded. A search was done in STAR and IAA and also in The Welding Journal from 1964-1966. Many abstracts were found and sent to the client. At this time it is probably too early for the client to have evaluated the abstracts. A report was made from open literature which revealed several practical and simple articles on aluminum brazing.

90. EVALUATION OF MOTOR OILS - March 1967; Joe Tidwell.

Problem - A client asked TUSC for information on evaluations of motor oils.

Solution - The client has an outside interest with a friend who is in the car business. They have had a lot of trouble with motor oils doing a thorough job of lubricating vital engine parts. They asked TUSC to find pertinent information on motor oil. A search in STAR and IAA was done and several reports were found. The client ordered N65-28624, "Method of Improving the Antiwear Properties of Lubricating Oils," and N66-11082, "Synthesis, Research, and Application of Sulfonate Additives to Lubricating Oils." Both of these reports were on oils which are intended for use in friction units and mechanisms with additives which would result in lowering of wear in lubricated parts and increase service. The client indicated that they were helpful.

91. SOLVENTS TO USE IN HIGH PRESSURE WASHING SYSTEM FOR AIRCRAFT - March 1967; Coin-Operated Equipment Manufacturing Co.

Problem - To find solvents to clean metal surfaces.

Solution - This company is developing a high pressure washing system for aircraft. This equipment is much like the automatic car washes except the pressure must be greater to cut heavy grease and oil deposits. A search was done in STAR and IAA and several abstracts were found. N65-11143, "Comparison of Solvents for Cleaning Metal Surfaces," was ordered. This report deals with a solvent testing program that was considered to determine the best solvent for cleaning operations.

There is a major problem in cleaning jet aircraft in that the jet fuel is an oil base and where the exhaust comes in contact with the metal surface, the oil tends to stack up. When the company gets its pressure equipment ready for operation, they have indicated that this report will be valuable in solving the problem.

92. (Reported in detail in Appendix I)

93. IMPROVED PLASTIC RESIN FOR FURNITURE FINISHING - June 1967; Wal-Zac Manufacturing Co., Inc.

Problem - To find a better plastic resin to finish furniture.

Solution - This client is having problems finishing furniture with plastic polyester resin. Between coats of plastic, the finish tends to develop small air bubbles which distort the finish of the product. A report from the open literature was compiled on new plastic finishes and causes of poor finishes. The client states the report has been of much benefit.

94. KILN-DRYING PROCESS FOR FURNITURE PRODUCER - June 1967; Wal-Zac Manufacturing Co., Inc.

Problem - To obtain knowledge of the state-of-the-art in kiln drying.

Solution - This client designs and constructs commercial furniture from rough oak timber. He starts the process in the woods where he fells the tree and takes it on to a finished product. His present plant does not include a kiln dryer. This type drying, compared with

air drying, would speed up his operations considerably. TUSC supplied the client with information and construction plans that he could build himself at a very low cost. TUSC also provided a report on processing raw lumber which was taken from Forest Industries magazine.

95. LASER WELDING - June 1967; Yuba Heat Transfer Corporation.

Problem - To find a better way to join light stainless steel tubing to heavy carbon steel.

Solution - The client asked for state-of-the-art on laser welding. The state-of-the-art has not advanced enough to put this type of welding into production usage.

96. EXPLOSIVE WELDING - June 1967; Yuba Heat Transfer Corporation.

Problem - The client's welding requirements are pushing the state-of-the-art. He is regularly welding thin wall stainless steel tubing to four-inch thick carbon steel and needs a better method of welding.

Solution - Explosive welding was examined for a solution to his welding problem. The method is not developed enough for production line usage.

97. WORK PERFORMANCE AND MAXIMUM NOISE LEVEL - September 1967; Systems Engineering Electronics Inc.

Problem - To determine the maximum noise level under which men can do useful work.

Solution - TUSC sent the client three NASA reports, N67-11677, "Material on the Physiological-Hygenic Basis of the Allowable Levels of Impulse Noise," N66-32496, "Maximum Level for Army Materiel Command Equipment," and N66-22768, "Human Performance as a Function of Changes in Acoustic Noise Levels." The last report covered the exact area of the client's interest. The others were peripheral in nature. The client has indicated that the information TUSC provided has saved him considerable time and effort.

98. LIGHTWEIGHT CONCRETE FOR HOUSE CONSTRUCTION - September 1967; Coin-Operated Equipment Manufacturing Co.

Problem - To find information on lightweight concrete for house or apartment construction.

Solution - This client is considering a new project utilizing lightweight concrete products in panel form. This type construction is not widely used at the present, but could become very popular when developed. The panels would be poured into molds and after drying be stored for future use. If this construction method proves successful, a house of 2,000 square feet could be constructed in less than a week. A search was done on the state-of-the-art of mixing lightweight concrete. Also, TUSC has a complete file of the Portland Cement Association Technical Bulletins. A field representative from the Portland Cement Association was contacted and was asked to work with the client. A search was also done in the NASA literature.

Four abstracts were found that were pertinent. As a result of the search, three NASA reports have been ordered. These reports dealt with research that has been done on concrete behavior. Also, five Portland Cement Association Technical Bulletins were ordered pertaining to the structural lightweight concrete field. At the present time it would appear that there is tremendous potential for significant transfer possibilities here. Future reports will give detailed information on the client's progress.

99. STEAM CURING CONCRETE - September 1967; Coin-Operated Equipment Manufacturing Co.

Problem - The present state-of-the-art in steam curing concrete.

Solution - This client has developed a new concrete panel for construction purposes that when painted resembles brick. This new type construction is very simple to assemble and is strong. The company plans to market the product for fencing purposes now, and later plans

to test the product for low cost housing. The client knows the product is strong enough for one story construction, but the panels would have to be structurally tested by a testing company before two story construction could be done. The company has ordered more concrete forms so they can pour up to fifty panels a day. By steam curing or drying, production would be speeded up several times. Present plans are to build a new building for manufacturing of the panels. The product should be on the market within a month. A search was done in STAR and IAA but no pertinent abstracts were found. A search was done in TUSC's Portland Cement Bulletins and several technical bulletins were found. Technical Bulletin #D22, "Optimum Steam Curing Procedure in Precasting Plants," dealt directly with the problem. (In this particular area of concrete construction it becomes evident that the auxiliary files developed by TUSC are of significant importance.)

100. (Reported in detail in Appendix I)

101. LIME AND DOLOMITE STABILIZATION FOR ROADBEDS - September 1967; Delta Mining Corporation.

Problem - To find comparison reports on lime and dolomite stabilization for roadbeds.

Solution - This company is processor of a dolomite for commercial applications. During their off seasons they thought of the possibility of processing dolomite for stabilization of highway roadbeds. Lime is used extensively for this purpose. Dolomite has about the same consistency as lime, but has a higher calcium content. A search was done in STAR and IAA but nothing was found. Letters were written to the National Lime Association, Federal Highway Administration, Washington, D. C., and the National Research Council. All of these agencies responded. The most productive reply was from the National Lime Association. They sent abstracts that dealt directly with the problem. The Highway Research

Board sent abstracts on reports dating back to 1910. All of these abstracts were on soil stabilization with lime.

