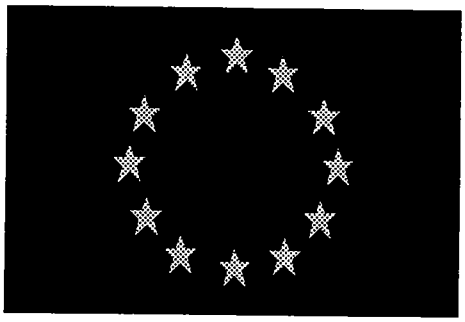
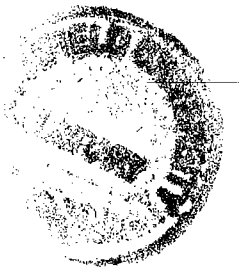
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Eurilia (European Initiative in Library and Information in Aerospace)

Aerospace Information: a literature review

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"The views expressed herein are those of the author/s alone and do not necessarily represent those of the University"

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CONTENTS

Page Number

Introduction ii

1. Purpose and search strategies 1

2. The cost beneficial context of Eurilia: methodological issues 1

3. The cost beneficial context of Eurilia: questions of value 3

4. Specific findings of the sectoral literature search 4

5. Conclusions 10

Bibliography 12

Appendix: Initial search strategies 18

INTRODUCTION

The study reported here is part of the Eurilia (European Initiative in Library and Information in Aerospace) project, the aim of which is to enhance the Libraries' R&D and education process which underpins the aerospace sector by establishing a new service based on a standardised pan-European system for information access, retrieval, image browsing and document delivery. This will in turn extend the access and availability of major aerospace collections.

The partners in this project are:

University of Limerick
Delft University of Technology
Digital Equipment Corporation
Sup'Aero, ENSAE - Ecole National Supérieure de l'Aéronautique et de l'Espace
Instituto Nacional de Tecnica Aeroespacial
Cranfield University

The work for this review was largely undertaken by Cranfield University, but all partners have provided useful input and comments. The University would also wish to thank the EC European Action Programme for Libraries for the support for Eurilia in general and this phase of the project in particular.

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1 Review parameters and search strategies

One of the first issues that the Eurilia team needed to confront was a working definition of the aerospace industry which would set the limits of the project. This was not just therefore required for the purpose of conducting this literature search, but was also needed as a criterion for selecting the 50 users drawn from 5 countries who will be feeding user input into the project. These parameters would also be required to define the scope of the input to the Eurilia database.

After discussion at the project's first meeting in Luxembourg and further circulation of industry definitions by Cranfield to the project team, it was agreed that Eurilia would work to the European Space Agency's (ESA) own scope notes[37]. It was also agreed that we would define the Eurilia project slightly more tightly by restricting the project's focus to three subject categories: Aeronautics, Chemistry and Materials and Structural Engineering.

The initial search strategies are given in the Appendix and searches were conducted on the following databases

Deutsche Luft-und Raufahrt Datenbank (Delura)
European Aeronautical Database (EAD)
Library and Information Science Abstracts (LISA)
National Aeronautics and Space Administration database (NASA)
Cranfield University's own Libertas online Public Access Catalogue

These search strategies were repeated in Spain, the Irish Republic, France and the Netherlands, but the focus here was on country specific studies as it was assumed that most major English language material (including UK and North American studies) would have been already identified through the initial five searches.

The key focus of all of these searches was on studies in the aerospace sector which shed light on:

- the information seeking behaviour of aerospace engineers and scientists;
- the effectiveness of literature and databases in supporting the work of the sector;
- the key methodological issues that Eurilia will need to address in both the pre and post user audit stages of the project.

2 The cost beneficial context of Eurilia: methodological issues

It is worth emphasising at this point that the literature search was sector specific. The search did not review the general literature on performance assessment of libraries and information systems and the various attempts that have been made to put a monetary or surrogate value on the information supplied to users. However, the sectoral searches did throw up some further studies in this area. It was therefore felt appropriate that before reviewing the specific studies of aerospace information, some attempt should be made to put these studies in a broader context.

The brief contextual comment described here is based on a review prepared by Blagden and Harrington [38]. This in turn was based on earlier studies produced by Allred [39], Blagden[40], Brookman[41], Goodall[42], Kania[43], Lancaster[44], Layzell Ward[45], and Powell[46].

