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The Technical Communications Practices of British Aerospace Engineers and Scientists: Results of the Phase 4 RAeS Mail Survey

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THE TECHNICAL COMMUNICATIONS PRACTICES OF BRITISH AEROSPACE ENGINEERS AND SCIENTISTS: RESULTS OF THE PHASE 4 RAeS MAIL SURVEY

Thomas E. Pinelli, Rebecca O. Barclay, and John M. Kennedy

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 R&D. Little is also known about the intermediary-based system that is used to transfer the results of federally funded R&D to the U.S. aerospace industry. 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 report, we summarize the literature on technical reports, present a model that depicts the transfer of federally funded aerospace R&D via the U.S. government technical report, and present the results of research that investigated aerospace knowledge diffusion vis-à-vis the technical communications practices of British aerospace engineers and scientists.

INTRODUCTION

NASA and the 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.

We are examining the system(s) used to diffuse the results of federally funded aerospace R&D as part of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* This project investigates, among other things, the information-seeking behavior of U.S. aerospace engineers and scientists, the factors that influence the use of STI, and the role played by U.S. government technical reports in the diffusion of federally funded aerospace 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. The project fact sheet is Appendix A.

In this report, we summarize the literature on technical reports, provide a model that depicts the transfer of federally funded aerospace R&D through the U.S. government technical report, and present the results of the Phase 4 RAeS mail survey. We summarize the findings of the Phase 4 RAeS mail survey in terms of the technical communications practices of British aerospace engineers and scientists.

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." They further state that "a more active and coordinated role in STI transfer is needed at the Federal level if technical reports are to be better utilized."

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.

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, including Shuchman's, it is often unclear 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.

THE TRANSFER OF FEDERALLY FUNDED AEROSPACE 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.

The Appropriability Model

The **appropriability model** emphasizes the production of knowledge by the Federal government that would not otherwise be produced by the private sector and competitive market pressures to promote the use of that knowledge. This model emphasizes the production of basic research as the driving force behind technological development and economic growth and assumes that the Federal provision of R&D will be rapidly assimilated by the private sector. Deliberate transfer mechanisms and intervention by information intermediaries are viewed as unnecessary. Appropriability stresses the supply (production) of knowledge in sufficient quantity to attract potential users. Good technologies, according to this model, sell themselves and offer clear policy recommendations regarding Federal priorities for improving technological development and economic growth. This model incorrectly assumes that the results of federally funded R&D will be acquired and used by the private sector, ignores the fact that most basic research is irrelevant to technological innovation, and dismisses the process of technological innovation within the firm.

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. User requirements are seldom known or considered in the design of information products and services.

The Knowledge Diffusion Model

The **knowledge diffusion model** is grounded in theory and practice associated with the diffusion of innovation and planned change research and the clinical models of social research and mental health. Knowledge diffusion emphasizes "active" intervention as opposed to dissemination and access; stresses intervention and reliance on interpersonal communications as a means of identifying and removing interpersonal barriers between users and producers; and assumes that knowledge production, transfer, and use are equally important components of the R&D process. This approach also emphasizes the link between producers, transfer agents, and users and seeks to develop user-oriented mechanisms (e.g., products and services) specifically tailored to the needs and circumstances of the user. It makes the assumption that the results of federally funded R&D will be under utilized unless they are relevant to users and ongoing relationships are developed among users and producers. The problem with the knowledge diffusion model is that (1) it requires a large Federal role and presence and (2) it runs contrary to the dominant assumptions of established Federal R&D policy. Although U.S. technology policy relies on a "dissemination-oriented" approach to STI transfer, other industrialized nations, such as Germany and Japan, are adopting "diffusion-oriented" policies which increase the power to absorb and employ new technologies productively (Branscomb, 1991; Branscomb, 1992).

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 of copies are set aside to be used by the author for the "scientist-to-scientist" exchange of information at the collegial level.

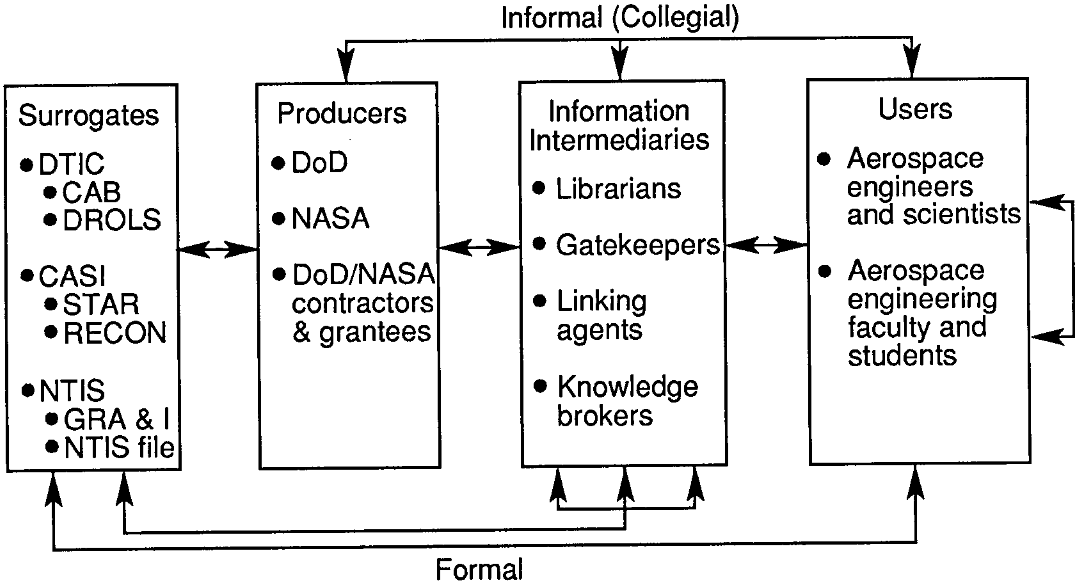

Figure 1. The U.S. Government Technical Report in
a Model Depicting the Dissemination of Federally Funded Aerospace R&D.

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), *STAR* (Scientific and Technical Aerospace Reports), and *GRA&I* (Government Reports Announcement and Index) and computerized retrieval systems such as *DROLS* (Defense RDT&E Online System), *RECON* (REsearch CONnection), and NTIS *On-line* that permit online access to technical report data bases. 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 inter-personal (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 or 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. Further, information 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.

THE INFORMATION-SEEKING BEHAVIOR OF ENGINEERS

The information-seeking behavior of engineers and scientists has been variously studied by information and social scientists, the earliest studies having been undertaken in the late 1960s (Pinelli, 1991). The results of these studies have not accumulated to form a significant body of knowledge that can be used to develop a general theory regarding the information-seeking behavior of engineers and scientists. The difficulty in applying the results of these studies has been attributed to the lack of a unifying theory, a standardized methodology, and common definitions (Rohde, 1986).

Despite the fact that numerous "information use" studies have been conducted, the information-seeking behavior of engineers and information use in engineering are neither broadly known nor well understood. There are a number of reasons (Berul, et al., 1965): (1) many of the studies were conducted for narrow or specific purposes in unique environments such as experimental laboratories; (2) many, if not most, of them focused on scientists exclusively or engineers working in a research environment; (3) few studies have concentrated on engineers, especially engineers working in manufacturing and production; (4) from an information use standpoint, some engineering disciplines have yet to be studied; (5) most of the studies have concentrated on the users' use of information in terms of a library and/or specific information packages such as professional journals rather than how users produce, transfer, and use information; and (6) many of the studies, as previously stated, were not methodologically sophisticated and few included testable hypotheses or valid procedures for testing the study's hypotheses.

Further, we know very little about the diffusion of knowledge in specific communities such as aerospace. In the past 25 years, few studies have been devoted to understanding the information environment in which aerospace engineers and scientists work, the information-seeking behavior of aerospace engineers and scientists, and the factors that influence the use of federally funded aerospace STI. Presumably, the results of such studies would have implications for current and future aerospace STI systems and for making decisions regarding the transfer and use of federally funded aerospace STI.

The literature related to aerospace and Europe produced some noteworthy findings. Raitt (1984) investigated the patterns of information seeking and use among engineers and scientists working in the European Space Agency (ESA). He compared the findings of his investigation with data collected from other international organizations and government-oriented aerospace organizations. Picken (1988) examined the organization and use of library and information services in the aerospace industry. Of particular interest to Picken was the organization and use of aerospace library and information services in the United Kingdom (UK). B.R. Coles and his colleagues looked at the scientific, technical, and medical (STM) information system in the UK (Royal Society, 1993). A related study looked at the economic relationships which exist in the STM information system in the UK (DJB Associates, 1993).

