METHODOLOGY FOR INDEXING NASA TECH BRIEFS

DEVELOPMENT AND IMPLEMENTATION

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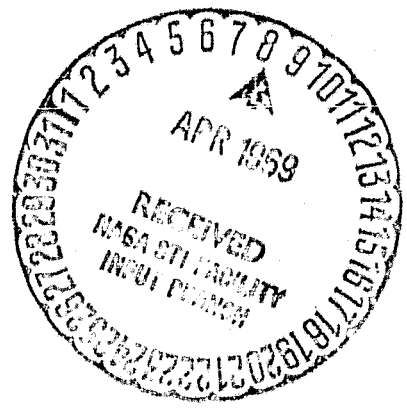

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FOREWORD

In November 1967, Denver Research Institute contracted with the National Aeronautics and Space Administration to perform research related to technology transfer. The major objective of the Project for the Analysis of Technology Transfer under Contract NSR 06-004-063 is to enhance the effectiveness of the National Aeronautics and Space Administration Technology Utilization Program by providing a more thorough understanding of the technology transfer process through documentation and analysis of specific operating experience.

Denver Research Institute subcontracted with Dr. William H. Clingman in July 1968 to conduct a study related to this contract. Work of this nature is provided for in TASK VI which states that " . . . the contractor shall undertake the conduct of other research projects or activities contributing to the objectives of this effort . . . ."

Dr. Clingman's findings were completed in late October 1968 and are reported in this publication, Methodology for Indexing NASA Tech Briefs Development and Implementation.

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SUMMARY

A study was carried out during 1968 to evaluate the indexing of NASA Tech Briefs, and based on this evaluation an improved indexing methodology was developed. The objective was suitable indexing for a user seeking technology for a problem unrelated to the NASA problem for which relevant technology was originally developed. One of the goals in the transfer of NASA developed technology to the private sector of the economy is the application of this technology to non-aerospace problems. The Tech Briefs play an important role in this technology transfer process. They represent a selection of innovations presented in capsule form and can serve as a link between someone in the private sector desiring technology and the more detailed NASA reports.

Consider the position of a user of the Tech Briefs who has a non-aerospace problem and needs relevant technology. Assume that he does not know what technology has been developed or what problems NASA had that may have resulted in technology relevant to his problem. A user in this position usually must choose terms in his search that either relate to his own problem or relate to the physical priniciples and novel relationships that would be present in relevant technology if it existed.

The study was conducted in two phases. Phase 1 of the project was carried out to determine the effectiveness of the current Tech Brief indexing procedure in serving the needs of such a user. Based on these results, a new indexing methodology was developed and evaluated in Phase 2 with the cooperation of the NASA Scientific and Technical Information Facility.

To conduct the first phase of the program a random sample of 100 Tech Briefs was analyzed to determine the physical principles and novel relationships present in each. A list of suggested index terms was then prepared for each Tech Brief based on this analysis and also based on the disclosed application of the technology. The suggested index terms were compared with the terms originally used to

index the Tech Brief, and on the basis of this comparison conclusions could be drawn as regards the indexing procedure.

It was concluded that for over 80% of the Tech Briefs issued through December 1967 there was at least one concept involved in the disclosed technology which was not covered by the original index terms. That is, a user for whom only this concept was relevant would not necessarily be led to the Tech Brief by the original index terms. The original indexing for the Tech Briefs issued in the latter half of 1967, however, covered disclosed concepts better than that for earlier Tech Briefs. Based on a further analysis of the results, a methodology was developed for generating a set of index terms with a high probability of the set covering all concepts disclosed in the Tech Brief.

It was desired that the methodology be applicable by indexers with a non-technical background and be less time consuming than making a technical analysis of the physical principles and novel relationships in each Tech Brief. To meet the user's needs, however, it still would be necessary that the methodology generate index terms equivalent to those suggested by such a technical analysis. In analyzing the Phase 1 results, it was observed that the index terms suggested by the technical analysis fell into various natural groupings. Examples were those terms related to the method of assembly or those terms related to the application of a piece of equipment. These groupings or categories also corresponded to the concepts covered by the index terms. With the primary objective being to provide index terms which cover each concept disclosed in the Tech Brief, it was hypothesized that names for these natural categories could serve as a checklist during the indexing process. Based on this hypothesis an indexing methodology was proposed, which was further developed and evaluated in Phase 2.

The final form of the methodology developed in Phase 2 involved three steps. First, the Tech Brief was classified into one of five types: Circuit or Equipment Tech Briefs; Process Tech Briefs; Computer Program Tech Briefs; Design Data or Design Techniques Tech Briefs; and Material Tech Briefs. The indexer was provided with a checklist which contained a set of questions corresponding to each of these classifications. Second, the Tech Brief was read for content and answers to the appropriate questions in the checklist. Key words were written down corresponding to each of these answers. In choosing key words, no distinction was made between those novel concepts which were the main theme of the Tech Brief and those which were parenthetical to the main application. Also the key words were as specific as the information given in the Tech Brief. In the third and final step the NASA Thesaurus was used to translate these key words into acceptable index terms.

