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The U.S. Government Technical Report and Aerospace Knowledge Diffusion: Results of an On-Going Investigation

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Abstract

The U.S. government technical report is a primary means by which the results of federally funded research and development (R&D) are transferred to the U.S. aerospace industry. However, little is known about this information product in terms of its actual use, importance, and value in the transfer of federally funded (U.S.) R&D. To help establish a body of knowledge, the U.S. government technical report is being investigated as part of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* In this paper, we summarize the literature on technical reports and provide a model that depicts the transfer of federally funded aerospace R&D via the U.S. government technical report. We present results from two surveys (one of five studies) of our investigation of aerospace knowledge diffusion vis-à-vis the U.S. government technical report and close with a brief overview of on-going research into the use of the U.S. government technical report as a rhetorical device for transferring federally funded (U.S.) aerospace R&D.

1. INTRODUCTION

NASA and DoD maintain scientific and technical information (STI) systems for acquiring, processing, announcing, publishing, and transferring the results of government-performed and government-sponsored research. Within both the NASA and DoD STI systems, the U.S. government technical report is considered a primary mechanism for transferring the results of this research to the U.S. aerospace community. However, McClure (1988) concludes that we actually know little about the role, importance, and impact of the technical report in the transfer of federally funded R&D because little empirical information about this product is available.

To help fill this knowledge void, we are examining the U.S. government technical report as part of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* This project investigates, among other things, the information environment in which U.S. aerospace engineers and scientists work, the information-seeking behavior of U.S. aerospace engineers and scientists, and the factors that influence the use of STI (Pinelli, Kennedy, and Barclay, 1991; Pinelli, Kennedy, Barclay, and White, 1991). The results of this investigation could (1) advance the development of practical theory, (2) contribute to the design and development of aerospace information systems, and (3) have practical implications for transferring the results of federally funded aerospace R&D to the U.S. aerospace community.

In this paper, we summarize the literature on technical reports and provide a model that depicts the transfer of federally funded (U.S.) aerospace R&D through the U.S. government technical report. We present results from two surveys (one of five studies) of our investigation of aerospace knowledge diffusion vis-à-vis the U.S. government technical report and close with a brief overview of on-going research into the use of the U.S. government technical report as a rhetorical device for transferring federally funded (U.S.) aerospace R&D.

2. THE U.S. GOVERNMENT TECHNICAL REPORT

Although they have the potential for increasing technological innovation, productivity, and economic competitiveness, U.S. government technical reports may not be utilized because of limitations in the existing transfer mechanism. According to Ballard, et al., (1986), the current system "virtually guarantees that much of the Federal investment in creating STI will not be paid back in terms of tangible products and innovations." He further states that "a more active and coordinated role in STI transfer is needed at the Federal level if technical reports are to be better utilized."

2.1 Characteristics of Technical Reports

The definition of the technical report varies because the report serves different roles in communication within and between organizations. The technical report has been defined etymologically, according to report content and method (U.S. Department of Defense, 1964); behaviorally, according to the influence on the reader (Ronco, et al., 1964); and rhetorically, according to the function of the report within a system for communicating STI (Mathes and Stevenson, 1976). The boundaries of technical report literature are difficult to establish because of wide variations in the content, purpose, and audience being addressed. The nature of the report -- whether it is informative, analytical, or assertive -- contributes to the difficulty.

Fry (1953) points out that technical reports are heterogenous, appearing in many shapes, sizes, layouts, and bindings. According to Smith (1981), "Their formats vary; they might be brief (two pages) or lengthy (500 pages). They appear as microfiche, computer printouts or vugraphs, and often they are loose leaf (with periodic changes that need to be inserted) or have a paper cover, and often contain foldouts. They slump on the shelf, their staples or prong fasteners snag other documents on the shelf, and they are not neat."

Technical reports may exhibit some or all of the following characteristics (Gibb and Phillips, 1979; Subramanyam, 1981):

- Publication is not through the publishing trade.
- Readership/audience is usually limited.
- Distribution may be limited or restricted.
- Content may include statistical data, catalogs, directions, design criteria, conference papers and proceedings, literature reviews, or bibliographies.
- Publication may involve a variety of printing and binding methods.

The SATCOM report (National Academy of Sciences - National Academy of Engineering, 1969) lists the following characteristics of the technical report:

- It is written for an individual or organization that has the right to require such reports.
- It is basically a stewardship report to some agency that has funded the research being reported.
- It permits prompt dissemination of data results on a typically flexible distribution basis.
- It can convey the total research story, including exhaustive exposition, detailed tables, ample illustrations, and full discussion of unsuccessful approaches.

2.2 History and Growth of the U.S. Government Technical Report

The development of the [U.S. government] technical report as a major means of communicating the results of R&D, according to Godfrey and Redman (1973), dates back to 1941 and the establishment of the U.S. Office of Scientific Research and Development (OSRD). Further, the growth of the U.S. government technical report coincides with the expanding role of the Federal government in science and technology during the post World War II era. However, U.S. government technical reports have existed for several decades. The Bureau of Mines *Reports of Investigation* (Redman, 1965/66), the *Professional Papers of the United States Geological Survey*, and the *Technological Papers of the National Bureau of Standards* (Auger, 1975) are early examples of U.S. government technical reports. Perhaps the first U.S. government publications officially created to document the results of federally funded (U.S.) R&D were the technical reports first published by the National Advisory Committee for Aeronautics (NACA) in 1917.