RESULTS OF THE PHASE 4 RAeS MAIL SURVEY

This research was conducted as a Phase 4 activity of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* Members of the Royal Aeronautical Society (RAeS) were surveyed in an attempt to investigate the technical communications practices of aerospace engineers and scientists in the UK. A self-administered (self-reported) survey was used for data collection. A random selection of 1,487 members were surveyed. The adjusted response rate was 75 percent. Data were collected between October 1991 and February 1992. The RAeS questionnaire is Appendix B.

Demographics

The following composite participant profile was based on RAeS survey data which appear as table 1: works in industry (45%) or other (32%); works in other (28%), as a manager (22%), or in design/development (20%), has a high national certificate/diploma (25%) or a bachelor's degree (31%), was educated (trained) as an engineer (81%), currently works as an engineer (59%), and has an average of 23 years of professional work experience.

Project, Task, or Problem

Survey participants were asked to categorize the most important job-related project, task, or problem they had worked on in the past 6 months. The categories and responses are listed in table 2. A majority of the job-related projects, tasks, and problems were categorized as either design/development (31.2%) or management (21.9%). About 14% of the job-related projects, tasks, and problems were categorised as research and about 14% were categorised as other.

Most respondents (84%) worked with others (did not work alone) in completing their most important job-related project, task, or problem. The average number of people per group was 8.95. About 49% of the respondents performed engineering duties while working on their most important job-related project, task, or problem. About 45% performed management duties.

<u>Project, Task, or Problem Complexity and Uncertainty</u>. Respondents were asked to rate the overall complexity of their most important job-related project, task, or problem. The mean complexity score was 3.68 (of a possible 5.00). Respondents were also asked to rate the amount of technical uncertainty they faced when they started their most important project, task, or problem. The average (mean) technical uncertainty score was 3.20 (of a possible 5.00).

Correlation coefficients (Pearson's *r*) **were calculated to compare (1) the overall "level of project, task, or problem complexity" and "technical uncertainty" and (2) the level of "project, task, or problem complexity by category" and "technical uncertainty."** The correlation coefficients appear in table 3. Positive and significant correlations were found for both comparisons. These findings support the hypothesis that there is a (positive) relationship between technical uncertainty and complexity.

<u>Project, Task, or Problem and Information Use</u>. Respondents were asked the identify which of the following information sources they used to complete their most important job-related project, task, or problem: (1) used personal store of technical information, (2) spoke with coworkers inside the organization, (3) spoke with colleagues outside of the organization, (4) used literature resources in the organization's library, and (5) spoke with a librarian. They were asked to identify the steps they followed to obtain needed information by sequencing these items (e.g., #1,#2,#3,#4, and #5). The results appear in table 4.

Table 1. Survey Demographics
[n = 1102]

Demographics	%	Number
Do You Currently Work In:		
Industry	45.4	483
Government	15.2	162
Academia	7.6	81
Other	31.8	338
Your Highest Level Of Education:		
No Degree	13.5	144
Ordinary Nat. Certificate/Diploma	5.9	63
High Nat. Certificate/Diploma	24.5	262
Bachelor's Degree	30.6	327
Master's Degree	11.8	126
Doctorate	2.8	30
Post Doctorate	1.2	13
Other	9.6	103
Your Years In Aerospace:		
Less Than 1 Year	5.8	62
1 Through 5 Years	10.8	116
6 Through 10 Years	8.0	87
11 Through 20 Years	19.0	204
21 Through 40 Years	44.3	476
41 Or More Years	12.0	127
Mean = 23.39 Median = 25 Years		
Are You Trained/Educated As An:		
Engineer	80.8	865
Scientist	4.3	46
Other	14.9	159
Your Present Professional Duties Classified As An:		
Engineer	58.5	619
Scientist	4.3	33
Other	14.9	406
Is Your Work Best Classified As:		
Teaching/Academic	5.4	58
Research	5.8	62
Management	22.1	236
Design/Development	20.1	215
Manufacturing/Production	2.2	24
Service/Maintenance	13.2	141
Sales/Marketing	3.3	35
Other	28.0	300

Table 2. Project, Task Or Problem Categorisation
[n = 1102]

	%	Number
Categories Of Project, Task Or Problem:		
Educational	6.4	38
Research	13.5	80
Design	16.7	99
Development	14.5	86
Manufacturing/Production	6.4	38
Computer Applications	6.2	37
Management	21.9	130
Other	14.3	85
Worked On Project, Task Or Problem:		
Alone	16.0	94
With Others	84.0	493
Mean Number Of People Per Group = 8.95		
Nature Of Duties Performed:	$\bar{X}$	
Engineering	48.8	522
Science	26.0	217
Management	45.3	486
Other	33.2	141

Table 3. Correlation of Project Complexity and Technical Uncertainty
by Type of Project, Task, or Problem
[n =1102]

Complexity - Uncertainty Correlation	*r*	n
Overall**	.38*	584
Education/Research	.48*	118
Design	.24*	98
Development	.33*	84
Manufacturing/Production	.24	38
Management	.39*	128
Computer Applications	.22*	36

* *r* values are statistically significant at $p \leq 0.05$.
** Overall mean complexity (uncertainty) score = 3.68 (3.20) out of a possible 5.00.

Table 4. Information Sources Used to Solve Project, Task, or Problem

Information Source	Used First %	Used Second %	Used Third %	Used Fourth %	Used Fifth %	Not Used %
Personal Store of Technical Information	**50.3**	21.0	15.6	4.4	1.9	6.8
Spoke With Coworker(s) Inside the Organisation	31.5	**42.3**	15.9	4.2	0.3	5.8
Spoke With Colleagues Outside of the Organization	7.7	17.2	**28.9**	11.5	5.6	29.1
Used Literature Resources in My Organisation's Library	8.0	11.9	16.6	**16.6**	6.1	40.8
Spoke With a Librarian/ Technical Information Specialist	1.6	4.0	9.1	13.6	**9.2**	**62.5**

Library Use and Importance

Survey respondents were asked how often they had used their organisation's library in the past 6 months (table 5). A 1 to 5 point scale was used to measure use with "1" being not often and "5" being very often. About 55% indicated that they had used their organisation's library very often; about 14% indicated they had used their organisation's library sometimes and about 31% indicated they had not used their organisation's library often. The average use rating was 3.42.

Survey respondents were asked rate the importance their organisation's library in performing their present professional duties (table 5). A 1 to 5 point scale was used to measure importance with "1" being not at all important and "5" being very important. About 56% indicated that their organisation's library was very important in performing their present professional duties, about 22% indicated that their organisation's library was neither important nor unimportant, and about 23% indicated that their organisation's library was not at all important in performing their present professional duties. The average importance rating was 3.63.

Technical Reports -- Use, Importance, and Frequency of Use

RAeS survey participants were asked several questions designed to obtain a greater understanding of the factors affecting the use of technical reports. In this study, technical reports were placed within the context of two technical information products: conference-meeting papers and journal articles. AGARD, Royal Aerospace Establishment (RAE), in-house, and NASA technical reports were included in this study.

Table 5. Use and Importance of the Organisation's Library to British Engineers and Scientists

Use	RAeS %	RAeS (n)
Not Often	31.3	161
Sometimes	13.8	71
Very Often	54.8	282
Mean	3.42	
Importance	**RAeS %**	**RAeS (n)**
Not At All Important	22.7	117
Neither Important Nor Unimportant	21.6	111
Very Important	55.7	287
Mean	3.63	

Use. RAeS survey participants were asked if they used the aforementioned technical information products in performing their present professional duties (table 6). In-house technical reports enjoyed the highest use rate (79%) followed by journal articles (58%) and conference-meeting papers (50%). AGARD, RAE, and NASA technical reports were used by 21%, 31%, and 23% of the RAeS survey respondents, respectively.

Table 6. Use of Technical Information Products By British Aerospace Engineers and Scientists

Information Products	Percentage	Number
Conference-Meeting papers	49.8	299
Journal Articles	57.7	316
AGARD Technical Reports	20.5	123
In-house Technical Reports	79.2	475
RAE Technical Reports	31.2	187
NASA Technical Reports	22.7	136

Importance. RAeS survey participants were asked to indicate "how important is it for you to use the aforementioned technical information products in performing your present professional duties?" Table 7 includes data regarding the importance of use technical information products. A 1 to 5 point scale (1.0 = very unimportant; 5.0 = very important) was used to measure importance. In-house technical reports received the highest importance rating ($\bar{X}$ = 3.76) followed by conference-meeting papers ($\bar{X}$ = 2.49) and journal articles ($\bar{X}$ = 2.38). The importance ratings for AGARD, RAE, and NASA reports were considerably lower.

Table 7. Importance Rating of Technical Information Products by British Aerospace Engineers and Scientists

Information Products	Mean ($\bar{X}$)	Number
Conference-Meeting Papers	2.49	571
Journal Articles	2.38	565
AGARD Technical Reports	1.70	531
In-house Technical Reports	3.76	575
RAE Technical Reports	2.00	551
NASA Technical Reports	1.78	541

[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.