The starting point for Phase 2 was the indexing methodology proposed by the author at the completion of Phase 1. This initial methodology differed from the final form principally in the questions on the checklist. The development and evaluation of the methodology were carried out with the participation of indexers from the NASA Scientific and Technical Information Facility. These indexers and the author independently applied the initial methodology to a sample of Tech Briefs. The index terms chosen were compared. Based on this comparison the checklist questions were modified to eliminate specific deficiencies that were observed. Modifications were also made so that language meaningful to both technical and non-technical participants in the study was used. The revised methodology was again evaluated by the participants independently indexing a second random sample of 75 Tech Briefs. A second variation in the methodology was also tested in which technical writers supplied the indexers with key words as additional input. Although in some cases this additional information was helpful, it did not greatly affect the indexing results.

With the final form of the methodology all participants were successful in indexing about 90% of the concepts identified and in indexing all of the concepts for about 70% of the Tech Briefs. By going through the Tech Brief a second time in the selection of key words, the indexers covered about 95% of the concepts identified. This improvement is at the expense of about a 50% increase in indexing time. The identified concepts included those determined by the author after analyzing the physical principles and novel relationships disclosed in the Tech Brief. The facility indexers using the methodology had non-technical backgrounds and did not analyze the Tech Briefs in this manner. Thus, on the basis of the above results, it was concluded that the project was successful in developing a methodology which could be consistently applied by different indexers and which would better serve the needs of the non-aerospace user.

It is the author's understanding that this methodology is currently being used to index Tech Briefs at the NASA Scientific and Technical Information Facility. Furthermore, the necessary information was transmitted to the NASA Scientific and Technical Information Division such that the methodology could be made a part of the formal operating procedures of the Facility.

INTRODUCTION

This project represented a continuation of an earlier study in which the indexing of NASA Tech Briefs was evaluated

by the author. The recommendations arising out of this previous study were experimentally tested and further developed in the present program. The program was carried out with the participation of indexers at the NASA Scientific and Technical Information Facility.

In the previous study, indexing was evaluated from the standpoint of a user seeking technology relevant to a particular problem that might be quite unrelated to the NASA problem for which the technology was originally developed. Assume that such a user does not know what technology has been developed or what problems NASA had that may have resulted in relevant technology. A user in this position usually must choose terms in his search that either relate to his own problem or relate to the physical principles and novel relationships that would be present in relevant technology if it existed. In the present project, an indexing methodology was developed and evaluated to serve the needs of such a user.

In the previous evaluation of indexing, a sample of Tech Briefs was analyzed by stating the physical principles and novel relationships in the disclosed innovation. Index terms suggested by this analysis were then listed and compared with those terms under which the Tech Brief was originally indexed. This comparison showed that for over 80% of the Tech Briefs issued through December 1967 there was at least one concept involved in the disclosed technology which was not covered by the original index terms. That is, a user for whom only this concept was relevant would not necessarily be led to the Tech Brief by the original index terms.

Next, consideration was given to an alternative method of generating index terms. An alternative was desired which would still generate terms equivalent to those suggested by the technical analysis, but which would be less time consuming and would produce consistent results. Based on an analysis of the results in the previous study, an indexing methodology was recommended as such an alternative. It was the objective of the present study, described in this report, to further develop and evaluate this methodology.

The methodology was comprised of the following series of steps. First, the Tech Brief was classified according to the type of innovation, such as equipment, process, etc. Second, a set of questions was provided for the particular classification. For each question, related key words were chosen using the information given in the Tech Brief. Third, the list of key words was then used in combination with the NASA Thesaurus to make a final choice of index terms.

The development and evaluation of this methodology were carried out with the participation of indexers from the NASA Scientific and Technical Information Facility. Through a series of discussions and experimental tests of variations in the above methodology, a final form was developed. This form was successful in indexing about 90% of the concepts identified and was successful in indexing all of the concepts for about 70% of the Tech Briefs. These results were achieved even though the indexers using the methodology had non-technical backgrounds and did not analyze the Tech Brief to determine the physical principles and novel relationships disclosed therein.

PROCEDURE

The procedure in the present program involved the independent indexing of Tech Briefs by the participants followed by discussion sessions. In these sessions results were compared and the indexing methodology modified. The starting point for the project was the indexing methodology recommended in the initial study.

The first goal of the program was to evaluate the consistency of this indexing methodology. This was accomplished by having two indexers at the NASA Scientific and Technical Information Facility and the author independently apply the indexing methodology with a sample of Tech Briefs. Prior to this, an initial discussion session was held at the Facility to provide the participants with the background for the project, to discuss the procedure to be followed, and to select this sample of Tech Briefs. The results of the independent indexing were then compared in a second discussion session. Based on these results the participants jointly developed a modified methodology. This was used to independently index a second sample of Tech Briefs. Results again were compared in a third discussion session. Recommendations were made as to the final version of the indexing methodology, which is described in a subsequent section of this report. This procedure enabled the methodology to be evaluated and improved. It also enabled those who would use the methodology to participate in its development.

Indexing Methodology Recommended in Previous Study

A key part of this methodology was the checklist shown in Table 1. The questions in this table were grouped according to various types of Tech Briefs. The first step in the methodology was to classify the Tech Brief into one of these types. Second, for each question under the appropriate type one listed related key words using the information given in the Tech Brief.

In choosing key words, no distinction was made between those novel concepts which were the main theme of the Tech Brief and those which were parenthetical to the main application. The third step was to use the list of key words in combination with the NASA Thesaurus to make a final choice of index terms. Related terms, as given by the Thesaurus, were used whenever appropriate in order to increase the probability of a user finding relevant information. Thus, each question given in Table 1 usually resulted in a set of index terms whenever the Tech Brief contained information related to the question. In some cases there was no information given relevant to a particular question or aspect of the innovation. It was found in the previous study, however, that this methodology indexed most of the concepts which were not covered by the original index terms.

