NASA/DoD Aerospace Knowledge Diffusion Research Project

Paper Sixteen:

Aerospace Knowledge Diffusion Research

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Aerospace knowledge diffusion research

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A co-operative research project is providing a pragmatic basis for understanding the aerospace knowledge-diffusion process from individual to international levels, which will help to increase productivity and improve the professional competence of aerospace engineers and scientists.

Aerospace research and development (R&D) is becoming more interdisciplinary in nature and more international in scope. Increasing co-operation and collaboration among nations is resulting in a more global manufacturing environment. These conditions are pressuring aerospace organisations to push forward with new technological developments and to maximise their involvement in R&D.

Recognition is growing within the aerospace community that knowledge transfer and diffusion is the key to the success of technological innovation. Although considerable research into technological innovation and knowledge diffusion has been conducted by various disciplines and from numerous perspectives, policy implications from the results of this research and investigation for aerospace are inconsistent, often contradictory, and frequently lacking.

Nevertheless, understanding the influences that motivate innovation and channel its direction is necessary t maximise aerospace R&D successfully. Meeting this challenge depends on a variety of factors, but largely on the efficient and effective transfer and diffusion of knowledge within the aerospace community. The problem is that, from an empirical standpoint, little is known about the transfer and diffusion of knowledge in the aerospace community.

Project overview

The project is a co-operative US effort between the National Aeronautics and Space Administration (NASA), the Department of Defense (DoD), and Indiana University. This research has been endorsed by the AGARD Technical Information Panel and the American Institute of Aeronautics and Astronautics (AIAA) Technical Information Committee.

The four-phase inquiry' focuses on scientific and technical information (STI) as knowledge, the channels through which this knowledge is communicated, and the members of the social system associated with and involved in diffusing this knowledge throughout the aerospace community. The project is based on two premises: that although STI is essential to innovation, STI by itself does not ensure innovation; and that utilising existing STI or creating new STI, does often facilitate technological innovation.

STI is central to the innovation process and its management. Testimony to the central role of STI in the innovation process is found in numerous studies which show strong relationships between the communication of STI and technical performance at both the individual and group levels. These studies also show, among other things, that United States aerospace engineers and scientists devote more time, on average, to the communication of STI than to any other scientific or technical activity.

Understanding how STI is communicated in the process of technolgical innovation is critical to developing and assessing the broad set of policies that influence the transfer and utilisation of aerospace STI. However, as important as the transfer and utilisation of STI is to technological innovation in aerospace, the linkages between the various sectors of the technology infrastructure are weak or poorly defined or both. Stimulating and nurturing aerospace technological innovation requires understanding of the context in which STI is transferred and utilised by aerospace engineers and scientists.

Information-seeking habits

Phase 1 of the project focuses on the information-seeking habits and practices of US aerospace engineers and scientists. The results of the Phase 1 pilot study indicate that US aerospace engineers and scientists spend approximately 65 per cent of a 40-hour week working with, or creating, new STI. Phase 1 will focus on the user of formal and informal channels to identify and obtain information, the use of STI products and services, and the reasons why these products and services are not utilised. Phase 1 activities will also investigate the extent to which selected demographic and attitudinal variables influence or explain information-seeking behaviour.

Knowledge transfer

Phase 2 concentrates on the transfer of knowledge and the model used within the US to distribute federally funded aerospace STI. This model is composed of an informal part that