Frequency of Use. RAeS survey participants were asked to indicate the number of times they had used each of the six technical information products in a 6 month period in the performance of their professional duties (table 8). Data are presented both as means and

Table 8. Average Number of Times (Median) Technical Information Products Used in a 6 Month Period by British Aerospace Engineers and Scientists

Information Products	$\bar{X}$ (Median)	Number
Conference-Meeting Papers	3.56 (2.00)	566
Journal Articles	3.06 (2.00)	561
AGARD Technical Reports	0.78 (0.00)	539
In-house Technical Reports	16.19 (5.00)	521
RAE Technical Reports	1.35 (0.00)	540
NASA Technical Reports	2.37 (0.00)	542

medians. In-house technical reports were used ($\bar{X}$ = 16.19) to a much greater extent than were the other technical information products, followed by conference-meeting papers ($\bar{X}$ = 3.56) and journal articles ($\bar{X}$ = 3.06). Technical report use was less, with NASA reports being used more than RAE and AGARD reports. The median number of times that AGARD, RAE, and NASA technical reports were used in the past 6 months was 0.00, indicating that the majority of RAeS survey respondents did not use these technical information products during that period.

Technical Reports -- Awareness and Acquisition

RAeS respondents were asked how they find out about (become aware of) RAE and NASA technical reports and how they obtain (acquire) them. The findings are shown in figure 2 and figure 3.

Awareness. RAeS respondents who used RAE and NASA technical reports were asked to indicate the various means by which they find out these reports (figure 2). For presentation and discussion, the awareness choices are grouped into three 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.

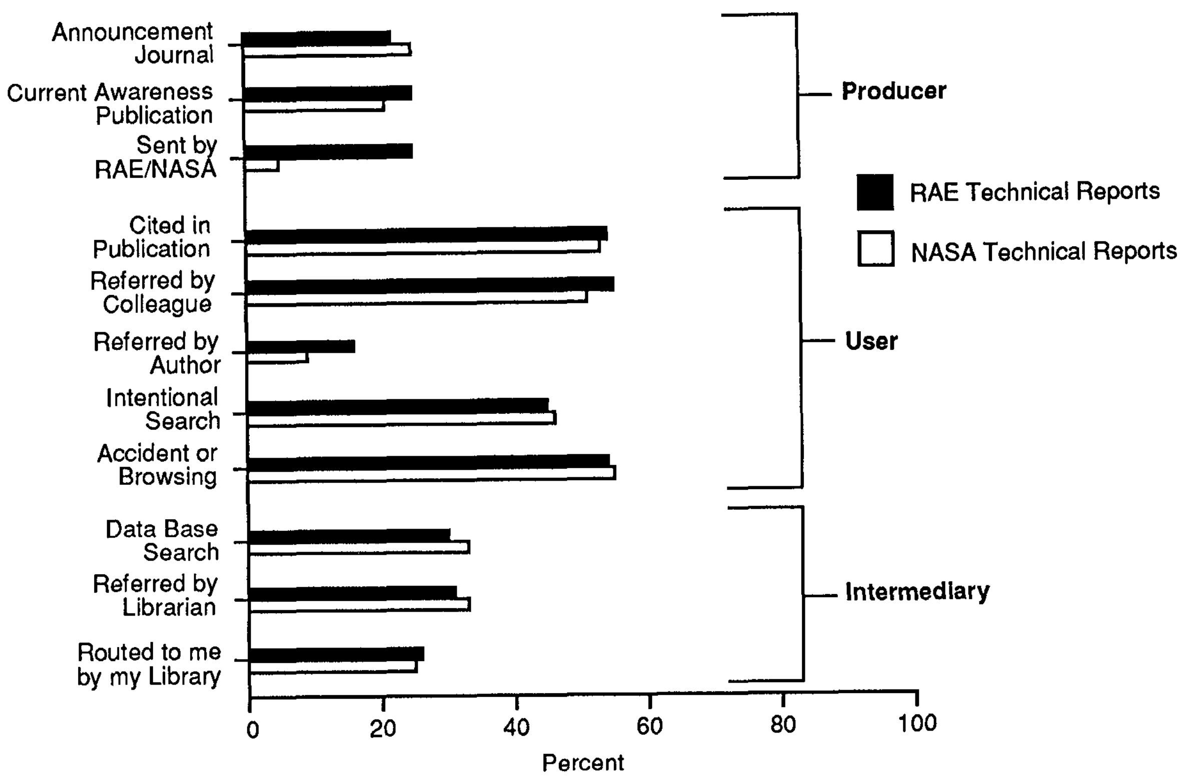

Figure 2. How British Aerospace Engineers and Scientists Find Out About RAE and NASA Technical Reports.

Minor differences were demonstrated in how British aerospace engineers and scientists find out about RAE and NASA technical reports. **User** methods dominate awareness choices with "cited in a publication," "referred by a colleague," and "accident or browsing" most frequently selected. **Intermediary** methods ranked second with "data base search" and "referred by librarian" being selected most frequently. **Producer** methods ranked third with "announcement journals" such as *STAR*, and "current awareness publication" being selected most frequently.

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

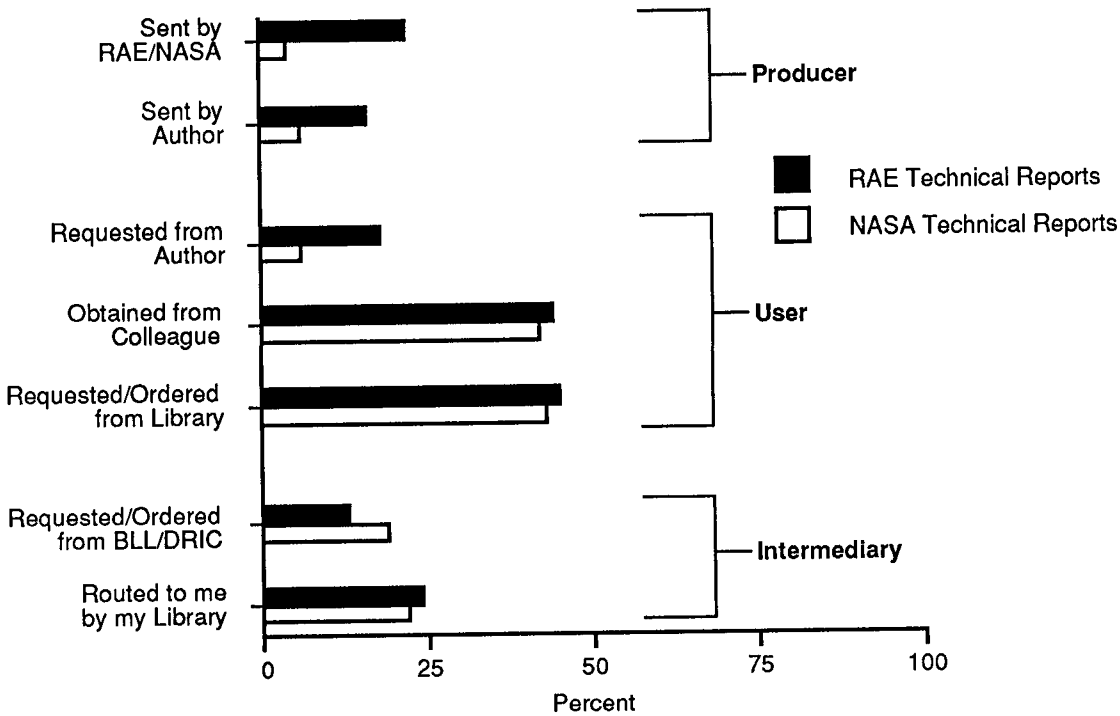

Figure 3. How British Aerospace Engineers and Scientists Acquire RAE and NASA Technical Reports.

Differences between how RAeS respondents acquire RAE and NASA technical reports include "sent by RAE/NASA," "sent by author," and "requested by author." Overall, **User** methods dominate access choices with "requested/ordered from my library" and "obtained from a colleague" being selected most frequently (figure 3). **Producer** methods ranked second for RAE technical reports with "sent by RAE" being the most frequently selected option, and ranked third for NASA technical reports with "sent by author" being the most frequently selected option. **Intermediary** methods ranked third for RAE reports and second for NASA reports with "routed to me by my library" being selected most frequently for both.

Technical Reports -- A Comparison of the Awareness and Acquisition Responses of RAeS and AIAA Survey Participants

The information-seeking behavior of U.S. aerospace engineers and scientists was investigated as a Phase 1 activity of the *NASA/DoD Aerospace Knowledge Diffusion Research Project.* Members of the American Institute of Aeronautics and Astronautics (AIAA) served as the sample population for three Phase 1 surveys. In the **yellow** survey (survey 2), AIAA participants were asked a series of questions about how often they (1) find out about and (2) physically obtain NASA technical reports (Pinelli, Barclay, and Kennedy, February 1994). The responses of those AIAA members who participated in survey 2 and who used NASA technical reports were compared with the responses of the RAeS respondents. Specifically, RAeS and AIAA respondents who use them were asked how they find out about NASA technical reports and how they obtain them. The findings are shown in figure 4 and figure 5.