Initial Discussion Session

Present at the first discussion in July, 1968 were Mrs. Lynn Haupt (LH) and her supervisor, Mrs. Sarah Gibson (SG). These were the two facility indexers who participated in the project with the author (WC). They were part of a group of three women who did the indexing of Tech Briefs and other special publications at the Facility. They were joined at the meeting by Mr. Elverson E. Baker (EB), who was manager of the Processing Department at the Facility, and the two participating indexers were in his department. Mr. Charles W. Hargrave, NASA Scientific and Technical Information Division, also participated in the discussions. At this meeting we proceeded to discuss the indexing methodology arising out of the previous study, the reasoning behind this methodology, and the procedure to be followed in the present project. As an additional part of the orientation each of us applied the methodology to three Tech Briefs which had been evaluated in the previous study. As a result of our discussion and this trial exercise, a revised checklist was prepared incorporating suggestions made by the participating indexers. Finally the sample of Tech Briefs to be independently indexed by the participants was selected.

This sample is shown in Table 2. It was comprised of four groups of 25 Tech Briefs each. The assignment of the participants to each group is also shown in Table 2. The group consisting of 25 Tech Briefs evaluated in the previous study was randomly selected from the 100 Tech Briefs included in that study. The other three groups were randomly selected from all Tech Briefs issued in the last half of 1967 and not included in the previous stdy. The choice of sample groups and assignment of indexers allowed several cross comparisons to be made. The two facility indexers, LH and SG, had A.B. degrees in English and Political Science respectively. EB and WC had training in Engineering and Science respectively.

Thus, the effect of different indexer backgrounds could be determined. In addition, the index terms generated by the methodology could be compared to those suggested by the technical analysis made in the previous study. Consistency could be evaluated by comparing the results of different indexers working with the same sample group.

After the initial discussion session, indexing was done independently by the participants using the revised checklist shown in Table 3 and the work sheet shown in Table 4.

Second Discussion Session.

At the second discussion in August, 1968 the same people were present as in the first session. Two Tech Brief writers, Messrs. Pearlstein (JP) and Kelley (MK), attended part of the meeting. The purpose of this second meeting was to compare the index terms chosen by the participants for the Tech Briefs in the above sample. The differences between terms were analyzed and the indexing methodology was modified accordingly. A second sample of 75 Tech Briefs was then chosen and independently indexed by the participants.

In comparing index terms, the same approach was used as in the previous study. The essential question asked was whether or not a concept disclosed in the Tech Brief was covered by the index terms. A concept was considered covered if a user, for whom only this concept was relevant, probably would be led to the Tech Brief by the index terms. The specific terms used to refer to the concept varied among the participants. As long as the concept was covered, however, no significance was attached to this variation in the present study. In Table 5 are shown the work sheets for three participants for a Tech Brief in which each participant indexed the same concepts. In Table 5A the grouping of terms by concept is shown for each indexer. One can note some difference in interpretation of the checklist questions among the indexers, even though each indexed the same concepts. This was true throughout the study. Another example is shown in Tables 6 and 6A. In this case the index terms chosen by one participant did not cover the application of the circuit to the processing of transducer signals.

For the purpose of tabulating results an omission was defined as occurring when one indexer did not cover a concept which was covered by another participant. The omissions, so defined, were noted and tabulated by indexer, type of omission, and type of Tech Brief. The interpretation of these results is discussed in the next section. This interpretation led to two alternative modified methodologies which were each tested in the next part of the program.

The first modification to the methodology involved essentially a change in the checklist questions. The second revised checklist is shown in Table 7. In addition it was agreed that in choosing key words the most specific ones consistent with the information in the Tech Brief would be used. It was also agreed that each key word so chosen would be translated into an index term independently of whether narrower and broader terms appeared simultaneously in the final set of index terms. A second random sample, consisting of 75 Tech Briefs issued during the last half of 1967, was chosen at the meeting and is shown in Table 8. The modified methodology was then applied to this sample by WC, SG, and LH during the next part of the project.

The second modification to the methodology used the first modification as a starting point. As an additional feature the technical writers supplied the indexers with their own list of key words. To evaluate this second modification the above sample was divided into three groups. The two technical writers, MK and JP supplied key words for Group 1 and 2 respectively during the next part of the project. In choosing these key words they used the revised checklist in Table 7. The two facility indexers first indexed all 75 Tech Briefs in the sample without the benefit of these key words. This allowed the first modification described above to be evaluated. The facility indexers then divided the Tech Briefs in Groups 1 and 2 between themselves and re-indexed these Tech Briefs in two ways. First, the indexer made a direct translation from the writer's key words to terms in the Thesaurus. Second, the indexer used the writer's key words to modify their own indexing of the Tech Brief. The net result was that the Tech Briefs in Sample Groups 1 and 2 were each indexed five times. Each Tech Brief was independently indexed by WC, SG, and LH, using the first modification to the methodology. In addition, there was a set of index terms which corresponded to a direct translation from the writer's key words to the Thesaurus. Finally, there was a set of index terms which corresponded to one of the facility indexers applying the first modification of the methodology but using the writer's key words as additional input information. This experiment was designed to determine whether the writer supplying key words was a procedure which should be included in the final recommended methodology.

The indexing was next carried out independently by the three participants as described above.