Auger (1975) states that "the history of technical report literature in the U.S. coincides almost entirely with the development of aeronautics, the aviation industry, and the creation of the NACA, which issued its first report in 1917." In her study, *Information Transfer in Engineering*, Shuchman (1981) reports that 75 percent of the engineers she surveyed used technical reports; that technical reports were important to engineers doing applied work; and that aerospace engineers, more than any other group of engineers, referred to technical reports. However, in many of these studies it is often unclear, as in Shuchman's study, whether U.S. government technical reports, non-U.S. government technical reports, or both are included.

The U.S. government technical report is a primary means by which the results of federally funded R&D are made available to the scientific community and are added to the literature of science and technology (President's Special Assistant for Science and Technology, 1962). McClure (1988) points out that "although the [U.S.] government technical report has been variously reviewed, compared, and contrasted, there is no real knowledge base regarding the role, production, use, and importance [of this information product] in terms of accomplishing this task." Our analysis of the literature supports the following conclusions reached by McClure:

- The body of available knowledge is simply inadequate and noncomparable to determine the role that the U.S. government technical report plays in transferring the results of federally funded R&D.

- Further, most of the available knowledge is largely anecdotal, limited in scope and dated, and unfocused in the sense that it lacks a conceptual framework.

- The available knowledge does not lend itself to developing "normalized" answers to questions regarding U.S. government technical reports.

3.0 THE TRANSFER OF FEDERALLY FUNDED (U.S.) R&D AND THE U.S. GOVERNMENT TECHNICAL REPORT

Three paradigms -- appropriability, dissemination, and diffusion -- have dominated the transfer of federally funded (U.S.) R&D (Ballard, et al., 1989; Williams and Gibson, 1990). Whereas variations of them have been tried within different agencies, overall Federal (U.S.) STI transfer activities continue to be driven by a "supply-side," dissemination model.

3.1 The Dissemination Model

The **dissemination model** emphasizes the need to transfer information to potential users and embraces the belief that the production of quality knowledge is not sufficient to ensure its fullest use. Linkage mechanisms, such as information intermediaries, are needed to identify useful knowledge and to transfer it to potential users. This model assumes that if these mechanisms are available to link potential users with knowledge producers, then better opportunities exist for users to determine what knowledge is available, acquire it, and apply it to their needs. The strength of this model rests on the recognition that STI transfer and use are critical elements of the process of technological innovation. Its weakness lies in the fact that it is passive, for it does not take users into consideration except when they enter the system and request assistance. The **dissemination model** employs one-way, source-to-user transfer procedures that are seldom responsive in the user context. In fact, user requirements are seldom known or considered in the design of information products and services.

3.2 The Transfer of (U.S.) Federally-Funded Aerospace R&D

A model depicting the transfer of federally funded aerospace R&D through the U.S. government technical report appears in figure 1. The model is composed of two parts -- the **informal** that relies on collegial contacts and the **formal** that relies on surrogates, information producers, and information intermediaries to complete the "producer to user" transfer process.

When U.S. government (i.e., NASA) technical reports are published, the initial or primary distribution is made to libraries and technical information centers. Copies are sent to surrogates for secondary and subsequent distribution. A limited number are set aside to be used by the author for the "scientist-to-scientist" exchange of information at the collegial level.

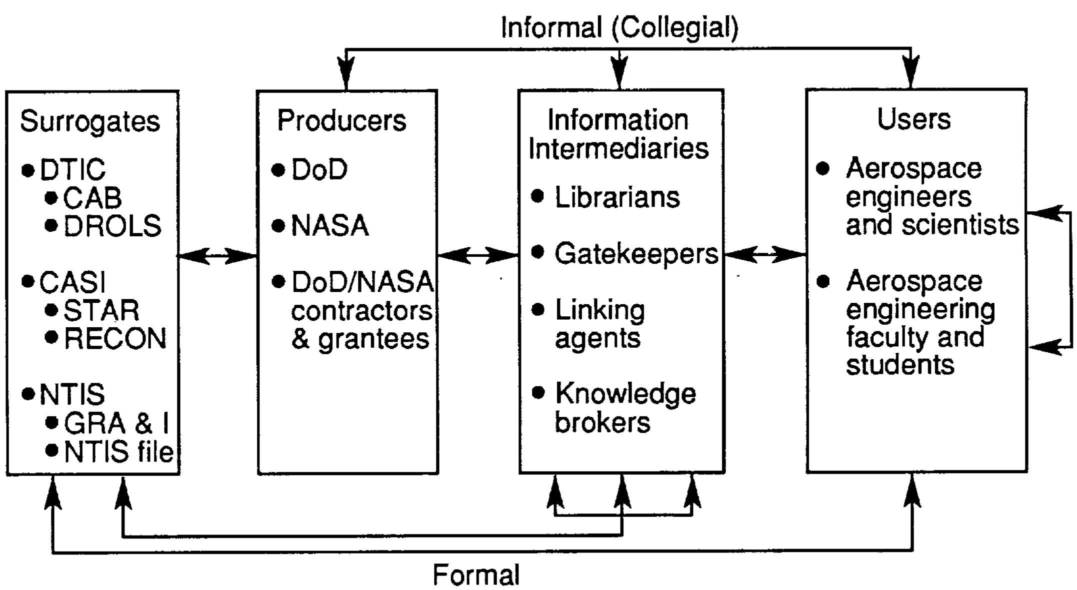

Figure 1. The U.S. Government Technical Report in a Model Depicting the Dissemination of Federally Funded Aerospace R&D.