Awareness. RAeS and AIAA respondents who used NASA technical reports were asked to indicate the means by which they found out about these reports (figure 4). For presentation

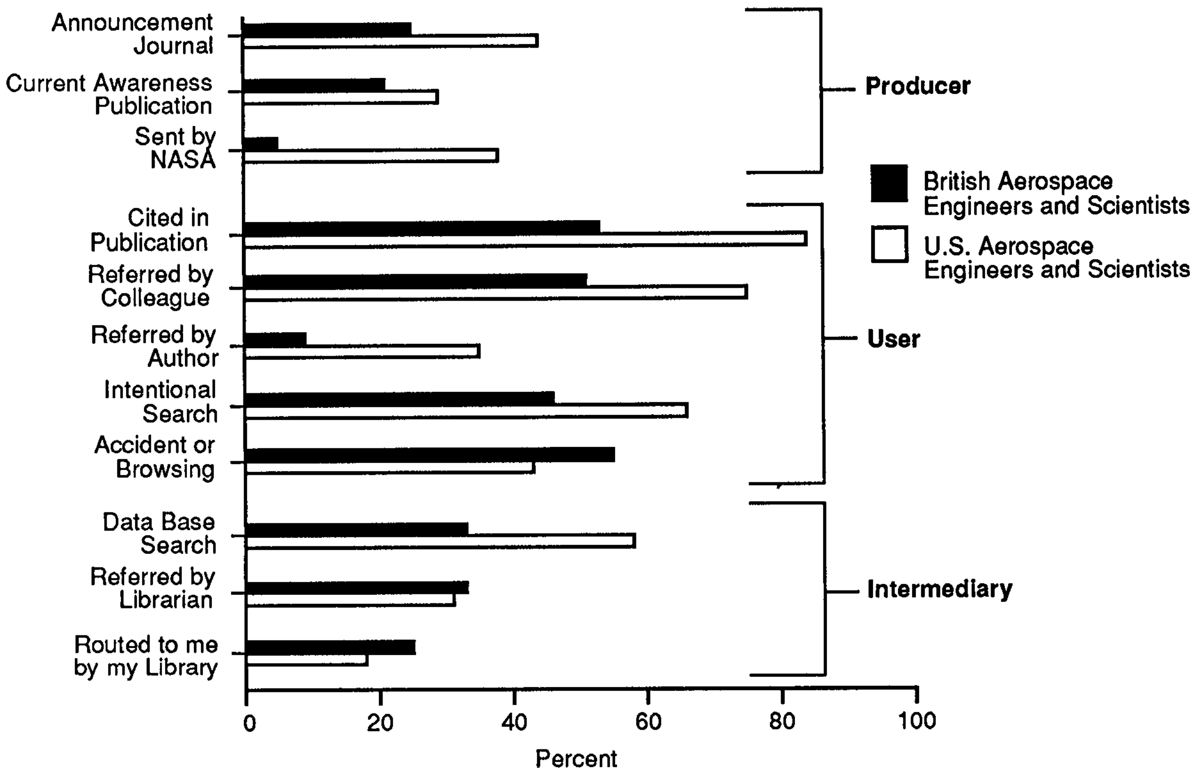

Figure 4. How British and U.S. Aerospace Engineers and Scientists Find Out About NASA technical Reports.

and discussion, the awareness choices are grouped into three 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.

Certain differences exist between how RAeS and AIAA respondents find out about NASA technical reports. Overall, AIAA respondents made greater use of the various means than did their RAeS counterparts. **User** methods dominate access choices for both groups with "cited in a publication" and "referred by a colleague" being selected most frequently by AIAA respondents and "accident or browsing" and "cited in a publication" being selected most frequently by RAeS respondents (figure 4). **Producer** methods ranked second for AIAA respondents with "announcement journal" being selected most frequently and ranked third for RAeS respondents with "announcement journal" being selected most frequently. **Intermediary** methods ranked second for RAeS members with "data base search" and "referred by librarian" being selected most frequently and ranked third for AIAA members with "data base search" being selected most frequently.

Acquisition. From a list of seven sources, RAeS and AIAA respondents were asked how they actually access or obtain copies of NASA technical reports (figure 5). For presentation and discussion, the acquisition choices have been grouped into three categories: **Producer**, including sent by author; **User**, including obtained from a colleague; and **Intermediary**, including routed to me by my library.

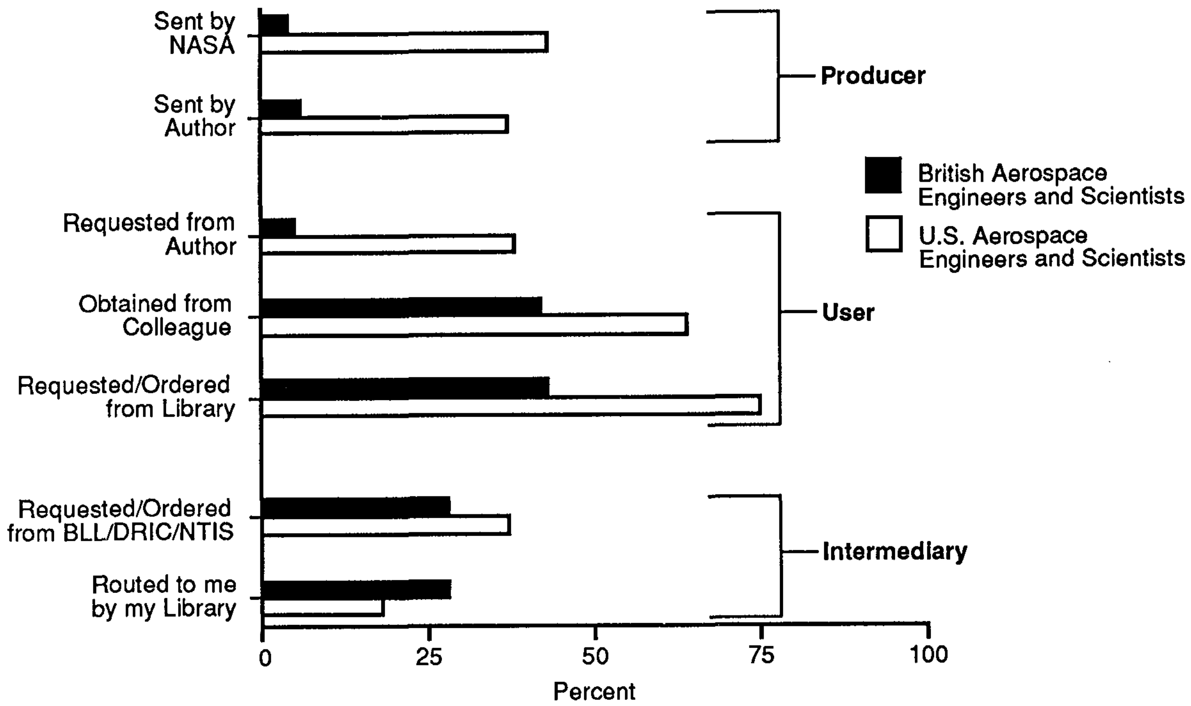

Figure 5. How British and U.S. Aerospace Engineers and Scientists Acquire NASA Technical Reports.

Differences between how RAeS and AIAA respondents acquire NASA technical reports include "sent by NASA," "sent by author," and "requested by author." Overall, **User** methods dominate access choices with "requested/ordered from my library" and "obtained from a colleague" being selected most frequently (figure 5). **Producer** methods ranked second for AIAA members with "sent by NASA" being selected most frequently and ranked third for RAeS members with "sent by author" being selected most frequently. **Intermediary** methods ranked second for RAeS members and third for AIAA members with "routed to me by my library" and "requested/ordered from BLL/DRIC being selected most frequently for RAeS members and "ordered from NTIS" being selected most frequently.

Rating of Technical Information Products

Even if they did not use them, RAeS survey participants were asked to rate the six technical information products on eight characteristics. For example, respondents were asked to indicate the extent to which they thought that conference-meeting papers are easy/difficult to obtain. A 1 to 5 point scale (1.0 = easy to obtain; 5.0 = difficult to obtain) was used to measure their opinions. The higher the number, the more difficult conference-meeting papers were considered by survey participants to obtain. An overall mean ($\bar{X}$) rating was calculated for users and non-users.