102. WEDGE LIGHTING - September 1967; Systems Engineering Electronics, Inc.

Problem - How are "Wedge Lights" produced?

Solution - Our retrieval specialist took the "shot gun" approach on this subject and retrieved fifteen abstracts. The client ordered eleven of the fifteen reports cited. The client cited N63-16101, "Transmittance Measurement of Optical Materials as Affected by Wedge Angle," as being "exactly what I need." We are attempting to obtain more details from the client as to his exact usage of the information we provided.

103. AIR COMPRESSORS AND AIR PUMPS FOR USE IN CARPET CLEANING MACHINE - December 1967; Coin-Operated Equipment Manufacturing Co.

Problem - To determine the applicability of a specific process using air compressors and air pumps.

Solution - This client has invented a new type carpet cleaning machine. It utilizes the high pressure pump used for automatic car wash machines for the cleaning. A certain amount of moisture is retained by the carpet and must be eliminated. A search was done last quarter on the problem but after reading the NASA reports the client felt he was approaching the problem in the wrong manner. The previous search related to high volume air machinery. The current search was keyed to "Devices to Produce Large Volumes of Air." In the search, abstracts on machinery that produce high volumes of air and could be bought commercially were found. The client feels that his problem has been solved.

104. (Reported in detail in Appendix I)

105. VIBRATION IN HEAT EXCHANGE TUBING - December 1967; Yuba Heat Transfer Corporation.

Problem - Vibration in heat exchange tubing.

Solution - Pertinent report number NASA TND-4189 was forwarded to this client in supplement to an original search made some three (3) months ago. He indicated that information contained in this report was directly applicable to his problem.

106. TIME-MOTION STUDIES - December 1967; Kellwood Co.

Problem - Current information relating to time-motion studies to be used in examining plant efficienty.

Solution - Fifteen (15) abstracts covering the general area of time-motion study were retrieved by manual search. The client selected six (6) reports from these abstracts. He indicated that they provided excellent information for devising a study of his own operation.

107. VELOCITY LOCK SERVOS - December 1967; Midwestern Instruments, Inc.

Problem - A client requested a state-of-the-art search on Velocity Lock Servos.

Solution - Ten (10) abstracts pertinent to this problem were retrieved. The client indicated that they had specific bearing on his problem.

108. FORAGE HANDLING - December 1967; Edwin L. Golden.

Problem - A client asked for information to be used in evaluating a concept for forage handling.

Solution - The Center provided the client with three (3) reports on the state-of-the-art in this area. An industrial specialist visited with machinery manufacturers and assembled statistics which indicated the client's project was not economically feasible. He has dropped it due, in part, to our assistance.

109. MATERIAL FOR REPLACING METAL IN A SERVO - December 1967; Midwestern Instruments, Inc.

Problem - A client needed information about material suitable for replacing metal in a Servo.

Solution - Five (5) pertinent abstracts and five (5) magazine articles were retrieved. This material

provided the client with specifications on plastic from which he selected the proper material.

110. DIP BRAZING - December 1967; Water Bonnet Corporation.

Problem - To determine the state-of-the-art of Dip Brazing.

Solution - This client is considering locating one of his manufacturing plants in southeastern Oklahoma. He toured the Southeastern State College campus and TUSC facilities and was amazed by the vast amount of technical information that is available. The company is in the business of manufacturing boat accessories, specifically windshield and boat top equipment. He asked for information on Dip Brazing that would apply to fabrication of his product. A search was done in STAR and IAA, and several abstracts were located that were pertinent to the subject. Dip Brazing is a relatively new process that has been developed in the past few years and is proving successful in welding small aluminum parts. Three (3) abstracts were found: A66-15002, "Joining Aluminum to Stainless Steel for Space Vehicle Applications," A67-23007, "Aluminum Dip Brazing," and N64-18979, "Brazing Sap-2 Sintered Aluminum Powder." Report number A67-23007, "Aluminum Dip Brazing," was ordered by the company. Additional information from open literature was provided. The client indicated that he was very pleased with the information. The company plans to expand its Texas facilities into southeastern Oklahoma.

111. SEPARATION OF FINELY GROUND SLURRY - December 1967; Lobaris Co.

Problem - How is a finely ground slurry separated into particles of 1 micron, 1 to 4 microns, 4 to 10 microns, and 10 microns and larger?

Solution - A conference was arranged with TUSC personnel, representatives of the SSC Physical Science Department,

and the engineer of the company attending. The engineer explained that he was sizing machinery for developing a copper deposit. He needed to know whether or not the mineral was evenly distributed in the particle sizes. So much capital would be invested in machinery that it was imperative for them to know if it was necessary to process all of the particles.

The conference disclosed that laboratory methods existed for separating these particles in accordance to size. The client was advised to use a combination centrifuge-filter system. The client was furnished with seven (7) abstracts among which the most pertinent appear to be N65-24318, "Particle Size Analysis in the Subsieve Range with an Awre Centrifugal Photosedimentometer," and N66-25218, "A Comparison of Different Methods of Particle Size Analysis." The other abstracts furnished were N67-29707, N64-11277, N65-29608, N66-14692, and N67-12415. The latter reports gave the client a broader background for accomplishing separation. Additionally, TUSC provided AD 65-3578, "A Review of the State-of-the-Art of Cyclone-Type Separates." The client believes that the discussion and the reports cited will give him confidence in the integrity of his findings and allow him to proceed to the next step in the copper mine development.

112. UHF/SHF SOLID STATE CIRCUITS - December 1967; Oklahoma Aerotronics, Inc.

Problem - What is the state-of-the-art of UHF/SHF Solid State Circuits?

Solution - A company asked TUSC for current information on the state-of-the-art of UHF/SHF solid state circuits. These systems have been used to provide data on flight dynamic gun-launched vehicles. The company has submitted a proposal to the Department of Defense and was one of the top contenders for the bid. A search was done in STAR and IAA which resulted in a retrieval

of nine (9) abstracts. All the abstracts retrieved were written in 1967. A search was done last year in the 1964, 1965, and 1966 STAR and IAA. A total of eight (8) abstracts were sent to the company. We were informed that the information provided was valuable.

113. SEISMOGRAPH PROCESSES - December 1967; David Westbrook.

Problem - Information on seismograph processes for a state-of-the-art study.

Solution - A student became aware of the services of TUSC through a seminar held at the Grayson County College. The student's instructor referred him to TUSC as a possible referral library in the science field. He asked TUSC for the latest information on seismograph processes. A search was done in the open literature, in STAR and IAA. Abstract N67-15426, "General Seismology" was found and also abstract N67-14380, "Technological Progress in Seismology Crystal Motion Wave Theory Propagation and Related Topics." This transfer falls under the classification of TUSC general educational endeavors. It takes little effort to expose selected students to the NASA file, and it could have significant future rewards.