Given that the Eurilia project has, from the outset, focussed on user needs, it is clear that the interaction of the user with the Eurilia database and delivery system is of prime importance. The emphasis in terms of user evaluation will be placed on the outputs and outcomes of the Eurilia system. This, of course, echoes the seminal paper by Orr[47] in which he divides performance assessment into studies of resource inputs (numbers of books, how many staff, expenditure levels, etc.) and studies that focus on the more important question of how much good the library does?

Performance assessment has, however, to be placed firmly in the context of the objectives that Eurilia is attempting to achieve. Although users have featured strongly in the Eurilia proposal and will continue to do so as the project progresses, all user needs are contestable as Green[48] makes clear. Projects cannot simply be driven by **individual** user sovereignty. They also need to be driven by resourcing issues - optimising the relationship between cost and benefit as well as constantly assessing needs analyses against overall project objectives.

The real outcomes of an effective library or information system as Powell[46] suggests are the stimulated student or teacher, the scientific discovery, the informed voter and the successful businessman. On the same lines, the ultimate successful outcome of the Eurilia project could be regarded as the development, design and manufacture of a profitable aircraft. How to isolate the Eurilia contribution to this complex process lies at the heart of this study.

Another complication is the one identified by Van House[50] that in evaluating how successful a service is in meeting user needs, studies often assume that such attempts can be classified into met fully, met partially and not met at all. Information seeking behaviour is rarely so simple or so linear. Needs may appear, disappear and change, all within the span of a single library transaction. Library users can gain satisfaction from a nil response, indicating that an area may present a fruitful research opportunity. Other users clarify their own thinking by examining the literature - not solving the problem but defining what the problem is. Of course there is also the serendipity factor - I enter a library searching for Y, I come out with X, happy with the outcome of the visit, even though it was unsuccessful in terms of the prior expectation.

Expectations are an important element in assessing satisfaction as Brindley[51] and many others before her have pointed out. If service is enhanced, satisfaction level rises initially, but this in turn raises expectations and if quality of service remains constant, then satisfaction levels will, in the medium term, go down again. Service enhancements also often increase demand, and if increased resources are not available to support greater demand, again satisfaction levels will start to fall. Similarly as Posnett[52] asserts, if users have been subjected to a poor service in the past, they may well have low expectations which could yield falsely high satisfaction rates.

It is important too, to recognise as D'Elia and Walsh[53] have done, that users' **general** level of satisfaction is independent of their use of the service. This is supported by the Totterdell and Bird study[54] which showed that there was little difference between users and non-users in their attitudes towards public libraries. The word general is highlighted earlier because the key to this problem may be the conclusion drawn from the National Consumer Council

study[55] in which global assertions of satisfaction may have masked significant specific dissatisfaction with the service.

Brinberg and Pinelli[16] state that in the aerospace industry information is not desired for itself, but rather to support the overall mission. This they argue will be the key factor in deciding on the willingness to pay for information. This, of course, has to be also assessed against the findings of an aerospace study reported by Resnick[33] in which there was a marked reluctance to pay for what were perceived as exorbitant online charges.

This does not appear to apply to US aerospace students[49]. The majority of database users pay all or a reduced cost for searching online databases (the practice of charging is also confirmed by US librarians in another study[50]). This of course, however, might explain the comparatively low take up of electronic databases with 34.1% of the aerospace faculty and 41.4% of students not using online databases.

Another methodological issue that needs to be addressed is how total quality management (TQM) can be applied to aerospace information services. Erwin, Colquitt and Eberline[60] report a recently successful attempt to implement TQM procedures and on the Eurilia project team two documents[61-62] have been produced to facilitate a TQM approach to all issues. There ought to be considerable scope generally for applying TQM to this sector given the exacting quality control standards to which the industry has to adhere.

