The MAGiC Project

Managing Access to Grey Literature Collections

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1. Introduction

1.1. Report structure

This report presents a detailed account of the research activities undertaken by the MAGiC project and the outcomes of that research. The purpose of the project has been to further understanding of the information needs of engineers, and to develop a system that effectively enhances the visibility, access and use of engineering technical reports. Data has been collected using a combination of methods, including questionnaires, informal and semi-structured interviews, seminar and direct examination of library catalogues and databases. The structure of this report is outlined below:

Chapter 1 introduces, and describes the background, to the project.

Chapters 2, 3 and 4 review and analyse the literature relevant to engineers' use of information, the value of information, and technical reports.

Chapter 5 reports on the results of the MAGiC impact study and gives conclusions arising from these findings.

Chapter 6 illustrates the results of a study of the use and value of information to engineers and gives conclusions from these findings.

Chapter 7 reports on the results of the exercise to map collections of reports in the UK.

Chapter 8 illustrates the results of a study into the development of a collection analysis methodology to identify reports digitisation priorities.

Chapters 9, 10 and 11 report on the development of the National Reports Catalogue, full text archive, and the demonstrator service – METReS, giving conclusions arising from findings.

1.2. Background

In the last few years there has been a meteoric rise in use of the Internet, with the result that the engineering community has begun to enjoy enhanced access to electronic information resources. However, while major collections of science and technology journals from mainstream publishers are now available electronically, comparatively little attention has been given to grey literature such as technical reports. Yet it is often the report – with its greater technical detail and rapid dissemination – rather than the refereed journal article, which is the formal information medium favoured by the engineering community.

In the United States, the present administration is making strenuous attempts to promote the dissemination of federally funded research, and report literature from agencies such as NASA and the Department of Energy and the Department of Transportation is now readily available on the Internet. In this country, apart from the substantial holdings of the British Library, major collections of technical reports tend to be scattered across academia, government and industry. These resources are invariably difficult to identify, locate and access.

MAGiC is a 2-year project, funded by the British Library Co-operation and Partnership Programme (BLCPP) and the Research Support Libraries Programme (RSLP) to address these issues. The MAGiC project represents a first and significant step towards establishing a new collaborative system for the collection, storage and utilisation of engineering grey literature. Importantly it seeks to ensure that access to technical reports becomes part of the continuing development of a distributed national electronic resource.

1.3. Aims and objectives

The aim of the project is to enhance awareness, access and utilisation of key collections of technical reports for the benefit of the UK engineering community and UK plc. Progress towards this goal is being undertaken through the following specific objectives:

- collection development, management and retention;
- enhancing the visibility of key collections;
- enhancing access via electronic storage and document supply.

1.4. Work Packages

The objectives have been carried forward, by breaking the work up into several work packages (WP), as described:

1.4.1. WP1 - Assessment of the use and value of engineering grey literature

The purpose is to investigate the use and value of engineering technical reports among engineers in the UK, and to assess the results of providing enhanced access to reports through a demonstrator service comprising the engineering National Reports Catalogue and an associated electronic full text archive.

Sub-tasks involve:

- A comprehensive literature review – investigating the evidence of the use and value of engineering technical reports and grey literature, and the information seeking habits of engineers
- An impact study on the use and value of technical reports
- A survey of the use and value of information –particularly technical reports - to engineers
- A seminar on the value of engineering grey literature

1.4.2. WP2 - Mapping and collection management

The purpose of this work package is to map key holdings of engineering technical reports series in the UK and to develop a set of collection analysis methodologies to inform decisions on prioritising reports for digitisation.

Sub-tasks involve:

- Mapping collections
- Developing a collection analysis methodology

1.4.3. WP3 - National Reports Catalogue

The purpose of WP3 is to lay the foundations of a National Reports Catalogue.

Sub-tasks involve:

- Investigation of methodologies, technologies and standards
- Database design

1.4.4. WP4 - Full text archive

The purpose of WP4 is to create a full text archive, initially populated with a subset of the Aeronautical Research Council Reports and Memoranda.

Sub-tasks comprise:

- Investigation of data conversion options
- Trial digitisation
- Investigating document supply options

Taken together, WP3 and WP4 comprise the MAGiC demonstrator service, METRES - the MAGiC Engineering Technical Reports Service – which is the culmination of all the work undertaken by the project.

During the course of the project, our research has thrown up a few surprises which have necessitated changes in the way that we tackled various issues. The most important key to solving the problems identified, and achieving positive results, has proved to be collaboration. Co-operation, collaboration and active participation are the fundamental tools that will:

- Enable uptake of the Open Archives Initiative (OAI) metadata harvesting
- Overcome the current paucity of reports cataloguing
- And enhance the opportunities for collection management and rationalisation

Hence, we have placed great importance on the dissemination of our work, and on engaging interested and relevant parties in dialogue to achieve the aims of the project.

1.5. Dissemination

We have undertaken a range of dissemination activities designed to promote the work undertaken by the MAGiC project, and to engage those individuals and organisations so important to the creation of a sustainable system that enhances the management and availability of engineering reports literature.

1.5.1. The MAGiC project website

The website was created at the outset of the project and has been a primary dissemination tool. Pages on the site have been updated frequently. They provide information about the aims and objectives of the MAGiC project, key tasks, publications and dissemination activities, Internet links to MAGiC, contact and survey forms, and useful links to other sites relevant to the work of the project. In addition, the 'partners area' has proved particularly useful as a tool for keeping the MAGiC project partners informed of activities and findings.

1.5.2. The end of project seminar

The theme of the seminar was "Use and Value of Engineering Grey Literature" and it provided an opportunity to:

- Disseminate the findings of the MAGiC project
- Present the MAGiC demonstrator service, METReS, incorporating the prototype National Reports Catalogue and full text archive
- Launch the NACA Reports UK mirror site
- Gain feedback from delegates on a number of key issues

The event, which was well attended by delegates with a knowledge and appreciation of reports literature, was very successful, providing confirmation of the validity of the work undertaken, and the results achieved, by the MAGiC team. See Appendix A for further information.

1.5.3. Presentations

- UKSG Conference, University of Warwick, 15th – 17th April 2002
- AIM-EU Seminar, ESA, Toulouse, France, 11th April 2002
- AIM-EU Seminar, CIRA, Caserta, Italy, 22nd March 2002
- AIM-EU Seminar, NLR, Amsterdam, Netherlands, 4th March 2002
- AIM-EU Seminar, INTA, Madrid, Spain, 1st March 2002
- ADLG Seminar, "Electronic information: success of failure?", 25th February 2002
- BBi AGM, De Montford University, Hammerwood Gate, Milton Keynes, 23rd May 2001
- ADLG AGM, Kings Norton Library, Cranfield University, 19th March 2001
- Raising Awareness of Engineering Information Resources, BL Conference Centre, St Pancras, 11th Jan 2001

- Project Showcase, BL Conference Centre, St Pancras, Tue 17 Oct 2000

1.5.4. Articles and press releases

- Sidwell, Needham and Harrington (2000), "Lightening grey literature: making the invisible visible"
- Needham (2000), "A MAGiC Project" - a basic introduction to the aims and objectives of MAGiC
- Press releases sent to engineering-related publications and major email lists announcing the launch of the project and launches of surveys

1.5.5. Events attended

The project officer has attended several events, relevant to the project, which include:

- The Open Archives Meeting: Developing an agenda for institutional e-print archives, Wed 11th Jul 2001. Co-ordinated by UKOLN on behalf of the DNER and CURL. The event provided background to open archive activity currently taking place in the UK and beyond, and considered implications for HE and FE in the UK. The focus of the event was for institutions to help set an agenda and contribute to shaping future open archive activity in the UK
- Preservation 2000, 6-8 Dec 2000. An international conference on digital preservation held in York, England. Sponsored by Cedars, JISC, the Research Libraries Group and OCLC
- 3rd RSLP Collection Description Concertation Day, 23 Oct 2000

1.5.6. Visits to professional organisations

The project officer visited a number of professional organisations to promote and discuss MAGiC. These included:

- The Institution of Civil Engineers (ICE)
- The Institution of Mechanical Engineers (ImechE)
- The Institution of Electrical Engineers (IEE)
- The Institute of Learning Research Technology (ILRT) at Bristol
- Rutherford Appleton Laboratory
- The British Library Document Supply Centre (BLDSC)
- The Public Records Office (PRO)

This report represents one of our last acts in the process of disseminating project activities and, we hope, it will itself help to engage further individuals and organisations in the process of improving the availability and management of engineering grey literature in the UK.

2. Engineers' use of information

2.1. Introduction

There have been many investigations into information use by engineers and a summary of findings from previous research is presented. The differences between engineers and scientists in their information seeking and use are described. The many different aspects of information use, including the context within which it is used, the reasons why information is sought by engineers and their information seeking behaviour is then examined. The information sources and formats preferred are outlined before a description of the factors related to information use. A brief discussion about the use of the Internet by engineers concludes this Chapter.

2.2. Differences between engineers and scientists

One definition of engineering is 'to produce or design a product, process or system, based on a new idea or a modification of existing ideas or products, within time constraints' (Wolek 1969; Taylor 1986). Engineers need reliable answers to specific questions, and information seeking is based on problem solving (Young and Harriott, 1979). The information must be in words that are easily understood and a format that is familiar, in other words, engineers want a packaged solution where information can be directly applied without translation or compilation from many sources (Cairns and Compton, 1970).

A distinction can be drawn between the information needs and uses of scientists and engineers. This is important because some research has considered the two synonymous, whereas in fact the way they communicate and use information is very different. Technology and engineering are based on scientific principles, but the working patterns, objectives and professional goals of engineers and scientists are diverse, and ideas are drawn from different sources (Marquis and Allen, 1966). Each discipline advances independently of the other, and the literature produced by each has a different nature (Kline, 1985).

This is encouraged by the different professional frameworks within which scientists and engineers work. Scientists publish to establish their reputation and set precedence for original work, pursuing their own ideas. Although often working independently, their working environment propels them to look outward, exchanging ideas for the ideal of advancing knowledge for its own sake. Rewards and status are directly influenced by the number and quality of papers published.

Engineers have less incentive to publish as their reputations are based on contributing to the company's profit, knowledge of management practices and policies, and an exploration of ideas that are not necessarily their own, on projects chosen by the organisation rather than the individual (Ritti, 1971). There is no need to publicise results of findings as rewards are internal to the organisation, and in some cases, commercial or contractual restrictions would prevent publishing externally.

Engineers need lots of information but do not generate literature, and what they do produce tends to be informal: letters, memos, technical drawings and specifications (Hanley, Harrington et al., 1998). Scientists rely on primary literature and external sources, whereas engineers mainly use internal and secondary sources (Allen, 1966). Price (Aloni, 1985, p282) sums it up as: 'The scientist wants to write but not to read, whereas the technologist wants to read but not to write.'

Herner (1954) highlights differences between engineers and scientists. Scientists are given the time to find the best and original answer, are interested in methods, data and theories, and derive 75% of their information from literature. Engineers, or applied scientists, need a workable solution and applicable results and obtain 50% of their information from literature.

In a comparison of 'applied workers' and 'basic researchers', Gerstenfeld and Berger (1980) illustrate other differences. Basic researchers spend time defining the problem, whereas applied workers usually know the scope of what they have to do, so that information is needed at the start of an applied project, but nearer the end of research projects. Information sources are more likely

to be written for researchers, where information is needed for understanding; whereas oral information is appropriate for applied researchers, where information is used to improve solutions to problems.

2.3. Information use by engineers

2.3.1. Information use in engineering projects

It is accepted that both information needs and information seeking depends on a worker's tasks (Belkin, 1982). Wolek (1969) posits that one cannot interpret fully a user group's need for information until one has gained knowledge of the nature of that group's work. Work documenting the stages of engineering projects, describing the manner in which they are executed and the information used at each stage has been undertaken by Orr (1970); Allen (1966; 1977), Vincenti (1990), Kaufman (1983) Pinelli, Barclay et al. (1997), and Ellis and Haughan (1997).

Engineers use different sources of information at different stages of a project. Allen (1966) documents the problem-solving process in R&D projects and found that different sources are used at different times depending on the stage of the research and on the problem encountered. He found most time was spent gathering information at the start of the project; this reduced a lot as solutions were tested but increased again towards the end. Rothwell (1975) confirms this by citing studies by Myers and Marquis (1969) and Utterback (1971), showing that information-seeking behaviour varies depending on the phase of the innovation process. There is an outward looking use of external sources at the idea generation or project initiation stage, and a more introspective use of internal sources during problem solving.

Ellis and Haughan (1997) used eight categories to describe the information-seeking patterns of researchers: (1) surveying (2) chaining (following references) (3) monitoring (4) browsing (5) distinguishing (6) filtering (7) extracting (8) ending. By interviewing 23 scientists and engineers at an international oil and gas company, Ellis confirms Allen's (1977) findings on the information needs at different stages of a project and his observations on the differences between scientists and engineers. Formal and informal channels are used at the initial project phase, when information seeking is most extensive. When researchers progress through to the advanced phases they are more knowledgeable and so more selective, and the use of formal channels decreases whilst informal channels are more dominant. Finally, both formal and informal are again used, but on a much smaller scale. The information gathering is an iterative process, and often recurs in the life of projects as new situations occur.

Wolek (1969) splits development projects into two stages: first, definition; second, model building and testing, where definition takes only 5-10% of the time. In the early phases of a project, the problem is seen as a system, broken down into sub-systems which are tackled individually but as a part of the whole. As a result of this designs get 'frozen' early on in the process and information needs narrow. This corresponds with Allen's (1966) findings that once a technical approach is preferred it is not easily rejected, and the longer it is preferred, the longer it takes to reject. Because of the complexity of projects, engineers rationalise by seeking to better the state-of-the-art rather than finding the 'best' solution, and by ignoring information unless it has a direct relation to their work.

External communication is critical to successful projects, but Allen (1977), Katz & Allen (1982) and Hauptman (1986) also demonstrate that different information sources are important to different types of project. Research oriented projects tend to use the published literature and people external to the organisation more, whereas development projects use alternative sources like vendors, marketing and in-house expertise. Tushman (1978) reported that high performing research projects had different patterns of communication than high performing technical projects. Both patterns of communication were not found in the low performing projects. Scientific literature was reported by Shotwell (1971) as being the best source for ideas for product and procedural innovations.

2.3.2. Task complexity/uncertainty

The early stages of a project as described by Wolek and Allen are those with the most uncertainty, where information is needed to define the problem and create alternative solutions to be tested. Information is needed to reduce the uncertainty (Moenart and Souder, 1990). Tushman (1977) studied organisational communication and found that one of two factors dominating communication patterns is task complexity, as the more complex the task, the greater the uncertainty and so the greater the need for information. Anderson, Glassman et al. (1997) show that the greater the uncertainty and project complexity, the higher the frequency of use of internal information, and the greater the need and search for information found outside the organisation, again confirming Myers and Marquis (1969) and, Utterback's findings (Utterback 1971).

Additionally, as the complexity of a task increases, so does the complexity of the information needed, as does the difficulty in finding useful information sources, so internal sources become only one of many different sources used (Bystrom and Jarvelin, 1995). Vakkari and Kuokkanen (1997) state that as task complexity increases, the use of internal sources decreases and the total number of sources increases. Towards the latter stages of a project, the levels of uncertainty and complexity are comparatively low, as new information is acquired both internally and externally only to supplement what was already gathered (Kerssens-Van Drongelen, de Weerd-Nederhof et al., 1996).

2.3.3. Size of organisation

The size of the organisation affects information use, as larger organisations tend to have a greater ability and tendency to use external sources, as there are more resources for journals, conferences and libraries. Increasing firm size is associated with increasing external contact (Rothwell and Townsend, 1973). However they also have a larger pool of in-house knowledge and talent to draw from so can be much more self-sufficient in ideas generation and development. Smaller firms have fewer internal resources in terms of finance, time or people to spend on a lot of external information seeking. However, they need to generate ideas and so must look to external sources for information and new technology. This tends to occur through informal, personal contact within industries (Allen, Hyman et al., 1983).

2.4. Sources of information available to engineers

Information sources can be divided into formal and informal sources. Examples of informal sources are products, vendors, suppliers and customers, or colleagues. Formal information sources can be divided again into primary and secondary sources. Primary sources contain and supply the information directly whereas secondary sources collate and present references to primary sources, and therefore provide a means of finding primary sources. The primary sources of information for engineers are:

- Journals
- Conferences
- Books
- Reports
- Standards
- Patents
- Theses
- Product/trade information

There are different types of **journals**, from the peer-reviewed academic journal, produced by established publishers and journals published by professional membership organisations or institutes, to trade journals, usually targeted to a specific sector of industry and carrying more 'newsy' items. Academic and to a lesser extent, professional journals, are expensive and likely to be found in the standard abstract and index databases. Trade journals are more current, inexpensive, generally un-indexed with a shorter life-span but vital for keeping abreast of developments in the marketplace.

Conferences provide engineers with a forum to discuss new ideas and developments in technology with peers in the same area of work. This means that conference proceedings and papers are usually current. Major conferences are indexed with journal articles in abstract and index databases.

Books contain established, tested knowledge, and are less current than conferences or journals, but are more likely to give a thorough overview of a subject area, collecting different aspects of a topic in one place. They are indexed in bibliographies and have good bibliographic control, so are relatively easy to track down.

Reports contain experimental detail, data and results. They are a primary means of communication for engineers, so are generally un-edited and un-refereed. Reports tend to be published within organisations, and have no standard bibliographic control, so are difficult to identify and obtain.

Standards are issued by many different organisations, nationally and internationally, and contain testing methodologies, performance, construction and specification standards, terminology and codes of practice for all sectors of industry. They can usually be found in the standard organisations' catalogues (e.g. British Standards Catalogue) or database, some of which can be freely searched via the Internet to discover the bibliographic details of a standard, and then bought online.