Conference and Meeting Papers. The ratings for conference-meeting papers are shown in table 9. The highest overall ratings were associated with (1) good/poor technical quality, (2) inexpensive/expensive, (3) easy/difficult to obtain, (4) easy/difficult to use and (5) obtaining them at a nearby/distant location. Statistically significant differences were found between users and non-users for seven of the eight characteristics -- good/poor technical quality is the exception. Overall, users rated the characteristics higher than did non-users of conference-meeting papers.

Table 9. Rating of Conference-Meeting Papers
by British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$)	Non-User Rating ($\bar{X}$)	Overall Rating ($\bar{X}$)
	n = 255	n = 311	n = 566
Being easy/difficult to obtain	3.55	2.95	3.24*
Being easy/difficult to use or read	3.43	3.07	3.24*
Being inexpensive/expensive	3.48	3.22	3.36*
Being of good/poor technical quality	3.50	3.36	3.45
Having comprehensive/incomplete information	2.81	2.98	2.91*
Being relevant/irrelevant to my work	3.51	2.36	2.95*
Obtaining them at a nearby/distant location	3.20	2.75	2.97*
Having good/bad prior experiences using them	3.42	2.45	2.94*

* *t* values are statistically significant at $p \leq 0.05$.

Journal Articles. The ratings for journal articles appear in table 10. The highest overall ratings for journal articles were associated with (1) easy/difficult to obtain, (2) inexpensive/ expensive, (3) easy /difficult to use or read, (4) good/poor technical quality, and (5) obtaining them at a nearby/distant location. Statistically significant differences were found between users and non-users for the following six characteristics: (1) easy/difficult to obtain, (2) inexpensive/expensive (3) easy/difficult to use of read, (4) obtaining them at a nearby/distant location, (5) good/bad prior experiences using them, and (6) relevant/irrelevant to my work. Overall, users rated the characteristics of journal articles higher than did non-users of journal articles with the single exception of "comprehensive/incomplete information."

Table 10. Rating of Journal Articles by
British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$) n = 248	Non-User Rating ($\bar{X}$) n = 313	Overall Rating ($\bar{X}$) n = 561
Being easy/difficult to obtain	4.08	3.45	3.76*
Being easy/difficult to use or read	3.82	3.28	3.56*
Being inexpensive/expensive	3.77	3.56	3.66*
Being of good/poor technical quality	3.51	3.47	3.51
Having comprehensive/incomplete information	2.89	3.00	2.96
Being relevant/irrelevant to my work	3.43	2.34	2.87*
Obtaining them at a nearby/distant location	3.76	3.20	3.46*
Having good/bad prior experiences using them	3.67	2.64	3.15*

* *t* values are statistically significant at $p \leq 0.05$.

In-House Technical Reports. The ratings for in-house technical reports are shown in table 11. The highest overall ratings for in-house technical reports were associated with (1) inexpensive/expensive (2) obtaining them at a nearby/distant location, (3) easy/difficult to obtain, (4) relevant/irrelevant to my work, (5) having good/bad prior experiences using them. Statistically significant differences were found between users and non-users for all eight characteristics. Overall, users rated the characteristics higher than did non-user of in-house technical reports.

AGARD Technical Reports. The ratings for AGARD technical reports appear in table 12. The highest overall ratings for AGARD technical reports were associated with (1) good/poor technical quality, (2) inexpensive/expensive, (3) comprehensive/incomplete information, (4) easy/difficult to use or read, (5) easy/difficult to obtain, and (6) obtaining them at a nearby/distant location. Statistically significant differences were found between users and non-users of AGARD technical reports and all but the two following characteristics -- comprehensive/incomplete and relevant/irrelevant to my work. With the exception of "easy/difficult to obtain," users rated the characteristics higher than did non-user of AGARD technical reports.

Table 11. Rating of In-house Technical Reports by
British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$) n = 410	Non-User Rating ($\bar{X}$) n = 110	Overall Rating ($\bar{X}$) n = 520
Being easy/difficult to obtain	4.52	3.29	4.30*
Being easy/difficult to use or read	3.85	3.17	3.75*
Being inexpensive/expensive	4.73	3.76	4.56*
Being of good/poor technical quality	3.75	3.39	3.71*
Having comprehensive/incomplete information	3.46	3.20	3.44*
Being relevant/irrelevant to my work	4.42	2.70	4.14*
Obtaining them at a nearby/distant location	4.52	3.29	4.31*
Having good/bad prior experiences using them	4.19	2.73	3.98*

* *t* values are statistically significant at $p \leq 0.05$.

Table 12. Rating of AGARD Technical Reports by
British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$) n = 104	Non-User Rating ($\bar{X}$) n = 469	Overall Rating ($\bar{X}$) n = 563
Being easy/difficult to obtain	2.66	2.69	2.91*
Being easy/difficult to use or read	3.53	2.87	3.03*
Being inexpensive/expensive	3.85	3.13	3.29*
Being of good/poor technical quality	3.81	3.29	3.42*
Having comprehensive/incomplete information	3.20	3.04	3.08
Being relevant/irrelevant to my work	3.73	2.17	2.55
Obtaining them at a nearby/distant location	3.69	2.67	2.89*
Having good/bad prior experiences using them	3.63	2.43	2.69*

* *t* values are statistically significant at $p \leq 0.05$.

RAE Technical Reports. The ratings for RAE technical reports appear in table 13. The highest overall ratings for RAE technical reports were associated with (1) inexpensive/expensive,

Table 13. Rating of RAE Technical Reports by British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$) n = 366	Non-User Rating ($\bar{X}$) n = 359	Overall Rating ($\bar{X}$) n = 725
Being easy/difficult to obtain	3.79	2.98	3.28*
Being easy/difficult to use or read	3.69	3.09	3.31*
Being inexpensive/expensive	4.07	3.32	3.61*
Being of good/poor technical quality	3.88	3.36	3.57*
Having comprehensive/incomplete information	3.57	3.11	3.30*
Being relevant/irrelevant to my work	3.82	2.33	2.85*
Obtaining them at a nearby/distant location	3.81	2.82	3.16*
Having good/bad prior experiences using them	3.78	2.60	3.00*

* *t* values are statistically significant at $p \leq 0.05$.

(2) good/poor technical quality, (3) easy/difficult to use or read, (4) comprehensive/incomplete information, and (5) easy/difficult to obtain. Statistically significant differences were found between users and non-users of RAE technical reports on all eight characteristics. Overall, users rated the characteristics higher than did non-users of RAE technical reports.

NASA Technical Reports. The ratings for NASA technical reports appear in table 14. The highest overall ratings for NASA technical reports were associated with (1) good/poor technical quality, (2) comprehensive/incomplete information, (3) inexpensive/expensive, (4) easy/difficult to read, and (5) having good/bad prior experiences using them. Statistically significant differences were found between users and non-users of NASA technical reports on all eight characteristics. Overall, users rated the characteristics higher than did non-users of NASA technical reports.

Table 14. Rating of NASA Technical Reports by
British Aerospace Engineers and Scientists

Factors	User Rating ($\bar{X}$) n = 368	Non-User Rating ($\bar{X}$) n = 384	Overall Rating ($\bar{X}$) n = 752
Being easy/difficult to obtain	3.15	2.39	2.61*
Being easy/difficult to use or read	3.34	2.86	3.00*
Being inexpensive/expensive	3.46	2.93	3.10*
Being of good/poor technical quality	3.90	3.40	3.52*
Having comprehensive/incomplete information	3.39	3.16	3.23*
Being relevant/irrelevant to my work	3.71	2.24	2.61*
Obtaining them at a nearby/distant location	3.47	2.42	2.69*
Having good/bad prior experiences using them	3.76	2.39	2.72*

* *t* values are statistically significant at $p \leq 0.05$.

Correlation coefficients (Pearson's *r*) were calculated for the RAeS frequency of use and rating responses. The correlations compared "past month's usage" with the eight opinion ratings for each of the six technical information products. A positive and significant correlation ($p \leq 0.05$) was found between the use of the six information products and the following rating factors:

Conference-Meeting Papers

	r
o relevant to my work	.345*
o easy to use or to read	.222*
o good prior experiences	.382*
o easy to obtain	.202*
o inexpensive	.159*
o nearby location or source	.128*

AGARD Technical Reports

	r
o good prior experiences	.307*
o relevant to my work	.364*
o good technical quality	.138*
o nearby location or source	.200*
o easy to use or read	.192*
o easy to obtain	.186*
o inexpensive	.106*

Journal Articles

	r
o good prior experiences	.383*
o relevant to my work	.338*
o easy to obtain	.157*
o easy to use or read	.109*
o nearby location or source	.098*

RAE Technical Reports

	r
o relevant to my work	.284*
o nearby location or source	.224*
o inexpensive	.234*
o easy to obtain	.157*
o easy to read or use	.164*
o good technical quality	.164*
o comprehensive data and information	.131*
o good prior experiences	.293*

In-House Technical Reports

	r
o relevant to my work	.166*
o good prior experiences	.160*
o nearby location or source	.096*
o easy to obtain	.202*

NASA Technical Reports

	r
o easy to read or use	.130*
o relevant to my work	.163*
o nearby location or source	.113*
o good prior experiences	.164*

*$p \leq 0.05$.