Third Discussion Session

During the third discussion in September, 1968 the same people were present as in the second discussion. The results of applying both the first and second modifications to the

methodology were compared. Based on these comparisions, conclusions were drawn as discussed below and the final recommended methodology form was outlined.

DISCUSSION OF RESULTS

Development of the Methodology

In the development of the methodology particular attention was given to the question of consistency. That is, did different indexers arrive at the same results? As discussed earlier, results were considered the same when the same concepts were covered by the index terms. To achieve consistency considerable attention was given to the exact wording of the questions in the checklist so that these questions were meaningful to the indexers with a variety of backgrounds. The first revised checklist in Table 3 was prepared during the inital discussion with the facility indexers. The initial revisions were made to make the checklist more meaningful to all participants prior to actual application of the methodology to indexing.

The results of applying the methodology to the first sample of Tech Briefs are shown in Table 9. As discussed in the prior section, results are presented in terms of the percent of identified concepts omitted by an indexer. An omission occurred when the terms selected by the indexer did not cover a concept which was covered by another one of the participants. In examining the omissions that are tabulated in Table 9, we observed that they could be classified into a small number of types. A definition of each type of omission follows:

Relevancy--- the concept or item was not indexed because it was not relevant to the disclosed innovation, in the judgement of the indexer.

Technical Information--- the participants who did index the concept or item either used background technical information not in the Tech Brief or used improper index terms due to a lack of such information.

Operation--- the concept or item which was not indexed concerned the operation of equipment or the operation of a process, that is, how the process works.

Application--- the concept or item which was not indexed concerned the applications of the disclosed innovation.

These four types of omission accounted for almost all of the omissions which occurred.

It is evident from the data in Table 9 that the first revised checklist was not satisfactory for indexing the Process Tech Briefs. The omissions that occurred for this sample group were each discussed in detail with the participants. As a result, the checklist questions for Process Tech Briefs were completely revised. Many of the omissions were a result of not listing verbs among the key words in applying the methodology. In the revised checklist the indexer's attention was focused on looking for key verbs in the Tech Brief.

A number of other conclusions were drawn from the data in Table 9. First, there was little difference between the two indexers, SG and LH, where each had indexed the same Tech Briefs. The background of both of these indexers was non-technical. Also there was little difference between WC and EB, who each had a technical background. The patterns in the data for each of the sample groups, except for the Process Tech Briefs, were also similar. For the other types of Tech Brief the main difference between indexers occurred for those omissions classified under "Relevancy". The indexers with a technical background omitted many items which they considered irrelevant but which were included by the indexers with a non-technical background.

In addition to modifiying the checklist questions for Process Tech Briefs, three further steps were taken in order to improve the consistency of the methodology. First, other modifications were made in the checklist to account for the "Operation" and "Application" types of omission as well as to use language more meaningful to all of the participants. Second, the effect of having the technical writers supply the indexers with a set of key words was evaluated as described in the last section. Third, it was agreed that each concept in the Tech Brief would be indexed as specifically as possible based upon the information in the Tech Brief.

In Table 10 are shown the results of applying the first modification of the methodology (second revised checklist used but no input from the technical writers). There was a significant improvement with regard to indexing Process Tech Briefs. As a result of this improvement, it was concluded that the particular form of the questions on the checklist was quite significant in determing the effectiveness of the

methodology. This would be particularly true if an indexer other than the participants in this study were to apply the methodology sometime in the future. In addition to the improvement in indexing Process Tech Briefs, there were also fewer omissions classifed under "Relevancy". Each of the three participants indexed about 90% of the concepts identified by a least one of the participants. This is probably the limit of consistency that can be expected with the first modification of the methodology.

Table 11 shows the results that were obtained when key words supplied by the technical writers were used as additional inputs by the indexers. As can be seen, the writer's key words were not in themselves sufficient to generate an improved set of index terms. In one case they were not sufficient to generate a satisfactory set of index terms. When the two indexers, SG and LH, re-indexed the Tech Briefs using the writers' key words as additional input some improvement was obtained. About 95% of the identified concepts were covered. In our discussion we reviewed the reasons for the indexer making changes during re-indexing and the specific use made of the writers' key words. Based on this discussion we concluded that the improvement in indexing was primarily due to the indexer's reviewing the Tech Brief a second time, although in some instances the information supplied by the writers was helpful. Thus, the first modification of the methodology, not involving the technical writers, was taken as the final recommended form of the indexing methodology given in this report.

Evaluation of the Methodology

Three characteristics of the methodology were considered in its evaluation: consistency, completeness, and efficiency. Consistency was concerned with the agreement between indexers in their choice of concepts to be covered by the index terms. Completeness was concerned with the question of whether the index terms generated by the methodology covered the same concepts that would have been identified by a technical analysis of the physical principles and novel relationships disclosed by the Tech Brief. Efficiency was concerned with the length of time required to index a Tech Brief using the methodology.

Consistency was evaluated by considering the results in Table 10. Each of the participants agreed on 90% or more of the concepts chosen by the others. Re-indexing did cause some improvement as shown in Table 11. Thus, there was a trade-off between consistency and efficiency that is discussed in more detail below.

To evaluate completeness a comparison was made between the concepts covered using the methodology and those identified by a technical analysis of physical principles and novel relationships. In making this evaluation it was quite significant that the two facility indexers had non-technical backgrounds. They did not make a technical analysis of the material in the Tech Brief. These indexers applied the methodology to a sample of 25 Tech Briefs that had been analyzed in the previous study. In this previous study, concepts were identified and indexed based on a technical analysis rather than on the application of the methodology. A comparision of results is shown in Table 12. In this table the Tech Briefs are classified according to the number of concepts they contain which were not covered by the index terms. The improvement over the original indexing of these Tech Briefs is evident. The data in Table 9 for this sample group show that 87% or more of the concepts were indexed by non-technical indexers applying the methodology.