3 The cost beneficial context of Eurilia: questions of value

Value has been defined by Vickery[64] as the degree to which an information system contributes to user needs. If, however, that value can be expressed in monetary terms and compared with the cost of the system, this then becomes a true cost benefit analysis. This issue will be explored in greater detail when the commercial framework paper for Eurilia is prepared. The key problem, of course, here is how to put a monetary value on the outputs of the information system. Clearly this can easily be resolved by developing the service as a fully commercial one. Even here, however, as Flowerdew and Whitehead[56] make clear

> *"Willingness to purchase an information service at a particular price only reveals that the purchaser values the information at that price or more. Price may not, therefore, measure the full benefit to the purchaser."*

Many other studies, a good example of which is the Barclay, Pinelli and Kennedy report[6], do not attempt to quantify the savings but emphasise that a key factor for success for aerospace engineers and scientists is the ability to acquire, process and communicate technical information. There is an impressive amount of hard data to support this assertion which will be reviewed later in this paper.

System managers can adopt a number of different approaches to value as both King and Schrems[57] and Schauer[58] make clear by adopting strategies that:

i maximise benefits for a fixed cost;

ii minimise costs for a given level of benefits;

iii maximise the ratio of benefits over cost;

iv maximise the net benefits (present value of benefits minus present value of costs).

The aerospace industry has certainly been aware of the value issue. Picken[1] for example quotes that US Department of Defense reports are read on some 12.4 million occasions with an average value of 4600 dollars per reading. Hart and Rice[13] claim that one weeks time per person per information search is saved in an aerospace organisation. Lawrence[18] quotes the Griffiths and King study[59] in which a number of returns on information investment are claimed

4.3 to one in terms of willingness to pay
2.5 to one in terms of cost to use alternative sources
1.5 to one in terms of avoiding research duplication.

4 Specific findings of the sectoral literature search

4.1 Bibliographical and textual information in context

Information derived from literature, whether this be delivered electronically or in hard copy, is only part of the range of information to which an aerospace engineer or scientist will be exposed. Albrecht, Bodini and Pascual[3] for example give an account of ESA's attempt to merge bibliographic information with raw astrophysical data. Caroll, Jack and Cotter[10] classify aerospace information into the following categories

bibliographic and full text systems
factual information - directories/handbooks
image or graphical systems, e.g. Landsat data, and
numerical data

Hull of British Aerospace[12] reviews the use of information technology applied to the effective management of project information. Hart and Rice[13] show that in aerospace organisations 53.5% of searches were for bibliographic information, 38.9% for full text and 7.2% for numeric data. Montague and Gregg[20] examine some of the issues associated with the development of a project information system. This system was attempting to develop a corporate memory in which users could learn from an aerospace organisation's past experience. What is clearly required here is some link between this internal information and external sources, as it could equally be argued that users must also learn from external experience.

Raitt[31] showed both how important project information is and also how few users (10%) believed that this kind of information should be supplied by a library. In another study in aerospace establishments Raitt[32] reports that 22% of requests are for project related information.

Westbrook and McCreight[35] report the need for a databank of aerospace materials and review some of the characteristics that such a databank might have.

It is worth noting here the importance the technical report plays in the dissemination of aerospace literature. As Pinelli, Barclay and Kennedy[66] make clear, the technical report is

usually an account of a commissioned or sponsored study. The report has the advantage over other forms of literature in that it appears promptly after the work is completed. It also usually provides an exhaustive exposition of the work undertaken including a full discussion of both methodology and results together with any unsuccessful approaches undertaken. Pinelli, Barclay and Kennedy[66] maintain that the history of technical report literature coincides almost entirely with the development of the aeronautics industry and the creation of NACA (as NASA then was).

Clearly it is important to ensure that the Eurilia system is aware of the wider information picture in which aerospace researchers have to operate.

4.2 The International Dimension

In 1979 Martin[19] discussed the issue of international access to aerospace information and in 1992 the earlier comments were still being echoed by four other studies[7,8,9,66] all of which emphasised that aerospace information is increasingly becoming more interdisciplinary and more international in scope These later studies all stated that although the NASA database is by far and away the most comprehensive database in the aerospace sector, it is by no means complete. The authors of these studies go on to argue that the most practical way to improve completeness is through international collaboration. The International Scientific and Technical (STI) exchange agreements concluded by NASA with other external institutions are good examples. The NASA/ESA Tripartite Exchange Program, which was established in 1964, now has more than 500 participants and provides more than 4000 relevant technical reports for the NASA & EAD databases each year. There is, of course, the question of how far co-operation can succeed, given the constraints of both commercial and defence factors. These are touched upon in three studies [1,16 and 33]. Harrington[65] also mentions that the principle of reciprocity has been used to regulate access. This operates on the basis that free or subsidised access to a database will only be given to those aerospace organisations willing to donate their reports for inclusion in that database.