FINDINGS

Readers should note that the data contained in this report reflect the responses of British aerospace engineers and scientists who were members of the Royal Aeronautical Society (RAeS). The results, therefore, are not generalizable to all aerospace engineers and scientists or to all British aerospace engineers and scientists. Further, the survey was conducted in October 1991 and February 1992, almost 3 years ago. The British aerospace industry has undergone significant changes in the years since the research was conducted.

1. The "average" RAeS respondent works in industry (45%) or other (32%), works as a manager (22%) or in design/development (20%), has a high national certificate/diploma (25%) or a bachelor's degree (31%), was educated (trained) as an engineer (81%), currently works as an engineer (59%), and has an average of 23 years of professional work experience.

2. A majority of the job-related projects, tasks, and problems were categorized as either design/development (31.2%) or management (21.9%). About 14% of the job-related projects, tasks, and problems were categorized as research and management (22%).

3. Most RAeS respondents (84%) worked with others (did not work alone) in completing their most important job-related project, task, or problem. The average number of people per group was 8.95. About 49% of the respondents performed engineering duties while working on their most important job-related project, task, or problem. About 45% performed management duties.

4. The mean complexity score of the most important job-related project, task, or problem was 3.68 (of a possible 5.00). The average (mean) technical uncertainty score of the most important job-related project, task, or problem was 3.20 (of a possible 5.00).

5. A statistically significant (positive) correlation (relationship) was found to exist between technical uncertainty and complexity.

6. RAeS respondents used their personal stores of information followed by discussions with colleagues inside the organization, colleagues outside the organization, literature resources in their organisation's library, and librarians/technical information specialists in securing the information needed to complete their most important job-related project, task, or problem. Almost two-thirds of the respondents did not use a librarian/technical information specialist in securing the information needed to complete their most important job-related project, task, or problem.

7. About 55% of the RAeS respondents indicated that they used their organisation's library very often; about 14% indicated they used their organisation's library sometimes and about 31% indicated they used their organisation's library not often. The average use rating was 3.42.

8. About 56% of the RAeS respondents indicated that their organisation's library was very important in performing their present professional duties. About 22% indicated that their organisation's library was neither important nor unimportant and about 23% indicated that their organisation's library was not at all important in performing their present professional duties. The average importance rating was 3.63.

9. Among RAeS respondents, in-house technical reports enjoyed the highest use rate (79%) followed by journal articles (58%) and conference-meeting papers (50%). RAE, AGARD, and NASA technical reports were used by 31%, 21%, and 23% of the RAeS survey respondents, respectively.

10. Among RAeS respondents, in-house technical reports received the highest importance rating ($\bar{X} = 3.76$) followed by conference-meeting papers ($\bar{X} = 2.49$) and journal articles ($\bar{X} = 2.38$). The importance ratings for AGARD, RAE, and NASA reports were considerably lower.

11. In-house technical reports were used to a much greater extent than were the other technical information products ($\bar{X}$ = 16.19) followed by conference-meeting papers ($\bar{X}$ = 3.56) and journal articles ($\bar{X}$ = 3.06). Technical report use was less, with NASA reports being used more than RAE and AGARD reports. The median number of times that AGARD, RAE, and NASA technical reports were used in the past 6 months was 0.00, indicating that the majority of RAeS survey respondents did not use these technical information products during that period.

12. Minor differences were demonstrated in how RAeS respondents find out about RAE and NASA technical reports. **User** methods dominate awareness choices with "cited in a publication," "referred by a colleague," and "accident or browsing" being selected most often. **Intermediary** methods rank second with "data base search" and "referred by librarian" being selected most frequently. **Producer** methods rank third with "announcement journals" such as *STAR*, and "current awareness publication" being selected most frequently.

13. Differences between how RAeS respondents acquire RAE and NASA technical reports include "sent by RAE/NASA," "sent by author," and "requested by author." Overall, **User** methods dominate access choices with "requested/ordered from my library" and "obtained from a colleague" being selected most frequently (figure 3). **Producer** methods rank second for RAE technical reports with "sent by RAE" being selected most frequently and third for NASA technical reports with "sent by author" being selected most frequently. **Intermediary** methods rank third for RAE reports and second for NASA reports with "routed to me by my library" being selected most frequently for both.

14. RAeS respondents assigned the highest overall product ratings to in-house technical reports, followed by RAE technical reports and journal articles. They rated conference-meeting papers highest for "good/poor technical quality," journal articles highest for "easy/difficult to obtain," in-house technical reports highest for "inexpensive/expensive," AGARD technical reports highest for "good/poor technical quality," RAE technical reports highest for "inexpensive/expensive," and NASA technical reports highest for "good/poor technical quality."

15. Overall, statistically significant correlation coefficients for RAeS frequency use and rating responses were highest for "good prior experiences" (4 out of 6 products). The exceptions were in-house technical reports with "easy to read or use" and AGARD technical reports with "relevant to my work" scoring highest.

CONCLUDING REMARKS

This survey of British aerospace engineers and scientists offers some insight into their information-seeking behavior, the factors that influence their use of STI, and the role played by U.S. government technical reports in the diffusion of aerospace STI . This Phase 4 investigation provides results that (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 government funded aerospace R&D to the aerospace community.

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APPENDIX A: PROJECT FACT SHEET

NASA/DoD AEROSPACE KNOWLEDGE DIFFUSION RESEARCH PROJECT

The process of producing, transferring, and using scientific and technical information (STI), which is an essential part of aerospace research and development (R&D), can be defined as *Aerospace Knowledge Diffusion.* Studies tell us that timely access to STI can increase productivity and innovation and help aerospace engineers and scientists maintain and improve their professional skills. These same studies indicate, however, that we know little about aerospace knowledge diffusion or about how aerospace engineers and scientists find and use STI. To learn more about this process, we have organized a research project to study knowledge diffusion. Sponsored by NASA and the Department of Defense (DoD), the *NASA/DoD Aerospace Knowledge Diffusion Research Project* is being conducted by researchers at the NASA Langley Research Center, the Indiana University Center for Survey Research, and Rensselaer Polytechnic Institute. This research is endorsed by several aerospace professional societies including the AIAA, RAeS, and DGLR and has been sanctioned by the AGARD and AIAA Technical Information Panels.

This 4-phase project is providing descriptive and analytical data about the flow of STI at the individual, organizational, national, and international levels. It is examining both the channels used to communicate STI and the social system of the aerospace knowledge diffusion process. Phase 1 investigates the information-seeking habits and practices of U.S. aerospace engineers and scientists, in particular their use of government-funded aerospace STI. Phase 2 examines the industry-government interface and emphasizes the role of the information intermediary in the knowledge diffusion process. Phase 3 concerns the academic-government interface and emphasizes the information intermediary-faculty-student interface. Phase 4 explores the information-seeking behaviors of non-U.S. aerospace engineers and scientists from Western European nations, India, Israel, Japan, and the former Soviet Union.

The results of this research project will help us to understand the flow of STI at the individual, organizational, national, and international levels. The findings can be used to identify and correct deficiencies, to improve access and use, to plan new aerospace STI systems, and should provide useful information to R&D managers, information managers, and others concerned with improving access to and utilization of STI. These results will contribute to increasing productivity and to improving and maintaining the professional competence of aerospace engineers and scientists. The results of our research are being shared freely with those who participate in the study.