	Phase 1 1989–1991	Phase 2 1990–1992	Phase 3 1990–1991	Phase 4 1991–1994
Level	National	National	National	International
	Individuals	Individuals and Organisations	Individuals and Organisations	Individuals and Organisations
	US Aerospace Engineers and Scientists	Aerospace librarians in government and industry US government and aerospace industries	US academic faculty, students, and engineering libraries	
Focus	Knowledge production and use	Knowledge transfer and use	Knowledge transfer and use	Knowledge production, transfer and use
Emphasis	Use, importance, and production of NASA DOD STI (technical reports)	Use, importance, and production of NASA DOD STI (technical reports)	Use, importance, and production of NASA/DOD STI (technical reports)	Use and importance of NASA DOD STI
	Impediments to access, transfer and use of NASA DOD STI	Impediments to access, transfer and use of NASA DOD STI	Impediments to access, transfer and use of NASA/DOD STI	Impediments to access, and use of aerospace STI
	Use and importance of AGARD and non-US STI	Use and importance of AGARD and non-US STI	Use and importance of AGARD and non-US STI	Use of AGARD and non-US STI
	Use and importance of information technology	Use and importance of information technology	Use and importance of information technology	Use of information technology
	Information sources used in problem solving	Effectiveness of system used to transfer US government funded STI	Effectiveness of system used to transfer US government	System used to transfer results of government funded aerospace STI, non-US aerospace STI, and systems, policies, and practices
Subjects	AIAA membership	US aerospace librarians in government and industry	US aerospace faculty, academic engineering libraries, and US aerospace students (seniors) in USRA capstone design courses	RAeS, DGLR, and JSASS Aerospace faculties and students, and aerospace librarians
	SAE membership	Selected US government facilities and aerospace companies		
Method	Self-administered mail questionnaires	Self-administered mail questionnaires	Self-administered mail questionnaires	Self-administered mail questionnaires
	Pilot study	Personal interviews	Personal interviews	Pilot study
	Telephone follow-ups	Telephone follow-ups	Telephone follow-ups	
Desired Outcomes	Understanding of individual information-seeking behaviours of US aerospace engineers and scientists	Understanding of the internal flow of aerospace STI in government and industry	Understanding of the internal flow of aerospace STI in academia	Understanding of individual information-seeking behaviour
	Explain use/non-use of US government funded STI products and services by US aerospace engineers and scientists	Understanding of the system used to transfer results of US government funded aerospace STI	Understanding of the system used to transfer results of US government funded aerospace STI	Understanding of the system used to transfer results of government funded aerospace STI
				Understanding of non-US aerospace STI systems, policies, and practices

Figure 1. The NASA/DoD aerospace knowledge diffusion research project

relies on collegial contacts, and a formal part that relies on surrogates, information products, and information intermediaries to complete the producer to user transfer process. However, little is known about this model or about these systems in an empirical sense or about the role played by information intermediaries in the knowledge diffusion process.

The large-scale STI programmes operated by the DoD, Department of Energy (DoE), and NASA, emphasise accessibility through the use of various information products and services plus information intermediaries. These agencies maintain STI systems for acquiring, processing, announcing, and disseminating the results of government-performed and government-sponsored research.

Within these systems, the US government technical report is used as a primary means of transferring the results of federally funded R&D. Librarians and technical information specialists, as information intermediaries, serve as linking agents between producers and users, and between the formal and informal (collegial) components of the model.

The model used by the US government to disseminate the results of federally funded aerospace R&D is mainly a one-way transfer from producer to user. However, one-way distribution often results in an accumulation of unused and unwanted STI. Research shows that two-way, interactive (producer to user to producer) communication is needed for effective knowledge transfer. Regrettably, federally supported STI dissemination policies have not incorporated these research findings about effective information transfer. One researcher has characterised these federal STI systems as "passive, fragmented, and nonresponsive to the user context".

Academic sector

Phase 3 examines knowledge transfer and diffusion within the academic portion of the aerospace community. Successful technological innovation in aerospace is directly related to the size and competency of the pool of aerospace engineers and scientists. Faced with decreasing budgets and enrolments, university aerospace programmes must find ways to maintain and educate the next generation of aerospace engineers and scientists who will advance aerospace technology. The success of this undertaking will depend in large part on the transfer and diffusion of knowledge. Phase 3 explores the information seeking behaviours of aerospace faculty and students in an attempt to understand how knowledge transfer and diffusion operates within the academic community.