Surrogates serve as technical report repositories or clearinghouses for the producers and include the Defense Technical Information Center (DTIC), the NASA Center for Aero Space Information (CASI), and the National Technical Information Service (NTIS). These surrogates have created a variety of technical report announcement journals such as CAB (Current Awareness Bibliographies) and STAR (Scientific and Technical Aerospace Reports) and computerized retrieval systems such as DROLS (Defense RDT&E Online System) and RECON (REmote CONsole) that permit online access to technical report databases. Information intermediaries are, in large part, librarians and technical information specialists in academia, government, and industry. Those representing the producers serve as what McGowan and Loveless (1981) describe as "knowledge brokers" or "linking agents." Information intermediaries connected with users act, according to Allen (1977), as "technological entrepreneurs" or "gatekeepers." The more "active" the intermediary, the more effective the transfer process becomes (Goldhor and Lund, 1983). Active intermediaries move information from the producer to the user, often utilizing interpersonal (i.e., face-to-face) communication in the process. Passive information intermediaries, on the other hand, "simply array information for the taking, relying on the initiative of the user to request or search out the information that may be needed" (Eveland, 1987).

The overall problem with the total Federal STI system is that "the present system for transferring the results of federally funded STI is passive, fragmented, and unfocused;" effective knowledge transfer is hindered by the fact that the Federal government "has no coherent of systematically designed approach to transferring the results of federally funded R&D to the user" (Ballard, et al., 1986). In their study of issues and options in Federal STI, Bikson and her colleagues (1984) found that many of the interviewees believed "dissemination activities were afterthoughts, undertaken without serious commitment by Federal agencies whose primary concerns were with [knowledge] production and not with knowledge transfer;" therefore, "much of what has been learned about [STI] and knowledge transfer has not been incorporated into federally supported information transfer activities."

Problematic to the **informal** part of the system is that knowledge users can learn from collegial contacts only what those contacts happen to know. Ample evidence supports the claim that no one researcher can know about or keep up with all the research in his/her area(s) of interest. Like other members of the scientific community, aerospace engineers and scientists are faced with the problem of too much information to know about, to keep up with, and to screen. To compound this problem, information itself is becoming more interdisciplinary in nature and more international in scope.

Two problems exist with the **formal** part of the system. First, the **formal** part of the system employs one-way, source-to-user transmission. The problem with this kind of transmission is that such formal one-way, "supply side" transfer procedures do not seem to be responsive to the user context (Bikson, et al., 1984). Rather, these efforts appear to start with an information system into which the users' requirements are retrofit (Adam, 1975). The consensus of the findings from the empirical research is that interactive, two-way communications are required for effective information transfer (Bikson, et al., 1984).

Second, the **formal** part relies heavily on information intermediaries to complete the knowledge transfer process. However, a strong methodological base for measuring or assessing the effectiveness of the information intermediary is lacking (Beyer and Trice, 1982). In addition, empirical data on the effectiveness of information intermediaries and the role(s) they play in knowledge transfer are sparse and inconclusive. The impact of information intermediaries is likely to be strongly conditional and limited to a specific institutional context.

According to Roberts and Frohman (1978), most Federal approaches to knowledge utilization have been ineffective in stimulating the diffusion of technological innovation. They claim that the numerous Federal STI programs are "highest in frequency and expense yet lowest in impact" and that Federal "information dissemination activities have led to little documented knowledge utilization." Roberts and Frohman also note that "governmental programs start to encourage utilization of knowledge only after the R&D results have been generated" rather than during the idea development phase of the innovation process. David (1986), Mowery (1983), and Mowery and Rosenberg (1979) conclude that successful [Federal] technological innovation rests more with the transfer and utilization of knowledge than with its production.

4.0 AEROSPACE KNOWLEDGE DIFFUSION AND THE U.S. GOVERNMENT TECHNICAL REPORT: AN ANALYSIS OF TWO SURVEYS

We have surveyed aerospace engineers and scientists in the U.S. and abroad as part of five studies. Survey populations have included members of professional (technical) societies as well as aerospace engineers and scientists at comparable aeronautical research facilities. Data follow that deal with technical report use from two surveys. A self-administered (self-reported) mail survey was used to gather data. A brief overview of the methodology is provided for each study. Data are presented in the order in which the surveys were conducted.

4.1 Study of the AIAA Membership

Two self-administered (self-reported) questionnaires were used for data collection. The membership (approximately 34,000) of the American Institute of Aeronautics and Astronautics (AIAA) served as the study population. Survey 1 investigated the relationship between the use of U.S. government technical reports and selected (seven) institutional and (six) sociometric variables. Survey 2 investigated the use and importance of Advisory Group for Aerospace Research and Development (AGARD), DoD, and NASA technical reports; reasons for non-use of these reports; how U.S. aerospace engineers and scientists find out about (become aware of) and physically obtain these reports, the influence of seven factors on the use of these reports; and the use of specified technical information (e.g., computer program listings) in electronic format. The sample frame for both surveys consisted of 6,781 AIAA members (1 out of 5) who reside in the U.S and who were employed in academia, government, and industry. Survey data were analyzed using the Statistical Package for the Social Sciences (SPSS).

Survey 1. Systematic sampling was used to select 3,298 members from the sample frame to participate in survey 1. Two thousand and sixteen (2,016) usable questionnaires were received by the established cut-off date. With an adjusted sample of 2,894 and 2,016 completed questionnaires, the adjusted response rate for survey 1 was 70 percent. The survey spanned the period from May 1989 to October 1989. The following composite participant profile was based on survey 1 demographic data: works in industry (52.6%), works as a manager (37.5%) or in design/development (28.1%), has a graduate degree (70.3%), was educated (trained) as an engineer (83.0%), currently works as an engineer (67.5%), has an average of 21 years of professional work experience, and has had some part of this work funded by the U.S. government (82.9%).