In applying the first modification of the methodology to the second sample of 75 Tech Briefs, the author studied each Tech Brief for technical content and for novel relationships relevant to each item on the checklist. For each checklist question key words were chosen based on this technical analysis. In applying the same methodology the two facility indexers did not make such a technical analysis. Thus comparing the results provided a further evaluation of completeness. In Table 13, all Tech Briefs in the second sample are classified according to the number of concepts they contain which were not covered by the index terms. These results are compared in the same table with the results of the author's previous study. The improvement in indexing achieved by applying the methodology is evident. Also from the data in Table 10 it is evident that the application of the modified methodology by non-technical indexers covered about 90% of the concepts identified with a technical analysis.

It was concluded from both Table 11 and Table 13 that re-indexing achieves a further improvement in completeness. Thus, there was also a trade-off between efficiency and completeness.

It was the experience of the facility indexers that the application of the methodology took about twice as long as their previous approach to indexing. About one half the time was used in writing down key words while reading the Tech Brief, and the other half was used in converting the key words to index terms with the Thesaurus. Re-indexing would approximately double the time required to generate the key words and this increase the total time by about 50% of that required for the first modification of the methodology. Thus, the

improvements available in consistency and completeness by re-indexing would be at the expense of this increase in indexing time.

RECOMMENDED METHODOLOGY--FINAL FORM

The final form of the indexing methodology recommended as a result of this project involves three steps. First, the Tech Brief is classified into one of the five types given in the checklist shown as Table 14. For any given classification, there is a set of questions in the checklist that are used in the second step. Second, the Tech Brief is read for content and key words written down corresponding to each of these questions in the appropriate set. Third, the key words are used in combination with the NASA Thesaurus to choose a final set of index terms.

In the checklist, Circuit and Equipment Tech Briefs are combined. This is the only change from the final checklist evaluated in the project (Table 7). This combination is made since the questions for each have the same wording. Definitions for the five classifications of Tech Brief follow:

Circuit or Equipment ---	The Tech Brief primarily describes hardware.
Process----------	The Tech Brief primarily gives instructions for carrying out a physical (as opposed to mathematical) operation. Examples are welding, machining, chemical synthesis, chemical analysis, testing, etc.
Computer Program -------	The Tech Brief covers a computer program.
Design Data or Design Techniques ------	The Tech Brief primarily describes data available in another report, gives instructions for carrying out a mathematical calculation, or gives other techniques useful in design.
Material ----------	The Tech Brief primarily describes a new material or composition of matter.

In some cases there may be more than one category into which a Tech Brief can be logically classified. For example, a piece of equipment may be described as well as a process in which the equipment is used. In such cases it has been our observation that the index terms chosen are not dependent on the classification. This is likely due to overlap in the interpretation of questions for each type. The question in the Circuit or Equipment classification, "What does it do and how does it work?", can apply to the process using the equipment. The question in the Process classification, "What novel materials or components are used in the process?", can apply to the equipment used. Where the Tech Brief is clearly of a single type, however, it becomes significant to use the particular questions for that type. The variation in consistency and completeness of indexing with the particular wording of these questions is brought out in the discussion of the project results.

In the second step, the Tech Brief is read for content and answers to the questions in the checklist. It is possible that some questions will not have answers, but each question should be considered. As the Tech Brief is read, key words are written down corresponding to these answers. In choosing key words, no distinction is made between those novel concepts which are the main theme of the Tech Brief and those which are parenthetical to the main application. The key words should be as specific as the information given in the Tech Brief. In other words, the key words should cover the concept in the narrowest possible terms. To accomplish this the "key word" may actually be a phrase. Also it has been demonstrated that the consistency and completeness of the indexing will improve if this second step in the methodology is repeated. This repetition should be considered as an available option in the final methodology.

In the third step, each key word or phrase in directly translated with the NASA Thesaurus into acceptable index terms. Since the key words cover each concept in its narrowest terms, it could be possible for different people to carry out the second and third steps. After screening related terms in the Thesaurus, however, the indexer carrying out the third step should have the flexibility of modifying the key words that he himself has chosen. In any case, the index terms will be a direct translation of the final set of key words.

It is the author's understanding that this methodology is currently being used to index Tech Briefs at the NASA Scientific and Technical Information Facility. Furthermore, the necessary information was transmitted to the NASA Scientific and Technical Information Division such that the

methodology could be made a part of the formal operating procedures of the Facility.

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Dallas, Texas October 30, 1968

TABLE 1

CHECKLIST FOR INDEXING TECH BRIEFS

Circuit Tech Briefs

What does it do?
What materials or components are used?
How is it assembled?
What other functions can similar networks perform?

Process Tech Briefs

What does it make?
How does it make it?
What are the novel unit operations or combinations of unit operations?

Computer Program Tech Briefs

What is the generic classification?
What does it calculate?
What are the mathematical techniques used?
What are the novel programming features?

Equipment Tech Briefs

What does it do?
What materials or components are used?
How is it assembled?
What are other possible functions of similar structures?

Design Data or Methods Tech Briefs

What information is presented?
How is the information presented?
How was the information obtained or selected?
What are the applications?