Non-US organisations

Phase 4 investigates knowledge transfer and diffusion among non-US aerospace engineers and scientists and aerospace organisations, specifically in Western Europe and Japan. As US collaboration with foreign aerospace technology producers increases, a more international manufacturing environment will arise, fostering an increased flow of US trade.

At the same time, however, international industrial alliances will result in a more rapid diffusion of technology, prompting the aerospace industry to forge ahead with new technological developments. To co-operate in joint ventures as well as to compete successfully at the international level, aerospace industries will need to develop methods to collect, translate, analyse, and disseminate the best of foreign aerospace STI. Therefore, an understanding of the process by which non-US aerospace engineers and scientists communicate at the individual and organisational levels becomes essential to successful technological innovation.

Present status

The initial thrust of Phase 1 is largely exploratory and descriptive, and examines aerospace knowledge use and production. Data was collected through the use of self-administered mail questionnaires. Phase 1 examined the behaviour of US aerospace engineers and scientists with respect to their use of the formal and informal systems when producing and using aerospace STI, and the importance of information technology and information products and services.

Members of the AIAA provided data about knowledge use, and members of the Society of Automotive Engineers (SAE) provided data about knowledge production. Collectively, the members of these two societies represent the entire spectrum of the aerospace R&D process in the US. Data collection and analysis for Phase 1 will be complete by the beginning of 1992.

Phase 2 focuses on aerospace knowledge transfer and use within the larger social system, placing particular emphasis on the flow of aerospace STI in government and industry, and the role in the knowledge transfer of the information intermediary (that is, the aerospace librarian or technical information specialist). Phase 2 examined many of the same concerns contained in Phase 1 but from the standpoint of the information intermediary. Although the information intermediary is considered a vital link in the knowledge transfer process, a strong methodological base for assessing the intermediary's effectiveness is lacking.

A self-administered mail survey was sent to approximately 300 government and industry aerospace libraries in the US. Data collection and analyses were completed early in 1991.

Phase 3 focuses on knowledge use and transfer at the individual and organisational levels in the academic sector of the aerospace community. Phase 3 examined many of the same concerns contained in Phase 1 from the standpoint of the academic community. Self-administered mail questonnaires were sent to the faculty, undergraduate students, and libraries at all accredited aerospace programmes in the US. Data collection and analyses were completed in early 1991.

Comparative study

Phase 4 examines knowledge production, use, and transfer among non-US aerospace society members and aerospace organisations in the United Kingdom (UK), Germany, and Japan. Phase 4 is a comparative study that examines many of the same concerns contained in Phases 1, 2 and 3 at the international level. Self-administered mail questionnaires are being used to collect data from members of the Royal Aeronautical Society (RAeS) and the Aerospace and Defence Librarians Group, plus the faculty, students and academic librarians at those universities offering aerospace education in the UK. Similarly, data will be collected from members of the Deutsche Gesellschaft fuer Luft-und Raumfahrt (DGLR), information intermediaries in government and industry, and faculty, students, and academic librarians at German universities offering aerospace education. A similar plan has been proposed to the Japan Society of Aeronautical and Space Sciences (JSASS).

Timetable

Phase 4 is the longest segment of this multi-year project that began in 1988. Data collection in the UK began in spring 1991; collection and preliminary analyses should be complete by end of 1991. Data collection and analyses for the rest of Phase 4 will carry through to 1994.

An understanding of the process by which knowledge is diffused is necessary to successfully manage technological innovation in aerospace. In terms of

empirically derived data, however, little is known about the diffusion of knowledge in aerospace both in terms of the communications channels and the individual habits and practices of members of the social system. The NASA/DoD Aerospace Knowledge Diffusion Research Project seeks to enhance understanding of this process and thereby contribute to increasing productivity, stimulating innovation, and improving and maintaining the professional competence of aerospace engineers and scientists.

Project results will be documented in a series of project technical reports and papers. In addition, papers will be presented at national and international conferences. □

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