114. OIL FIELD CORROSION PREVENTION - December 1967; Midwest Oil Corporation.

Problem - General information on oil field corrosion prevention.

Solution - Corrosion in the oil field is a common problem to which no positive solutions have been found. Each individual oil well appears to have different corrosion problems since each has different contaminants. The company has approximately 60 oil wells in eastern Oklahoma. Several of their wells produce an iron oxide that is unique to the eastern Oklahoma area. The company has contacted several oil field corrosion companies, and the only solution they have found has been filtering

systems which cost about $60.00 a day to filter each well. A search was conducted in the open literature, the TUSC library, STAR and IAA. Nine (9) abstracts of STAR listings were sent. The company has indicated that this information is guiding them to a cheaper solution to the corrosion problem.

115. RADIATION EFFECTS ON HUMANS - December 1967; Bill Flagg.

Problem - Information regarding radiation effects on humans.

Solution - This requestor is a student at Grayson County College and was introduced to TUSC services through his science instructor. He asked TUSC to locate information on radiation effects on humans. A search was done in the open literature which resulted in a large quantity of information. STAR produced three (3) abstracts. Also, three (3) reports were ordered: N66-15043, "Radiation Protection," N67-17085, "The Biochemical Effects in Radiation Damage," and N67-17081, "The Biochemical Primary Effects in Radiation Damage." This is another educational transfer.

116. ELECTROPLATING - December 1967; Oklahoma Aerotronics, Inc.

Problem - Find state-of-the-art information on electroplating.

Solution - This client is in the business of engineering, design, and fabrication of electronic assemblies. The company previously had been contracting their machine shop electroplating out to other companies but found it more feasible and economical to set up their own plating process. They have installed approximately $50,000.00 worth of electroplating equipment and are in the process of educating their employees to operate this machinery. A search was done in STAR and IAA, and thirteen (13) abstracts were found that were pertinent to the subject. They are building their training program based on this information.

117. NUMERICALLY CONTROLLED MACHINE TOOLS - December 1967; Red River Research and Manufacturing Co.

Problem - To determine the latest information relative to numerically controlled machine tools.

Solution - The firm is in the precision machine work business. At the present time, they have subcontracts with major firms. They have recently secured a government loan to expand their facilities. They have purchased approximately $250,000.00 worth of new machine tools in the past year. During their rapid expansion, training personnel has become a problem. The personnel they had in the past year were acquainted with the standard type machine tools; but during the expansion, several pieces of sophisticated machinery have been purchased. The company asked TUSC for any information they might use in educating their machine tool operators. An industrial application report was obtained and was sent to the company. The report was Y-1579, "Automatic Tool Setting for Numerically Controlled Machines." This report deals directly with numerically controlled and automatic tool settings. The purpose of the report was to aid machine tool operators with an automatic system of tool setting which could be integrated into the over all state-of-the-art of numerically controlled equipment. The company indicates it has been quite useful in their training program.

118. FM STEREO BROADCASTING - December 1967; Glen Burke.

Problem - A local radio station desired latest information concerning FM stereo broadcasting. The station is considering installing this kind of equipment.

Solution - Tech Brief 65-10055, "FM Oscillator Uses Tetrode Transistor," along with the back-up package, was provided to the client. He has indicated that the information is exactly what is needed in order to make a decision as to the installation of equipment.

119. EXPLOSIVES - December 1967; Delta Mining Corporation.

Problem - To find information on types and uses of explosives in the U. S.

Solution - This company is engaged in mining and processing dolomite products. During the initial phase of the operation, the material must be blasted with explosives in order to render it small enough to run through hammer-mills for pulverizing. The company had tried several sources for this information and had not been able to obtain what they needed. A search of the NASA file did not provide the necessary information. The next step was to contact the Institute of Makers of Explosives in New York who provided the necessary information. TUSC performed a valuable switching service which allowed solution of this client's problem.

120. UTILIZATION OF SOYBEAN PRODUCTS - December 1967; Rev. Bill McFatridge.

Problem - To obtain general information on utilization of soybean products.

Solution - This client asked for any information on processing and utilization of edible soybean products. He feels that soybeans are not being utilized as extensively as they should in this region. Soybeans are becoming a major agricultural product in southeastern Oklahoma. The client (who is an active, ordained minister) inherited a sausage processing plant that belonged to his late father and is faced with managing the operation. He is looking into the possibilities of utilizing soybean products as an additive to sausage. TUSC searched the NASA literature but found nothing on soybeans. A search of open literature in the SSC library uncovered a book, Soybean Products, that had much pertinent material. The client indicated that the information sent could

be very valuable to his operation in the future.

121. FUTURE AVIATION NEEDS OF THE UNITED STATES - December 1967; Southeastern State College Aviation Program.

Problem - To obtain information projecting future aviation needs of the U. S.

Solution - The Director of the Aviation Program at Southeastern State College asked TUSC to look for any information on future aviation needs in the U. S. NASA report N67-30464, "Aviation Forecasts: Fiscal Years 1967-1977," was retrieved. This forecast deals with future pilot needs and airport facilities from the present to 1977. The Southeastern Aviation Program has been contacted by the Federal Aviation Agency in Washington to look into the possibilities of conducting an air space controller school in conjunction with the aviation school. Requirements for entry into the controller school are very rigid. A student entering the program must either have or obtain a private and commercial pilot's license with an instrument rating. The air controller program could be adapted quite satisfactorily into the college aviation program since it offers the ratings required for the controller school. The information contained in the report will provide the primary basis for further study relative to establishing this school.

122. FUTURE AVIATION NEEDS OF THE UNITED STATES - December 1967; American Flyers, Inc.

Problem - To find information projecting future aviation needs of the U. S.

Solution - This client is the Chief Link Instructor for a private aviation training school. As a side business, he has a placement service for students who are entering the aviation field. Apparently, he has done quite well with this business and has expanded; but he needs more financing to take care of overhead. He is currently writing a plan of action to propose to bankers or other financial institutions in order to

get the needed finances. NASA report N67-30464 was sent to the client. He indicated this report would be helpful in writing his plan.

123. HIGH ALTITUDE SLIDES AND PHOTOGRAPHS - December 1967; Father Patrick Quirk.

Problem - To provide information through high altitude slides and photographs.

Solution - This client is an oil and gas lease broker in addition to his duties as a Catholic priest. He viewed the slides TUSC obtained from the Technology Application Center at the University of New Mexico. Although his examination is still in a preliminary stage, he has indicated that the slides have proven most valuable.

124. ZIRCONIUM CHLORIDES - December 1967; Professor Arnold Walker.

Problem - What is the state-of-the-art on zirconium chlorides? (A professor at Southeastern needed this in his own research activity.)