Material Tech Briefs

What is the composition or form?
How is it made?
What are its novel properties?
What are the applications?

TABLE 2

FIRST SAMPLE GROUPS USED IN INDEXING EXPERIMENT

Recent Process Tech Briefs	Recent Equipment Tech Briefs
Indexers: LH WC	Indexers: SG WC
#67-10132	#67-10231
-10237	-10234
-10243	-10242
-10244	-10264
-10245	-10256
-10283	-10274
-10290	-10288
-10295	-10305
-10299	-10336
-10303	-10361
-10324	-10379
-10337	-10385
-10341	-10388
-10350	-10399
-10352	-10412
-10371	-10424
-10377	-10426
-10381	-10427
-10391	-10433
-10420	-10448
-10428	-10461
-10452	-10466
-10485	-10503
-10554	-10517
-10574	-10535

TABLE 2

FIRST SAMPLE GROUPS USED IN INDEXING EXPERIMENT (CONTINUED)

Recent Tech Briefs of All Types	Tech Briefs Evaluated in Previous Study by WHC
Indexers: EB, SG, LH, WC	Indexers: SG, LH
#67-10221	#63-10613
-10232	66-10034
-10239	-10053
-10241	-10161
-10250	-10437
-10263	-10539
-10277	-10543
-10278	-10648
-10300	67-10018
-10311	-10118
-10314	-10167
-10340	-10235
-10346	-10247
-10357	-10248
-10362	-10298
-10364	-10330
-10390	-10347
-10409	-10359
-10431	-10389
-10437	-10419
-10441	-10423
-10464	-10440
-10478	-10456
-10493	-10489
-10514	-10505

TABLE 3

CHECKLIST FOR INDEXING TECH BRIEFS (FIRST REVISION)

Circuit Tech Briefs

What kind of circuit is it?
What does it do?
What materials or components are used?
How is it assembled?
What other functions can similar networks perform?

Process Tech Briefs

What type of process is it?
What does it make or do?
How does it make it?
What are the novel unit operations or combinations of unit operations?

Computer Program Tech Briefs

What is the generic classification?
What does it calculate?
What are the mathematical techniques used?
What are the novel programming features?

Equipment Tech Briefs

What kind of equipment is it?
What does it do?
What materials or components are used?
How is it assembled?
What are other possible functions of similar structures?

Design Data or Design Techniques Tech Briefs

What information is presented?
How is the information presented?
How was the information obtained or selected?
What are the applications?

Material Tech Briefs

What kind of material is it?
What is the composition or form?
How is it made?
What are its novel properties?
What are the applications?

TABLE 4

TECH BRIEF INDEXING WORK SHEET

Tech Brief Number Originator Number Date

Title:

Type of Tech Brief:

Indexer:

Key Words	Index Terms
1. Question:	
2. Question:	
3. Question:	
4. Question:	
5. Question:	

TABLE 5

TECH BRIEF INDEXING WORK SHEET

Tech Brief Number	Originator Number	Date
B67-10239	KSC-67-94	July 1967

Title: A Phonocardiogram Simulator

Type of Tech Brief: Circuit

Indexer: WHC

Key Words	Index Terms
1. Question: What kind of circuit is it?	
Simulator Phonocardiogram	Simulators Training Simulators Phonocardiography
2. Question: What does it do?	
Simulation Mixing Pulse Amplitude Control	Signal Generators Mixing Circuits Pulse Amplitude
3. Question: What materials or components are used?	
Low Frequency Multivibrator Pulse Circuits	Multivibrators Low Frequencies Pulse Generators
4. Question: How is it assembled?	
5. Question: What other functions can similar networks perform?	
Telemetry Systems Checkout Instrumentation Systems Medical Instrumentation Personnel Training	Telemetry Checkout Instruments Bioinstrumentation Training Devices

TABLE 5 (CONTINUED)

TECH BRIEF INDEXING WORK SHEET

DATE: July 1967

TECH BRIEF NUMBER:	ORIGINATOR NUMBER:	INDEXER:
B67-10239	KSC-67-94	S. P. Gibson

TITLE: A Phonocardiogram Simulator

TYPE: Equipment

1 QUESTION: What kind of equipment is it?

KEY WORDS:	INDEX TERMS:
phonocardiogram simulator	phonocardiography simulators

2 QUESTION: What does it do?

KEY WORDS:	INDEX TERMS:
electrical signals pattern human heart device checkout	waveforms heart test equipment

3 QUESTION: What materials or components are used?

KEY WORDS:	INDEX TERMS:
wave multivibrator circuit resistances potentiometer	multivibrators electrical resistance potentiometer (resistors)

4 QUESTION:

KEY WORDS:	INDEX TERMS:

5 QUESTION: What are other possible functions of similar structures?

KEY WORDS:	INDEX TERMS:
physiological monitoring of astronauts telemetry systems training instruments	medical equipment monitors biotelemetry training devices

TABLE 5 (CONTINUED)

TECH BRIEF INDEXING WORK SHEET

DATE: July 1967

TECH BRIEF NUMBER:	ORIGINATOR NUMBER:	INDEXER:
B67-10239	KSC-67-94	L. Haupt

TITLE: A Phonocardiogram Simulator

TYPE: Equipment

1

QUESTION: What kind of equipment is it?

KEY WORDS:	INDEX TERMS:
Phonocardiogram simulator	Cardiograms Simulators

2

QUESTION: What does it do?