Most of the studies that will be reviewed under the results section have taken place in the USA, either initiated by the American Institute of Aeronautics and Astronautics or the National Aeronautics and Space Administration. Other studies have been conducted in Japan[14], Germany[1,2], France[1,2 and 17],Ireland[63], the Netherlands[1,2,6,31 and 32] and the UK[2,49 and 66]. Not surprisingly, language is a major obstacle to **identifying** and accessing Japanese material. In a study of US aerospace scientists and engineers[72] it was also reported that less than 25% of respondents used foreign language material. An important finding in one of the Dutch studies[6] however, is that the information seeking behaviour of Dutch respondents did not vary greatly from their American counterparts. Overall all of these studies appear to transcend national boundaries and aerospace researchers face the same information problems wherever they are located. Specific results from some of these studies will be reviewed later.

International access to aerospace information has been given a dramatic fillip with the development of Internet. Harrington[65] has reviewed some of the resources currently available including the full text of some NASA reports together with information emanating from two Eurilia participants - Delft and Cranfield Universities. This use of Internet by the aerospace community is likely to grow and it is intended to make the Eurilia database available through this exciting facility.

4.3 Scientists, Engineers and the Aerospace Industry

In this review the user has been described as an aerospace engineer and/or scientist and it is interesting to note that Pinelli et al[23] reported no difference in the information seeking behaviour of aerospace engineers and scientists. Pinelli et al[23] in the same study also reported no differences between engineers in general and aerospace engineers in particular. Raitt[31] however argues, possibly without justification, that science and scientists are concerned with knowledge for its own sake, whilst engineers are dedicated to producing useful products. The scientist, so Raitt claims, is therefore information oriented, whilst the engineer is more results oriented.

The differences between the scientist and the engineer may not be critical in studying the information requirements of the aerospace industry. However, the characteristics of the industry itself are critical as Pinelli et al[23] makes clear.

> *"The industry is characterised by the high degree of complexity embodied in the design and development of its products. Aerospace must deal with technical and market uncertainty from outside as well as inside the organisation. Organisations use business and technical information obtained largely from the external environment to reduce complexity and uncertainty... The greater the complexity and uncertainty the greater the information processing requirements and the greater the need for information external to the organisation."*

This is reinforced in a recent study[63] conducted by the Irish government which emphasises how different aerospace is from other industries with its long product life cycles, low volumes, high unit costs and exacting quality control procedures.

Clearly as Pinelli et al[23] point out, competitive pressures and military sensitivities work against the need to rely on external information and this is another factor the Eurilia team will need to address.

4.4 Database access with particular reference to the NASA database

Another issue that also has to be addressed is what relationship any future Eurilia system will have with the NASA database. This database dominates the aerospace information handling arena as a number of studies make clear[7,8 and 9]. The NASA database has a total file of 1,950,447 items whilst the European Aeronautical database has a file of 151,867 items.

Given the strong international focus of the aerospace industry, however, the industry also has to grapple with the issue of accessing Japanese information[14] and sources emanating from Germany and Eastern Europe. In 1993 the German aerospace database, Delura (Deutsche Luft-und Raufahrt) became available for the first time and this includes some 14000 citations covering the period from 1985. France[73] is also developing an aerospace database known as GIBUS. This is being organised through GIFAS (Groupement des Industries Francaises Aéronautique et Spatiales). The database is in an experimental phase and currently contains 500 bibliographic references.

The NASA database itself needs enhancing as Hunter and Shockley[15] make clear. They argue for better user guides, more effective user training, access to the database from a users own personal computer, more up to date information and the need to deliver the database in CD-

ROM form. A CD-ROM version of the database has been made available in the United States. At the time of writing, NASA had just announced their intention to make this available to customers in Europe.