Survey 2. Systematic sampling was used to select 1,735 members from the sample frame to participate in survey 2. With an adjusted sample of 1,553 and 975 completed questionnaires, the adjusted response rate for survey 2 was 63 percent. Survey 2 was conducted from July 1989 through February 1990. The following composite participant profile was based on survey 2 demographic data: works in industry (49.3%), works in management (35.1%) or in design/development (26.9%), has a graduate degree (72.5%), was educated (trained) as an engineer (83.6%), currently works as an engineer (66.7%), has an average of 21 years of professional work experience, and has had some part of this work funded by the U.S. government (84.3%).

4.1.1 Survey 1

Data regarding the use of U.S. government technical reports were collected from survey 1 participants. Within the context of other technical information products (i.e., conference-meeting papers, journal articles, and in-house technical reports), survey respondents were asked to indicate their use of and the importance of these four information products and approximately how many times they had used each product in the past 6 months in performing their present professional duties. As shown in table 1, almost all the U.S. aerospace engineers and scientists in survey 1 use the four information products in performing their present profes-

Table 1.
Use of Technical Information Products

Information Products	Percentage Using Product In --			Overall Percentage Using Product (n = 1,839)
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)	
Conference-Meeting Papers	99.4	99.1	95.5	97.1
Journal Articles	99.4	97.4	95.5	96.7
In-house Technical Reports	97.9	99.6	98.8	98.8
U.S. Government Technical Reports	98.9	99.1	96.6	96.6

sional duties. There is no statistical difference in use among the academically-, government-, and industry-affiliated respondents. In terms of the highest level of education, career, and years of professional work experience, almost all the respondents use the four information products in performing their present professional duties.

Respondents rated the importance of conference-meeting papers, journal articles, in-house technical reports, and U.S. government technical reports using a 1 to 5 point scale (table 2). Of the four information products, in-house technical reports received the highest overall mean rating. The overall mean importance rating, although lower, does not differ considerably for conference-meeting papers, journal articles, and U.S. government technical reports. Statistically, academically-affiliated respondents attribute a higher importance rating to conference-meeting papers

Table 2.
Importance of Technical Information Products

Information Products	Average[a] (Mean) Importance Rating In --			Overall Average (Mean) Importance Rating (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Conference-Meeting Papers	4.04	3.64	3.31	3.53	1,777
Journal Articles	4.35	3.49	3.26	3.52	1,775
In-house Technical Reports	3.02	3.98	4.05	3.84	1,766
U.S. Government Technical Reports	3.45	3.73	3.44	3.51	1,778

[a] A 1 to 5 point scale was used to measure importance with "1" being the lowest possible importance and "5" being the highest possible importance. Hence, the higher the average, the more important the product.

and journal articles. Government- and industry-affiliated respondents attribute a higher importance rating to in-house technical reports. (Government-affiliated respondents probably view U.S. government technical reports as synonymous with in-house technical reports.)

Statistically, participants who hold a doctoral degree attribute a higher importance rating to conference-meeting papers and journal articles. Survey participants who hold a master's, bachelor's, or no degree rate in-house technical reports more important than do survey participants who hold a doctoral degree. Scientists rate conference-meeting papers and journal articles more important than engineers rate them. Engineers rate in-house technical reports more important than scientists rate them. Engineers and scientists rate the importance of U.S. government technical reports about equal. With two small exceptions, the importance rating of the four information products increases as years of professional work experience increase.

Survey participants were asked to indicate the number of times they had used each of the four information products in a 6-month period in the performance of their professional duties (table 3). Data are presented both as means and medians. On the average, in-house technical reports are used to a much greater extent than the other three information products are used. Conference-meeting papers and journal articles are used to a greater extent by academically-affiliated participants. In-house technical reports are used to a greater extent by government- and industry-affiliated participants. Average use of U.S. government technical reports is about equal for all three groups. With the exception of in-house technical reports, use of the three remaining information products increases as the level of education increases. Survey participants possessing a doctorate make significantly greater use of conference-meeting papers and journal articles.

Table 3.
Frequency of Technical Information Product Use

Information Products	Average Number of Times (Median) Product Used In 6-Month Period For Respondents In --			Overall Average Number of Times (Median) Products Used (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Conference-Meeting Papers	17.98 (7.00)	13.41 (4.00)	9.23 (4.00)	12.02 (4.00)	1,527
Journal Articles	26.60 (10.00)	15.41 (5.00)	9.99 (4.00)	14.74 (5.00)	1,503
In-house Technical Reports	9.22 (5.00)	17.91 (6.00)	23.91 (8.00)	20.30 (6.00)	1,535
U.S. Government Technical Reports	10.01 (5.00)	12.41 (5.00)	11.49 (4.00)	11.45 (5.00)	1,495

Scientists make greater use of the four information products than do engineers. Engineers and scientists make about equal use of in-house technical reports. Scientists make greater use of conference-meeting papers and journal articles than do engineers. The use of the four information products does not seem related to increasing years of professional work experience.

To help define the role of the U.S. government technical report within a formal information structure, survey respondents were asked to indicate what percentage of the conference-meeting papers, journal articles, in-house technical reports, and U.S. government technical reports they use are for purposes of education, research, management, and other. Overall, they use conference-meeting papers most often for research, followed by education and management (table 4).

About 74 percent of the conference-meeting papers used by survey participants working as scientists are used for research, and about 55 percent of the conference-meeting papers used by survey participants working as engineers are used for research. It is noteworthy that as the years of professional work experience increase, the use of conference-meeting papers for purposes of education and research decreases. The use of conference-meeting papers for purposes of management increases as years of professional work experience increase.