Patents are valuable information sources, as often they will be the first place information will be published, and much of patent literature contains information which will not be found anywhere else. They can be used for competitor intelligence and are required to give detail about a product or invention. Like standards, patents are produced both nationally and internationally, and can be accessed from the nation's patent office. Many patents are freely available via the Internet, but for a complete search there are comprehensive commercial databases.

Theses are academic pieces of work submitted to gain a higher qualification from a higher education institution. Universities are winning sponsorship and/or research funding by working in partnership on industrial projects, and theses are the major document resulting from such work. They contain the methodology and results of original research carried out in very specific areas. There are abstract and indexing databases covering theses, but theses can sometimes be difficult to obtain, especially if there is an embargo on their availability and distribution due to confidentiality agreements.

Product/trade information is vital for industry to source components and stay aware of competitors' products and services and development. Generally this data is published by the organisations themselves, changes rapidly and is not indexed anywhere.

Secondary sources of information include:

- Abstracts and indexes
- Bibliographies
- Reviews
- Reference works, e.g. handbooks, dictionaries, encyclopaedias, directories

Abstracts and indexing services give bibliographic details of documents, along with a summary (or abstract) describing the document's contents. There is usually some delay between the original document being produced and its details appearing in an abstract and indexing service. They are usually based around a subject area and can cover world-wide literature. Bibliographies cover specific subject areas and can be of books, but mostly cover journal literature, as do reviews of a topic, but reviews not only give references but also give an overview of a subject area and progress to date.

2.4.1. Internal and external information sources

In their study of information access amongst engineering designers, Court and Culley (Court, Culley et al., 1994; Court, Ullmann et al., 1998) found that the following types of information were used by engineering designers, and grouped the sources as internal and external:

Internal: product specification, previous design schemes, existing design reports, other department reports, data handbooks, development and test data, sales data, commercial data, marketing data, manufacturing data, service feedback, in-house parts catalogues and design guides.

External: journals, magazines, catalogues and design guides, libraries, patent information, the Government, non-specialist (press releases, press), suppliers, bibliographic databases, exhibitions, trade fairs, conferences, seminars, lectures and courses.

The use of internal sources may relate to the need to use validated results. The work of the organisation will build on the experience contained within it. If an approach worked previously, then the tendency will be to use that approach again, rather than search for external answers which would have to be checked and tested before being used. This would discourage use of external sources or information from other organisations, as extra work would be needed without necessarily finding a better answer.

2.4.2. Preferred sources of information

There is overwhelming evidence that engineers prefer to use sources immediately available, in their own library or talking with colleagues close to hand. Rosenberg's (1967) study involved industrial and Government personnel, asking them to rank their preference of eight information gathering methods in three hypothetical situations. These results were aggregated to give the rankings shown below:

1. Search your personal library
2. Search material in the same building where you work, excluding your personal library
3. Visit a knowledgeable person who may be of help
4. Consult a reference library
5. Use a library that is not within your organisation
6. Write a letter requesting information from a knowledgeable person – 20 miles away or more
7. Visit a knowledgeable person – 20 miles away or more.

More recently, Von Seggern and Jourdain (1996) gained almost the same results from aerospace engineers when they were asked which information sources they used when solving a technical problem. Their personal store and speaking with people within the organisation were both used by 99% of the 228 respondents, probably because personal collections will reflect the individual's area of expertise. Ward (2001) identified that memory, personal files and books, departmental files and books and other records of previous work were the favoured information sources amongst automotive engineers, along with the library and other engineers.

Pinelli et al (1991) found that aerospace engineers only use formal information sources like libraries, literature and databases after informal sources are exhausted. Chakrabarti (Chakrabarti, Feinman et al., 1983) found that work groups were the most frequently used source, with trade periodicals and experts in the firm coming after. Much other work is consistent with these findings (Katz and Tushman, 1979; Leckie, Pettigrew et al., 1996; Court, Ullmann et al., 1998; Anderson, Glassman et al., 2001).

From these results, it is clear that engineers prefer talking to people as a source of information. Oral communication is a very 'information rich' and effective method of transferring information (Allen and Cohen, 1969). It is very quick and flexible, with immediate feedback and clarification. It also can be more current and efficient than more formal communication (Czepiel, 1975). As mentioned previously, ideally engineers want information that can be directly applied, and discussion with a colleague, already familiar with the project, can be such a source.

Zipperer (1993) suggested a number of reasons why engineers prefer approaching colleagues, including getting feedback on their ideas, either as a trusted opinion or for stimulating discourse, and often colleagues' memories are the easiest and sometimes only access to filed documents (other than wading through the files). Hertzum (Hertzum and Pejtersen, 2000) investigated how the search for documents and people intertwine, and found that engineers search for documents to find people, search for people to find documents, and interact socially to obtain oral and written information without having to perform an explicit search.

2.4.3. Gatekeepers

Allen (1971) revealed the presence of 'technological gatekeepers' or 'boundary spanners' within organisations. Tushman and Scalan (1981) found that these were high performing individuals, who were experienced and professionally and operationally oriented, gathering information both internally but also interacting and having strong links outside the organisation, bringing information together and dispersing it to fellow team members. Gatekeepers not only gathered and translated external information, but also facilitated the external communication of their fellow team members (Katz and Tushman, 1981).

Ward's (2001) survey of automotive engineers uncovered 'virtual colleges' within the company, which he named 'knowledge clubs'. Unlike gatekeepers, who were unusually active, these free and interactive clubs consisted of ordinary engineers who aired problems and tested out solutions on colleagues chosen for their usefulness.

2.5. Factors affecting information seeking and use

It is not enough to consider which sources are used the most, when they are used and in what context. There is also a need to know why those sources are chosen. The major factors considered are the accessibility and ease of use, awareness of information sources, information content and quality and the cost, both financially and in time spent.

2.5.1. Accessibility and ease of use

Allen (1977) concluded from a series of studies that accessibility is the factor that dominates the choice of information channel. He states that engineers are more likely to use handbooks, standards, specifications and technical reports. Young and Harriott (1979) state that engineers needing technical information tend to use the most accessible sources rather than the highest quality sources, which are respected colleagues, vendors, familiar (but possibly out-of-date) texts, and technical reports.

Gerstberger and Allen (1968) conducted a study to measure the perceived cost of information to the user, involving 19 engineers in a large electronics firm. The engineers were asked to rank nine information channels by four criteria: accessibility; ease of use; technical quality; and degree of experience with channel. It was found that accessibility is the single most important consideration in the frequency of use. There was a strong positive relationship between the amount of experience an engineer has with an information source and its perceived accessibility and ease of use. That is, the more a source is used, the easier and more accessible it seems.

Chakrabarti (Chakrabarti, Feinman et al., 1983) split information into:

- sources (books, periodicals, other printed material like conferences and technical reports, people, microfilm and magnetic media)
- content (new knowledge, indexes to knowledge, derived knowledge and other types like facts, data, current awareness)
- channels (telephone, library, information specialist, computer, conference, etc)

He received 500 replies from engineers in a research laboratory, evaluating each on a five-point scale. He found that five variables are good predictors of frequency of use of an information source - availability, ease of use, cost, utility and skill needed to use, with ease of use and availability being the most important. Similarly, for information channels, availability and skills needed to use

were the most important factors. There was a negative correlation between frequency of use and cost.

Rosenberg (1967) surveyed 996 personnel from government and industrial organisations and found that the ease of use of an information gathering method is more important than the amount of information expected from it.

Reviewing the many surveys on information seeking and use behaviour, Meadows (1998) concluded that the most common finding is that the intrinsic value of an information channel has very little or no bearing at all on how often it is used. Accessibility is always the ultimate factor in frequency of use.

These findings follow a 'law of least effort' (Zipf, 1949), where engineers choose information sources to minimise loss, rather than maximise gain, which is also supported by the findings of other research (Rosenberg, 1967; Hardy, 1982; O'Reilly, 1982; Culnan, 1983; Swanson, 1987).

2.5.2. Awareness

One possible reason for the low use of traditional primary sources of information is a lack of awareness of those sources on the part of engineers. Pinelli (Hanley, K., Harrington, J. and Blagden, J., 1998) concluded that the vast majority of engineers are not aware of standard bibliographic databases, which have low use. This could be due to a lack emphasis on information skills and training when engineers are studying, so their education does not equip them with the knowledge or experience to search for information efficiently using the best sources for the particular job at hand.

In an American university, librarians found that students entering engineering courses are highly information technology literate, but lack the skills to search for and evaluate information; that is, they are information illiterate. However, because they have searched the Internet with a search engine they believe they have good information skills. Even though communication skills and information literacy are seen as key skills for the professional engineer, there is not the training to support this as it is not seen as an integral part of engineering curriculum (Fosmire and Macklin, 2002).

Petersen-Holland and Powell (1995) observed the information seeking habits of aerospace students who had received information skills training compared with those who had not, to see if there was any difference in their use of sources and therefore assess the impact of the training given. They found that very few of the engineers had received any training in accessing information while they were working professionally. Those who had received training were aware of the more specific resources that were available, rated formal sources more highly than those who had not and spent more time searching for and reading information. However, the use of information sources was very similar between the two groups for a specific task. Whitehall, Breadmore, et al. (1989) note that engineers use informal sources rather than databases and primary sources because they know the information is likely to be there. Observing the law of least effort, it seems reasonable to assume that even if engineers are aware of a broader range of information sources, they will only be used if the information cannot be found closer to home. However, if that awareness is not there, then time and effort will be wasted searching in inappropriate places, and the information needed may not be found. Engineers who use information well avoid the potentially devastating costs of being ill-informed, and have a competitive advantage over those who do not (Rodrigues, 2001).

2.5.3. Content/Quality

Gerstberger and Allen (1968) found that the technical quality of an information source is unrelated to frequency of use. Although there is a lack of quality judgement in selecting an information channel, engineers do compensate by filtering the information received, but this is an inefficient method of locating useful information.

This surprising result is explained by O'Reilly (1982), who noted that there are social and economic costs in seeking out quality information that is not immediately available, especially when there are time constraints, pressures to produce results and numerous distractions from a large workload. He

also gives examples of how the organisation influences information seeking, possibly restricting access on grounds of cost, or incentive systems may favour information types and sources (whether intentional or not).

Swanson (1987) posited that the disregarding of quality for accessibility, or least effort, could be situational, and pointed out the need to find out in which situations quality, rather than accessibility, determines choice of information source. Anderson et al (2001) found that task uncertainty and complexity, accessibility, quality, and prior use of a source played secondary roles to the perceived importance of the data in choosing to use a written information source. Even if a written source is considered to be of high quality, the data it contains is the primary factor in use. So whilst preferring to use personal collections and oral communication, if written sources had to be used, accessibility and quality were not as important as the perceived relevance of the content to the job in hand.

2.5.4. Personal factors

Orr (1970) expounded the personal factors that influence the choice of information channel. King and Tenopir (1999) review them as:

- Education, training and past work.
  This includes the discipline, or profession, of the individual, the level of training and the nature of their work, and their experience with the different channels. It has been shown that those with a university education use formal channels more readily.
- Status and stage of career.
  The length of time spent in a firm, and the position in terms of rank and seniority are factors.
- Demographics (age, sex).
- Inherent capabilities
  The ability to understand messages, the skills needed to use the sources, the cognitive styles and psychological traits all play a part.
- Personality/work style.
  An individual's character, maturity, disposition to problem-solving, and motivation will impact on information seeking.

The evidence from the literature suggests that personal factors, or demographics, are not influential factors in information seeking. Anderson et al (2001) review studies that attempt to find the effects of demographic factors. Although some of the earlier studies suggested that demographic variables affect information-seeking behaviour, they tended to examine the variables in isolation. When tested independently of other factors, or cast into a multi-variate model, their impact was not found to be significant.

2.6. Use of the Internet

Smith (1993) reports on surveys carried out in Autumn 1988 and 1990 in the chemical, academic and engineering sectors. He stated that engineers were interested in networking and video conferencing as wider applications of the technology, but less searching was carried out, and in terms of using email and word processing, compared with the other sectors engineers were less advanced in using the technology available.

Meadows and Buckle (1993) found that over the previous decade informal communication had increased as a result of electronic communication tools like email and fax. They pose the question of how many engineers have a PC/workstation on their desk, and is this number changing with time? How easily can engineers access electronic information?

As part of AIM-UK study (Hanley, Harrington et al. 1998) 400 engineers were surveyed about their information use, a part of which was their use of the Internet. All of the academic engineers had access to the Internet from their desktop, and 80% of industrial engineers had access to the Internet at work, but only 41% of these had access from their desktop. Perhaps unsurprisingly, the academics used the Internet more frequently than the industrial engineers for information seeking, and those

industrial engineers that had access from their desktop used the Internet more frequently than those who did not. Overall, industrial engineers used the Internet much more infrequently than academics.

	Academic engineers	Industrial engineers
Frequent use of the Internet overall	63% (52)	40% (124)
Frequent use (desktop access)	100% (52)	59% (74)
Frequent use (without desktop access)	n/a	40% (50)

Results from AIM-UK study (1998)

More recently, Fidel and Efthimiadis (1999) observed and interviewed nine Boeing engineers who search the Internet for information. The engineers stated they used a variety of information sources for their work, but the preferred sources were other people and the Internet. This is an interesting, but perhaps not surprising development, since the studies previously mentioned were conducted.

Ease of use was the most important criterion when selecting a means of searching for information. The engineers were looking for reliability and relevance when selecting a source of information on the web. The importance of the web as a tool for communication was highlighted and when information was not directly accessible, the Internet provided contact details of people who could help.

In the UK, academic sector use of both electronic journals and the web has increased over the last five years. National consortium negotiations under the auspices of NESLI (National Electronic Site Licence Initiative) have made e-journals from large publishers more affordable for many libraries. Internet initiatives, like the engineering gateway EEVL (Edinburgh Engineering Virtual Library), provide access to quality Internet resources of relevance to the higher and further education communities.

These Internet services are well used by both academic and industry sectors. AERADE, an Internet gateway to quality aerospace and defence information, averaged 50,000 page hits per month between January and June 2002. This usage is broken down into access by:

Higher education	41%
Industry	29%
Government	20%
Other	10%

The NACA (National Advisory Committee for Aeronautics, the predecessor to NASA) reports server receives approximately 1,400,000 hits per month world-wide (from a private communication with Michael Nelson, NACA Reports Server Curator, NASA Langley, July 21, 2002). When it was shut down from 23rd October - 7th November 2001, due to a knee-jerk reaction by the US Government to the terrorist attack on September 11th, the site received emails from upset users from many different organisations, including:

- Boeing
- Lockheed Martin M&DS
- Sikorsky
- Vought aircraft
- Arnold Engineering Development Center
- NASA
- Coleman Aerospace
- Dehavilland.com

So the Internet is used by engineers to locate information for their work, although the extent to which engineers in smaller organisations have access to the Internet from their desktops is unknown.

2.6.1. E-print servers

The established and traditional method of scholarly information transfer is the journal article. What began as an effective method of communicating scientific discoveries and experimental results in the 17th century has been challenged in recent years by the widespread use of the Internet and the rapid communication and exchange of documents it allows. Coupled with large price increases, delays in publishing articles due to peer review and the number of articles awaiting publication, and the growing awareness that transferring all intellectual rights to publishers diminishes rather than encourages dissemination of results, an alternative has evolved in the form of e-print (or pre-print) archives.

The idea originated at Los Alamos National Laboratory in the US, where what is now known as arXiv.org was created in 1991 to allow authors to deposit ('self-archive') research papers in physics and related disciplines. It is now the largest collection of non-peer reviewed research in the world, containing 203,751 documents on 26th July 2002 (arXiv, 2002a), with an average of 3 million connections per month.

E-prints are challenging scholarly journal literature which has been shown to be used predominantly by scientists more than by engineers. Engineers do not usually publish formally unless they work in an academic setting and so may feel there is no need to find more timely alternative means of disseminating information. This could be why there are servers for physics and other scientific disciplines, but as yet, no engineering e-prints server.

2.7. Summary

Engineers' need for information is task-oriented and based on problem-solving, and the information needs to be in an easily-understood format which is intelligible, without too much effort to translate it for the particular problem at hand. Information is sought keenly at the start of projects to diminish uncertainty and define possible solutions. At this stage, information is more likely to be sought in sources external to the company, whereas information seeking becomes more introspective during development and testing.

The dominant factor in the use of an information source is its accessibility, followed by its ease of use. However, engineers could be missing vital information because the awareness of different sources of information is low. The Internet is used by engineers as an information-seeking tool, although to what extent is unknown.

It has been shown that successful engineers spend between 40-66% of their time communicating (King, Casto et al. 1994), and that personal and informal sources of information are preferred. However, an engineer's work would be impossible if recourse was not made to documentation and formal sources. Engineering problems have both a conceptual side, met by the informal communication of Ward's (2001) knowledge clubs, and a hard data side, where literature is indispensable. There is also a personal side, existing in a time-pressured environment.

Personal contact is not more important than the literature. The problem-solver uses personal contacts to discover the availability of particular areas of service or expertise, or customer requirements. Literature provides things like the properties of products or materials, data and experimental techniques (Johnston and Gibbins 1975). Often literature is used to find people to talk to about an aspect of work, and vice versa.

3. Value of information

Determining the true and total value of information is notoriously difficult and probably impossible. There is no one definition of what value means in the context of information. Information is not a consumer product, in that it is not consumed and changed as a result of being used, and so cannot be measured by regular accounting methods.

Any system designed to measure such an intangible and subjective concept as value will be flawed and imperfect. This chapter will give an overview of the different attributes of value and information and some systems that have emerged from economics and management. Before that is possible, comment should be made on the definition of information and the semantic arguments over the difference between information and knowledge, as the basis for determining its value. Philosophically, debate on the definitions of value and information has stretched over centuries, with no definitive answer.