Pinelli and Glassman[28] also evaluated the NASA database and around 85% of all respondents either strongly agreed or agreed that both the Scientific and Technical Aerospace Reports (STAR) and the International Aerospace Abstracts (IAA) services were adequate in terms of coverage, currency and quality of abstracts. The word adequate, however, was a somewhat curious choice and possibly some form of scaling might have been more appropriate on the lines of excellent, good, adequate, inadequate and grossly inadequate. It is also worth repeating here the point made by Pinelli, M Glassman and N Glassman[29] in an earlier study that 95% of respondents from NASA's Langley Research Center use **non** NASA sources.

One of the key factors affecting database use is accessibility as Hart and Rice[13] emphasise. Again the Eurilia team need to be clear about who the database is being designed for - the librarian/intermediary or the end user or both. Hart and Rice[13] report that only 9.6% of all searches are conducted by the end user in an aerospace organisation. In other settings[13] the percentage is much higher - law 71.8% and banking as high as 99%. Pinelli et al[27] report that librarians are used on a last resort basis with informal sources almost always preferred. They also report that the use of online databases is also low because of lack of awareness, costs of use, lack of skills needed to use, poor accessibility including the barriers of physical distance and adverse perceptions about the quality of the information that these databases contain. In a more recent study of US aerospace students[69] 34.1% of faculty and 41.4% of students do **not** use online electronic databases. This has to be contrasted with another recent study[49] of UK students where 55.7% were already using electronic databases and 40.9% might in the future. It should be noted here however that the US study was of all students whilst the UK study was restricted to postgraduate students.

Pinelli et al[27] do show, however, a much stronger trend to end user searching with some 25% doing all or most of their searching. In another study[66] Pinelli, Barclay and Kennedy report that UK aerospace scientists and engineers only use literature in the library on 40.8% of information seeking occasions yet curiously 62.5% had spoken with a librarian intermediary. Less encouraging (from a librarian's viewpoint) was the report[66] that almost two thirds of respondents did not use a librarian/technical intermediary in securing information needed to complete their most important job related task. This does not square with two reports by the same authors[70,71] that 86% and 62% of searches are conducted through an intermediary. In the same study it was reported that approaching 60% of UK aerospace engineers and scientists find out about relevant reports through browsing or simply by accident. In contrast members of the AIAA appeared to make greater use of the current awareness tools to determine what reports are available. Browsing, however, almost always takes place in a library and can be seen as a complement to rather more formal literature searching as Ayris[67] makes clear.

In the study[49] of UK postgraduate aerospace students at Cranfield University 33.7% of students claim to do all searches on their own whilst 40.2% claim to conduct most searches on their own. One factor clearly affecting this trend to search without intermediary help is the development of services 'free' at the point of consumption via networked CD-ROMs and the UK BIDS service (a service providing access to a number of databases via Janet) both of which are available at Cranfield. However in the same study 76.4% of respondents frequently or always use the library and 36.4% frequently or always use the librarian.

Lawrence[18] makes the important point that in order to develop an effective information access strategy, one needs to understand both the environment of the information intermediary, as well as that of aerospace scientists and engineers. He also makes the point that many technical libraries and information centres in aerospace are undervalued and under-utilised. This is further reinforced by Pinelli et al[23] where only 4.6% used the library as a first resort and only 19.6% used it as even a third resort. Raitt[31] also emphasises this when he reports that 71% of respondents answered no to the question whether most information needed for work purposes was available from the library. He also emphasised that the main source of information for both aerospace scientists and engineers in aerospace was their own colleagues and that the main mode of delivery was oral.

4.5 Other key results

Glassman and Pinelli[11] report that a very high proportion of respondents (75%) had not encountered any problems in using the NASA STI system. Of course this does not necessarily mean that the **outcome** of the search met the respondents information need, but clearly ease of use is an important criterion in assessing any information system.

On a scale of 1 to 7, with 1 very ineffective and 7 very effective, 78.2% of respondents gave a favourable rating of the library in meeting their information needs[49]. If you add to this percentage total the number of respondents marking the middle point of the scale(4) the number of favourable responses rises to 86.9%. It still leaves a significant number of dissatisfied customers although virtually all of these respondents ticked the 3 point on the scale.

Of course, as stated previously, use of sources have to be put firmly in the context of how aerospace engineers and scientists spend their time. Raitt[32] records the significant amount of time spent on informal and formal oral communication.