Table 4.
Use (Purpose) of Conference-Meeting Papers

Purpose	Average Percentage Of Use For Respondents In --			Overall Average Percentage Of Use (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Education	20.16	25.27	25.41	24.23	1,355
Research	70.37	50.09	47.86	53.34	1,355
Management	6.05	17.62	18.16	15.38	1,355
Other	3.41	7.02	8.57	7.05	1,355

On average, journal articles are used most often for research, followed by use for education and management. Overall, journal articles are used about 52 percent of the time for research (table 5).

Table 5.
Use (Purpose) of Journal Articles

Purpose	Average Percentage Of Use For Respondents In --			Overall Average Percentage Of Use (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Education	23.09	29.76	28.86	27.80	1,327
Research	69.14	49.41	45.60	51.83	1,327
Management	5.27	14.04	16.22	13.22	1,327
Other	2.50	6.79	9.32	7.15	1,327

Statistically, survey participants who hold a doctorate make greater use of journal articles than do participants with a master's degree or less. About 72 percent of the journal articles used by survey participants who work as scientists are used for research, and about 53 percent of the journal articles used by survey participants who work as engineers are used for research. As years of professional work experience increase, the use of journal articles for education and research decreases. The use of journal articles for management increases as the years of professional work experience increase.

In-house technical reports are used most often for research (52.86 percent), followed by management (21.54 percent) and education (16.20 percent) (table 6). Academic participants use in-house reports most often for research, followed by use for education and management. Government and industry respondents use in-house technical reports most often for research, followed by use for management and education.

About 71 percent of the in-house technical reports used by survey participants working as scientists are used for research, and about 57 percent of the in-house technical reports used by survey participants working as engineers are used for research. As years of professional work experience increase, the use of in-house technical reports for purposes of education and research decreases. The use of in-house technical reports for management increases as years of professional work experience increase.

Table 6.
Use (Purpose) of In-house Technical Reports

Purpose	Average Percentage Of Use For Respondents In --			Overall Average Percentage Of Use (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Education	14.76	18.20	15.61	16.20	1,349
Research	66.94	50.73	50.38	52.86	1,349
Management	11.70	23.73	22.94	21.54	1,349
Other	6.70	7.33	11.07	9.39	1,349

Overall, U.S. government technical reports are used most often for research, followed by education and management. Overall, U.S. government technical reports are used about 56 percent of the time for research (table 7.)

Table 7.
Use of (Purpose) U.S. Government Technical Reports

Purpose	Average Percentage Of Use For Respondents In --			Overall Average Percentage Of Use (n = 1,839)	Total Respondents
	Academia (n = 341)	Government (n = 454)	Industry (n = 1,044)		
Education	17.04	18.79	18.11	18.09	1,332
Research	70.50	52.60	52.18	55.89	1,332
Management	7.71	20.09	19.25	17.22	1,332
Other	4.75	8.52	10.47	8.80	1,332

Academically-affiliated participants use U.S. government technical reports most often for research (70.5 percent), followed by use for education and management. Government- and industry-affiliated respondents use U.S. government technical reports about 52 percent of the time for research, followed by use for management and education.

About 72 percent of the U.S. government technical reports used by survey participants who work as scientists are used for research, and about 59 percent of the U.S. government technical reports used by survey participants who work as engineers are used for research. Survey participants who work as engineers make greater use of U.S. government technical reports for education (18.93 percent) than do those participants who work as scientists (13.89 percent). As years of professional work experience increase, the use of U.S. government technical reports for education and research decreases. The use of U.S. government technical reports for management increases as years of professional work experience increase.

Overall, research purposes account for the use of more than 50 percent of the four information products. Within academia, research use accounts for about 70 percent of these products. In academia, conference-meeting papers, journal articles, and U.S. government technical reports are used more for educational than for management purposes. In industry, in-house technical reports are used more for management than for educational purposes.

4.1.2 Survey 2

Survey participants were asked to provide information about their use of certain information products (table 8). Survey respondents make the greatest use of journal articles (85%) and con-

Table 8.
Use of Technical Information Products

Information Products	Percentage	Number
Conference-Meeting Papers	84.1	820
Journal Articles	85.2	831
Technical Translations	24.5	239
AGARD Technical Reports	32.2	314
DoD Technical Reports	58.7	572
NASA Technical Reports	73.5	717

ference-meeting papers (84%), followed by NASA and DoD technical reports (74% and 59%), AGARD technical reports (32%), and technical translations (25%). Survey participants were asked to rate the importance of these same information products. (See table 9.) Importance was

Table 9.
Importance of Technical Information Products

Information Products	Average[a] (Mean) Importance Rating	Number
Conference-Meeting Papers	3.65	956
Journal Articles	3.66	949
Technical Translations	2.84	841
AGARD Technical Reports	2.09	842
DoD Technical Reports	2.98	901
NASA Technical Reports	3.31	933

[a]A 1 to 5 point scale was used to measure importance, with "1" being the lowest possible importance and "5" being the highest possible importance. Hence, the higher the average (mean), the greater the importance of the product.

measured on a 1 to 5 point scale with "1" being the lowest possible importance and "5" being the highest possible importance. Survey participants accorded the highest importance rating to the information products they use the most -- journal articles and conference-meeting papers. In terms of U.S. government technical reports, survey participants assigned a higher importance rating to NASA technical reports than to those published by the DoD. AGARD technical reports are used more frequently than technical translations (34% vs 25%). However, survey respondents assigned a higher level of importance to technical translations than to AGARD technical reports ($\bar{X}$ = 2.84 vs. $\bar{X}$ = 2.09).