KEY WORDS:	INDEX TERMS:
Physiological monitoring Electric signals Human heart Waveforms	Physiological responses Monitors Electric pulses Heart

3

QUESTION: What materials or components are used?

KEY WORDS:	INDEX TERMS:
Multivibrator Circuit resistances Voltage regulators Pulse amplitude control	Multivibrators Voltage regulators Pulse amplitude

4

QUESTION:

KEY WORDS:	INDEX TERMS:

5

QUESTION: What are other possible functions of similar structures?

KEY WORDS:	INDEX TERMS:
Telemetry Medicine	Telemetry Medical equipment

TABLE 5A

COMPARISON OF INDEX TERMS
Tech Brief #67-10239

WC	SG	LH
Simulators Training Simulators Signal Generators Training Devices	Simulators Training Devices	Simulators
Phonocardiography Bioinstrumentation Instruments	Phonocardiography Medical Equipment Heart	Cardiograms Medical Equipment Heart Physiological Responses
Checkout Telemetry	Monitors Biotelemetry Test Equipment	Monitors Telemetry
Multivibrators Low Frequencies Pulse Generators Pulse Amplitude	Multivibrators Electrical Resistance Potentiometer (Resistors) Waveforms	Multivibrators Voltage Regulators Pulse Amplitude Electric Pulses

TABLE 6

TECH BRIEF INDEXING WORK SHEET

Tech Brief Number	Originator Number	Date
B67-10221	NUC-10056	July 1967

Title: Amplifier Provides Dual Outputs from a Single Source with Complete Isolation

Type of Tech Brief: Circuit

Indexer: WHC

Key Words	Index Terms
1. Question: What kind of circuit is it?	
Amplifier	Amplifiers
2. Question: What does it do?	
D.C. Isolation Modulation Transformer Coupling Differential Amplifier Output Isolation	Isolation Coupling Circuits Differential Amplifiers
3. Question: What materials or components are used?	
Transformer Isolation Modulator Carrier Amplifier Demodulator Output Amplifiers	Modulators Demodulators Transformers Circuit Protection
4. Question: How is it assembled?	
5. Question: What other functions can similar networks perform?	
Thermocouple Transducer Strain Gage Control Monitoring	Thermocouples Transducers Strain Gages Electronic Control Monitors

TABLE 6 (CONTINUED)

TECH BRIEF INDEXING WORK SHEET

DATE: July 1967

TECH BRIEF NUMBER:	ORIGINATOR NUMBER:	INDEXER:
B67-10221	NUC-10056	S. P. Gibson

TITLE: Amplifier Provides Dual Outputs from a Single Source with Complete Isolation

TYPE: Circuit

1 QUESTION: What kind of circuit is it?

KEY WORDS:	INDEX TERMS:
amplifier	amplifiers

2 QUESTION: What does it do?

KEY WORDS:	INDEX TERMS:
transformer isolation modulation techniques dual output one input	transformers phase modulation output input

3 QUESTION: What materials or components are used?

KEY WORDS:	INDEX TERMS:
conductor cable demodulators	conductors demodulators

4 QUESTION:

KEY WORDS:	INDEX TERMS:

5 QUESTION:

KEY WORDS:	INDEX TERMS:

TABLE 6 (CONTINUED)

TECH BRIEF INDEXING WORK SHEET

DATE: July 67

TECH BRIEF NUMBER:	ORIGINATOR NUMBER:	INDEXER:
B67-10221	NUC-10056	L. Haupt

TITLE: Amplifier Provides Dual Outputs from a Single Source with Complete Isolation

TYPE: Circuit

	QUESTION:	KEY WORDS:	INDEX TERMS:
1	What kind of circuit is it?	amplifier	amplifiers circuits
2	What does it do?	dual output input signal	output input
3	What materials or components are used?	sensors demodulator	thermocouples strain gages demodulators
4	How is it assembled?	transformer isolation modulation techniques	circuit protection isolation pulse modulation
5	What other functions can similar networks perform?	signal monitoring control signal	signal transmission monitors control equipment

TABLE 6A

COMPARISON OF INDEX TERMS
Tech Brief #67-10221

WC	SG	LH
Amplifiers	Amplifiers	Amplifiers
Differential Amplifiers	Phase Modulation	Circuits
Modulators	Demodulators	Pulse Modulation
Demodulators	Conductors	Demodulators
Isolation	Output	Isolation
Coupling Circuits	Input	Output
Transformers	Transformers	Input
Circuit Protection		Circuit Protection
Thermocouples	Thermocouples	Thermocouples
Strain Gages	Strain Gages	Strain Gages
Electronic Control		Control Equipment
Monitors		Monitors
Transducers		Signal Transmission

TABLE 7

CHECKLIST FOR INDEXING TECH BRIEFS (SECOND REVISION)

Circuit Tech Briefs

What kind of circuit is it?
What does it do and how does it work?
What novel materials or components are used?
How is it assembled?
What are the applications?

Process Tech Briefs

What type of process is it?
What does it make or do?
What are the operations (include key verbs)?
What novel materials or components are used in the process?
What are the applications of the end product?

Computer Program Tech Briefs

What is the generic classification?
What does it calculate and what are the applications?
What are the mathematical techniques used?
What are the novel programming features?

Equipment Tech Briefs

What kind of equipment is it?
What does it do and how does it work?
What novel materials or components are used?
How is it assembled?
What are the applications?