Solution - Professor Walker has been doing advanced research on zirconium chlorides. The aspect of the subject in which he was most interested was beyond the capability of the Center's personnel. Consequently, he was burdened with approximately 170 abstracts. From these abstracts he selected five (5) documents, AD 619244, N66-14998, N66-18751, N63-11027, and N65-16381. He was pleased and a bit embarrassed to find that one of the abstracts referred to an article in a two year old chemical journal that he had in his own library. One of the documents, N66-14998, he described as being the exact answer to his search. Mr. Walker described our service in this manner: "The Center has a library that can't be found, to my knowledge, in this area of Oklahoma, for that matter, it can't be found in Oklahoma. This library and staff offers an invaluable tool to the college personnel

of this region. I have talked to professors in other colleges about this service in the interest of TUSC expanding to other college campuses. The expansion will be easy because there is a genuine need for it."

125. LIQUID-TO-LIQUID INJECTION - December 1967; Dan Stone.

Problem - How can minute quantities of liquids be injected into a high pressure flow of a dissimilar liquid?

Solution - The client did not know when he submitted the request that there were "off-the-shelf" metering devices that would meet his requirements. A search of NASA literature was made but produced little that would be of use to an "in-production" process. We checked our open literature and found several advertisements and brochures depicting suitable metering pumps. The client was able to solve his problem with this information.

126. ELECTROPLATING TECHNIQUES - December 1967; Hal Myers.

Problem - The client is establishing an electroplating firm and requested latest information on electroplating techniques. His primary interest is in avoiding contamination of expensive plating solutions.

Solution - TUSC provided the client with NASA SP-5045, "Contamination Control Principles," and commercial brochures from several major plating material suppliers. He indicated the material provided was very useful and has a potential cost savings of several thousand dollars.

The client in this case is establishing an electroplating shop designed to triple plate large automobile parts for antique and classic automobile enthusiasts over a several state area. This type of plating employs three (3) metals (copper, nickel, and chrome) with the chrome layer having a thickness of ten to twenty-thousandths of an inch. Most commercial plating shops

dealing in auto parts plating use only nickel and chrome, with the chrome "flash plated" to a thickness of only two or three-thousandths of an inch. The flash plating is not acceptable to the antique and classic auto enthusiasts.

The client has a standing order from one automobile museum and several automobile clubs in Oklahoma City, Tulsa, and Dallas for all their plating work. Their demands for quality are extremely high. In view of this, a quality plating will attract more customers; but one poor quality job will possibly cost the client several good customers. Contamination control and plating techniques developed through NASA research are therefore quite important and useful to this client.

The initial cost for materials and equipment which the client is using is approximately $8,000.00. A major part of this cost is the three chemical solutions. The tank of nickel solution alone costs nearly $2,000.00. If contamination is avoided, these solutions need never be changed completely. Periodic replenishment is all that is required.

The client has stated that the material provided him by TUSC will contribute significantly to his efforts in two ways. The NASA originated techniques of metal cleaning and preparation will help avoid contamination which could at one time ruin two to six thousand dollars worth of solution. In addition, the same methods will result in a higher quality plating which should prove more attractive to a type of customer who is very hard to please.

127. (Reported in detail in Appendix I)

128. $WITCHING OF FLUID CIRCUIT - March 1968; Midwestern Instruments, Inc.

Problem - How can a fluid circuit be switched in 1 to 1 1/2 milliseconds?

Solution - A retrospective search provided some fifty (50) abstracts from which the client selected six (6) reports. He appraised the reports as being exactly what he needed to proceed with the development of a fluidic-driven computer tape system.

129. RELIABILITY OF SERVO SYSTEMS - March 1968; Midwestern Instruments, Inc.

Problem - Which servo system, phase lock or velocity lock, is more reliable?

Solution - A retrospective search of the NASA file provided ten (10) abstracts; the client ordered five (5) reports. He indicated that the information he needed was in the reports. He has designed a new tape driven system which is proprietary in nature and will go on the market in the summer of 1968. More detailed information about this transfer may be obtained at that time.

130. (Reported in detail in Appendix I)

131. BATTERY POWER SOURCES - March 1968; Coin-Operated Equipment Manufacturing Co.

Problem - Identify power source for small golf cart.

Solution - The client has developed a new two-wheel golf cart built somewhat like a motor scooter. The vehicle can travel up to twenty (20) miles per hour and can run for about four (4) hours on two 12 volt automotive batteries. The client is seeking smaller batteries which will hold charge for a longer time. Results of a retrospective search were provided to him. From this, he determined that space batteries were too expensive for this application. The reports provided allowed him to complete a comprehensive study of available sources of power for the cart. Without the information provided, such a study would not have been possible. He expects to choose a suitable source of power in the near future.

APPENDIX I

SPECIAL TECHNOLOGY TRANSFER CASES

APPENDIX I

SPECIAL TECHNOLOGY TRANSFER CASES

Introduction

The effectiveness of the technology utilization phase of the TUSC experiment was measured by the number of transfers generated. Technology transfers have been defined by TUSC in a very broad manner. If assistance supplied by TUSC contributed in any way to the solution of a problem, then there is a transfer. As of 31 March 1968, TUSC had recorded 131 transfers. Several of these are discussed below. A description of all other TUSC transfer cases is contained in Appendix H. The particular cases amplified upon here have some characteristic which makes each an element of a certain group having the same characteristic. The numbers are those given the transfer when initially reported.

Transfer #43. TREE DRAGGING DEVICE - June 1966; Jack Bain and Associates.

Frequently the TUSC Industrial Specialist is able to draw upon his own experience in contributing to a solution of a client's problem. Given the general level of technological sophistication within the TUSC primary 17-county region, this is not surprising.

A client in the southeastern area had invented and was testing a tree dragging device. The device had been adapted for use on Ford tractors and was designed to replace large winch trucks in the timber areas of southeastern Oklahoma. This machine was designed to drag large trees from the cutting area to a loading area. Two ice-tong type hooks were mounted at the rear of the tractor for this purpose. A unique feature of the machine was that it would allow the operator to hook, transport, and release logs without getting off the tractor. The inventor was having a problem with the pin that connected the two tongs. TUSC was asked to contact the inventor by the manager of the Chamber of Commerce at Idabel. An Industrial Specialist with machine shop experience was sent to confer with the client about his problem.

Picking up large trees with the tongs places great strain on the connector pin and was shearing the pin, causing loss of the trees from the dragging device. The TUSC Industrial Specialist recommended a company to make a shoulder bolt with high shear strength to replace the heat-treated bolt being used. Also, the Industrial Specialist recommended using a new type bearing as a swivel point for the tongs. The company was machining shafts to fit the inside of metric-size bearings. The Industrial Specialist recommended a standard 2-inch I.D. bearing with the same specifications as the metric-size bearing. Although the price of the bearing would be about the same, considerable time could be saved by not machining the shaft to fit the bearing. It is estimated that at least $20 per unit could be saved by using the new type bearing, and probably four to five hours labor could be eliminated.

The client worked several months developing and testing the device and spent a considerable amount of money on the project. At this point he found that he could not begin manufacturing the product due to insufficient funds. The client personally knew an industrialist who had an extensive farming operation in the area and was able to sell this individual a part-interest in the product. The tree dragging device is now being manufactured in Louisiana and from information TUSC has received, the venture is very successful. The advertisement on the following pages provides a description of the commercial device now on the market, partially as a result of this TUSC transfer.