3.1. Philosophy of value

One philosophical view of value described by Saracevic and Kantor (1997) proffers four distinctions or types of value:

- Intrinsic value - the basic worth of an object or experience or condition in and of itself, *e.g. being informed*.
- Extrinsic/instrumental value - the means to, or contributing towards intrinsic value, *e.g. information contributes to being informed*.
- Inherent value - usually a 'thing' contributing to intrinsic value through experience, contemplation or understanding, *e.g. an article or book or anything that 'carries' information*.
- Contributing value - some constituent contributing to the value of the whole of which it is a part, *e.g. information provided by an information service which is linked to a decision or action by the informed person*.

However, it is the real-life assessment of value in the context of engineering information and technical reports in particular that we are concerned with, and although it is helpful to be aware that there are different concepts of value, no further philosophical investigations will be explored.

3.2. Economic view of value

Saracevic and Kantor (1997) also examine an economic view of value, which distinguishes between value-in-exchange and value-in-use. Value-in-exchange works when the exchange value of a commodity has a price in a market economy, then the market price is the measuring rod of what the commodity is worth. Cost-benefit analysis is seen as one application of this, described as giving a monetary value to gains and losses following a particular course of action. This type of value is dismissed as being generally applicable to information as there is no set market price or exchange value, and because it does not take account of value-in-use and so is incomplete.

Value-in-use theory came into being to address the limitations of value-in-exchange. It requires that the information be used, or have utility. That is, once the information has been obtained it is processed or understood, and then applied and put to use. This assumes that the user of the information is engaged in some task or problem-solving activity to which the information can be applied.

3.3. Information and uncertainty

Badenoch, Reid et al. (1994) give one definition of information as ‘that which reduces uncertainty’. Information reduces uncertainty and so changes the probable outcome of an event and this change in probabilities can have a financial value. This is also a problem-oriented view of information, implying that information should be used for a purpose, to decrease uncertainty about a problem or situation, to have value. However, the definition is incomplete as information can also increase

uncertainty. Some information does not increase or decrease uncertainty in that manner, and information is not alone in being able to reduce uncertainty about situations.

Machlup (1980) pointed out that to use knowledge does not necessarily mean to act upon it and its use cannot be defined as being used as a basis (or not) of action, as something of no immediate application may be invaluable in the future. A delay can occur between receiving information and using it whilst performing a task. He acknowledges this practical knowledge but also adds intellectual knowledge, for the satisfaction of intellectual curiosity, whose value is much more difficult to ascertain.

Machlup (1980) also raises the paradox that we cannot know what information is worth until we have it, so our perceived value of information is based on our expectation of it rather than the experience of it. The expected reduction in uncertainty determines what corporations are prepared to pay for information. The previous chapter indicated that engineers use information to solve problems within the context of projects they currently work on so the uncertainty definition sits well in the context of engineering information.

The definition of knowledge and its relationship to information is even more complex. Different authors use the term 'knowledge' in very different ways, and there has been much discussion concerning the borders between medium and message. It could be said that knowledge is the message, and information the medium in which knowledge is carried and communicated. Knowledge itself exists in a human mind, and so is personal and specific to the individual. It is inaccessible until it is communicated, and in being communicated is represented in some form, whether audio, pictorial or textual. This leads to a systemic view of information, which is concerned with accuracy of data transfer and the limiting of ambiguity. One medium can carry many messages; for example a journal article can review a subject or describe new knowledge in a subject area.

It is clear that knowledge and information are inextricably linked; information changes an individual's state of knowledge, is often sought to fill a perceived gap in knowledge, but knowledge exists independently of the pieces of information feeding it and is continually changing and adapting. The same piece of information can be perceived very differently by separate individuals, depending on their existing state of knowledge. This leads on to a perception of value.

Value can be examined theoretically and pragmatically. The theoretical attributes of value are timeliness, context, relevance and socio-cultural background. Practically, systems from economics, organisational or resource management and cost/pricing models have developed.

3.4. Timeliness, context and relevance

These three attributes are very closely related, and sometimes mutually dependent, perhaps best illustrated by example. A piece of data required to complete a response to a Request For Proposal is extremely valuable to a chief engineer whilst in the battle to win the job over the competition from other companies. However, after the job is won, the same piece of data needed by a draughtsman to finish a design drawing could have a value one or two orders of magnitude less (Carlson, 1980). Both the context of the two engineers and the timeliness of the information create a different value for the same piece of information, although in both cases the information is relevant to the job in hand.

The socio-cultural context of information must not be ignored and although it may not play a great part in assessing the value of a particular technical report, it does influence generally how information is perceived and the manner in which it is used. There has been a definite shift in the perceived importance of information to individuals and corporations. This shift has been brought about in part by the incredible developments in computing and communications, an indication of how the medium can affect the message. This shift has heralded the start of an information technology revolution to match the impact of the industrial revolution, where knowledge and information are as important as material goods.

The importance of careful management of information resources resulted in the development of Information Resources Management and its progeny (Competitive Business Intelligence, Strategic Information Management, and Knowledge Management, amongst others) within businesses. The realisation that information contributes to increased effectiveness and competitiveness of industry has led to information being considered a resource in itself along with human, physical and financial resources, which in its turn requires an assessment of information cost and value.

Ascertaining the cost of information is difficult as traditional accounting techniques, which evolved to account for physical resources, struggle to define the expenditure on information activities within an organisation. Is the cost of acquiring the information the only measure, or should the overhead costs of maintaining and organising the information also be considered? The cost of acquiring (the market price) is probably not the cost of creating the information. An illustration of this difference is given by Badenoch, Reid et al. (1994) who cite the case of the theft of an AT&T document which was subsequently widely copied. AT&T valued this document at $79,449, as the cost of its creation, but the court pointed out that the same data was available in a BellCorp Technical Reference Document for just $13.

Determining the cost of information resources, which is a quantitative and objective exercise, is easier than determining the value added to the organisation by making the information available. Badenoch, Reid et al. (1994) propose a number of definitions of value:

- Asset-based
  The cost to replicate the information; residual value of equipment
- Cost-saving
  Costs saved through not using an external information source; cost of replicating results
- Risk-based
  Cost to the organisation if the system is not available
- Profit-based
  The generation of revenue through trading information

They list common considerations when assessing value:

- Quality
- Utility
- Impact on productivity
- Impact of effectiveness
- Impact on financial position
- Strategic importance to activities and the organisation

Much literature has been produced dealing with the role of information in economics, where the concept of information reducing uncertainty is paramount. Unfortunately much of this work cannot be directly applied, as it is too mathematically complex and theoretical. Badenoch, Reid et al. (1994) summarise the lessons from the econometric approach and conclude that the most important contention from this body of work is that a discrete value can be calculated for a given information resource, which is entirely dependent upon the circumstances in which the information will be used, giving the examples of risk analysis, loss aversion, and profit differential. They make the important point that generic information services (such as series of technical reports) are far more difficult to tie in with specific revenue benefits and therefore much more difficult to price in this manner.

More literature has been produced on the cost and value of information services and corporate libraries. The increasing imperative for library services to justify their value for money has led to different but related approaches to assessing the value of information practically.

Measuring value of information relies on considering information as a defined, separate variable, but there are usually many variables affecting a decision or action, and the difficulty lies in separating those variables to be able to attribute the outcome solely to the information used. Given this difficulty and the fact that decisions are subjective by their nature, two approaches are

commonly used to measure value. Both these approaches make assumptions but have been workable in practice as long as their limitations are understood.

The first 'realistic value approach' measures the effect of information on the outcomes of decisions or the performance of decision-makers using a before-and-after method. In practice measuring this for every piece of information used is unworkable, so a sampling method needs to be employed. The second 'perceived value approach' introduces the information users' views into the assessment of value, which is the major benefit of this approach. The disadvantage is that is assumes that users can recognise and/or assign a value to the information, and is by nature explicitly subjective. However, since concepts of value are also intrinsically subjective, this method offers the best chance of accurately reflecting the value of the information used (Ahituv and Neuman 1986).

Another method of assessing value is to use scales, as Kantor, Saracevic et al. (1995) did in a study of value of five large academic research libraries. Users were asked to represent their responses on a scale of, say, 1 to 10. However, this too cannot be translated into an economic model, and in the study it was found that assigning economic value was difficult as only a small proportion of the participants had ever purchased information before.

The difficulty of discerning a quantitative value of published literature is demonstrated in a study by Weil performed in 1974 (Weil 1980) at the Exxon research centre. Participants could only assign a 'dollar value' to 2% of the beneficial impacts of published literature, although where this was assigned the benefit to cost ratio was estimated (conservatively) to be 11 to 1. A much greater proportion, 62%, of published literature impacts was seen as qualitatively beneficial to researchers.

When examining information provided by journals, Machlup proposes two types of value - purchase value and use value. The purchase value is the market price, that is, what scientists are willing to pay in terms of money and time spent acquiring and reading the journal. Use value describes the consequences of using the information found there. Tenopir and King (2000) examined electronic journals and found that the use value was 5-10 times the purchase value of the journals and journal articles for any one scientist.

Extensive work on the value of information was carried out by Griffiths and King in the early 1990s, in their work on evaluating information services. King and Griffiths (1991) split the measurement of library resources into input and output measures. Measuring input includes the cost of resources for operational functions (e.g. acquisitions, processing); user-related functions (e.g. access to facilities, systems, collection, materials); and support functions (e.g. management, personnel, administration). Measuring output includes quantity of output of services and operational functions, timeliness, availability, quality.

When management decides upon resource allocation to library and information services, input and output measures are often the only measures used, but these are not measures of value or cost benefit. They do not describe the effect of the services or information on the work of users and the larger organisation.

Griffiths and King describe three ways of assessing value:

- How much are people prepared to pay (in terms of time saved)
- How much would it cost to get the information if the services were not available
- The extent to which the services achieve cost savings for the users

The first indicator of the value of information is the amount of time that engineers and scientists are willing to spend acquiring and reading it, given that their time is a scarce resource and they are careful how they spend it. Their work deals with finding and obtaining documents, and is founded on being able to calculate the cost of obtaining those documents by some other means.

They go on to quantify the value of information in terms of US dollars using data collected over 16 years (1984-1990) from 20 different studies of information use by professionals in academia, companies and government agencies. These studies gave data on the amount of reading and the extent to which library services were used (King and Tenopir, 1999).

The willingness to pay is estimated by taking the number of journal articles, books and technical reports that scientists and engineers read (found to be an average of 262 readings per year) and the number of hours spent acquiring and reading those documents (299 hours per year). By applying the average salary of engineers (approx. $40 per hour in 1993) and adding a 50% overhead, the average cost of acquiring and reading that information was found to be $9120 per year for each engineer. This 'price' of information is cited as an indicator of the value placed upon it.

3.5. Benefits of reading

There are other personal and organisational benefits of reading. The role of the 'gatekeeper' of information in an organisation has been described previously. They seek, digest and distribute both internal and external information to team members. The individuals who fill this role have been shown to be highly motivated and tend to be promoted with the organisation.

As long ago as 1958, Maizell (1958) found a positive correlation between the number of journal articles read and the number of publications produced by scientists. Technical communication is considered an integral part of professional engineering. In a survey of 595 Berkeley engineering alumni, Spretnak (1982) found that more the half an engineer's working life is composed of communication tasks, with 23% reading technical and business material.

There is a definite correlation between information literacy and individual performance and promotion. Shotwell (1971) found that the most active users of literature were also those who were active communicators and also high performers. This confirms Lufkin and Miller's (1966) survey of 1765 engineers, which found that non-supervisory engineers who had won awards or were high achievers read a great deal more than average. Griffiths and King (1993) studied six organisations and found that the amount of reading is positively correlated with productivity. Twenty-five people who stood out as being high achievers read 59% more articles than their colleagues.

3.6. Summary

Value is a subjective, individualistic concept, firmly rooted in the context of an individual's current state of knowledge and also dependent on context and timeliness. Value in terms of what information users are prepared to pay is based on the user's expectation of what the information will provide, rather than its actual content. Practical assessments of value of information rely on its use in the context of problem-solving, decision-making or to reduce uncertainty, and have been driven by the requirement from managers to justify information expenditure. However, Allen (1987) reiterates the truism that those in management positions often see information services as dispensable when they have to make savings. Executives very rarely realise the value of information systems, or information's volatile nature, and it is not perceived as being as important as other resources.

No quantitative method captures the value of information or information services, although there have been attempts, most notably by Griffiths and King (1993), to attach a monetary value to the time spent acquiring and reading information which reflects the value individuals place on information. The qualitative method most practicable in reality is the perceived value approach, where users are consulted about the value of the information.

These methods do not account for any 'latent' value in information which is not currently in use but may be invaluable in the future. This is truly impossible to calculate without the benefit of hindsight, but is nonetheless important when considering engineering information. The fluctuating nature of information need dictates that at the time the information is needed it could be very valuable indeed, but be 'worthless' again in a few weeks' time.

4. Technical reports

4.1. What is Grey Literature?

There are a couple of well-known definitions of grey literature. Auger (1998) includes reports, technical notes and specifications, datasheets, trade literature, pre-prints, conference proceedings and supplementary publications in his definition, all of which are characterised by poor bibliographic control and information, low print runs and a non-professional layout and format. They are difficult to obtain, as they are not available through normal book-selling channels.

Another definition is known as the 'Luxembourg Convention on GL', named after the location of the 3rd International Conference on Grey Literature. It states that grey literature is produced at all levels of government, academia, business and industry, in print and electronic formats, and is not controlled by commercial publishers. Within the engineering sector, one of the most common and important types of grey literature is the technical report.

4.2. The importance of technical reports

The vast majority of engineering research, technology acquisition and development address a particular need or problem. The results of this research are disseminated, if at all, through journal articles, conference papers and technical reports. Journal articles and conference papers give a compressed summary of the work undertaken and often present a shop window for the technical expertise or competence of the author's organisation or company, and hence put a positive gloss on the final results. They do not give experimental detail of exactly how the results were arrived at, the raw data or the mistakes that were made along the way. Sometimes the information is so compressed as to make understanding or validation difficult.

Technical reports may contain experimental procedure, production data, specifications, standards, operating plans, drawings and/or raw results (Mildren and Kicks, 1996). Importantly, they will set out the conclusions and recommendations to come from the research, and include all aspects of the research, sometimes including those parts that failed. This means that the information is very specific, addressing a particular problem, and very rich in experimental detail.

A large amount of valuable information contained in reports will never be formally published as a journal article or within a book. Even if refined versions appear later, 12 to 18 months' delay is common due to the publishing cycle, so reports are frequently at the cutting edge of engineering research, design and development.

Within many organisations the report is the primary means of technical communication, as it is cheap and quick to produce. Reports must be detailed enough to satisfy the requirements of the funder or contractor of the research, and their detailed nature is their greatest strength as an information source. Once the report has been circulated within the organisation, if appropriate, it is then distributed to a wider audience, without peer-review or editing. Of course, some reports will be held in confidence if there are military or commercial restraints.

For an engineer who has specific queries about experimental method, who wants to know about the latest developments in a field or who needs to disseminate results promptly, the report is invaluable.

4.3. History of technical reports

The Dictionary of Report Series Codes (1973) gives a brief history of technical report literature. It traces their development as a major means of communication from the Second World War, when the number of reports produced increased greatly. The Office of Scientific Research and Development (OSRD) shaped government-sponsored research by decentralising scientific effort through research contracts, deriving impersonality through research teams. Unpublished reports were the most suitable means of recording and disseminating these research results. The Allied

teams investigating enemy scientific and technological research also produced large numbers of reports, as well as capturing many thousands of German and Japanese documents.

Post-war science continued in the pattern of OSRD, with other US government agencies and departments' expenditure on research and development doubling in the decade following the war. By 1950 results of US government-sponsored research were being published in reports at the rate of 75,000 to 100,000 per year. When the OSRD was disbanded, there was no central agency to control or monitor research reports. New agencies were created in specific areas, such as the Atomic Energy Commission establishing a technical information service to disseminate scientific and technical information relating to atomic energy, and the Office of Royal Naval Research contracted with the Library of Congress to service technical reports of interest to ONR contractors. The method of bibliographic control over the reports was by a report numbering system, and report numbers have come to be accepted as the principal device for report control, although there is no standardisation between organisations producing reports.

Thompson (2001) describes US grey literature and describes reports at length. During the 1980s and 1990s, some report series that were freely available as part of a Federal Depository Library Program were given to the National Technical Information Service (NTIS) to maintain and distribute. NTIS supplies reports from US government agencies and departments commercially at a cost, and many libraries ceased collecting reports when a charge was introduced. Reports from the Department of Transportation (DOT) and the Environmental Protection Agency (EPA) were amongst those transferred to NTIS. The format of reports has also changed over the years, from paper to microfiche, and more recently on CD-ROM, and soon to be produced on DVD. Many US government technical reports can also be found on the Internet.

In the UK, the Technology Reports Centre provided access to unpublished reports by government research establishments until it closed in 1981. Its function was split between the Defence Research Information Centre (DRIC) and the British Library. DRIC (now an agency known as Dstl Knowledge Services) disseminated scientific and technical information to the UK defence community for more than 75 years, and is the focus for exchange of scientific and technical defence reports with other countries, publishing the 'Defence Reports Abstracts' and 'Defence Technology Abstracts'. The British Library used to publish 'R&D Abstracts' twice a month, but does so no longer.

The Public Record Office preserves the records of central government. Those technical reports that are produced by government departments and so form a part of that record are collected and recorded, but only available to access if they are more than 30 years old.

The continuing use of, and growth in the number of reports, emphasises the importance of the report as a means of communication for engineers. In 1963 the estimates of the number of reports issued annually, in the US, varied from 50,000 to 150,000. In the next ten years to 1973, estimates ranged as high as 500,000, but no reliable figures were obtained. The British Library estimates that 50,000 UK local authority documents are produced each year, and about 70,000 US scientific and technical reports are added to NTIS each year. The British Library itself acquires approximately 19,000 UK reports each year, compared with 7,500 UK doctoral theses and 17,000 conference proceedings.