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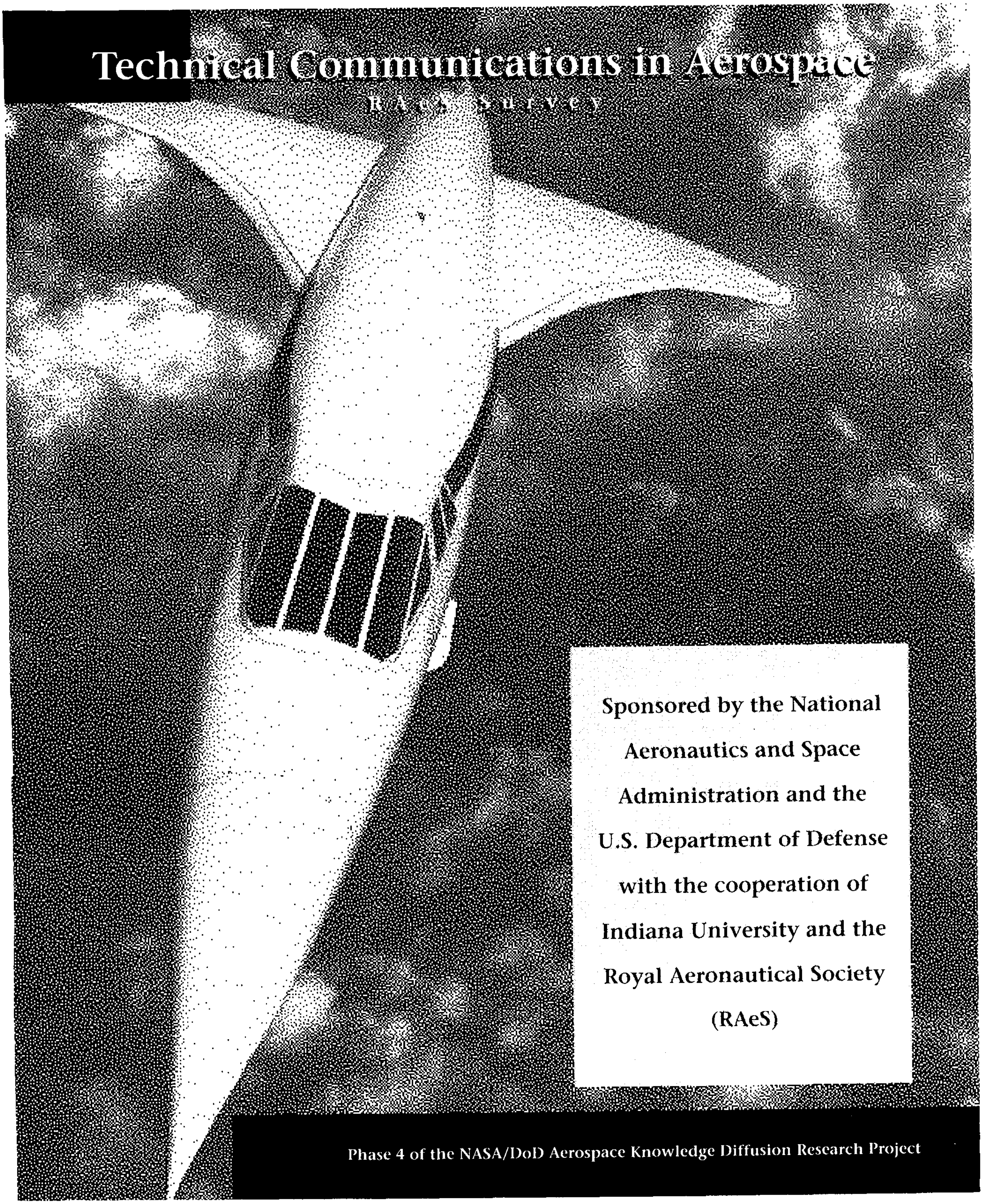
APPENDIX B: RAeS QUESTIONNAIRE



1. Are you a member of a Branch of the Royal Aeronautical Society? (Please circle a number.)

1 Yes

2 No

2. During the past season, how often did you attend: (Please indicate how many times.)

RAeS Conferences:	**RAeS Lectures:**	**RAeS Courses:**
_____ Times at Hamilton Place	_____ Times at Hamilton Place	_____ Times at Hamilton Place
_____ Times at a Branch	_____ Times at a Branch	_____ Times at a Branch

3. If applicable, please provide the name of the Branch where you most recently attended a Conference, Lecture, or Course in the past season.

Branch most recently attended for a RAeS Conference: ____________________

Branch most recently attended for a RAeS Lecture: ____________________

Branch most recently attended for a RAeS Course: ____________________

4. <u>If you did not attend</u> a RAeS Conference, Lecture, or Course at a Branch site in the past six months, what reasons did you have for not attending? (Please circle <u>ALL</u> numbers that apply.)

	Yes	No
I was not interested in any topics	1	2
I find the lecture programmes uninteresting	1	2
I live too far from a Branch to attend	1	2
I work too far from a Branch to attend	1	2

Other (Please specify.) ____________________

5. About how far away do you live from the nearest Branch? ______ miles

6. During the past year, how many times did you use the RAeS library?

______Times **(If you did not use the RAeS library, please TICK here _____ and skip to Q. 10.)**

7. When you used the RAeS library over the past year, was the information you wanted: (Please circle number for each.)

	Yes	No
Technical	1	2
Commercial	1	2
General	1	2
Historical	1	2

8. If you circled more than one "yes" on Q. 7, which did you use most often? (Please circle ONLY ONE number.)

1	Technical	3	General
2	Commercial	4	Historical

9. When you use the RAeS library, do you normally use: (Please circle number for each.)

	Yes	No
Loan Material	1	2
Photocopies	1	2

10. Do you think that the RAeS provides an adequate information service? (Please circle a number.)

1 Yes

2 No ——► **How would you like to see it improved?** ______________________

____

11. Should the RAeS develop a computerized data centre that would allow access to the RAeS library holdings by modem? (Please circle a number.)

1 Yes

2 No

The following questions are about the RAeS publication AEROSPACE.
(Please circle a number for each.)

		Yes	No
12.	**Do you look at AEROSPACE when seeking career opportunities?**	1	2
13.	**Do you think AEROSPACE should contain a regular page on education and training?**	1	2
14.	**Do you think the RAeS should publish more journals covering sectors of specialist aerospace subjects?**	1	2
15.	**Do AEROSPACE articles influence your own buying decisions?**	1	2
16.	**Do AEROSPACE articles help you do your job better?**	1	2
17.	**In your current position, do you:**		
	1. Make procurement decisions?	1	2
	2. Influence procurement decisions?	1	2

18. As a RAeS member, would you be interested in acting as a mentor for young persons at nearby schools or work? (Please circle a number.)

1 Yes

2 No

19. Are you registered with the Engineering Council as: (Please circle a number.)

	Yes	No
Chartered Engineer	1	2
Incorporated Engineer	1	2
Engineering Technician	1	2

(If you are RETIRED, please TICK here _____ and skip to the top of page 10.)

The following questions concern the most important TECHNICAL project, task, or problem you have worked on in the past six months.
(If you are not involved with technical projects, tasks, or problems, please TICK here _____ and skip to the top of page 10.)

20. Thinking of the most important job-related project, task, or problem you have worked on in the past six months, which category best describes this work? (Please tick ONLY ONE box.)

- ☐ Educational (e.g., for professional development or preparation of a lecture)
- ☐ Research (either basic or applied)
- ☐ Design
- ☐ Development
- ☐ Manufacturing
- ☐ Production
- ☐ Computer applications
- ☐ Management (e.g., planning, budgeting, and managing research)
- ☐ Other (Please specify.) ____________________

21. Considering the time you spent on this project only, how would you describe the kinds of duties you performed while working on the project in terms of engineering, science, and management? (Please enter amounts as percentages that total 100%.)

_______% Engineering

_______% Science

_______% Management

_______% Other (Please describe.) ____________________

22. How would you describe the overall complexity of the technical project, task, or problem you categorised in Q. 20? (Please circle a number.)

Very simple 1 2 3 4 5 Very complex

23. How would you rate the amount of technical uncertainty that you faced when you started the technical project, task, or problem categorised in Q. 20? (Please circle a number.)

Little uncertainty 1 2 3 4 5 Great uncertainty

24. **While you were involved in the technical project, task, or problem, did you work with others, or did you work alone? (Please circle a number.)**

1 With others ——→ **With about how many other persons? ________**

2 Alone

25. **What steps did you follow to get the <u>information you needed</u> for this project, task, or problem?**
(Please sequence these items (e.g., 1, 2, 3, 4, 5) and put an X beside the steps you did not use.)

<u>Sequence</u>

_____ Used my personal store of technical information, including sources I keep in my office

_____ Spoke with co-workers or people <u>inside</u> my organisation

_____ Spoke with colleagues <u>outside</u> my organisation

_____ Spoke with a librarian or technical information specialist

_____ Used literature resources (e.g., conference papers, journals, technical reports) found in my organisation's library

(If you used none of the above steps, please TICK here_____.)

The following questions concern your use of information sources.

26. **Which of the following information sources do you use in performing your present professional duties? (Please circle a number for each source.)**

	Yes	No
Conference/Meeting Papers	1	2
Journal Articles	1	2
In-House Technical Reports	1	2
AGARD Technical Reports	1	2
RAE Technical Reports	1	2
NASA Technical Reports	1	2

27. **In terms of performing your present professional duties, how important is each of the following sources? (Please circle a number for each source.)**

	Not at All Important				Very Important
Conference/Meeting Papers	1	2	3	4	5
Journal Articles	1	2	3	4	5
In-House Technical Reports	1	2	3	4	5
AGARD Technical Reports	1	2	3	4	5
RAE Technical Reports	1	2	3	4	5
NASA Technical Reports	1	2	3	4	5

28. **In the past six months, approximately how many times did you use <u>CONFERENCE/MEETING PAPERS</u> in performing your present professional duties?**

_____ Times in the past six months

29. **Even if you don't use them, please rate <u>CONFERENCE/MEETING</u> <u>PAPERS</u> on each of the following. (Please circle a number for each rating.)**

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

30. **In the past six months, approximately how many times did you use <u>JOURNAL</u> <u>ARTICLES</u> in performing your present professional duties?**

_____ Times in the past six months

31. **Even if you don't use them, please rate <u>JOURNAL</u> <u>ARTICLES</u> on each of the following. (Please circle a number for each rating.)**

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

32. **In the past six months, approximately how many times did you use <u>NASA</u> <u>TECHNICAL</u> <u>REPORTS</u> in performing your present professional duties?**

_____ Times in the past six months

33. Even if you don't use them, please rate NASA TECHNICAL REPORTS on each of the following. (Please circle a number for each rating.)