Transfer #1. SOLDERING TECHNIQUE - September 1965; Oklahoma Scientific Co.

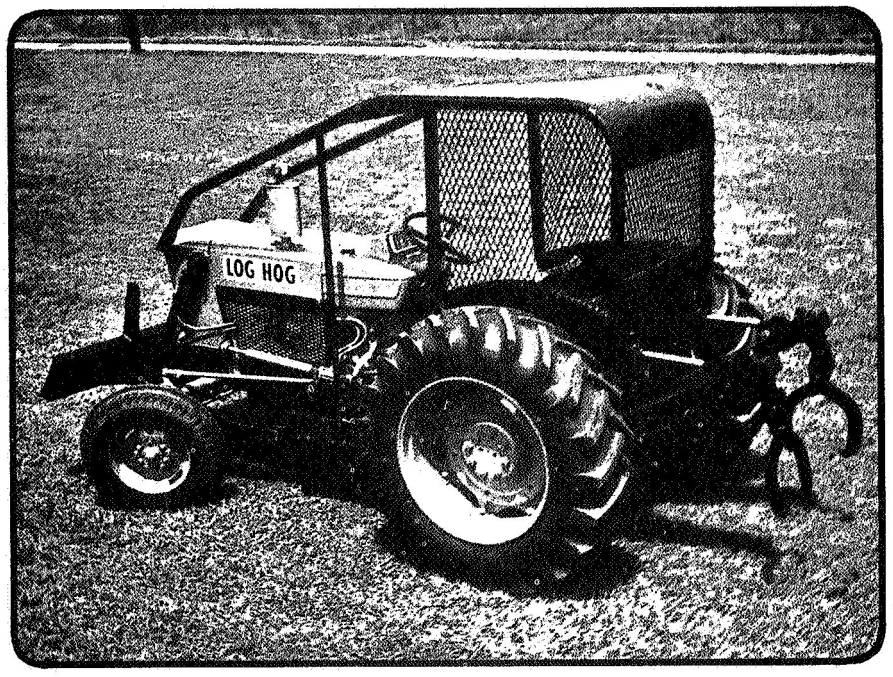
The quality of a region's labor force represents an important ingredient of economic growth. Some economists contend that changes in the quality of labor provide the explanation for growth rates in advanced countries being more rapid than inputs of capital and labor can account for.

In underdeveloped regions, the level of skills certainly is a critical factor in determining the current ceiling on the growth rate.

A firm in the TUSC area desired to upgrade the skills of its work force via improving soldering techniques. NASA headquarters

DUNHAM

A name backed by 28 years of diversified research and development



MODEL 400 LOG HOG SKIDDER

AT HOME IN ROUGH COUNTRY as well as on yard operations, the LOG HOG'S exclusive automatic grabs* enable the operator to hook, transport, and release logs without dismounting from tractor. Increased production, lower operating costs, and a minimum of maintenance combined with an amazingly powerful heavy duty dozer blade, make the LOG HOG the world's first truly automatic logging tractor.

Exclusive automatic grabs
Heavy duty dozer blade
Power train by Ford
Heavy duty overhead guard
Steel screen side shields

Rugged tubular subframe
Deluxe seat and power steering
Reinforced wheels with protected valve stems
Curved Belly guard is easily removable.
*Patent Applied For

DUNHAM MANUFACTURING COMPANY
A DIVISION OF ANDERSON-DUNHAM, INC.

DUNHAM LOG HOG

Exclusive automatic grabs* enable operator to hook and release logs without dismounting from tractor. Note that no cumbersome chains and cables are required.

*Patent applied for

SPECIFICATIONS

ENGINE:
Make — Ford
Horsepower 52.7*
No. Cylinders 3
Displacement 201 cu. in.
Bore & Stroke 4.4 x 4.4
Compression Ratio 16.5:1
Dual Fuel Filters

POWER TRAIN:
Eight speed, dual range
Differential lock

CAPACITIES & DIMENSIONS:
Wheelbase 84.5 in.
Turning Radius
(Brakes Locked) 10 Ft.
Front Axle capacity 4,000 lbs.
Rear Axle capacity 9,000 lbs.
Fuel Tank — 16 gal.
Shipping Weight — 6,375 lbs.

*Mfg. Observed Net Flywheel Horsepower

STEERING:
Automatic type, power assisted

TIRES:
Standard:
Rear 14.9 x 30, 6 ply
Front 7.50 x 16, 4 ply
Optional
Rear 16.9 x 30, 6 ply
Front 7.50 x 16, 8 ply

HYDRAULIC SYSTEM:
Pump 14 g.p.m. @ 2,000 p.s.i.
Rear boom lift capacity,
7,000 lbs. per boom
Cylinders D. A. 2½ x 20 in.

ELECTRICAL SYSTEM:
12 volt
Fuel gauge
Instrument panel illumination
Oil pressure & generator
Warning lights
Water temperature gauge

Heavy duty dozer blade delivers unexcelled push power in its class. The efficient weight transfer system and touch control hydraulics give maximum flexibility.

DUNHAM MANUFACTURING COMPANY
A DIVISION OF ANDERSON-DUNHAM, INC.
SALES OFFICE AND FACTORY: P.O. BOX 430
TEL. 377-3535 • MINDEN, LOUISIANA 71104
(Area Code 318)

Sold By:

was contacted to provide assistance in allowing two employees of the firm to attend a NASA soldering school.

The employees returned from the NASA school at Langley and trained other employees for the firm. This firm had about 30 employees at that time. The reprecussions from this initial TUSC transfer provide an example of the cumulative effect such a transfer can have. Refer to the company above as firm "A."

Some employees of Firm A went to work for another company, Firm B, and assisted the latter in improving their soldering techniques. Firm B employs about 350 persons.

Firm A later became a casualty of our competitive free enterprise system. Then a company in another town, Firm C, started operations with some of Firm A's former employees. These employees trained others in Firm C to use the improved soldering technique. Within two and one-half years Firm C had some 300 people on its payroll.

As a result of the initial two employees of Firm A trained by NASA, there are now many additional workers in the TUSC region using the improved soldering technique. It would be most difficult, if not impossible, to place a monetary value upon this type TUSC transfer.

Transfer #127. ELECTROLUMINESCENCE - March 1968; Systems Engineering Electronics, Inc.

This case differs in two respects from many of the others. It benefited the client by causing him to drop an unprofitable project, and it involved an area of research in which major advances occurred in an extremely short time frame.

The client, a builder of aircraft instrument panel components, was interested in applying electroluminescence materials and techniques to his products. He requested a state-of-the-art search on electroluminescence. Six months prior to this, in a similar search for two other clients, very little information on electroluminescence was to be found. The new search initiated by this recent client produced a volume of excellent current state-of-the-art information indicating that there was much activity in this new field.