Along with their proliferation, reports have become accepted as a respected means of communication, as evidenced by the increasing inclusion of high profile report series in standard abstract and indexing services. With this acceptance has come a freedom for authors to refer to reports in their publications. Reports are no longer just a 'private communication' but are becoming far more in the public domain.

However the proliferation of sources of reports and the lack of any standardising body means that reports can be very difficult to trace.

4.4. Obstacles to using technical reports

As the organisation producing the reports effectively controls their distribution, they can be difficult to obtain. The concept of collaboration and sharing has less support in a commercial

organisation than in government or academic institutions. This urge to restrict commercial and defence information in the UK means that many reports may never be publicly available. Reports can be subject to embargo until the company decides the information cannot be used for commercial gain by its competitors. Often company reports can only be accessed by direct contact with the company, and can only be discovered from citations or recommendation.

The haphazard and specialised distribution of reports is exacerbated by the manner in which many libraries and institutions have gathered reports, by gift or exchange. Gaps in series are not chased or claimed, and so holdings are often incomplete.

Another way of discouraging access to reports is to price them out of the market. Thompson (2001) cites the example of ERPI TR-106294, 'An assessment of distribution system power quality'. This can be found easily from the EPRI web site (http://www.epri.com), but each volume in the three-volume set is priced at $25,000, a price so high as to make accessing the contents impossible for all but a very few.

A characteristic of technical reports is that they are not an end-product of research performed or a project completed, they are generated as a by-product of the process. The product or design is the reason the work was commissioned or contracted, and it is this that is valued, not the report itself, even though the report may hold valuable information for the future. This contributes to the difficulty of locating and obtaining reports.

Reports are not subject to rigorous bibliographic control and awareness of the available report literature is poor. From the perspective of the engineer, identifying a report on a particular topic can be very laborious as there are few abstracting and indexing services focussing on report literature, and they are not comprehensive. Obtaining a report in the UK can also be very difficult if the British Library doesn't hold the item. Identifying holdings of other libraries can be problematic, as library report collections are generally incomplete and catalogued inconsistently. Many do not contain title-level information, but only include information about the report series, making searches for subject-based information impossible.

Studies have shown that engineers are reluctant to use formal information sources such as databases (Hanley, Harrington et al., 1998). Often their task is problem-solving and so their information seeking behaviour focuses on discussion with colleagues, which is 'information rich' in terms of synthesis and experience (Pinelli, Barclay et al., 1994). Formal sources are in comparison 'information poor'; often requiring additional input or modification before the information is usable. Many may not realise that a report will hold the answers they need. When compared to journal and conference literature, technical reports, and their unique qualities, are poorly publicised. Even if this need is recognised, the obstacles to identifying and obtaining reports are discouraging and make reports difficult to track down.

4.5. Use of technical reports

There has been some examination of technical report use in the literature. Research in 1994 by Blagden et al. showed that 40% of respondents used reports as an information source, second only to books (Blagden, Harrington et al. 1994).

Anderson et al (2001) mentions the AAES 1986 survey of 3106 engineers (Societies 1986), which reported that 81% of the respondents used internal technical reports over the previous year in their current project or job. Their own survey of 872 US aerospace scientists and engineers asked participants how they found the information for one project, with the correlating result that 83% indicated they had used internal technical reports.

In Chakrabarti's (Chakrabarti, Feinman et al., 1983) study of use of different information sources technical reports came 5th for utility of information, behind people sources (1st, 3rd) and books (2nd, 4th). The findings discussed in a previous chapter show that accessibility is the main determiner of use of a source, and Chakrabarti's results were no different, finding that source availability and ease of use were the two most important factors in frequency of use. Technical reports came 10th

for ease of use and 12th for availability, but 8th in terms of frequency of use. These findings indicate that reports are very useful but difficult to locate and obtain.

King and Griffiths (1991) characterise technical reports as containing very specific, very new information, as they are often the first place information is recorded, before (if ever) being presented to conferences or published as journal articles. However, along with books, they are also used over a longer period of time after publication than journal articles; the average age of technical reports read is two years, although one-half of readings involve reports under six months old. Most readings (57%) of older reports along with 33% of new technical reports are due to recommendations from colleagues. Other ways of identifying new technical reports were through library staff, online searches, technical report bulletins and citations in other publications. They also found that the purpose of 90% of technical report readings involved specific work activities (compared to 60% of journal articles and 70% of book readings).

Their work places a monetary value on reading. Information found in technical reports resulted in $709 worth of savings in time and other resources per technical report reading (compared to $265 per journal article and $650 per book reading). The savings were due to

- stopping unproductive lines of research
- avoiding having to do some primary research
- offering confirmation of research undertaken
- modifying a research or engineering design

The ratio of savings gained per time spent acquiring and reading technical reports was 14.9:1. This compares with 5.1:1 for journal articles and 10.8:1 for books.

These savings resulted from 52% of report readings, but should not be regarded as 'typical' savings, as just 1-2% of readings accounted for nearly all the estimated savings. Therefore it could be concluded that when a very relevant report is found and read it is extremely valuable.

A recent BLDSC demand survey showed over 3,000 customers making over 30,000 requests per year, broken down below in table 4-1. When compared with the 15,000 requests received by BLDSC each day, these figures may seem low, but are actually significant when you consider the obstacles to report use already discussed.

SECTOR	USERS	REQUESTS
Academic/HE	1,157	7,648
Government	693	7,648
Industrial/Commercial	1,034	8,626
Public Library/Other	358	2,520
TOTAL	3,242	34,025

Table 4-1 Annual demand for reports from BLDSC

4.6. Availability and supply of technical reports

There have been attempts to increase the accessibility and supply of report literature in Europe with the EAGLE/SIGLE service, but with more success in the US, where many reports are made freely available via the Internet. There are also international agreements and organisations promoting access to grey literature.

4.6.1. International initiatives

The International Nuclear Information System (INIS) promotes peaceful uses of nuclear energy and has a membership of 107 states from 1970. It processes the world's scientific and technical information within its area and produces a bibliographic database with full text service on 'non-conventional' sources like technical reports.

The Energy Technology Data Exchange began in 1987 and has 18 member countries which exchange energy research and technical information through the creation of a common database. There is no centralised document supply, but there are some links to download some documents.

The European Space Agency had its roots in previous organisations but was formed in 1975. It contains 15 member states and exists to promote the exploitation of space science research and development. It used to produce the European Aerospace Database (EAD) but this ceased publication a few years ago.

4.6.2. US initiatives

Organisations in the US have been much more effective in making report literature accessible. The government has a responsibility to disseminate the results of federally sponsored research as broadly as possible as a public good. Recognising the Internet as a powerful means to increase dissemination, the US government funded digitisation projects such as NTRS and the GrayLit Network.

4.6.3. NASA & NACA Technical Reports Servers

NACA was established during the First World War in 1915, and was the precursor to NASA, which was created in 1958 in response to the Sputnik crisis. Both organisations have produced enormous amounts of literature, with much basic research literature from the 1950s and 1960s, unusually, still in use and valued today (Thompson 2001). Both organisations have produced report series of high quality and are using modern technology to increase their accessibility.

NASA's Scientific and Technical Information (STI) programme produces a database of US and other sources of technical information and makes a small portion of it available to the public as CASI TRS (Center for Aerospace Information Technical Reports Server). There is also the electronic abstract journal STAR (Scientific and Technical Aerospace Reports) which contains similar information to CASI TRS and is also available publicly over the Internet. The NASA Technical Reports Server (NTRS) brings together and allows the cross-searching of many different databases in different locations.

During the first six months of the service (June-Dec 1994), 10,000 customers logged on to NTRS and usage was steadily increasing. The average weekly accesses increased from 1,100 in July to over 2,300 in December (Nelson, Gottlich et al. 1995).

There has also been a great deal of interest in the NACA Report Server. On a monthly basis, the NACA server disseminates over 5,000 PDF files. There are over 3,000 searches per month performed directly from the NACA server, and approximately 10,000 searches a month performed via the NTRS interface. For comparison, NTRS now handles over 30,000 searches per month, so as much as one third of the NTRS searches involve NACA. The managers of the service frequently receive emails from users from all over the world requesting specific reports to be added and thanking them for making available a collection that to many university and industry users is not ordinarily available (Nelson 1999).

4.6.4. GrayLit Network

The GrayLIT Network was launched as a response to recommendations from a DOE (Department of Energy) workshop in May 2000 (2000). Providing access to the grey literature of US federal agencies, GrayLIT allows cross-searching of more than 100,000 full-text technical reports located at DOE, the DOD (Department of Defense), the EPA (Environmental Protection Agency), and NASA.

4.6.5. Research and Technology Organization

Another notable online collection of reports is from the RTO (Research and Technology Organization), which is the focus for defence research and technology activities within NATO. The RTO web site provides access to a collection of full text documents produced by the NATO Research and Technology Organization and its predecessor, AGARD (Advisory Group for Aerospace Research & Development). In fact the RTO has stopped distributing hardcopy reports, so the only access to its material is through the Internet.

By providing Internet access to the full text of technical reports, these initiatives have made a huge step in raising the visibility of their literature, and also made it relatively easy to obtain the reports when they have been identified by the ability to download documents as PDF files.

4.6.6. EAGLE/SIGLE - a European initiative

The major European project for raising the visibility of reports is SIGLE (System for Information on Grey Literature in Europe), which is co-ordinated by EAGLE (European Association for Grey Literature Exploitation) (British Library 2001). SIGLE's aim is to provide access to European grey literature, which it does by means of a network of national centres, one of which is the BLDSC (The British Library Document Supply Centre) (EAGLE 2002). SIGLE has centres in 16 countries, each centre is responsible for collecting grey literature in its own country and providing bibliographic details for entry into the SIGLE database, which now comprises about 630,000 citations (Wood and Smith, 1993). Over 86,000 of these citations refer to reports from the UK. Reports, dissertations, and other grey literature found in SIGLE can be ordered from the source indicated in each record.

4.6.7. The UK situation

There are cultural differences between the US and UK. The US can drive disclosure and dissemination through the federal agencies within a political culture of freedom of information. Within the UK the need to publish is not necessarily recognised by the agencies carrying out the research and there can be debate over who owns the intellectual property rights of the research. Even if the government has funded the research, the agency or company can be reluctant to divulge information which it sees as being its property and of commercial advantage. Additionally, in contrast to the scientific community, engineering publication is not linked to a reward system, and so there is no personal professional gain in publishing results.

Little attention has been given to UK technical reports and compared with the big sisters of research publication such as journals and conferences, the report has played the role of Cinderella. The British Library holds more than 240,000 reports from 1980 onwards, from more than 4,000 sources. Apart from these substantial holdings of BLDSC, major collections of technical reports tend to be scattered across academia, government and industry. These resources are difficult to identify, locate and access, as there has been little co-ordination across or within sectors and there is no national database of holdings.

The work done by the British Library in maintaining the UK part of SIGLE is the most discernible act of making report literature visible and accessible. Unfortunately SIGLE is not the most accessible or high profile of databases. Even within the British Library the full extent of the reports collection is unknown, as items prior to 1980 are not on the computer catalogue. The holdings of US reports are not catalogued at all, although they number more than 4 million from some 12,000 reports series, mainly from NTIS (from 1940s), NASA/NACA (from 1900s), AIAA, US DoE/AEC (from 1940s), ERIC and INIS (from 1970) (Auger 1998). These are much larger than their holdings of UK reports.

4.7. Summary

Although reports form a valuable part of the everyday currency of engineers' work, and are an important information source, they are generally difficult to locate and obtain. Their publication and dissemination is controlled by the particular company or agency performing the work, and so many reports will never be distributed externally to the organisation. Even if a report series is disseminated externally, academic libraries are short of space, industry libraries are being rationalised or closed down, and collections are being dumped in the hope that 'someone else will have them'. The pressures of meeting ever-decreasing budgets force short-term savings; it will never be known how many greater savings would have been made if the information were there and accessible.

The US is leading the way, taking advantage of the opportunities of new technologies and partnership arrangements to increase the availability of technical reports, with major US sources offering free full text access via the web. Apart from the work carried out by the British Library, the UK has done little to organise and disseminate UK reports, and has not addressed the issues of control and supply of technical reports to UK academia and industry.

5. MAGiC Impact Study

5.1. Introduction

The impact study was intended to investigate the reasons why engineers use technical reports, how reports are found and read, if reports are useful and relevant, and how they compare in importance to other sources of information engineers use. It was hoped that this study would illuminate and contribute to an understanding of the impact of technical reports on the work and study of engineers, as there has been little work carried out in this area previously.

5.2. Methodology

The impact study was executed at Cranfield University, Queen Mary and Dstl, in person and over the telephone. There were 87 respondents, 41 from Cranfield and Queen Mary and 45 from Dstl. This further breaks down into 13 staff, 17 PhD/DEng/MPhil students and 11 MSc/MRes students from Cranfield, and 29 engineers, 13 external company clients and 3 government clients from Dstl.

Participants were identified when they returned technical reports to the libraries. At Cranfield, a personal email invitation was sent explaining the research and asking for a response. At Dstl, participants were telephoned and asked for participation. These direct approaches produced a very high return rate; 42% of those approached at Cranfield and 95% at Dstl agreed to participate.

The questionnaire consisted of eight questions. These questions were open so the participant could answer however they liked, but had suggestions of possible answers that could be given in order to prompt memory if needed (see Appendix B). At Dstl the interview was conducted over the phone at the time of the original contact, whereas at Cranfield there was a mixture of telephone and face-to-face interviews.

The respondents are obviously not a random sample, and therefore these results cannot be seen as representative of a wider constituency of engineers. However, with the mix of engineers from different backgrounds and contexts, the results should be indicative of general trends in use of reports.

Another consideration that was not addressed with this study was the views of engineers who don't use reports, or don't use them very often. It would be interesting, if difficult, to identify them and complete the picture. The participants in this study had decided to borrow a report, and therefore some evaluation or expectation of the usefulness and relevance of the report must have occurred before borrowing. Therefore it is possible that the study could have a bias towards positive results, although, as discussed in a previous chapter, the value of information for a specific purpose can only be properly judged after the information has been used.

5.3. Results and discussion

Respondents were asked about a particular report they had borrowed or ordered (Question 1). When asked how the report was found, over half (53%) of the respondents stated they found it in the library catalogue. Both Cranfield and Dstl are unusual in that both libraries fully catalogue individual reports, and customers can access and search the catalogue via the Internet (or intranet at Dstl). It would be surprising if this result was repeated in other organisations whose reports are not catalogued, and/or who do not have strong report collections. 17% had the report recommended to them by a member of staff, and 16% found the report by referral in an article or book.

An interesting difference between the academic and company responses was that over two-thirds (71%) of those who had followed a reference were from Cranfield and over four-fifths (86%) of those who followed a recommendation were from Dstl. This split could reflect the different working patterns of the two groups. Academics work in a much more isolated fashion and are required to be grounded in literature, whereas industrial engineers work closely in groups and rely on colleagues for information.

	Cranfield	Dstl	TOTAL	%
Recommended by staff	3	12	15	17.24
Recommended by other	0	1	1	1.15
Referred to	10	4	14	16.09
Library catalogue	28	18	46	52.87
Subject database	1	2	3	3.45
Internet	0	0	0	0.00
Other	0	8	8	9.20
TOTAL	42	45	87	100

Question 1: How did you find out about the report?

Overwhelmingly 66% of reports were borrowed because they were relevant to current research, coursework or design projects. This was confirmed by 94% of participants who said the subject matter of the report they used was relevant to their current work. The next most cited reason (16%) was for the data the report contained (Question 2).

	Cranfield	Dstl	TOTAL	%
Relevant to current research	32	19	52	48.15
Relevant to coursework	3	10	13	12.04
Relevant to design project	3	4	7	6.48
Methodology	5	0	5	4.63
Data	9	8	17	15.74
References	2	1	3	2.78
Introduction to subject	2	1	3	2.78
No other info	2	0	2	1.85
New research area	0	1	1	0.93
Immediately available	0	0	0	0.00
Other	1	4	5	4.63
TOTAL	59	48	108	100

Question 2: Why did you decide to borrow the report?

When the report was borrowed, only 40% of participants read it fully, whereas 59% were selective about which parts of the report they read.

Of those who only read parts of the report, the abstract was the most popular, with the results and conclusions the next most frequently read (Question 3b).

	Cranfield	Dstl	TOTAL	%
Abstract	11	12	23	27.06
Introduction	7	5	12	14.12
Methodology	6	4	10	11.76
Results	10	5	15	17.65
Conclusions	8	7	15	17.65
References	4	6	10	11.76
TOTAL	46	39	85	100

Question 3b: Which parts of the report did you read?

When asked if the contents of the report met their needs, 92% of participants said the report had either partially (41%) or fully (51%) met their need (Question 4). This is substantiated by 85% of the replies that said the report was useful to their current work and 7% to their future work.

	Cranfield	Dstl	TOTAL	%
Fully	20	24	44	51.16
Partially	20	15	35	40.70
Not at all	1	4	5	5.81
Might in the future	1	1	2	2.33
TOTAL	42	44	86	100

Question 4: Did the contents of the report meet your need?

Given the studies showing that engineers seek information within a problem-solving context, it was surprising to see that 46% of participants obtained new knowledge from the report, whereas a much smaller response of 15% stated the report helped them to solve a problem.

	Cranfield	Dstl	TOTAL	%
Give new knowledge	20	28	48	45.71
Refresh memory	3	10	13	12.38
Substantiate hypothesis	6	0	6	5.71
Save time	7	0	7	6.67
Solve problem	7	9	16	15.24
Didn't help me at all	0	5	5	4.76
Other	9	1	10	9.52
TOTAL	52	53	105	100

Question 5: How did the report help you?