Carroll, Jack and Cotter[10] report that aerospace engineers and scientists spend 35% of their work time in communicating technical information to others. An examination of the sources used will give a better insight into how aerospace scientists and engineers spend their time. The focus here will be on two aspects relevant to the Eurilia project - use of aerospace literature and libraries and use of information technology. Of course, this distinction is increasingly blurred and in the Barclay Pinelli and Kennedy study[6] it is interesting to note the high percentage of both Dutch and US respondents who would be likely to use full text electronic sources if they became available. US libraries appear somewhat luke-warm about the prospect of full text electronic files of NASA reports with only 57% and 60% in favour[70,71].

In terms of print on paper and other sources, the high use by both Dutch and US engineers of US **and** European reports was highlighted[6]. Two interesting examples from this report:

i 54% of the US respondents used the British Aeronautical Research Council and Royal Aircraft Establishment reports, whilst 49.5% of Dutch respondents used this same source;

ii almost the same percentage (40% +) of both Dutch and US respondents used the French ONERA series (Office National d'Etudes et de Recherches Aerospatiales).

It was however disappointing to learn[70] that comparatively few US aerospace libraries hold foreign technical reports with the highest holding given as 21.2% for the British Aeronautical Research Council/Royal Aircraft Establishment series. In another study[71] ESA reports were the highest holding, with 32.1% of libraries maintaining a file.

Pinelli and Glassman[25] also reported comparative user rating of conference papers, journal articles, in-house company reports and US government technical reports. It is perhaps, not an entirely unexpected result that in-house reports, consistently score higher than the other categories in both this study and a later one by Pinelli, Barclay and Kennedy[65]. In-house information scores highly in another study[26] where letters and memos are the most frequently used technical information products. Again in the same study[26] it is revealed that there is a much higher incidence of use (around 2:1) of discussions with colleagues than the use of literature, libraries and electronic databases. Pinelli and Glassman[28] also examined literature sources in isolation from other sources and found that journal articles, closely followed by conference meeting papers, were the most common sources of information used in research. Hecht et al[49] point out that the most frequently used source by students is journals with the library perhaps not surprisingly being regarded as the most important source. When students were asked what publication products were most important, however, journals came third (44%) to conference papers (46.7%) and text books surprisingly top (57.8%). Interestingly, too, UK students used NASA reports more heavily than UK reports but this may be a reflection of the run down of government sponsored aerospace research and development in the UK. In an earlier study conducted within the Australian Aeronautical Research Laboratories[34] again discussion with colleagues was one of the most frequently used sources of information. However, in this case technical reports were used more heavily and conference papers and journal articles were of equal importance to oral discussion.

In terms of the use of information technology, many would support the general statement made by Alloway[4]

> *"In response to the complex information environment many aerospace engineers feel that electronic information tools are essential to the success of any engineering project."*

Hart and Rice[13] would support this when they report the results of their study which shows that the use of online databases appears to be associated with improved effectiveness. However they go on to state that the need to interpret increasing amounts of information, now obtained through online retrieval, may result in information overload. In the aerospace research centre studied, use of online databases has reduced the clerical costs of obtaining information and increased the number of research reports that have to be evaluated, but which in turn increased researchers awareness of the number of critical variables. This can increase the likelihood of obtaining contradictory information from different sources, requiring even more investigation and assessment.

This point is echoed by Lawrence[18]

> *"While all had personally tried to use existing information search and retrieval systems and many had high hopes for their access, most were disappointed with their current experiences."*

In terms of the use of electronic databases and networks, the following results are of interest.

In a Barclay Kennedy and Pinelli study[6]:

- of Dutch and 56% of US aerospace engineers and scientists use electronic databases but, encouragingly, most of the other respondents report that they might use such systems in the future;

- the use of electronic networks is even higher. 58% Dutch, 76% US and, again, most other respondents are likely to use these in the future.

It is interesting to note here that a significant amount of use of these networks is for searching library catalogues, document delivery, use of databases and other information search activities.

There is a good match between the study reported above[6] and another study[26] of US aerospace engineers and scientists where 50.3% of respondents use electronic databases with, again, a high proportion of other respondents likely to use databases in the future. There is not, however, such a good match on networking, where only 32.2% of respondents use networks, but again a very high proportion might use these in the future.