Survey 2 participants were asked to indicate the average number of technical translations, AGARD technical reports, DoD technical reports, and NASA technical reports they used in a 6-month period. (See table 10.) Although a higher percentage of the survey participants used

Table 10.
Frequency of Technical Information Product Use

Information Products	Average Number of Times (Median) Used in a 6-Month Period	Number
Technical Translations	4.5 (2.0)	131
AGARD Technical Reports	4.2 (2.0)	190
DoD Technical Reports	9.0 (4.0)	424
NASA Technical Reports	8.5 (5.0)	521

NASA technical reports (74%) than DoD technical reports (59%), the average number of DoD technical reports used was slightly higher. Although the percentage of respondents using AGARD technical reports and technical translations was low, the frequency of use rate and the overall use rate for these information products were consistent.

The use of the four technical information products was correlated with their importance rating (table 11). Although the correlations were statistically significant, they were low for each of the four products. NASA technical reports had the highest use-to-importance correlation.

Table 11.
Technical Information Product Use Correlated With Product Importance

Information Products	Pearson's r	Number
Technical Translations	0.191*	128
AGARD Technical Reports	0.161*	188
DoD Technical Reports	0.198*	418
NASA Technical Reports	0.239*	516

* $P \leq 0.05$

Survey 2 participants who did not use selected technical information products were asked to indicate their reasons for non-use of these products (table 12). About 69% of the survey respondents gave not relevant to their research as their reason for non-use of technical translations, followed by availability/accessibility (54.8%), the time it takes to physically obtain

Table 12.
Reasons for Non-Use of Selected Technical Information Products

	Technical Translations		AGARD Reports		DoD Reports		NASA Reports	
Reasons	%	n	%	n	%	n	%	n
Not Available/Accessible	**54.8**	**278**	**53.7**	**212**	**49.6**	**127**	**39.0**	64
Not Relevant To My Research	**68.8**	**366**	**70.0**	**297**	**69.0**	**194**	**72.9**	159
Not Used In My Discipline	**45.1**	**205**	**51.1**	**181**	**37.1**	**85**	**47.5**	86
Not Reliable/Technically Inaccurate	7.9	27	3.1	8	5.5	10	2.3	3
Not Reliable/Language Inaccurate	13.5	47	16.2	44	17.1	33	5.4	122
Takes Too Long To Get Them	**51.0**	**214**	----	----	----	----	----	----
Not Timely/Current	39.1	152	----	----	----	----	----	----

a translation (51.0%), and not used in their discipline (45.1%). Reliability, in terms of either technical accuracy or language accuracy, was not a major factor in the non-use of technical translations.

Seventy percent of the survey participants gave "not relevant to my research" as their reason for not using AGARD technical reports. About 51 percent of the respondents listed "not used in my discipline" and about 54 percent of the respondents listed "not available/accessible" as reasons for not using AGARD technical reports. Sixty-nine percent of the survey participants gave "not relevant to my research" as their reason for non-use of DoD technical reports followed by "not available/accessible (49.6%) and "not used in my discipline" (37.1%). About 73 percent of the respondents gave "not relevant to my research" as their reason for non-use of NASA technical reports followed by "not used in my discipline" (47.5%).

Survey 2 participants were asked to rate selected technical information products on the following characteristics: quality of information, accuracy/precision of data, adequacy of data/documentation, organization/format, quality of graphics, timeliness/currency, and "advancing the state of the art" in their discipline (table 13). Survey participants rated the quality of information highest ($\bar{X}$ = 4.11) for AGARD technical reports, followed by the precision/accuracy of the data ($\bar{X}$ = 3.99), and adequacy of data/documentation ($\bar{X}$ = 3.83). Survey participants rated the quality of information in DoD technical reports highest ($\bar{X}$ = 3.89), followed by precision/ accuracy of data ($\bar{X}$ = 3.81), adequacy of data/documentation ($\bar{X}$ = 3.58), and organization/format ($\bar{X}$ = 3.58).

Table 13.
Average (Mean) Rating of Selected Technical Information Products

Characteristics	AGARD Reports		DoD Reports		NASA Reports	
	Average (Mean)[a] Rating	Number	Average (Mean)[a] Rating	Number	Average (Mean)[a] Rating	Number
Quality Of Information	**4.11**	**227**	**3.89**	**500**	**4.18**	**625**
Precision/Accuracy Of Data	**3.99**	**227**	**3.81**	**501**	**4.12**	**626**
Adequacy of Data/Documentation	3.83	225	3.58	499	3.90	622
Organization/Format	3.81	225	3.58	499	3.92	624
Quality of Graphics (e.g., charts, photos, figures)	3.62	228	3.41	500	3.88	626
Timeliness/Currency	3.60	225	3.56	498	3.80	622
"Advancing the State of the Art" in Your Discipline	3.57	223	3.52	493	3.84	612

[a]A 1 to 5 point scale was used to measure importance, with "1" being the lowest possible importance and "5" being the highest possible importance. Hence, the higher the average (mean), the greater the importance of the product.

Survey participants rated the quality of information in NASA technical reports the highest ($\bar{X}$ = 4.18), followed by precision/accuracy of data ($\bar{X}$ = 4.12), and organization/format.

Survey 2 participants were asked the purpose(s) for which they use the four technical information products. The bulk of these products are used for research, followed by management, and education. Use (purpose) responses from survey 1 and 2 were compared (table 14). The use patterns are very similar: the technical information products from both surveys are used most often for research.