The client reviewed the information provided by TUSC. For some time, there was little response from the client as to the usefulness of the material. TUSC postponed a report on the case pending comments from the client. The answer, recently provided to TUSC, indicated that the client had decided not to use the electroluminescent techniques in his products. He stated that his survey of the material provided by TUSC convinced him that he did not want to pursue further research and development in the area of electroluminescence at this time. He further stated that the information had saved him $10,000 by influencing his decision to discontinue the research and development in this field.

This case contains two points to be remembered in technology transfer. (1) The rapid advances in research and development necessitate a state-of-the-art awareness in all fields of reaearch on the part of the information center, and (2) it is possible to bring about considerable savings in some cases by achieving a "negative" transfer, thus freeing economic resources to pursue alternative objectives of the firm.

Transfer #46. FREQUENCY SYNTHESIZERS - September 1966; Oklahoma Aerotronics, Inc.

This client is an electronics company which has grown from a small job shop over the past four years to the point of employing over two hundred (200) persons. They have used TUSC extensively during this time and give TUSC much credit for contributing to their growth. Since they have no engineering research department, they placed strong emphasis on the use of the NASA technical information available through TUSC.

This particular case involved a state-of-the-art search on frequency synthesizers with peripheral information on automatic phase control loops, sample and hold circuits, and solid state circuitry. The client stated that the information supplied resulted in a savings of several thousand dollars. They could not have accomplished their objective without the information because of their lack of engineering capability. Success in reaching this objective allowed them to compete in a market which would have been out of their reach otherwise.

The following four documents, obtained from the NASA information bank, were the major contributing factors in this transfer. (1) N66-10423 Conceptual Description of a Family of Frequency Synthesizers from Lincoln Labs at Massachusetts Institute of Technology. This document was originally produced under an Air Force contract. (2) N66-12519 Research and Development Investigation of a Precision Digital Frequency Synthesizer for SSB, by Collins Radio Co., of Dallas, Texas. This document was produced under a Department of Army contract relating to miniaturized single side-band radio units for the army. (3) N65-10735 Frequency Synthesizing Techniques Permitting Direct Control and Rapid Switching from the Naval Research Lab, Washington, D. C. This document, considered to be one of the best on the subject, was presented in the Army Signal Corps' 17th annual symposium on frequency control in 1963. (4) N65-35645 A Feasibility Model of a Microminiature VLF/LF Frequency Synthesizer - Final Development Report, by Westinghouse Electric Corp., Baltimore, Md. The purpose of the phase of the contract covered by this document was to design and fabricate a VLF/LF frequency synthesizer in microelectronic form for the Naval Observatory. Though not specifically related to the portion of the electromagnetic spectrum in which the client was interested, it did contribute to solving his problem.

The client in this case is outstanding in that he possesses considerably more entrepreneural ability than many small business owners. He realizes the value of the information available, has definite ideas on how to best apply it, and does not require as much assistance in assimilating the information provided as many clients do.

This client reports a $15,000 saving on one particular program due to the information furnished by TUSC. The firm began operations in 1964 with $18,000 capital and 10 employees. Today this firm employs some 200 people and last year did over $4 million worth of business. Expansion is still occuring and the president of the company says that he expects to have 500 people on the payroll by 1970. The company is now a firmly established producer of telemetry and communication equipment. TUSC assistance to the firm has been

valuable in providing technical knowledge in such areas as electroplating and miniature transmitters.

Transfer #34. PEANUT DRYING PROJECT - 1966-1967; Oklahoma Peanut Commission.

An analysis of raw shelled peanuts will disclose that they contain slightly more than 50% protein. Peanuts are grown in temperature climates around the world. The USDA estimated a world production for 1967 of 19,975,000 tons. Peanuts are the world's cheapest source of protein for human consumption. Production techniques range from primitive hand methods employed in Africa, where more than 1/4 of the world's supply is produced, to highly mechanized methods in the United States.

In 1960, Aspergillus flavus was found to have produced a highly toxic compound in peanuts imported into Great Britain. This particular type of mold produced a compound called "alfatoxin" which proved deadly to turkey poults. This alarming discovery inspired the publication of more than 400 research papers during the next three years. McGraw-Hill estimates that more than $5,000,000 was spent researching the problem during the same period. The Hatch Project at Texas A & M University demonstrated that Aspergillus flavus is not present in properly dried peanuts.

New technology has promoted the remarkable progress made in peanut production in the post World War II era. Machinery manufacturers have developed combines which will harvest the nuts as soon as the vine is plowed up. The farmer can plow up and combine 30 to 60 tons per day. He is in trouble at this point because the present drying system will take 3 to 7 days to dry what he harvests the first half day. If the newly harvested bulk peanuts are not dried, mold will develop in a matter of hours.

The present drying system reflects the technology in use at the turn of the century. An open gas burner is used to heat air which is moved by a squirrel cage fan. The air is ducted into a plenium chamber between a false, perforated floor and the floor of a four-wheel trailer or permanent type building. The air moves up through a 4-5 foot bed of undried peanuts. The nuts are subjected to this process for 30 to 72 hours. The open gas flame

creates two cubic feet of water vapor for each cubic foot of gas burned. During high humidity weather, no moisture can be removed with this system. A few days in the exhaust atmosphere of the open gas burner, and the peanuts taste like exhaust fumes smell. The maximum 95^{o} temperature is still too high for the lower layers of peanuts. A high percentage of these "split" or "bald" during further processing.

The Oklahoma Peanut Commission's (OPC) Technical Committee (chaired by TUSC Industrial Specialist A.M. Moore) examined the state-of-the-art in heat and mass transfer. The NASA information bank yielded quite significant data on these subjects. These data became the foundation for the OPC examination. It was determined that the probability of success in applying new heat transfer approaches to the peanut drying problem warranted additional effort. The Technical Committee invited eighteen organizations to propose a solution to the peanut drying problem. The invitation specified that the respondents should have capabilities in the field of heat and mass transfer. Nine proposals from some of the giants of the aerospace industry have been made to the OPC. The total cost of the selected proposal is $24,823. No funds have as yet been allocated to this project by the OPC.

A representative of the Coastal Plain Experiment Station at Tifton, Georgia, heard of this project through NASA headquarters in Washington. He visited with the Oklahoma Peanut Commission Technical Committee and other personnel involved in the project last November and suggested that the project be presented to the Agricultural Research Service (ARS), USDA, Advisory Committee in Washington on 12 January 1968.

A TUSC Industrial Specialist went to Gorman, Texas, to explain the program and the proposal to a member of the Advisory Group. The Advisory Group later recommended the project for study and assigned it to the Facilities Engineering Group within ARS.

A representative from the ARS visited with the Technical Committee in Durant, on 1 April 1968. He informed the Technical Committee (which includes two members of the OPC) that whenever the OPC officially appropriates funds to pursue the proposal, the USDA would look favorably upon assisting.