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

34. How often do you find out about NASA TECHNICAL REPORTS from each of these sources? (Please circle a number for each source.)

	Frequently	Sometimes	Seldom	Never
Bibliographic database search	1	2	3	4
Announcement journal (e.g., STAR)	1	2	3	4
Current awareness publication (e.g., SCAN)	1	2	3	4
Cited in a report/journal/conference paper	1	2	3	4
Referred to me by colleague	1	2	3	4
Referred to me by librarian	1	2	3	4
Routed to me by library	1	2	3	4
By intentional search of library resources	1	2	3	4
By accident, by browsing, or looking for other material	1	2	3	4
NASA informed me	1	2	3	4
The author informed me	1	2	3	4
Other_______________				

35. How often do you usually obtain physical access to NASA TECHNICAL REPORTS from each of these sources? (Please circle a number for each source.)

	Frequently	Sometimes	Seldom	Never
NASA sends them to me	1	2	3	4
Referred to me by the author	1	2	3	4
The author sends them to me	1	2	3	4
I request/order them from my library	1	2	3	4
I request/order them from British Library Lending Division (BLLD)	1	2	3	4
I request/order them from Defense Research Information Center (DRIC)	1	2	3	4
I get them from a colleague	1	2	3	4
They are routed to me by my library	1	2	3	4

36. In the past six months, approximately how many times did you use <u>IN-HOUSE TECHNICAL REPORTS</u> in performing your present professional duties?

_____ Times in the past six months

37. Even if you don't use them, please rate <u>IN-HOUSE TECHNICAL REPORTS</u> on each of the following. (Please circle a number for each rating.)

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

38. In the past six months, approximately how many times did you use <u>AGARD TECHNICAL REPORTS</u> in performing your present professional duties?

_____ Times in the past six months

39. Even if you don't use them, please rate <u>AGARD TECHNICAL REPORTS</u> on each of the following. (Please circle a number for each rating.)

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

40. **In the past six months, approximately how many times did you use RAE TECHNICAL REPORTS in performing your present professional duties?**

______ Times in the past six months

41. **Even if you don't use them, please rate RAE TECHNICAL REPORTS on each of the following. (Please circle a number for each rating.)**

Physically, they are easy to obtain	1	2	3	4	5	Physically, they are difficult to obtain
They are easy to read or to use	1	2	3	4	5	They are difficult to read or to use
They are cost free	1	2	3	4	5	They are costly
They are of good technical quality	1	2	3	4	5	They are of poor technical quality
They have complete data and information	1	2	3	4	5	They have incomplete data and information
They are relevant to my work	1	2	3	4	5	They are irrelevant to my work
They can be obtained at a nearby location or source	1	2	3	4	5	They must be obtained from a distant location or source
I've had good prior experience using them	1	2	3	4	5	I've had poor prior experience using them

42. **How often do you find out about RAE TECHNICAL REPORTS from each of these sources? (Please circle a number for each source.)**

	Frequently	Sometimes	Seldom	Never
Bibliographic database search	1	2	3	4
Announcement journal (e.g., STAR)	1	2	3	4
Current awareness publication (e.g., DRA)	1	2	3	4
Cited in a report/journal/conference paper	1	2	3	4
Referred to me by colleague	1	2	3	4
Referred to me by librarian	1	2	3	4
Routed to me by library	1	2	3	4
By intentional search of library resources	1	2	3	4
By accident, by browsing, or looking for other material	1	2	3	4
The RAE informed me	1	2	3	4
The author informed me	1	2	3	4
Other______________________________				

43. How often do you usually obtain physical access to <u>RAE TECHNICAL REPORTS</u> from each of these sources? (Please circle a number for each source.)

	Frequently	Sometimes	Seldom	Never
RAE sends them to me	1	2	3	4
The author sends them to me	1	2	3	4
I request them from the author	1	2	3	4
I request/order them from my library	1	2	3	4
I request/order them from BLLD	1	2	3	4
I request/order them from DRIC	1	2	3	4
I get them from a colleague	1	2	3	4
They are routed to me by my library	1	2	3	4

These data will help us determine what use is made of libraries and technical information centres and services, and how information technology is used by aerospace engineers and scientists.

44. Does your organisation have a library and/or technical information centre? (Please circle a number.)

1 Yes ———► **45. How far are you from it?** _______ miles

2 No **(If No, skip to Q. 48.)**

46. In the past six months, about how often did you use your organisation's library/technical information centre? (Please circle a number.)

Not often 1 2 3 4 5 Very often

47. In terms of performing your present professional duties, how important is your organisation's library/technical information centre? (Please circle a number.)

Not at all important 1 2 3 4 5 Very important

48. In the past year, did you use any of the following external libraries to perform your present professional duties? (Please circle a number for each.)

	Yes	No
RAeS library	1	2
Public library	1	2
University or other school library	1	2

Other library (Please specify.) ____

These last few questions concern your background and professional training.

49. What is the highest level of education you have completed? (Please circle ONLY ONE number.)

1 No degree
2 Ordinary national certificate
3 Higher national certificate
4 Ordinary national diploma
5 Higher national diploma
6 Bachelor's degree
7 Master's degree
8 Doctorate
9 Postdoctorate
10 Licence (Please specify.) ____________________

50. What is your primary professional duty? (Please circle ONLY ONE number.)

1 Academic/teaching (may include research)
2 Research
3 Administrative/management in industry
4 Administrative/management in government, non-profit
5 Design/development
6 Manufacturing/production
7 Marketing/sales
8 Service/maintenance
9 Private consultant
10 Other ____________________

51. What is the type of organisation where you work? (Please circle ONLY ONE number.)

1 Academic
2 Government
3 Industry
4 Non-profit
5 Retired or unemployed
6 Other ____________________

52. Are you trained as: (Please circle a number.)

1 An engineer 2 A scientist 3 Other ____________________

53. Would your present professional duties be classified as: (Please circle a number.)

1 An engineer 2 A scientist 3 Other ____________________

54. How many years of professional work experience in aerospace do you have?

________Years in aerospace

55. Do you currently have a pilot's licence? (Please circle a number.)

1 Yes → **56. How many flying hours do you have?** _____ hours

2 No **(If No, skip to Q. 58.)**

57. For what aircraft are you licenced? ____________________

OVER →

58. **Are you a qualified engineer? (Please circle a number.)**

1 Yes   2 No   **(If No, skip to Q. 60.)**

59. **Are you: (Please circle a number.)**

	Yes	No
An aircraft maintenance engineer	1	2
Licenced as an aircraft maintenance engineer	1	2
A flight engineer	1	2
Licenced as a flight engineer	1	2

60. **What is your principal RAeS interest group? (Please circle ONLY ONE number.)**

1 Aeromarine (joint group with SUT and RINA)

2 Aerodynamics

3 Air Law

4 Air Transport

5 Airworthiness and Maintenance

6 Aviation Medicine

7 Avionics Systems

8 Flight Simulation

9 Graduates, Young Technicians and Students

10 Guided Flight

11 Historical

12 Human-Powered Aircraft

13 Light Aeroplanes

14 Management Studies

15 Mechanical and Structural

16 Propulsion

17 Rotorcraft

18 Space

19 Test Pilots

61. **Which of the following best characterizes your area of work or application of your work? (Please circle ONLY ONE number.)**

1 Aeronautics

2 Astronautics

3 Engineering

4 Space Sciences

5 Mathematics & Computer Sciences

6 Materials & Chemistry

7 Physics

8 Other ______________________________

62. **Is any of your work funded by the British Government? (Please circle a number.)**

1 Yes   2 No

63. **Who supplies the largest proportion of funds for your current research/project(s)? (Please circle a number.)**

1 British Government

2 Private Industry

3 Educational Institution

4 Non-profit

5 Do not receive research funds

6 Other ______________________________

Thank you for your time and cooperation.

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13. ABSTRACT *(Maximum 200 words)*
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 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 report, 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 our investigation of aerospace knowledge diffusion vis-á-vis the U.S. government technical report, and present the results of research that investigated aerospace knowledge diffusion vis-á-vis the technical communications practices of British aerospace engineers and scientists.

14. SUBJECT TERMS
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