The final question asked participants to rank the importance of several information sources to their current work on a scale of one to ten, with ten being very important, and one being very unimportant. The sources they were asked to consider were:

- Books
- Journal articles
- Conference papers
- This particular report
- Technical reports in general
- Standards
- Patents
- Theses
- Internet

A consolidation of these results is shown below (Question 7), where the results are split into three ranges of the ten point scale to highlight which sources were the most important to the participants. It can be seen that the most important sources were technical reports, closely followed by journal articles, the Internet and the particular report that prompted their participation. The reliance on reports is emphatic.

	1-3	4-7	8-10
Books	12	37	37
Journal articles	8	32	44
Conference papers	11	39	27
This report	14	31	41
Reports in general	1	32	45
Standards	16	29	18
Patents	25	21	3
Theses	26	34	14
Internet	9	29	42

Question 7: Rank the importance of sources on a scale of 1-10 to current work.

It can be seen that journal articles and reports have very similar profiles, as do the Internet and the particular report the participant used.

Comparing the perceptions of importance at Cranfield and Dstl shows an interesting difference, perhaps again distinguishing the types of organisation the respondents work for. Cranfield's top responses were more widely spread across the sources than Dstl's, and journal articles were the clear leader in importance. Reports rank amongst the traditional forms of academic literature of books, journal articles and conference papers in importance and yet receive very little recognition in comparison. Dstl's top responses were more concentrated on reports and books, with reports perceived as clearly the most important source in relation to current work.

	1-3	4-7	8-10
Books	5	18	17
Journal articles	4	8	27
Conference papers	3	15	17
This report	7	22	12
Reports in general	1	16	17
Standards	5	7	7
Patents	5	5	1
Theses	1	22	12
Internet	4	14	17

Cranfield responses for Question 7

8-10	4-7	1-3	
20	19	6	**Books**
16	24	4	**Journal articles**
9	24	8	**Conference papers**
28	9	7	**This report**
27	16	0	**Reports in general**
11	22	10	**Standards**
1	16	20	**Patents**
1	12	25	**Theses**
24	15	5	**Internet**

Dstl responses for Question 7

5.4. Conclusions

The main conclusion from this study is that when a relevant report is found, it is extremely useful to the engineer. It demonstrates that reports are just as important to an engineer's work as the more traditional information sources such as journals and conferences. It also highlights the value of a good quality catalogue, listing individual reports by title and giving full bibliographic details. This was the major tool for locating reports used by participants in the study. It would be useful to survey engineers from organisations which have no access to a reports catalogue to see how use and perceptions of reports differ.

It is interesting to note the high importance attached to the Internet amongst participants, evidence that the Internet is popular and often used by engineers to locate information. However, it is clear from the answers to Question 1 that these particular respondents are not using the Internet to find reports! This is probably because the catalogue provides a quicker and more reliable access point.

The differences in use of information by engineers and scientists have been discussed in a previous chapter. This study has uncovered a further difference in information use between engineers in an academic and industrial context. Academic engineers rate a broader range of information sources

as important, with journals being of primary importance to their work, whereas industrial engineers favour reports as the most important information source, with the Internet and books next.

A possible weakness of this study is that those who found reports useful may have been more minded to participate and feel they had something to contribute than those who didn't find them useful. However, the high return rate supports the conclusion that those who find and use reports generally find them useful and relevant to their work.

6. A study of the use and value of information to engineers

6.1. Introduction

This study was intended to test some of the conclusions from the analysis of the literature and to complement the work carried out in the MAGiC impact study. It represents a further component of the project and was designed to aid the achievement of the key objective of investigating, and understanding, the value to the engineer of having access to a digitised reports service and the impact on productivity.

6.2. Methodology

The study was executed employing a web-based questionnaire, located on the project website at http://www.magic.ac.uk/questionnaire/index.html. The questionnaire was widely promoted, via organisations that have indicated an interest in participating in a National Reports Catalogue (see Chapter 8). These included the Learning and Teaching Support Network for Engineering (LTSN Engineering), the NACA UK mirror website, AERADE, Cranfield University library website, Dstl Knowledge Services newsletter, engineering institutes and a number of engineering discussion forums. By the time of this analysis (August 2002), there were 67 respondents from around the globe, of these just over a third came from the UK.

The questionnaire, which contains 21 questions, is based on a tried and trusted methodology that has been utilised in two previous studies: EURILIA (Blagden, J., Harrington, J. and Woodfield, H. 1997) and AIM-UK (Hanley, K., Harrington, J. and Blagden, J. 1998), with an additional set of questions, which employ the critical incident technique. These additional questions are intended to complement and confirm the findings of the impact study.

It is divided into four sections dealing with:

- Respondent profiles
- Questions about general engineering information
- Questions about engineering technical reports
- Comments and willingness to participate in engineering grey literature discussions

6.3. Results and discussion

The first section asked questions designed to find out which sector respondents came from, the activities they are involved in and their experience levels.

6.3.1. Respondent profile

Respondents were asked in which sector of engineering they worked (Question 1). The largest group (40%) was from the aerospace and defence engineering sector, followed by the mechanical engineering (12%) and electrical, electronic and computer engineering (10%) sectors.

Aerospace and defence engineering	27	40.30%
Bioengineering	1	1.49%
Chemical engineering	5	7.46%
Civil engineering	3	4.48%
Electrical, Electronic and Computer engineering	7	10.45%
General engineering	3	4.48%
Manufacturing engineering	2	2.99%
Mechanical engineering	8	11.94%
Nanotechnology	2	2.99%
Petroleum and offshore engineering	2	2.99%
Other	7	10.45%
Total	67	100.00%

Question 1. Which one of the following characterises your area of work/research?

The large response from the aerospace and defence sector may reflect the strong involvement of Cranfield University and Dstl in these areas, however, overall, there is a broad mix of engineers from different sectors and backgrounds, so results should be indicative of general trends.

Nearly half of the respondents (47.5%) were engineers from government or industry, one in five were graduate students (Question 2). With less than 5% of responses coming from scientists, no attempt has been made to analyse these separately from engineers.

Academic staff	2	2.99%
Engineer - government	8	11.94%
Engineer - industry	24	35.82%
Graduate student	14	20.90%
Research officer	9	13.43%
Scientist - government	2	2.99%
Scientist - industry	1	1.49%
Student - other	3	4.48%
Other	4	5.97%
Total	67	100.00%

Question 2. Which one of the following choices predominantly characterises your job?

The experience levels of respondents varied widely, though the largest group, comprising one third of respondents, was in the 0 – 5 years experience band (Question 3). Most of this group were either graduate or undergraduate students. Among government and industry engineers, the largest group were those with 11 – 20 years experience.

0 to 5 years	21	31.34%
6 to 10 years	13	19.40%
11 to 20 years	18	26.87%
21 to 40 years	15	22.39%
41 years or more	0	0.00%
Total	67	100.00%

Question 3. How many years of professional work experience/researching, teaching or studying in engineering do you have?

Almost half the respondents were involved in research activities and one in five worked on final process or product development (Question 4).

Applied research	22	32.84%
Basic research or concept formulation	11	16.42%
	14	20.90%
Operational and maintenance	6	8.96%
Production	1	1.49%
Teaching	2	2.99%
Validation and demonstration	2	2.99%
Other	9	13.43%
Total	67	

Question 4. Which one of the following best describes the activities in which you are involved?

6.3.2. Questions about general engineering information

The second section of the questionnaire dealt with questions pertaining to engineering information in general.

Nearly all respondents (97%) regarded access to scientific and technical engineering information as 'very important' or 'important' (Question 5), confirming that such information is used and valued by engineers in all sectors and areas of work.

Very important	52	77.61%
Important	13	19.40%
Neither important nor unimportant	1	1.49%
Of little importance	1	1.49%
Of no importance	0	0.00%
Total	67	100.00%

Question 5. In your current role, how important is it for you to have access to scientific and technical engineering information?

Half of the respondents spent at least 40% of their time using scientific and technical information (Question 6), with one in five exceeding 60% usage. That so much time is spent on searching for technical information may be an indicator of the difficulties of the search process itself, however, it certainly confirms the importance of having access to such information.

0 to 10 percent	4	5.97%
11 to 20 percent	13	19.40%
21 to 40 percent	17	25.37%
41 to 60 percent	20	29.85%
61 to 80 percent	9	13.43%
81 to 100 percent	4	5.97%
Total	67	100.00%

Question 6. Please estimate what percentage of your work time is spent using scientific and technical information when conducting engineering research.

Not surprisingly, given that an online questionnaire was employed for this study, almost all respondents (97%) have Internet access at work (Question 7). However, nearly 20% of those do not have Internet access at their own desktop. Of these two-thirds were students and a quarter were aerospace engineers.

Yes	65	97.01%
No	2	2.99%
Total	67	100.00%

Question 7. Do you have access to the Internet at work/within your institution?

Another computer elsewhere in your organisation	12	19.67%
Your desktop computer	49	80.33%
Total	61	100.00%

If yes, from which of the following do you get access to the Internet?

The respondents' organisations had a library or technical information centre in 80% of cases (Question 8). Of the respondents who stated that their organisation did not have a library (16%), over a quarter indicated that there had been such a facility in the past, confirming evidence that there have been library closures taking place in the engineering community over the last few years.

Don't know	2	2.99%
No	11	16.42%
Yes	54	80.60%
Total	67	100.00%

Question 8. Does your company/institution have a library or technical information centre?

Respondents were asked to rate how frequently they used a range of information sources when searching for scientific and technical engineering information (Question 9). General Internet use was the most frequent source of information, followed by Internet search engines, and then the respondents' own personal store of information.

As expected, discussion with colleagues and experts at the respondents' institution were also frequently employed, as were books, databases and journal articles. The respondents' library, technical reports, standards and conference papers were the next most frequently used sources. Interestingly, respondents indicated that they used external reports more often than internal reports. Of course, frequency of use of a resource is an indicator of its popularity and may not necessarily be an indicator of its value.

	V. frequently	Frequently	Infrequently	Never
Personal store of technical information	25	32	6	2
Informal discussion with work colleagues	21	30	14	0
Discussion with experts at own institution	8	35	18	4
Discussion with experts outside own institution	5	15	37	8
Institutions library	14	23	23	6
Other library	8	18	25	15
Books	18	35	11	0
Journal articles	17	27	16	4
Trade/promotional literature	5	12	35	11
External technical reports	13	24	25	2
Internal technical reports	8	23	30	3
Conference papers	14	22	22	5
Abstracts	10	18	26	8
Standards	12	22	25	4
Dissertations/theses	5	19	26	13
Patents	1	7	23	31
Electronic databases	21	23	14	6
Internet - general	36	25	3	0
Internet - search engines	34	25	4	0
Internet - subject gateway	12	7	31	14
Intranet	9	19	26	10
Discussion forums	4	9	29	21
Mailing lists	6	8	27	22
Other	1		3	11

Question 9. How frequently do you use the following information sources when searching for scientific and technical engineering information?

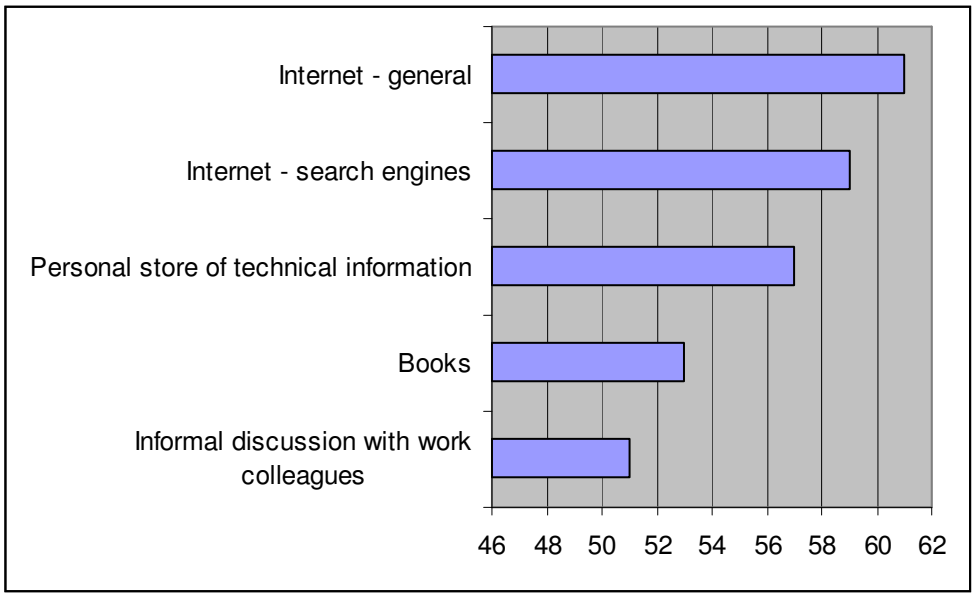

Figure 6-1 Top five very frequently/frequently used engineering information sources

Figure 6-1, above, shows the top five engineering information sources when 'frequent' and 'very frequent' use scores are combined. By and large, these sources share the common characteristics of being immediately or quickly available, inexpensive, and easy to access – characteristics that will be essential to any service aiming to enhance use, access and visibility of engineering technical reports. This is in agreement with the findings of the literature review.

Respondents were asked to rank the importance of several information sources to their current work on a scale of one to five, with five being very important, and one, of no importance. The results, which are shown below (Question 10), have been consolidated into three ranges of the five point scale to highlight the most important sources. It can be seen that books were the most important source, followed by Internet search engines and general Internet use.

	1-2	3	4-5
Books	14	9	41
Journal articles	24	10	31
Conference papers	20	13	29
Int. tech reports	15	20	29
Ext. tech reports	19	15	30
Standards	26	14	23
Patents	46	5	11
Theses	32	17	14
Internet – general	12	17	36
Internet - search engines	12	13	39
Internet - subject gateways	35	11	19

Question 10. rank the following sources in terms of how important they are to your current work on a scale of 1 to 5, 1 representing no importance and 5 representing very important.

The next most important information resources were technical reports, conference papers and journal articles, which received very similar rankings and were also clearly regarded as having value. It is interesting to note that internally and externally produced technical reports were accorded similar value by respondents. This is at variance with the literature review which showed that internal reports were rated more highly than external reports. Patents, theses and Internet subject gateways were held to be of little importance.

The low rating accorded to subject gateways corroborates the findings of the Research Support Libraries Group (RSLG 2002), the JISC Usage Surveys: Trends in Electronic Information Services (JUSTEIS) Report (Armstrong, C. J., Lonsdale, R. E., Stoker, D. A. and Urquhart, C. J. 2000) and other studies. There was low awareness of the existence of subject gateways and a feeling, amongst users, that subject gateways constrained freedom of choice.

Asked about the way they search for information, an overwhelming majority (95%) of respondents perform most searches by themselves. Only 5% use the services of an information or subject specialist intermediary.

Do most searches yourself	62	95.38%
Do half yourself and half through an intermediary	3	4.62%
Do most searches through an intermediary	0	0.00%
Not applicable	0	0.00%
Total	65	100.00%

Question 11. When searching for information, do you?

Moving on to the use of the critical incident technique, respondents were asked to think back to the last or recent occasion that they searched for scientific and technical engineering information.

When asked how easy it was to identify the source of information required, 28% found it difficult or very difficult.

Very difficult	2	3.17%
Difficult	16	25.40%
Neither difficult nor easy	19	30.16%
Easy	21	33.33%
Very easy	5	7.94%
Total	63	100.00%

Question 12a. How easy was it for you to identify the source of relevant information, e.g. an individual report, journal, database, etc.?

When asked how easy it was to obtain the information, 28% found it difficult - a very similar profile to the previous question.

Very difficult	4	6.35%
Difficult	14	22.22%
Neither difficult nor easy	22	34.92%
Easy	19	30.16%
Very easy	4	6.35%
Total	63	100.00%

Question 12b. How easy was it for you to obtain that information?

Nearly three-quarters (71%) of respondents felt that the information they received met their needs well, while one in ten stated that the information gained was of limited use.

Extremely well	4	6.35%
Well	41	65.08%
Neither well nor of limited use	11	17.46%
Limited use	7	11.11%
No use	0	0.00%
Total	63	100.00%

Question 12c. How well did the supplied information meet your need?

Only 27% of respondents were confident (25%) or very confident (2%) that they did not miss any significant information.

Very confident	1	1.59%
Confident	16	25.40%
Neither confident nor unconfident	25	39.68%
Not confident	20	31.75%
Not at all confident	1	1.59%
Total	63	100.00%

Question12d. How confident were you that you did not miss significant information?

The responses confirm that engineers prefer not to employ the services of professional intermediaries when conducting searches, this despite the fact that many of them feel that they may have missed some significant information. This highlights the need for the provision of a service targeted at end users, and the need to design the service in a manner that satisfies the perceived desires of those users.

Observations from the literature review, the MAGiC studies and comments made by engineers (Question 13), all indicate that there is a need and a desire for a 'one-stop shop', a trusted Internet engineering information source that offers a well-organised, easily searchable comprehensive set of engineering resources, at low cost and in a timely fashion. The following general comments on using the engineering literature were made:

A lot of it comes from governmental web sites, which are a mess.
Engineering information is very diverse and held in many unrelated places - probably because it has had no central focus point to date where it could be collated. Many technical reports are uncatalogued and difficult to obtain even if they have been produced within (your own) internal organisation.
Engineering is a dynamic industry. Books are frequently out of date before they are put into print. Having completely abolished the use of my college learning centre, I turned to the Internet for more up to date information. I still believe I'm the first person to complete an HNC course without purchasing a single book.
ESDU for few Pounds, please...
I think that the cost of ESDU, patent information, journal subscriptions &c is proportional to their usefulness, and hence the best information is inaccessible for people who want it only for educational purposes.
I will be glad if you could assist me with some relevant materials, they as follows; helpful textbooks, magazines, journals etc.
Information (books, sources, standard specifications) is generally not indexed and very sparse on the internet
It would be very helpful if there was just one source of reference (institute, online database....) where an engineer could search for information and that source would be linked with all available databases.
Make searching for journals / databases / articles A LOT easier. Up to 50% of my time is spent understanding HOW to search for material.
One of the most important things is trust the information source.
Sometimes it is not easy to get some engineering information (books, reports, papers, etc) and once we got them we realise it wasn't exactly what we were looking for! Sometimes an abstract of what is it about or the books index might be helpful!
There should be a more readily available source of information available in one portal. For a fact work has been done on the areas I research but it's not out there!