TUSC involvement in this project is an example of the "switching mechanism" role in which the Center has induced interdisciplinary thinking on a technical problem. One result has been to join together various researchers and agencies in pursuing a common problem and to stimulate effective communication regarding the problem. Hopefully, the major result will be to speed the use of newly generated knowledge across interdisciplinary lines. Additionally, as implied above, the economic benefits to the peanut industry would be significant.

Transfers #92, 100, 104. ELECTRICALLY FIRED INCINERATOR - June 1967 — September 1967; Mar-Jean.

Among the many problems facing cities in this period of population explosion and urban concentration is the enormous and increasingly difficult task of refuse disposal. Present techniques cost city governments large expenditures for man-hours and equipment to remove the waste while at the same time creating disposal and pollution problems once the waste has been taken to the dump area.

With this worldwide problem in mind, a TUSC client conceived the idea of on-the-spot incineration which would virtually eliminate three costly facets of refuse disposal. He envisioned an electrically fired incinerator which could be truck-mounted for on-the-spot disposal. This method would eliminate or reduce (1) extensive transportation costs and man-hours involved in hauling refuse from the city, (2) the necessity for collection points or dumps with their unsightly appearance and occupation of potentially valuable suburban land, and (3) air and water pollution resulting from present waste disposal methods.

The technical problems involved in an undertaking of this size were enough to stagger the imagination of a seasoned engineer. However, at the time the client approached TUSC, he had not let these problems stop him. His company had a patent pending on the idea, and possessed the technical facility and capability to build and test the incinerator. The client was running into problems due to lack of engineering capabilities; and because of the many separate technical disciplines involved in the incinerator design, he was in need of extensive technical information and assistance.

TUSC assistance to this client, particularly in the area of scientific and technical information, was extensive and extremely varied as related to subject matter. From March 1967 to July 1967, more than a dozen literature searches were performed for this client. The following paragraphs summarize the most important of these searches, their relation to design problems encountered by the client, and characteristics of the information provided.

1. Information on Insulation for Electrical Connections in High Temperature Environment.

   Manual and computer searches produced numerous NASA and IAA abstracts which contributed to the solution of this problem. One document, A66-33144, a Technical Translation entitled, Electrically Insulating Tube of Boron Carbonitride for the Protection of Metal Thermocouples, dealt specifically with this problem.

2. High Temperature Materials for Use in Lining Incinerator Unit.

   This problem involved two literature searches and resulted from the client's desire to obtain a material which could withstand extremely high temperatures and yet not entail extreme costs of purchase and fabrication. Refractory materials, both metal and non-metal, were investigated. As a result of the vast amount of research in recent years in refractories such as ceramics, metal alloys, metalloceramic composites and ablative materials, the two searches resulted in an avalanche of excellent information. The client, though somewhat stunned by the volume of information, managed to apply it effectively in selecting the material and methods best suited to his purposes.

3. State-of-the-Art in Brazing.

   This information search resulted from the client's desire to use only the most effective welding and brazing techniques in fabrication of his product. This search resulted in several specific documents relating to aluminum brazing from the NASA files as well as excellent material from sources in TUSC's non-NASA material. NASA documents especially related were N66-3556, Aluminum Weld Development Conference at Marshall Space Flight Center, N66-24657, Joining Steel to Aluminum by Solar Corp., San Diego, California, and A66-15002, Joining Aluminum to

Stainless Steel for Space Vehicle Applications by North American Aviation. Other helpful material came from the Aluminum Data Book, Reynolds Metal Co., The Welding Journal of American Welding Society, and the periodical, Materials in Design Engineering.

4. Air Pollution.

This literature search grew from the client's realization that his incinerator would generate considerable amounts of vapor which, in quantity, would create an air pollution problem. This search resulted in several specific documents relating to filtration and purification of air, ranging from N67-11019, Fundamentals of Air Purification by Marine Engineering Lab., Annapolis, Maryland, to AD638-293, Gaseous Containment Removal by Absorption produced by Lockhead Missiles and Space Co., of Palo Alto, California. The latter document very nearly fit the criteria the client had established for a filter. It proved to be extremely helpful. One document resulting from this search was N66-25488, The Use of Incinerators for Treatment of Combustible Wastes, from the Department of Atomic Energy, Bombay, India. Though not contributing significantly to the solution of the filtering problem, it served the purpose of graphically demonstrating that the problem our client was attacking is most certainly a worldwide problem.

5. Instrumentation for Temperature Measurement to 3800°.

This search was conducted for the purpose of locating a temperature measurement device which would accurately measure the expected high temperatures within the incinerator. Again, the NASA files were extremely useful; and the information forthcoming contributed immensely to solving the problem. The documents which related closely to the subject were, A65-16197, High Temperature Measurements and Standards 1000° - 3000° by the National Bureau of Standards, Washington, D. C.; A65-15775, Temperature Measurements in the 3000° - 5000° Range Using Ribbon Thermocouples by Nanmac Corp., of Needham, Massachusetts; and N67-11147, Device for Multiple Point Measurement of Temperature, a Technical Translation from Air Force Systems Command.

6. High Temperature Electrodes.
Components comprising the heart of the incinerator, and those subjected to the harshest temperature environment are the electrodes which actually fire the device. The electrodes must withstand extreme temperature and pressure without excessive erosion while maintaining good electrical conductance properties. They must also be located in such positions as to achieve even combustion throughout the incinerator chamber. This particular problem required two searches of NASA, AIAA, and supplementary material. In this case, much of the NASA and AIAA material was helpful, as were charts and articles from Materials in Design Engineering magazine. However, professional consultants and considerable experimentation with working models of the unit were necessary to determine the right combination of materials and location of electrodes. The document relating more closely to the problem faced was a chart from Materials in Design Engineering showing state-of-the-art in carbon, graphite, and composite materials suitable for high temperature electrodes.

7. Gases, Combustion Elements, and Pressure Environments.
This problem contained two related facets. First, the amount of oxygen to support combustion in a container of a given size had to be determined. Second, it was considered necessary from a structural standpoint to estimate the pressures resulting from the combustion. Though several documents relating to these subjects were found to be available in the NASA files, variables such as moisture content, volume, and burning rate still required consultants and experimentation before the proper parameters of gas and pressure were determined.

8. Information on Human Waste Disposal and Filtering Systems for Human Waste Disposals.
This search could be considered a follow-up to previous ones for purposes of refining various characteristics of the waste disposal systems. The client realized that there was still much room for improvement of his system. This search provided several documents related to waste disposal and filtering problems in closed ecological systems. Though not directly

related to the client's system, these documents contributed to refinements in the client's product.

At the present time the waste disposal incinerator is not yet in production. However, the present delay is due to non-technical problems within the client company. Though there are expected to be minor refinements in design when production is started, the incinerator as presently designed shows great promise. Many private concerns as well as government agencies in the U. S. and abroad have shown considerable interest in the device, and the client has received several lucrative offers concerning production rights.