Table 14.
Use (Purpose) of Technical Information Products

Information Products	Percentage* (Number) Used for the Following Purposes			
	Education	Research	Management	Other
Survey 1				
Conference-Meeting Papers	24.23 (1,355)	53.34 (1,355)	15.38 (1,355)	7.05 (1,355)
Journal Articles	27.80 (1,327)	51.83 (1,327)	13.22 (1,327)	7.15 (1,327)
In-house Technical Reports	16.20 (1,349)	52.86 (1,349)	21.54 (1,349)	9.39 (1,349)
U.S. Government Technical Reports	18.09 (1,332)	55.89 (1,332)	17.22 (1,332)	8.80 (1,332)
Survey 2				
Technical Translations	40.2 (101)	86.5 (142)	45.0 (27)	34.7 (15)
AGARD Technical Reports	47.1 (56)	85.5 (207)	43.0 (28)	45.3 (19)
DoD Technical Reports	40.5 (37)	83.9 (413)	51.9 (131)	50.9 (63)
NASA Technical Reports	45.7 (169)	84.9 (530)	47.3 (107)	51.1 (59)

*Percentages do not total 100 percent for Survey 2 responses.

Survey 2 participants were asked to indicate the extent to which their use of the selected technical information products was affected by seven factors. Their responses are contained in table 15. Accessibility, technical quality, and relevance exert the greatest influence on overall use. Technical quality, ease of use, and familiarity or experience influence the use of technical translations. Accessibility, relevance, and technical quality are the factors that influence the use of AGARD technical reports. Relevance and accessibility influence the use of DoD technical reports. Relevance and accessibility influence the use of NASA technical reports.

Survey 2 respondents were asked how they find out about AGARD, DoD, and NASA technical reports and how they obtain them. The findings are shown in figure 2 and figure 3. Survey 2 respondents who used AGARD, DoD, and NASA technical reports were asked to indicate the various means by which they find out about these reports (figure 2). For presentation and discussion, the awareness choices are grouped into 3 categories: **Producer**, which includes announcement journals such as *STAR*; **User**, which includes colleagues and coworkers; and **Intermediary**, which includes interaction with a librarian or technical information specialist.

Table 15.
Factors Affecting the Use of Selected Technical Information Products

Information Products	Average[a] (Mean) Influence of the Factor on Use							Total Respondents
	Accessibility	Ease of Use	Expense	Familiarity	Technical Quality	Comprehensiveness	Relevance	
Survey 1								
Conference-Meeting Papers	**3.79**	3.43	2.50	3.56	**3.74**	3.38	**3.97**	1,552
Journal Articles	**3.88**	3.51	2.64	3.58	**4.03**	3.59	**3.87**	1,509
In-house Technical Reports	**4.01**	3.61	2.50	**3.78**	3.77	3.51	**4.15**	1,538
U.S. Government Technical Reports	**3.65**	3.38	2.51	3.52	**3.73**	3.55	**3.90**	1,573
Survey 2								
Technical Translations	3.54	3.43	2.34	3.40	**3.68**	**3.73**	**3.86**	223
AGARD Technical Reports	**4.09**	3.78	2.74	3.84	**3.91**	3.74	**4.07**	621
DoD Technical Reports	**3.79**	3.36	2.33	3.27	**3.47**	3.19	**3.83**	155
NASA Technical Reports	**3.89**	3.45	2.55	**3.59**	3.54	3.43	**3.94**	492

[a] A 1 to 5 point scale was used to measure influence, with "1" being the lowest possible influence and "5" being the highest possible influence Hence, the higher the average (mean), the greater the influence of the product.

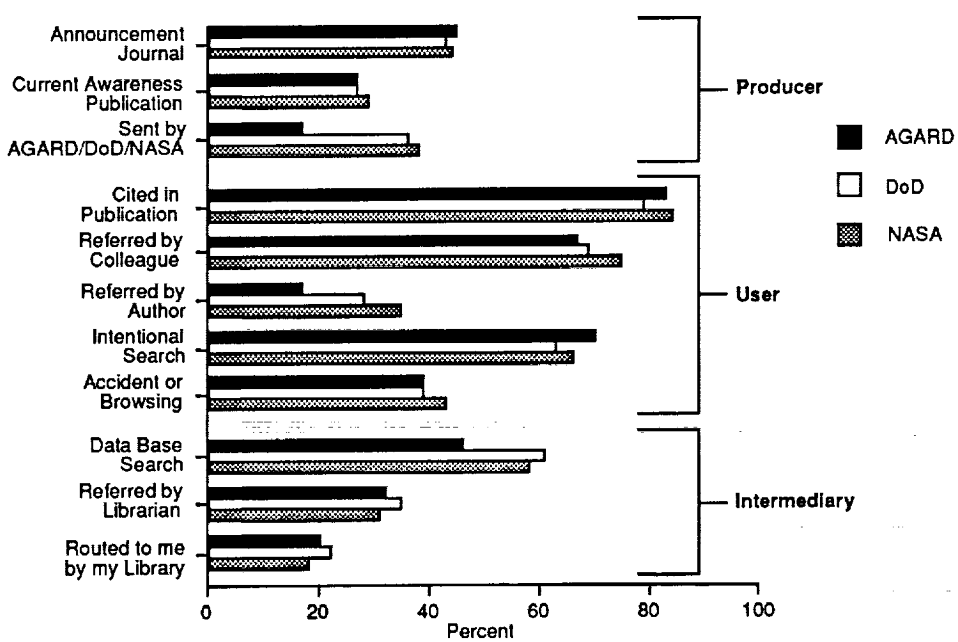

Figure 2. How U.S. Aerospace Engineers and Scientists Find Out about DoD and NASA Technical Reports.

Little difference was demonstrated in how U.S. aerospace engineers and scientists find out about DoD and NASA technical reports. **User** methods dominate awareness choices with "cited in a publication" and "referred by a colleague" being selected most often. **Intermediary** methods ranked second with "data base search" being selected most frequently. **Producer** methods ranked third with "announcement journals" such as *STAR* being selected most frequently.