Question 13. Do you have any comments you would like to make about using engineering information in general?

6.3.3. Questions about engineering technical reports

Respondents were asked if they could recall the last, or a recent occasion, when they had used a technical report. Nearly four-fifths (77%) replied that they could recall using a technical report, again demonstrating their importance to engineers.

No	14	22.95%
Yes	47	77.05%
Total	61	100.00%

Question 14. Can you recall the last (or a recent) occasion you used a technical report?

A third of respondents found the technical report on the Internet, a quarter from a reference in an article or book, and one-fifth through recommendation from a fellow member of staff (Question 15).

recommended by a member of staff	9	19.57%
recommended by someone else	2	4.35%
referred to in an article or book	11	23.91%
found in the library catalogue	5	10.87%
found in a subject database	4	8.70%
found on the Internet	15	32.61%
Other	0	0.00%
Total	46	100.00%

Question 15. How did you find out about the report?

Levels of discovery by recommendation and reference are similar to those found in the MAGiC impact study, however there are notable differences in findings regarding the use of the Internet and library catalogues. The impact study found that over half of reports were discovered in a library catalogue and none through the Internet, whereas this study found that only one in ten respondents became aware of a report through a library catalogue, and the Internet was the largest single source for discovery of reports.

Respondents were asked to give all the reasons they had decided to borrow a report (Question 16). Early answers to this question are not available due to a programming glitch (subsequently corrected), so the figures presented are based on the last twenty-four questionnaires received.

43% of reports were borrowed because they were relevant to current research, coursework or design projects. This was confirmed by 98% of respondents who said the subject matter of the report they used was relevant to their current work. The next largest reasons were for the references and the data the report contained.

relevant to current research	12	26.09%
relevant to coursework	1	2.17%
relevant to a design project	7	15.22%
for the methodology it contained	4	8.70%
for the data it contained	6	13.04%
for the references at the end	7	15.22%
as an introduction to the subject	2	4.35%
because no other information could be found on the subject	2	4.35%
to investigate a new research area	1	2.17%
because it was available immediately	4	8.70%
Other	0	0.00%
TOTAL	46	100.00%

Question 16. Why did you decide to borrow the report?

When the report was borrowed, 61% of respondents read it fully, whereas 39% were selective about which parts of the report they read. Of those who read only parts of the report, the results and conclusions were most popular, followed by the abstract - the same three sections which came top in the impact study.

Abstract	14	16.47%
Introduction	12	14.12%
Methodology	11	12.94%
Results	17	20.00%
Conclusions	19	22.35%
References	12	14.12%
TOTAL	85	100.00%

Question 17b. If you read the report partially, can you remember which parts you read?

When asked if the contents of the report met their needs, 98% of respondents said the report has either partially (71%) or fully (27%) met their need (Question 18). This is substantiated by 80% of the replies that said the report was useful to their current work and 18% to their future work.

fully	12	26.67%
partially	32	71.11%
not at all	1	2.22%
Total	45	100.00%

Question 18. Did the contents of the report meet your need or expectation?

43% of respondents obtained new knowledge from the report, whereas only 18% stated that the report helped them to solve a problem (Question 19). These figures closely mirror the findings of the impact study.

give new knowledge	35	42.68%
Refresh your memory of details or facts	13	15.85%
substantiate a hypothesis	10	12.20%
save time	7	8.54%
help solve a problem	15	18.29%
other	2	2.44%
TOTAL	82	100.00%

Question 19. How did the report help you?

An overwhelming majority of respondents (98%) did not have to pay to obtain the report. Therefore not surprisingly, when asked how much they would be prepared to pay to acquire a report, 73% stated that they would pay only £5 or less, and 22% would be prepared to pay up to £20.

less than £5	27	72.97%
£5 to £20	8	21.62%
£21 to £50	1	2.70%
£51 to £100	1	2.70%
More than £100	0	0.00%
Total	37	100.00%

Question 21. How much would you be prepared to pay?

6.3.4. Comments and willingness to participate in engineering grey literature discussions

Respondent comments provided some confirmation that technical reports can be hard to find and obtain, and that there is a reluctance to pay for them.

Can be very difficult to track down. Often have release restrictions - can be hard to persuade holder to release a copy.
Hard to find!
I search for free information.
Provide them free
Technical Reports often contain a wealth of knowledge of experience. If not used/accessed we do not learn from experience and repeat the same mistakes.
The use of key words is critical to success in my finding the report.

Do you have any comments you would like to make specifically about technical reports?

Of the 67 respondents, 17 (25%) indicated that would be interested in receiving further news from the MAGiC project or taking part in topic discussions, which indicates a high level of interest in the provision of engineering technical reports.

6.4. Conclusions

Although the number of returns is relatively small, this study provides confirmation of the results provided by the literature review and impact study, and mirrors the research results obtained, in the past, by EURILIA, AIM-UK and AIM-EU:

- Engineers spend a significant proportion of their time using scientific and technical information;
- Engineers needing technical information tend to use the most accessible sources rather than the highest quality sources;
- Engineers are reluctant users of formal information sources;
- Engineers maybe missing significant information through lack of awareness of information sources;

- Increasingly, engineers are frequent users of the Internet, which is used to locate information for their work;
- Most engineers use technical reports at some time;
- Technical reports are important and useful to engineers, but can be hard to find.

These points highlight the need for an Internet-based solution, providing easily searchable bibliographic details of individual technical reports, linked to online full-text documents (where available) or offering an effective and low-cost document supply option.

7. Mapping and collection management

7.1. Introduction

An important objective of the MAGiC project is to improve the management of engineering technical literature collections, thus raising the visibility of engineering technical reports in the UK. In order to achieve this, it is necessary first to identify:

- The producers of reports;
- Bibliographic records describing the reports;
- Collections where reports are held.

Taken together, Chapters 7 and 8 document our attempts to understand the problems in managing grey literature collections, and to provide solutions that work toward the goal of improved management of those collections. This is far from a trivial task, and there is much to be considered.

The mapping of reports production and collections, dealt with in this chapter, is an important first step in achieving the goal of improved collection management. Chapter 8 contributes to the goal by examining the issues related to unlocking the potential of reports within individual collections, focussing on the development of a methodology to prioritise reports for digitisation.

This chapter addresses the following issues relating to the production, management and location of technical reports:

- Understanding the complexity of issues relating to technical reports through a case study of the reports produced by the Aeronautical Research Council;
- Exploring collection rationalisation through a brief case study of DERA and its predecessors;
- Examination of reports metadata cataloguing practices in the UK;
- A new approach to the management of technical reports – solutions to the problems identified.

It further describes the work undertaken to address:

- Mapping reports production;
- Mapping map key holdings in the public domain;
- A summary of findings.

The mapping exercise represents a first step and is a fundamental precursor to the creation of an engineering National Reports Catalogue that will improve the visibility, access, and use of technical reports in the UK.

7.2. Understanding complexity

It has long been recognised that the issues surrounding the production and dissemination of engineering technical reports (and indeed all forms of grey literature) are complex. If it were otherwise, and the issues were simple, an all-encompassing system for the management of technical reports would have been put into operation years ago - and the MAGiC project itself would not exist. While the complexity of issues is well recognised, that complexity is, perhaps, less well understood.

In order to reveal the scope of the problem, we decided to begin, as an example, with an initial investigation into the history and cataloguing of Aeronautical Research Council reports. ARC reports were selected for a number of reasons.

As stated by Auger (1998): “In Great Britain, the principal agency with a major output of reports on matters aeronautical was the Aeronautical Research Council (ARC)”. It went through several changes in name, though its functions remained virtually unchanged. The ARC “was concerned

purely with research as distinct from development", and throughout most of the twentieth century, published several distinct series of technical reports.

The reports series collectively represent a body of research of the highest quality and international reputation. They are, therefore, an important national resource. As such, the reports represent an ideal study to test some of our assumptions, and to reveal the complexities of controlling reports. By gaining an in depth understanding of their history it becomes possible to begin the process that will help raise their visibility, improve their availability, and increase their use.

The study, below, is a first step towards fulfilling two important objectives of the MAGiC project: "to enhance the searchability of ARC reports" and "make a subset of the most important of these available electronically as part of the development of the full-text archive" (MAGiC 2000), and the investigation tests the following assumptions, which were made at the start of the project:

- Major collections of technical reports tend to be scattered across academia, government and industry;
- These resources are difficult to identify, locate and access;
- Bibliographic references to report literature are embedded in library catalogues.

7.2.1. Reports of the ARC – scoping the problem

The Aeronautical Research Council (ARC) existed, in various incarnations, between 1909 and 1979 (see Table 7-1 below), and published reports until 1980. The main function of the ARC was to identify areas of technical need and to direct research by academia, government and industry to those areas. Published ARC reports were rigorously peer-reviewed by expert panels, and thus collectively represent a body of research of the highest quality and international reputation.

Advisory Committee on Aeronautics	1909 – 1920
Aeronautical Research Committee	1920 – 1945
Aeronautical Research Council	1945 – 1979

Table 7-1 History of the ARC

There were four major reports series produced:

- Reports & Memoranda (R&M), 1909-1980, numbers 1-3850, highest quality refereed reports
- Current Papers (CP), 1950-1976, numbers 1-1393, refereed
- Typed Reports (T), 1910-1941, numbers 1-4300?, often not in the public domain
- Unprefixed, 1935?-1980, numbers 1-38393, often not in the public domain

Reports & Memoranda and Current Papers were usually revised versions of existing reports. Reports from the R&M series were also brought together, each year, in a bound volume known as the annual Technical Report. The Royal Aircraft Establishment (RAE) was the largest corporate source of original versions of these reports and many can be found in both ARC and RAE reports series.

The reports are referred to commonly as 'Aeronautical Research Council' reports, however, earlier reports, when the organisation was constituted as the Advisory Committee on Aeronautics, were given an 'ACA' prefix, while middle period reports were Aeronautical Research Committee reports. So in fact, the R&M series is composed of three contiguous sub-series, as shown in Table 7-2.

Advisory Committee on Aeronautics	ACA/R&M	1909-1920	numbers 1-673
Aeronautical Research Committee	ARC/R&M	1920-1945	numbers 674-2041
Aeronautical Research Council	ARC/R&M	1945-1980	numbers 2042-3850

Table 7-2 Reports and Memoranda expressed as three sub-series

The R&M and CP series both contain reports that index or list other reports in those series, and thus acts as 'finding aids' to those series. The R&M series features reports that provide author and other indexes for different time periods, and usefully, every fiftieth report in the CP series is a list detailing the preceding forty-nine reports.

Reports in the series are numbered sequentially, however, there are some gaps in the numbering. So, for example, ARC/CP-528, which does not exist, is listed in ARC/CP-550 as 'Cancelled as C.P.' (Aeronautical Research Council, 1962).

As much is already known about ARC reports, they make an ideal body of material on which to base an examination of technical reports cataloguing practices in the UK.

ARC reports cataloguing in the UK.

The methodology employed to investigate cataloguing practices was the use of direct searches of publicly available library catalogues, beginning with a simple keyword search for 'aeronautical research council'.

The catalogues of the several national institutions were examined (see Table 7-3). The British Library and the Institution of Civil Engineers (ICE) both treat ARC reports as serials – the reports are not individually catalogued. The PRO and the Institution of Electrical Engineers (IEE) both catalogue individual reports, however records at the PRO are very 'thin' and the IEE had less than ten ARC reports listed in their catalogue.

National Institutions	ARC Report Series				Comments
	R&M	CP	Unpref.	T	
British Library	S	S	S		
PRO			I	I	
Institution of Civil Engineers	S	S			
Institution of Electrical Engineers	I				Less than 10 items
Key: S = series level cataloguing, I = item level cataloguing					

Table 7-3 Cataloguing of ARC reports at National Institutions

Using a list provided and maintained by the National Information Services and Systems (NISS 2002), cataloguing of ARC reports in library catalogues at Higher Education Institutions was investigated (see Table 7-4). From the results obtained, it is apparent that, like BL and ICE, the vast majority of HE institutions treat ARC reports as serials. Institutions that catalogued individual ARC reports had less than seventy reports, the only the exception was Cranfield University with holdings in excess of 11,000 ARC reports, all individually catalogued.

Higher Education Institutions	ARC Report Series				Comments
	R&M	CP	Unpref.	T	
Birmingham, University of	S	S			
Bristol, University of	S	S			Some item level, but no detail
Brunel University	S				Less than 10 R&M and CP at item level
Cambridge, University of	S	S			Found using Title search in Union List of Serials
Cardiff University	I		I		Less than 70 items
City University, London	S	S			
Cranfield University	I	I	I		
Durham, University of	S	S			
Exeter, University of	S	S			
Imperial College of Science, Technology and Medicine, University of London	S	S			
Kingston University	S	S			
Leeds, University of	S	S			
Liverpool, University of	S	S			
Loughborough University	S	S			

Manchester, University of, Institute of Science and Technology (UMIST)	I	I			Less than 30 items
Newcastle University	S				
Oxford University		S			
Queen Mary & Westfield College, University of London	S	S			
Queen's University Belfast	I	I			11 items
Southampton, University of		S			
Strathclyde, University of	S				
Swansea, University of Wales	S				
University College London	S	S			
York, University of	S				

Table 7-4 Cataloguing of ARC reports at HE Institutions (Key: S = series level, I = item level)

The cataloguing practices and amount of detail provided by institutions that treated the reports series as serials varied greatly. Some catalogued the three R&M sub-series separately, others as one series. In some cases indication of actual holdings was minimal or non-existent, however, in many cases information was given as to which report numbers the institution holds and lacks. This will allow institutions, to compare their holdings against master metadata sets of reports series in the National Reports Catalogue with relative ease.

Conclusions

This investigation confirms that ARC reports are scattered in collections around the country. In the majority of instances, bibliographic references to the reports are not embedded in library catalogues, and, due to the practice of treating report series as serials, the reports are likely to be difficult to identify, locate and access.

The lack of cataloguing base for, and hence knowledge of, individual reports has important implications for collection mapping, collection rationalisation, and the provision of a National Reports Catalogue:

- In order to begin mapping collections, it becomes necessary to build up a general picture of which report series are held in which libraries – a collection level description - before going on to a detailed investigation of their individual reports holdings.
- Without widespread individual cataloguing of reports, it becomes impossible to build "a distributed National Reports Catalogue ... by implementing a system architecture based around the Z39.50 protocol [to] give access to specifically identified Library catalogues, other external databases and web resources" (MAGiC 2000a). However by harvesting reports metadata from sources that do individually catalogue reports, it becomes possible to build a central repository that effectively mitigates the paucity of cataloguing.
- While, in the short term, the possibility of creating consolidated collections through rationalisation of holdings is limited, in the mid- to long-term, by measuring reports collections against the records in the National Reports Catalogue, it will be eminently achievable.

The next section examines the task of collection rationalisation in greater detail.

7.3. Collection Rationalisation

The MAGiC proposal stated that the "creation of a … National Reports Catalogue, and associated full text reports archive, would assist the identification, location and supply of engineering report literature", as well as providing the Public Record Office (PRO) and others "with a framework in which to review collection management, retention and disposition policies, as applied to science and technology grey literature" (MAGiC 2000).

This is very fitting in the context of the disposition policy for the PRO (2000), which sets out principles and criteria underlying future decisions to offer public records to bodies other than the PRO, either as a deposit or presentation. This identifies scientific and technical reports as an

example of 'national specialist records', and a category of material to which the new policy should be applied, and confirms the PRO's intention "to develop partnerships with other institutions for the preservation of such material". In developing the policy, the PRO wishes to ensure that records of research value are preserved in the most appropriate repository and disseminated to the widest user community.

In order to examine the feasibility and implications of collection rationalisation, in addition to scrutiny of ARC reports, the team has also investigated the history of the Defence Evaluation Research Agency (DERA) and the report series produced by one of its major predecessors - the Royal Aircraft Establishment (RAE).

7.3.1. DERA and its predecessors

DERA existed between 1995 and 2001, when it was divided into two new organisations – Dstl and QinetiQ. DERA itself replaced five organisations:

- Defence Research Agency
- Defence Operational Analysis Centre
- Army Personnel Research Establishment
- Chemical & Biological Defence Establishment
- Defence Test & Evaluation Organisation

Each of these organisations had its own predecessors, and in fact, the DERA family tree embraces over sixty-five distinct organisations, with the earliest – the Admiralty Experiment Works – dating back to 1879 (See Appendix C). Throughout the twentieth century, the various establishments and facilities changed names, merged or were divided into other organisations. Virtually all of these organisations produced technical reports, which were assigned to various report series.

A brief consideration of the reports produced by just one of DERA's predecessors, the Royal Aircraft Establishment (RAE), highlights the sheer complexity of any attempt to understand and control the production of technical reports.

The RAE existed between 1918 and 1988. As revealed in a report detailing technical reports series produced by the RAE and its predecessors (Thornton, S. A., 1979), in that period, departments changed names, merged or were divided into other smaller departments and the RAE was responsible for the creation of many thousands of reports in over one-hundred distinct report series. Prior to August 1964, each department produced its own series of documents. From August 1964, all Technical Reports and Technical Notes series were consolidated into one RAE Technical Reports series, with a five-figure reference number composed of two digits identifying the year the document was published and a three-figure serial number. Also, in September 1964, Technical Memoranda, which previously were intended for internal use only, became a more formal means of communication. These were issued with the prefix of the originating department under a variety of numbering schemes.

Like ARC reports, RAE reports are to be found in collections scattered throughout the UK. Clearly, without a knowledge of the history of DERA and its predecessors, a comprehensive understanding of the reports series they produced is not possible. And, without an understanding of the extent of those series as created, libraries and archives lack the information they require to measure the completeness and extent of reports holdings in their own collections, even where reports have been catalogued individually.