This case is probably the most extensive, from a standpoint of assistance and information provided, of any in the history of TUSC. As indicated in the preceding paragraphs, there are several instances where technical information was transferred almost en toto from TUSC files to applications in the client's shop. There are other instances where the information required considerable interpretation by expert consultants before it could be applied. It was to be expected that some of the information might lead to blind alleys with no resulting problem solution. This was true in the case of several items of information supplied. However, with state-of-the-art changes and increased capabilities of the client, it is possible some of this information might yet be applicable and provide useful technology transfer at a future date.

If one specific point in technology transfer was brought forth through TUSC efforts to aid this client, it probably is that there is a definite necessity for an interpretive step in the dissemination of research and development material to firms with limited engineering capability. A client in this category simply cannot assimilate the sophisticated material in many cases unless a consulting specialist defines it in terms of the client's problem.

Transfer #130. COMPUTER PROGRAMMING AND PERSONNEL - March 1968; Janie L. Jones.

Many TUSC transfers relate to the education area rather than directly to industry. In this field, a client may be a college or university faculty member who is engaged in research for publica-

tion; a student desiring information not found in textbooks; or a faculty member seeking to upgrade his teaching skills. In terms of stimulating the economic growth of a region, these types of transfers which increase the quality of educational attainment are significant over time.

The client in this case is a college faculty member who teaches data processing, business, and statistics courses, while pursuing a Ph.D. degree. The graduate study is in the area of vocational guidance and counseling. Two document searches were performed at the request of the client.

The first document search was on Fortran Programming. NASA material and magazine articles from the open literature were provided. The TUSC information center located 14 "N" reports and 26 extensive articles appearing in the Oil and Gas Journal. The latter were deemed most appropriate. The client stated that the information did relate to subject material being taught at the present time, and the magazine articles are assisting in teaching Fortran Programming.

The second search was in the area of human factors engineering, personality, personnel aptitude, and man-machine relations. It relates to the client's dissertation entitled, "Determination of Potential Computer Personnel by Individual Characteristics and Personality Traits." A TUSC "in-house" search retrieved 19 "N" reports dealing with these characteristics. The client stated that the documents provided were very helpful and that all were used as reference material. Several of the documents were quoted directly from the text in the dissertation.

The expected benefits from this transfer are better subject material for classroom presentation in computer programming courses, and more effective vocational counseling for prospective computer personnel.

APPENDIX J

QUESTIONNAIRE

APPENDIX J

Questionnaire

PUBLICATIONS, ORGANIZATIONS

1. Please list the professional and technical magazines you read:

   (1) Most Important _____

   (2) Next Most Important _____

   (3) Third Most Important _____

   (4) Other: _____

2. How many hours would you estimate you spent reading technical journals in the last 30 days? _____

3. Please list the professional organizations you belong to:

   (1) Most important organization in keeping up to date with new technical and scientific developments _____

   (2) Next most important organization _____

   (3) Third most important _____

INTERNAL CHANNELS OF TECHNICAL INFORMATION

4. What sources has your firm utilized in their search of technical information in the past 12 months? Please mark an (x) in column one. Please rank in column two the three most important in descending order--(1 is most important).

Technical Information Channels Outside your firm	Used in Past 12 Months	Order of Importance
(1) Personal or in-house library facilities and library personnel		
(2) Personal knowledge, experience or experimentation		
(3) Other personnel in the organization, colleagues, etc.		
(4) Company meetings workshops, courses, etc.		
(5) Company sponsored research and development		
(6) Formal Company reports		
(7) Others (please identify)		
_____		
_____		

OUTSIDE CHANNELS OF TECHNICAL INFORMATION

5. In the first column please check (x) the channels listed below which you have used in the past 12 months. In the second and third columns, please rank the <u>five</u> most important in descending order (the most important is one, etc.)

Technical Information Channels	Used in Past 12 Months	Order of Importance	
		For awareness	For Problem solving
(1) Suppliers or Vendor personnel			
(2) Vendor or Supply catalogs			
(3) Customer			
(4) University or other outside consultants			
(5) Conventions, conferences, symposia, trade shows, etc.			
(6) Technology Use Studies Center			
(7) Trade Publications			
(8) Professional Journals			
(9) Libraries (other than personal or in-house libraries)			
(10) Textbooks and Handbooks			
(11) Contract Monitors			
(12) Others (please identify)			
_____			
_____			

6. How do you keep aware of new technology developed by various government programs (NASA, Dept. of Defense, etc.)? Check as many as appropriate.

(1) By personal contact _____

(2) By attending trade and professional meetings _____

(3) Through trade and professional publications _____

(4) Through indexing services _____

6. Continued

(5) By government announcements and publications _____

(6) Other ways (please specify)

_____ _____

(7) Government developed technology not pertinent to my job so I make no effort to keep up with it. _____

7. Please indicate your familiarity with the information channels listed below: Check as many columns as appropriate for each channel.

Channels	Have Heard About	Have Used	Will Continue to Use
(1) Tech Briefs (NASA)	_____	_____	_____
(2) TUSC Regional Dissemination center	_____	_____	_____
(3) NASA Special Reports	_____	_____	_____
(4) Non-NASA Material from TUSC	_____	_____	_____
(5) STAR (Scientific and Technical Aerospace Reports)	_____	_____	_____
(6) IAA (International Aerospace Abstracts)	_____	_____	_____

8. Do you have any suggestions how TUSC information can be made more readily available to your firm (Check appropriate items)

(1) Special periodicals or newsletters _____

(2) Presentation before groups (Professional and civic) _____

(3) Periodic calls on your firm _____

(4) Others (please identify) _____

_____ _____

_____ _____

_____ _____

9. a. How many of your employees know of the services of TUSC? _____

b. Are the above all of the employees that might have a use for the information provided by the Technology Use Studies Center?

Yes _____

No _____

10. In the past you have received information from the Technology Use Studies Center. How was the data provided to your firm utilized?

_____ (a) Permitted the development of a new product or process

_____ (b) Permitted the improvement of a specific product or process

_____ (c) Lowered the cost of existing product or process

_____ (d) Saved time and funds in research on our own

_____ (e) To verify or explain a product or process contemplated

_____ (f) Others (please specify) _____

Please comment on the above: _____

_____

_____

11. What dollar savings resulted from the information received from TUSC? $_____

GENERAL

12. In comparing internal versus external channels of technical information, which is most important to you? (Check appropriate item)

(1) Internal channels most important _____

(2) External channels most important _____

(3) Both of equal value _____

(4) Don't know _____

13. What barriers, or specific problems, have you encountered in your attempt to acquire new technical information?

(1) Too time consuming _____

(2) Difficult to identify and reach source _____

(3) Information too general; does not contain sufficient technical detail. _____

(4) Others (please list)

_____ _____

_____ _____

_____ _____

14. Name of your firm? _____

15. Location (City) _____

16. Size of your firm

1-10 employees _____

11-19 employees _____

20-50 employees _____

51-99 employees _____

100-499 employees _____

500 or over employees _____

17. Your job duties?

Development engineer _____

Research engineer _____

Research Scientist _____

Teacher _____

Project supervisor _____

Field Engineer _____

Management _____

Other (please specify)

_____ _____