Design Data or Design Techniques Tech Briefs

What information is presented?
How is the information presented?
How was the information obtained or selected?
What are the applications?

Material Tech Briefs

What kind of material is it?
What is the composition or form?
How is it made?
What are its novel properties?
What are the applications?

TABLE 8

SECOND RANDOM SAMPLE OF TECH BRIEFS

GROUP 1	GROUP 2	GROUP 3
B67-10219	B67-10229	B67-10225
10254	10238	10227
10265	10259	10230
10273	10286	10240
10276	10301	10249
10281	10306	10261
10282	10310	10266
10292	10315	10267
10312	10331	10287
10320	10351	10291
10321	10356	10338
10327	10368	10366
10328	10373	10387
10353	10401	10392
10393	10422	10397
10398	10447	10415
10405	10458	10430
10443	10470	10438
10459	10475	10442
10473	10487	10460
10476	10492	10468
10483	10494	10497
10504	10495	10509
10560	10506	10510
10561	10559	10545

TABLE 9

CLASSIFICATION OF INDEXER OMISSIONS

Tech Brief Sample Group	Type of Omission	% of Total Concepts Omitted — Indexer WC	SG	LH	EB
Previously Evaluated	Relevancy	8	1	2	-
	Technical Information	1	6	5	-
	Operation	1	0	3	-
	Application	0	0	1	-
	Other	1	1	2	-
	TOTAL	11	8	13	-
Process	Relevancy	5	-	13	-
	Technical Information	1	-	5	-
	Operation	0	-	10	-
	Application	0	-	10	-
	Other	0	-	1	-
	TOTAL	6	-	39	-
Equipment	Relevancy	11	2	-	-
	Technical Information	1	1	-	-
	Operation	0	4	-	-
	Application	0	0	-	-
	Other	0	1	-	-
	TOTAL	12	8	-	-
Recent-All Types	Relevancy	11	2	3	11
	Technical Information	1	4	3	1
	Operation	0	2	2	2
	Application	0	0	0	0
	Other	1	2	1	2
	TOTAL	13	10	9	16

TABLE 10

CLASSIFICATION OF INDEXER OMISSIONS
First Modification of The Methodology

Tech Brief Sample Group	Type of Omission	% of Total Concepts Omitted — Indexer WC	SG	LH
Total Second Random Sample	Relevancy	7	3	4
	Technical Information	0	1	2
	Operation	0	1	1
	Application	0	5	3
	Other	0	0	0
	TOTAL	7	10	10
Process*	Relevancy	7	0	0
	Technical Information	0	2	5
	Operation	0	2	2
	Application	0	8	5
	Other	0	0	0
	TOTAL	7	12	12

*For each indexer, omissions are tabulated for those Tech Briefs which that indexer classified as Process Tech Briefs.

TABLE 11

CLASSIFICATION OF INDEXER OMISSIONS
Second Modification of The Methodology

Tech Brief Sample Group	Type of Omission	% of Total Concepts Omitted — Indexer MK	JP	SG*	LH*
Group 1-- Second Random Sample	Relevancy	30	-	2	4
	Technical Information	0	-	0	0
	Operation	13	-	0	0
	Application	14	-	2	1
	Other	1	-	0	0
	TOTAL	58	-	4	5
Group 2-- Second Random Sample	Relevancy	-	1	0	0
	Technical Information	-	0	0	2
	Operation	-	6	0	2
	Application	-	6	4	0
	Other	-	0	0	0
	TOTAL	-	13	4	4

*Result of re-indexing with technical writer's input.

TABLE 12

CLASSIFICATION OF TECH BRIEFS
ACCORDING TO
NUMBER OF CONCEPTS OMITTED IN INDEXING

Number of Concepts Omitted	Percent of Tech Briefs in Sample		
	Original Indexing All Tech Briefs in Previous Study	Indexer is SG Previously Evaluated Tech Briefs	Indexer is LH Previously Evaluated Tech Briefs
0	4	72	56
1	46	24	36
2	35	4	8
3	15	0	0
	100	100	100

TABLE 13

CLASSIFICATION OF TECH BRIEFS
ACCORDING TO
NUMBER OF CONCEPTS OMITTED IN INDEXING

Number of Concepts Omitted	Percent of Tech Briefs in Sample				
	Original Indexing Tech Briefs in Previous Study Issued July-Dec., 1967	Indexing Methodology Second Random Sample from This Study Issued July-Dec., 1967			
		Indexer			
		SG	SG*	LH	LH*
0	0	75	88	65	79
1	54	17	8	28	21
2	28	7	4	5	0
3	18	1	0	0	0
	100	100	100	100	100

*Result of re-indexing

TABLE 14

CHECKLIST FOR INDEXING TECH BRIEFS (FINAL FORM)

Circuit or Equipment Tech Briefs

What kind of circuit or equipment is it?
What does it do and how does it work?
What novel materials or components are used?
How is it assembled?
What are the applications?

Process Tech Briefs

What type of process is it?
What does it make or do?
What are the operations (include key verbs)?
What novel materials or components are used in the process?
What are the applications of the end product?

Computer Program Tech Briefs

What is the generic classification?
What does it calculate and what are the applications?
What are the mathematical techniques used?
What are the novel programming features?

Design Data or Design Techniques Tech Briefs

What information is presented?
How is the information presented?
How was the information obtained or selected?
What are the applications?

Material Tech Briefs

What kind of material is it?
What is the composition or form?
How is it made?
What are its novel properties?
What are the applications?