7.4. Reports metadata cataloguing practices

While many organisations do not catalogue individual reports, there are also many that do, however, cataloguing practices vary considerably both within and between organisations.

Figures 7-2, 7-3 and 7-4, below, show three records for the same report from the National Engineering Laboratory – NEL-678 – as catalogued by King's Norton and Silsoe libraries at Cranfield

University, and Cardiff University library. The level of detail varies greatly, and divers MARC fields have been used to convey the same information in a variety of ways.

```
041: eng
100: Grattan, E
245: Two-phase flow through gate valves and orifice plates / E Grattan et al
260: East Kilbride: National Engineering Laboratory, 1981
300: 34 p; 30 cm
440: (NEL report)
490: (NEL-678)
507: Affiliation: University of Strathclyde, Glasgow: Department of Thermodynamics
and Fluid Mechanics University of Strathclyde, Glasgow: Department of
Thermodynamics and Fluid Mechanics University of Strathclyde, Glasgow: Department
of Thermodynamics and Fluid Mechanics
700: Simpson, H C
700: Rooney, D H
710: National Engineering Laboratory
970: Reports NEL-678
```

Figure 7-1 Kings Norton Library catalogue record for NEL-678

```
110: National Engineering Laboratory
245: Two-phase flow through gate valves and orifice plates / by E. Grattan and
others
260: : Department of Industry, 1981
440: (Nel report ; 678)
700: Grattan, E
972: 532.52
```

Figure 7-2 Silsoe Library catalogue record for NEL-678

```
Author:  Grattan, E.
Title:   Two-phase flow through gate valves and orifice plates / by E.Grattan,
D.H.Rooney and H.C.Simpson.
Publisher:  Glasgow : N.E.L., 1981.
Description:  34p.
Control No.:  X20050771X
Series:  NEL reports ; 678
Other Contributors:  Rooney, D.H.
Simpson, H. C.
```

Figure 7-3 Cardiff University library catalogue record for NEL-678

Report numbers are entered in a number of different ways, and information about the authors, publishers and corporate sources vary greatly. Where they are applied, a variety of classification schemes are employed. Further examination of other library catalogues has confirmed that inconsistencies are the norm in application of MARC fields to disparate parts of the bibliographic data. These variations are a clear hindrance to resource discovery. The adoption of the National Reports Catalogue, containing standardised master metadata sets for reports would offer improvements both to the management and discovery of reports.

Although it is unlikely to be applied retrospectively, a further possibility for improving access to technical reports, now and in the future, would be the promotion and adoption of the International Standard Report Number (ISRN) as recommended in the ANSI/NISO standard Z39.23-1997 (NISO 1997).

7.5. A new approach to the management of technical reports

Our investigations have shown that the management and discovery of engineering technical reports in the UK is beset by three problems:

- Reports are dispersed in collections scattered across the country;
- Reports series, as produced, are complex;
- The cataloguing of reports is generally poor or inconsistent.

As a solution, the MAGiC team suggests that the accurate identification of report series as produced, and the creation of single master metadata sets for those series, linked to producers and collections in a National Reports Catalogue, would provide a system that effectively:

- Removes the need for libraries to catalogue reports holdings in detail themselves;
- Serves as a comprehensive reference point for the understanding of reports series;
- Offers a standard by which collections may be measured.

The ARC and RAE are just two corporate sources out of many hundreds to be considered in the UK, but they do reveal many key attributes required for understanding the production of reports. Figure 7-4, below, illustrates a highly simplified and generalised case, considering the relationships between a single corporate source, the reports series it has produced, the reports belonging to those series and the collections in which those reports are to be found. One source may be responsible for the production of reports in several series. Various reports are located in a number of collections, some of which have treated the reports as serials, while others have individually catalogued the reports. In order to facilitate the mapping, management and rationalisation of reports in the UK, it is these relationships which will need to be represented in the design of an engineering National Reports Catalogue.

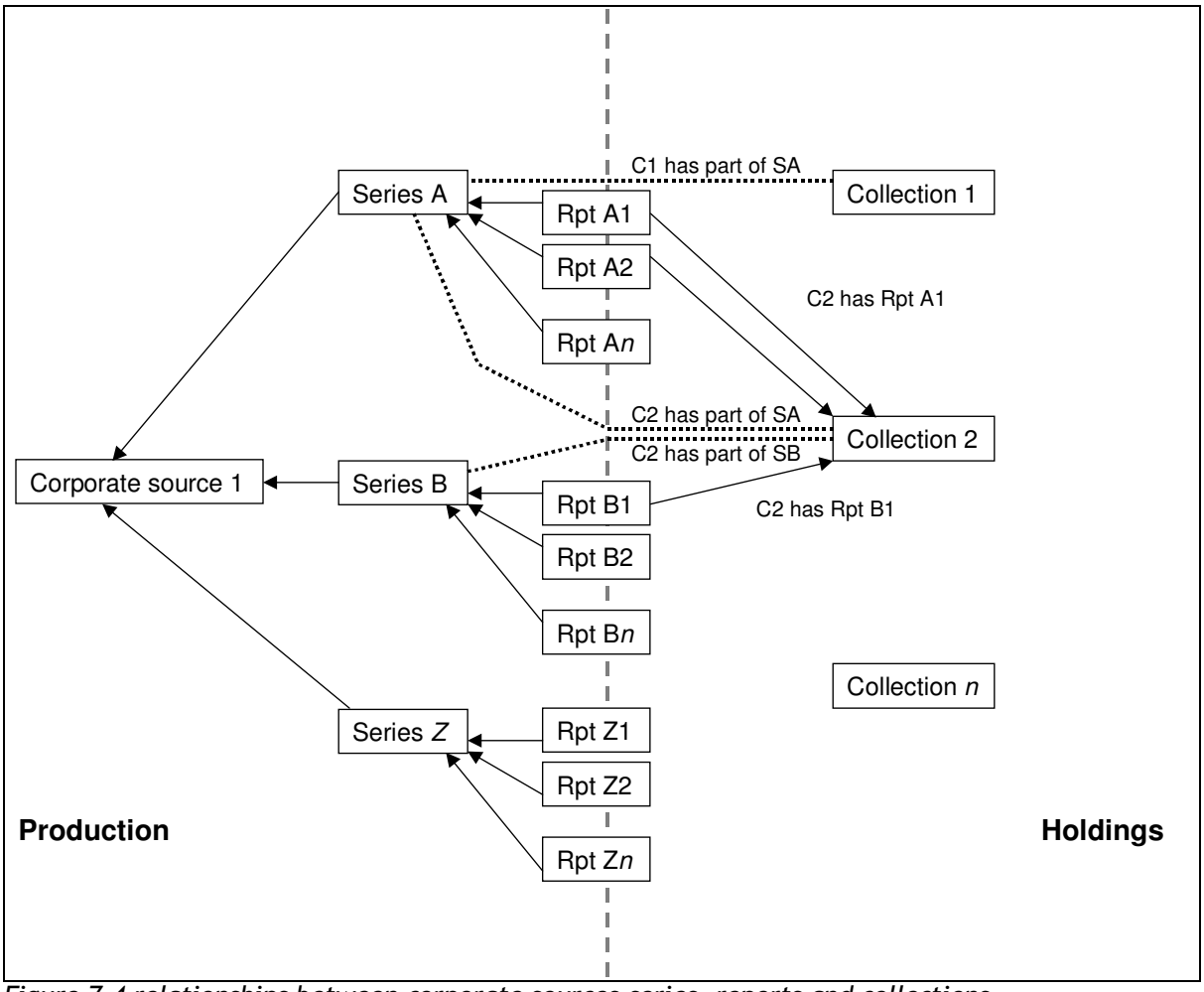

Figure 7-4 relationships between corporate sources,series, reports and collections

Because of the complexities in understanding the production of reports and because collections tend to be scattered and incomplete, and cataloguing rudimentary, two forms of mapping are required. One provides a real-world view of who are producing reports and where collections are held. The second, the provision of an idealised view of significant reports series as produced, enables collection managers to have better appreciation of the completeness of their own collections.

The approach developed by the team will facilitate collection management by providing a solution to the paucity of technical reports cataloguing.

7.6. Mapping reports production

While the task of understanding reports production is complex, it is never the less achievable. There are a number of 'signposts', or finding aids, which assist in identifying which organisations produce engineering technical reports, and provide some of the information necessary to begin the creation of master metadata sets for report series.

7.6.1. Signposts

The British Library has, in the past, produced several editions of the Alphanumeric Reports and Publications Index – ARPI. The third edition (ARPI 1995) lists over 12,000 report series, of these more than 2,000 are series produced by organisations in the UK. Entries in ARPI link corporate sources to report series prefixes and their BL shelfmark. While the corporate sources are not classified into subject areas, by cross-referencing with other directories and indexes, e.g. the ASLIB Directory of Information Sources in the UK (ASLIB, 1998), it is possible to identify organisations that produce reports relevant to engineers. So, ARPI would form an excellent basis for populating an engineering National Reports Catalogue with skeletal metadata about the corporate sources of reports and the report series they produce.

Another useful starting place for gaining an overview of reports production in the UK is the System for Information on Grey Literature (SIGLE 1999) database, produced by the European Association for Grey Literature Exploitation (EAGLE). The British Library supplies all UK entries (over 100,000) in the database, the records are classified by subject, and many are relevant to engineering.

While both ARPI and SIGLE provide names of organisations and basic information about some of the series they produce, they do not provide details of contact names or addresses, which are essential ingredients for the ongoing management of technical reports.

As revealed earlier, ARC and RAE report series include reports that themselves act as indexes or finding aids to the series, thus providing a series map and skeletal bibliographic records of the reports. This is also true of many other series including those produced by the Advisory Group on Aerospace Research and Development (AGARD), the British Hydromechanics Research Association (BHRA), the European Space Agency (ESA), the European Space Research Organisation (ESRO), the National Engineering Laboratory (NEL), the National Physical Laboratory (NPL) and the Transport and Road Research Laboratory (TRRL).

Increasingly, organisations are making lists, indexes and databases of their reports, and in many cases the reports themselves, available on the Internet through their web-sites. These include, for example, NIREX (2001), AEA Technology Environment (2002), Council for the Central Laboratory of the Research Councils (2002) and UKAEA Fusion (2002).

As engineers themselves are aware, one of the most important sources of information is people. There are many individuals in organisations, with a great deal of knowledge about the reports produced now and in the past, who have information about reports in their heads that is not recorded elsewhere. Such individuals act as a living knowledge bank, and their importance should not be under-estimated.

The very fact that there are so many different sources available, providing information about the reports that organisations produce, again highlights the desirability of a system of reports management that brings all this information together in one place.

7.6.2. Preliminary reports producers questionnaires

To begin the process of establishing the landscape of reports production in the UK and to identify individuals with knowledge of reports, with a view to the creation of a National Reports Catalogue, the MAGiC team produced two versions of a reports producers preliminary questionnaire (see Appendix D), one in hardcopy and the other web-based.

The hardcopy questionnaire was sent out, along with an explanatory cover letter (see Appendix E), to two hundred and sixty one organizations. These were identified as likely producers of engineering technical reports by cross-referencing BL's ARPI (ARPI, 1995), which does not have any subject classification, with the ASLIB Directory of Information Sources in the United Kingdom (ASLIB, 1998), which does classify organizations and the SIGLE database. The online version (which remains available at http://www.magic.ac.uk/producers.html) was widely promoted via a number of HE mailing lists, engineering institutions, newsletters and engineering discussion forums.

In order to maximise the chances of obtaining returns, staff at Cranfield University library went to great lengths to identify the appropriate contact details at listed organisations before the questionnaires were sent out. In the course of the task, several problems were encountered, and the work took several weeks - far longer than anticipated. Some of these problems are highlighted:

- Organisation produced reports, but not of a technical variety.
- When departments or specific areas of large organisations were not given, identifying which part of an organisation to send the questionnaire to was problematic, e.g. Rolls Royce PLC.
- Where departments/subject areas were given, often they no longer existed, having been taken over or merged.
- Staff were unable to find phone numbers or any details for some organisations. (Presumably they no longer exist or have changed names, been taken over or merged).
- A number of listed parties are/were based within AEA Technology, which has been going through a period of change and reorganisation, making individuals very hard to locate.
- Some centres span more than one site with relevant contacts working between sites, creating problems with regard to whom and where the most appropriate contacts were.
- Many organisations could not identify the relevant persons to whom questionnaires should be sent. They do not have specific posts relating to the production, management and dissemination of reports. Many staff involved in reports have now left.
- Larger organisations that once had resource centres and libraries have closed them down in order to save money.

This resulted in a significant reduction in the number of potential contacts, from an original list of nearly 400, down to the 261 questionnaires actually sent out.

Forty-four hardcopy questionnaires were returned, 17% of the number issued, and three online forms were received. Nine out of ten of the respondents stated that their organisations produce reports (Table 7-5). Given that organisations polled were identified from ARPI and SIGLE, in theory, this figure might have been expected to be 100%. That it is less is a reflection of the difficulties listed above.

Hardcopy questionnaires sent out	261
Hardcopy returns	44
Technical reports producers	39
Online returns	3
Technical reports producers	3

Table 7-5 Reports producers questionnaires

Responses were received from a wide range of organisations representing academia, government, industry and others such as engineering institutions, learned societies and consultancies (table 7-6).

Academia	15	36%
Government	9	21%
Industry	12	29%
Other	6	14%

Table 7-6 Number of respondents by sector.

Half of the organisations produce less than twenty reports per year; a third produce between twenty and one hundred reports per year. One in ten organisations produce between one hundred and five hundred reports, with only one in twenty producing in excess of five hundred (table 7-7).

Less than 20	21	50%
20 to 100	14	33%
100 to 500	4	10%
More than 500	2	5%

Table 7-7 Number of reports produced per year

96% of the organisations make their reports available externally, with 93% supplying reports on request or making them available electronically (tables 7-8 and 7-9). That so many organisations are prepared to make their reports available highlights the need for a system that makes those reports easy to manage, locate and access.

Yes	40	96%
No	1	2%

Table 7-8 Are reports made available externally?

Yes	38	93%
No	1	2%

Table 7-9 Are reports supplied on request?

The individuals who responded positively to the questionnaire effectively form the basis of a core community of reports producers, which can actively participate in the laying the foundations of the National Reports Catalogue. The data contained in the returns from the preliminary reports producers questionnaire, regarding reports production and contact details for each organisation, has been used to begin populating the 'Corporate Sources' table of the demonstration version of the Catalogue (see Chapter 9).

7.7. Mapping collections

7.7.1. Introduction

Mapping which reports are held in which collections is an enormous undertaking. To give some idea of the scale of the task: Cranfield University library currently has more than 120,000 reports in over 1,400 series (see Appendix F) from over 300 different corporate sources (see Appendix G). The Institution of Civil Engineers holds in excess of 15,000 reports in 500 report series. Add to this the complexity of report series as produced, and the lack of cataloguing at many organisations, and it becomes clear that the mapping exercise needs to be carried out in several stages.

Again, one of the most important sources of information is people. There are many individuals in organisations, with a great deal of knowledge about their reports collections. In order to gain a comprehensive overview of collections, it is extremely useful to engage these individuals in the mapping exercise.

A first logical step, then, is to identify which organisations have technical reports holdings and the individuals concerned, in order to build a collection level description of their holdings. Once this information has been acquired, it is then possible to re-visit individual collections and gradually build up a more detailed picture revealing which report series they hold, and then moving on to the reports themselves.

7.7.2. Preliminary reports holdings questionnaires

To begin the process of building up a series of collection level descriptions, for inclusion in the National Reports Catalogue, the MAGiC team produced two versions of a preliminary reports holdings questionnaire (see Appendix H), one in hardcopy and the other web-based.

The hardcopy questionnaire was sent out to one hundred and sixty seven organizations, along with an explanatory cover letter (see Appendix I), comprising academic libraries, engineering institutions and various other companies and research institutes. The online version (which remains available at http://www.magic.ac.uk/holdings.html) was widely promoted via a number of HE mailing lists, engineering institutions, newsletters and engineering discussion forums.

Thirty-seven hardcopy questionnaires were returned, 22% of the number issued, and eight online forms were received (table 7-10). 56% of all respondents stated that their organisations have some technical reports holdings.

Hardcopy questionnaires sent out	167
Hardcopy returns	37
Technical reports holdings	17
Online returns	8
Technical reports holdings	8

Table 7-10 Preliminary reports holdings questionnaires

Six out of ten responses were received from academia; nearly a third from engineering institutions and consultancies; and a small number came from government and industry (table 7-11).

Academia	15	60%
Government	1	4%
Industry	2	8%
Other	7	28%

Table 7-11 Responses by sector.

Nine out of ten respondents stated that their reports holdings were indexed or catalogued (table 7-12). Nearly half of those respondents do not catalogue individual reports; and those that do tend to hold only a small number of reports (table 7-13). Additionally, less than half of those respondents were able to identify reports as a separate category in their catalogues (table 7-14).

Yes	22	88%
No	3	12%

Table 7-12 Are your reports holdings indexed or catalogued?

Individually	13	59%
Serials	4	18%
It varies	5	23%

Table 7-13 Are reports indexed individually or as serials?

Yes	13	59%
No	4	18%
It varies	5	23%

Table 7-14 Can you identify reports as a separate category?

These results reinforce the findings of the study of ARC reports, confirming that reports series are often treated as serials, particularly within academia, making them difficult to identify, locate and access. The inability to identify reports separately from other holdings also limits the possibilities of managing and developing reports collections effectively.

The individuals who responded positively to the questionnaire effectively form the basis of a core community of reports holders, which can actively participate in the laying the foundations of the National Reports Catalogue. The data contained in the returns from the preliminary reports holdings questionnaire has been used to begin populating the 'Collections' table of the demonstration version of the National Reports Catalogue (see Chapter 9).