From a list of seven sources, survey 2 respondents were asked how they actually access or obtain copies of DoD and NASA technical reports (figure 3). For presentation and discussion, the acquisition choices have been grouped into 3 categories: **Producer**, including sent by author; **User**, including obtained from a colleague; and **Intermediary**, including routed to me by my library.

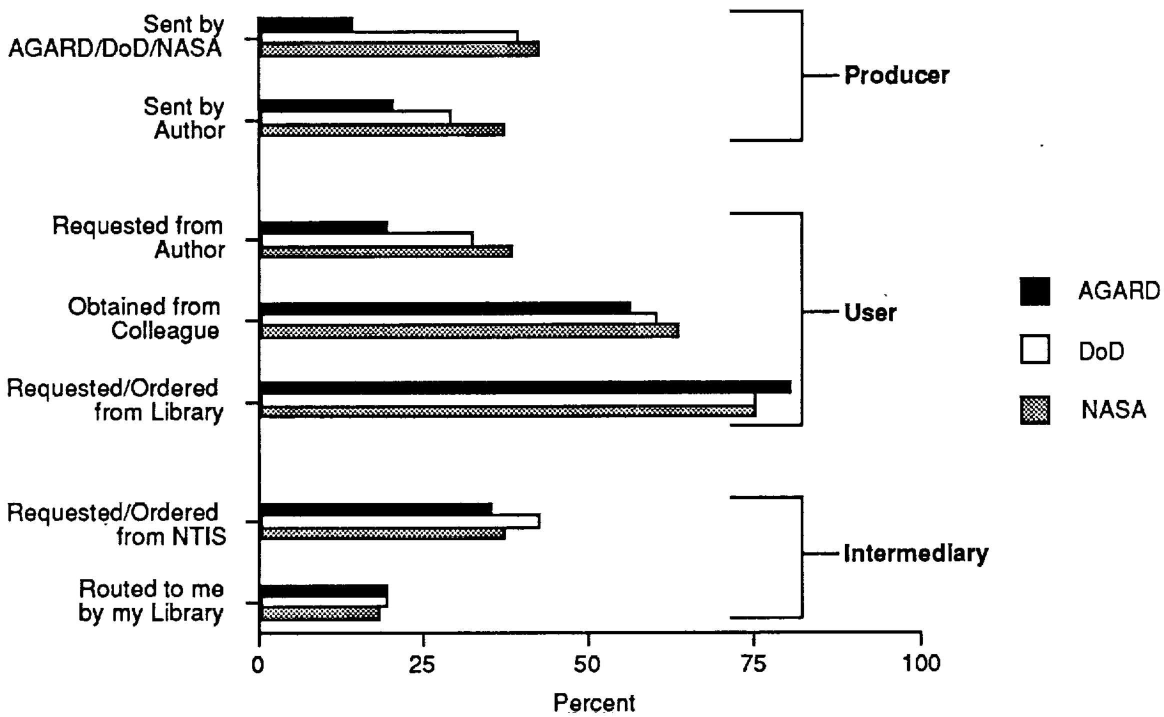

Figure 3. How U.S. Aerospace Engineers and Scientists Acquire DoD and NASA Technical Reports.

Overall, **User** methods dominate access choices with "requested/ordered from my library" being selected most frequently. (See figure 3.) **Producer** methods ranked second with "sent by DoD and NASA" being selected most frequently. **Intermediary** methods were third with "requested/ordered from NTIS" being selected most frequently.

5.0 FINDINGS

Readers should note that the data reported in this paper reflect responses of U.S. aerospace engineers and scientists belonging to the AIAA. The data may not be generalizable to U.S. aerospace engineers and scientists who are not members of the AIAA or who are members of some other professional (technical) society. Because the samples came from the AIAA, the responses may not necessarily be generalizable to the population of all U.S. aerospace engineers and scientists.

1. U.S. government technical reports are used by and are important to U.S. aerospace engineers and scientists. Overall, U.S. government technical reports are used most often for research. As years of professional work experience increase, the use of U.S. government technical reports for education and research decreases. The use of U.S. government technical reports for management increases as years of professional work experience increase.

2. "Not relevant to my research" and "not used in my discipline" are the reasons most frequently given for the non-use of (U.S.) DoD and NASA technical reports.

3. The quality of information and the precision/accuracy of the data in DoD and NASA technical reports are highly rated.

4. Relevance, accessibility, and technical quality influence the use of DoD technical reports. Relevance, accessibility, and familiarity influence the use of NASA technical reports.

5. **User** methods, with "cited in a publication" and "referred by a colleague" being selected most often, dominate the choices by which U.S. aerospace engineers and scientists find out about DoD and NASA technical reports. **Intermediary** methods ranked second with "data base search" being selected most frequently. **Producer** methods ranked third with "announcement journals" such as *STAR* being selected most frequently.

6. **User** methods, with "requested/ordered from my library" being selected most frequently, dominate the access choices by which U.S. aerospace engineers and scientists acquire DoD and NASA technical reports. **Producer** methods ranked second with "sent by DoD and NASA" being selected most frequently. **Intermediary** methods were third with "requested/ordered from NTIS" being selected most frequently.

6.0 CLOSING REMARKS

The data reported in this paper provide valuable insight into the use of U.S. government technical reports. Research presently underway will help determine the use of U.S. government technical reports by non-U.S. aerospace engineers and scientists. An empirical investigation of the U.S. government technical report as a rhetorical device for transferring the results of federally funded (U.S.) aerospace R&D is also being considered.

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