However, Lawrence[18] reports only 14% of respondents regularly searching computer based bibliographic databases. This same set of respondents had a fairly neutral view of online or CD-ROM access to literature in contrast with the very high importance they gave to having access to an electronic mail system for AIAA activities.

4.6 The NASA/DoD Aerospace knowledge diffusion project

Many of the references already cited have been drawn from the excellent work currently being undertaken under the framework of the Aerospace Diffusion Research Project. This research is being sponsored by the National Aeronautics and Space Administration, Indiana University, the Langley Research Center, Rensselaer Polytechnic Institute and selected universities in the USA and abroad, including Cranfield University. The project's overall aim is to develop a better understanding of how aerospace, scientific and technical information is communicated, through which channels, by whom, and with what effect. Overall, the project is aimed at increasing productivity, stimulating innovation and improving and maintaining the professional competence of engineers and scientists working in aerospace.

Good links have been established between the Eurilia team and the Aerospace Knowledge Diffusion Research Project and it is hoped that these would be further strengthened as the Eurilia project develops.

5 Conclusions

It is important for the Eurilia team to take on board many of the methodological and conceptual issues that have been discussed in this review. User input should be built around reactions rooted in specific, recent experiences that they have had with electronic and other information support systems. The focus too should be on the outcomes of the system although outcomes will partly be determined by the user friendliness of the developed system - accessibility, ease of use and, of course, quality of data contained in the system.

It is also important to take on board the crucial part that expectations (both low and high) play in the evaluative process. It was encouraging to learn how effective the telephone appeared to be in gathering data which confirms one of the suggested methods of collecting the data which were incorporated in the original Eurilia proposal.

A recurring theme in the literature was the wider arena in which libraries and computerised databases will have to operate.

The lack of awareness of both libraries and, to a lesser extent, databases combined with a heavy emphasis on internal information (project data, memos, letters etc.) are key factors which the Eurilia team should note.

This review has also confirmed that aerospace is a genuinely international industry and that researchers display the same, or similar, information seeking characteristics wherever they are located. It was also encouraging to note that there would appear to be little or no difference in the behaviour of aerospace engineers and scientists. The critical variable that the Eurilia team will have to contend with, however, is the nature of the industry itself. Although the sheer scale and size of most aerospace projects involves collaboration it also inevitably involves competition. Military sensitivity is another issue which will constrain information access.

Although many commentators in the literature have urged more collaboration in aerospace information, we are still a long way from developing a database that is both truly international and comprehensive in its scope. The collaboration between ESA and NASA is encouraging and the Eurilia project itself is an example of collaboration between European industry and academia. Of course, the NASA database does lie at the heart of the aerospace information business and the Eurilia project team will continue to monitor the impressive range of output from the NASA/DoD Aerospace Diffusion Project. One final point, the literature did not list any studies that specifically focussed on the role that aerospace dissertations might play in enhancing access to aerospace knowledge. The Eurilia project should, therefore, be able to break new ground whilst, at the same time, building on the foundation of work reviewed in this report.

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WPI: Pre-Project Audit
Subtask 1.1.1 - Search Strategy

Sources searched include Library and Information Science Abstracts (LISA) on CD-ROM, as well as the NASA, EAD databases on ESA/IRS and Delura together with Cranfield's own online public access catalogue.

Search strategies as follows:

Search 1 User Studies

Set 1 (Information or Library/ies)
and
Set 2 (Aerospace or Aviation or Aeronautic(s) or Air Transport)
and
Set 3 (User or Researcher(s) or Scientist(s) or Engineer(s)) or (cost benefit(s) or cost justification)

Search 2 Research Methodology

Sets 1 and 2 as above and further qualified using the term research method (truncated) (to include methods, methodology, etc).

Search 3 Information Technology

(Information Technology or Information Retrieval or Network (truncated to include networks/networking) or Document delivery)

Note, search 3 was combined with sets 1 and 2 above on LISA only.

Search 4 Aerospace databases

NASA
European Aerospace Database
Delura

These searches were repeated in Holland, Spain, France and Ireland on local catalogues in an attempt to identify additional material employing similar search strategies to those shown above.