7.8. Summary

Our investigations have shown that cataloguing of engineering technical reports is of poor quality and is inconsistent, both within and between libraries.

In general, academic libraries treat reports series as periodicals and have only a single catalogue entry at series level. Where there is item level cataloguing, report numbers are entered inconsistently and few library catalogues allow collections to be searched by reports as a separate category.

Libraries in industry and government generally do catalogue reports individually, however access to their catalogue records is problematic for reasons of commercial sensitivity and security. In addition, many libraries in these sectors are currently closing down with a reduction in potentially searchable resources.

The preliminary questionnaires represent the first step in identifying those organisations producing and holding technical reports. Nearly sixty individuals registered an interest in providing further information and participating in the National Reports Catalogue. Those individuals, and the organisations they represent, form the core of a UK engineering technical reports stakeholder community.

It is the formation of such a community that will make it possible to populate the National Reports Catalogue and to move, from a generalised high-level picture of organisations involved with technical reports, to a detailed understanding of the production, location and supply of the reports themselves.

Collaboration, cooperation and active participation are three of the most important keys to the foundation of a sustainable National Reports Catalogue, which will increase the visibility of, and improve the management of, engineering technical reports in the UK.

8. Developing a collection analysis methodology

8.1. Introduction

One of our key objectives has been to examine the feasibility of developing a collection analysis methodology to enable libraries and archives to identify the most important documents within a collection, in order to prioritise material for digitisation.

We wanted to find out if it is possible to aid collection managers looking to undertake retrospective digitisations of a number of reports in their collections. Recognising that close examination of collections can be an expensive process, our task is to discover whether it is feasible to create a collection analysis methodology which is practical, useful and affordable.

In attempting to construct a set of collection analysis tools, the MAGiC team has conducted investigations into both quantitative and qualitative indicators. The results of these investigations, and recommendations based on our findings, are presented in the remainder of this chapter.

8.2. A preliminary investigation into the efficacy of citation analysis in selecting reports for digitisation.

8.2.1. Introduction

A possible selection criterion for material to be digitised is that of previous use. Usage can be measured by the number of times a report is borrowed from libraries or requested through interlibrary loan but these are local measures. One possible method of discerning use globally is to use citation analysis. This rests on the presumption that the more often a report is cited the more it has been used and therefore the more valuable or useful it is.

This investigation was to see if this was a plausible method for the selection of reports. It was therefore interested in establishing how often technical reports were cited in the literature, if more than one researcher has used the same report and if any reports stood out as key references.

8.2.2. Methodology

Using the Science Citation Index, volume 213 of the *Proceedings of the Institute of Mechanical Engineers Part C - Journal of mechanical engineering science (1999)* was chosen for analysis. The references for each article were viewed and those to reports were picked out and entered into an Excel spreadsheet. A citation search was performed for each report to see how many other papers cited it and the results entered into the spreadsheet.

8.2.3. Obstacles

A common problem with citation analysis is the quality of the references. References can be incomplete, inaccurate and/or inconsistent. Sometimes it is also difficult to discern which are technical reports without looking at the journal article itself. In this study an 'educated guess' was used by a subject specialist. It was decided that conference or meeting papers should not be included, even if they are published separately rather than as part of a proceedings. However, lecture series were included in the definition of a 'technical report'. Appendix J lists the references searched upon.

A first approach was to use the 'related records' search for the report references. This searches the database for articles with references in common with the original article. By using the checkboxes beside each to only select the report references, this would have been a quick method to establish how often the report had been cited. Using this method, not one of the reports was cited by other papers.

The second approach was to perform a citation search on the author's surname with first initial truncated, and date, to pick up all the variations in citing patterns of the same report. An example of inconsistent referencing is:

1	KATSANIS T	D2546 NASA	1964
1	KATSANIS T	D2546 NASA TN	1964
1	KATSANIS T	TN2546 NASA	1964

This is the reason the 'related records' search produced a nil result. It looks for references that are exactly the same. In this example three papers refer to NASA TN 2546, but all have referred to it differently.

8.2.4. Results

There were 66 articles in volume 213, which contained 1244 references. Of these, 62 references were to technical reports. This is 5% of the total. Of these 62, 4 were referred to by more than one paper within volume 213, leaving 58 unique references.

Using the cited reference search, 21 unique references out of the 58 were cited more than once (36%). 12 were cited twice, 2 were cited three times, 3 were cited 6 times, and the four remaining were cited 11, 18, 84 and 752 times. 37 were single citations (64%); 18 were from the 1990s, 13 from the 1980s, 8 from the 1970s, 10 from the 1960s, 5 from the 1950s, and 1 from the 1940s.

8.2.5. Discussion

One question is: are we providing access to popular reports, that is reports which are already widely known about in the literature, or are we opening up access to reports which otherwise would not have been found? If the former, then from these results, citation analysis may help to identify reports for digitisation, as there are a small number of highly cited reports. If the latter, it is next to useless.

However, it is a very time consuming exercise and to get a good coverage of the literature the number of references to be checked will be large. In this example, if reports with over 10 citations were digitised, then four out of 58 would be contenders - just 7% of the report references and 0.3% of the total number of references checked.

Almost two-thirds of the reports were single citations. This indicates that the majority of reports are not widely used. Although this test sample is not big enough to be indicative of the general picture this result is in line with other findings of how engineers obtain and use information.

8.3. Analysis of circulation data at Cranfield Library

8.3.1. Discussion on issues versus issues/renewals

The first important question is to consider which loan statistics are the most meaningful - simple issue figures, or issues and renewals together. It could be assumed that counting issues and renewals would show a higher and more meaningful pattern of use, but does a single issue and 30 renewals for the same person, show that a report is of higher value than a report with 4 issues to four different people. How is the importance of a report to be measured?

For items where issues and renewals were counted, the vast majority of those issued/renewed 10 times or over in 1999-2000, were actually only issued once and renewed the rest of the time. (The raw data underlying this discussion is given in Appendix Q.)

Of the 82 reports identified as having high issue/renewal rates in the same period, (over 10) none had been borrowed by more than three users. Three reports had been borrowed by three users, thirteen reports had been borrowed by two people, and 66 reports had only been borrowed by one person but then renewed between one and 68 times. Only one was charged three times in the same academic year and this appears in the issue only list.

Reports are generally very specific and so it may be assumed that in a postgraduate institution individual students will be researching in slightly different areas. Where a report is relevant to a research area, there may be a need for constant reference to that report and so it is issued and

then regularly renewed. Often the detailed analysis shows that a report has been issued early in the academic year, and then renewed throughout the year, and returned at the end of the academic year.

The only method of really measuring how important these reports were to the users is to undertake an impact study (see Chapter 5).

8.3.2. Number of users per report

The simplest measure of identifying the number of different users of a report is to use issue data alone.

The average users per borrowed report show that a report issued and renewed is often only renewed by the same person, whereas a simple count of issues lists different users of a report. The average number of users for a 'high use' issued/renewed report in 1999-2000 is 1.2 users. (Table 8-1).

1999/2000 issues/renewals	Ave. users per borrowed rpt
Rpts issued/renewed 20 times or over	1.3
Rpts issued/renewed 15-19 times	1.1
Rpts issued/renewed 10-14 times	1.3
All rpts issued/renewed 10 times or over	1.2

Table 8-1 Average number of borrowers per report - issues/renewals

The average for a high issue report in the same period ranged from 4 reports issued over 6 times, to 2.5 for those issue 3 times, with an average of 2.5 overall (Table 8-2).

1999/2000 issues	Ave. users per issued rpt
Rpts issued 6 times	4
Rpts issued 5 times	3.3
Rpts issued 4 times	2.8
Rpts issued 3 times	2.5

Table 8-2 Average number of borrowers per report - issues

8.3.3. Age of reports used

Data for both issues (figure 8-1) and issues/renewals (figure 8-2) in 1999-2000 show that the more heavily used reports were those published more recently in the 1990's.

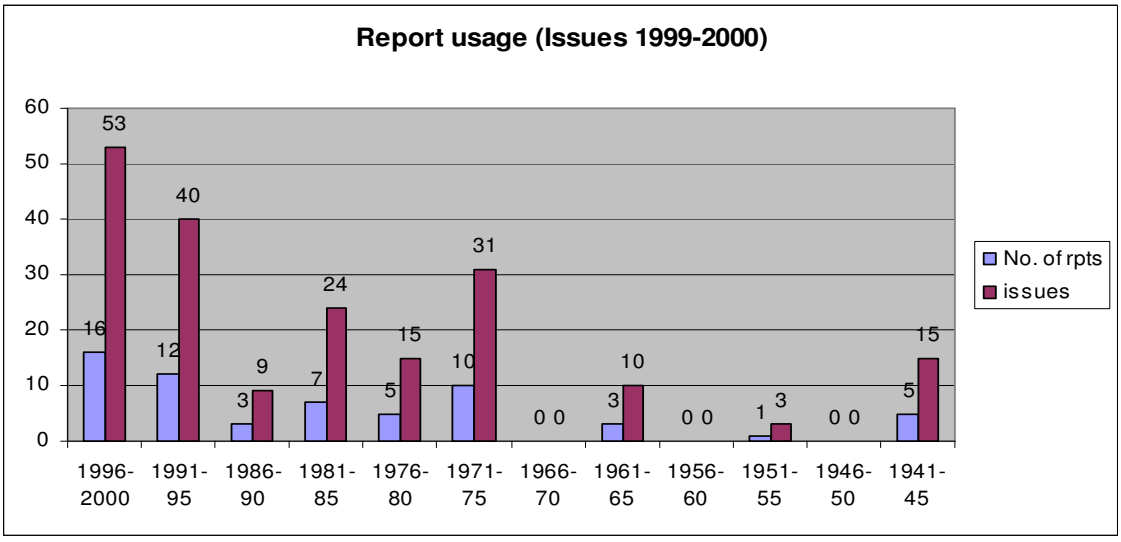

Figure 8-1 Report usage by date range - issues (1999-2000)

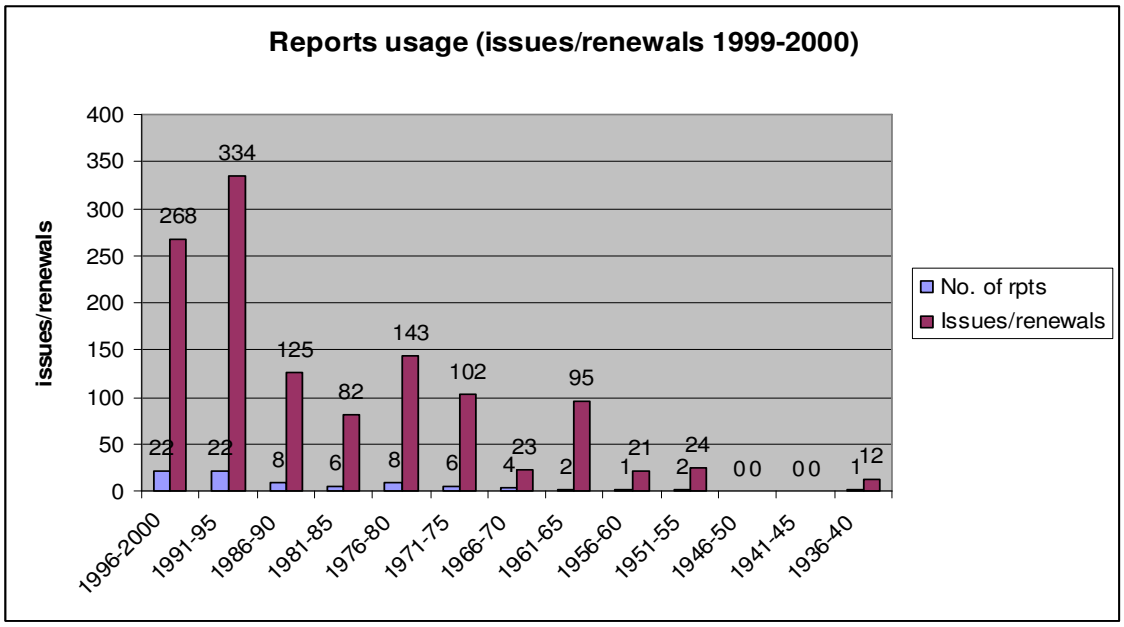

Figure 8-2 Report usage by date range - issues/renewals (1999-2000)

This is also the case for issue data in 2000-2001 (figure 8-3), although looking at issue/renewal data (figure 8-4), there is significant use of reports in the 1970s and 1980s.

Interestingly, in the academic year 1999/2000, no reports published in 2000 were issued or renewed at all. This is also the case for 2000-2001 where no reports published in 2001 were issued/renewed.

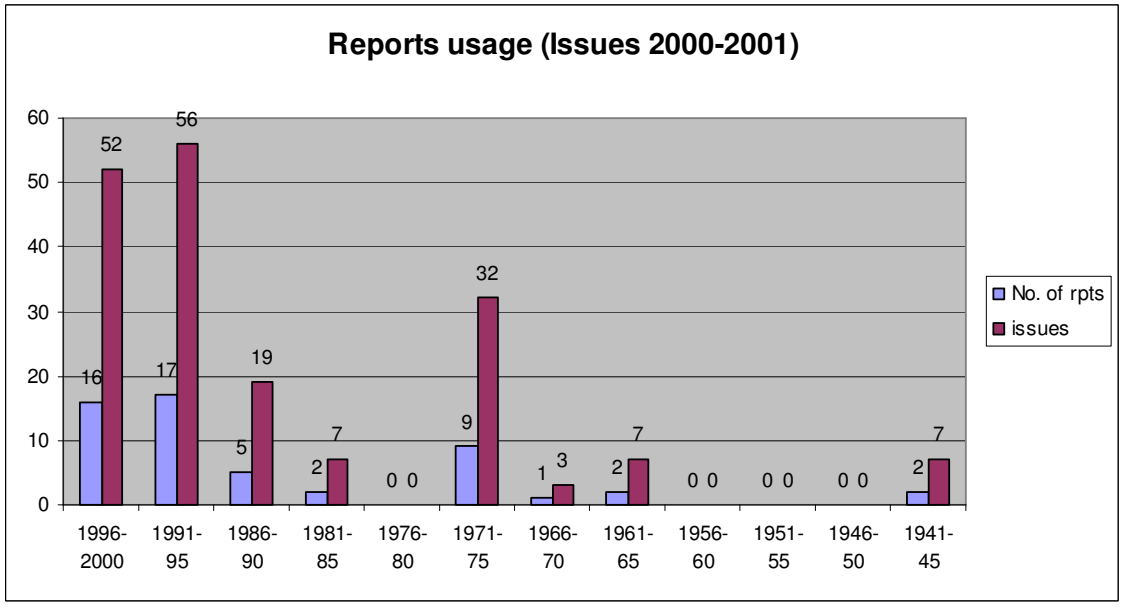

Figure 8-3 Report usage by date range - issues (2000-2001)

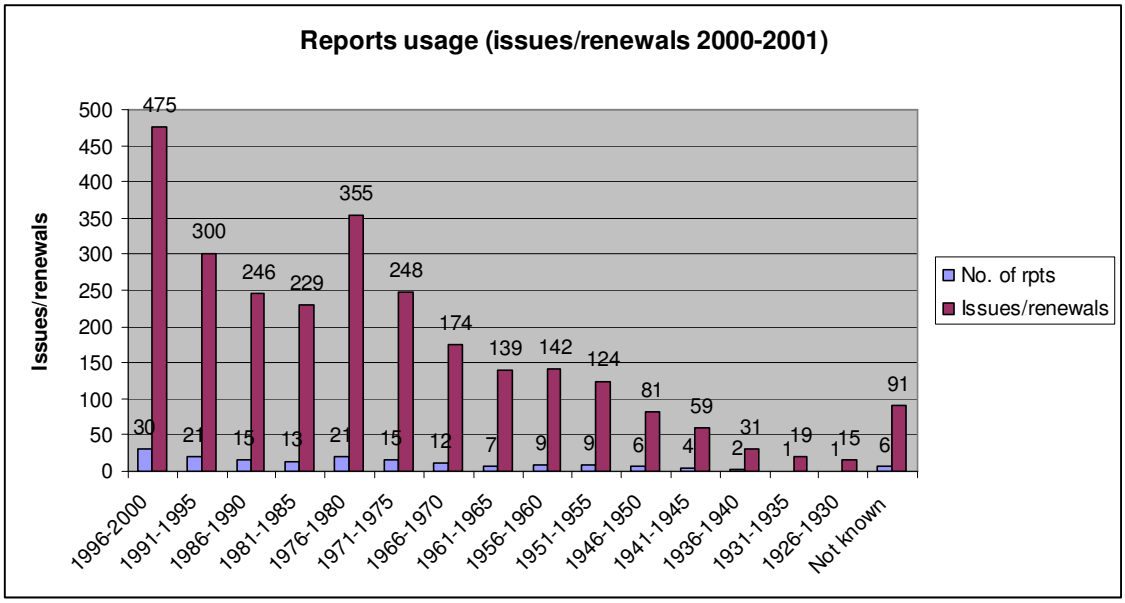

Figure 8-4 Report usage by date range - issues/renewals (2000-2001)

The figures for date of publication of reports used in 1999-2000 show a slight dip in the 1980's and this is true of both issued and issued/renewed reports. The issue figures in 2000-2001 show a dip in usage in the second half of the 1970s. Issue/renewal figures for 2000-2001 show a fairly even gradual decline of use to the 1980s then an increase in the 1970s followed by another fairly even gradual decline. Figures for both periods also show that reports published in the 1930's and 1940's are still of use. This was one of the original assumptions made at the beginning of the MAGiC project.

8.3.4. Report series

The most heavily used reports in terms of both issues and issues/renewals for both academic years were those emanating from the AIAA. In 1999-2000 AIAA issues/renewals made up 26% of the total (figure 8-5), while they made up 22% of the issue figure (figure 8-6).

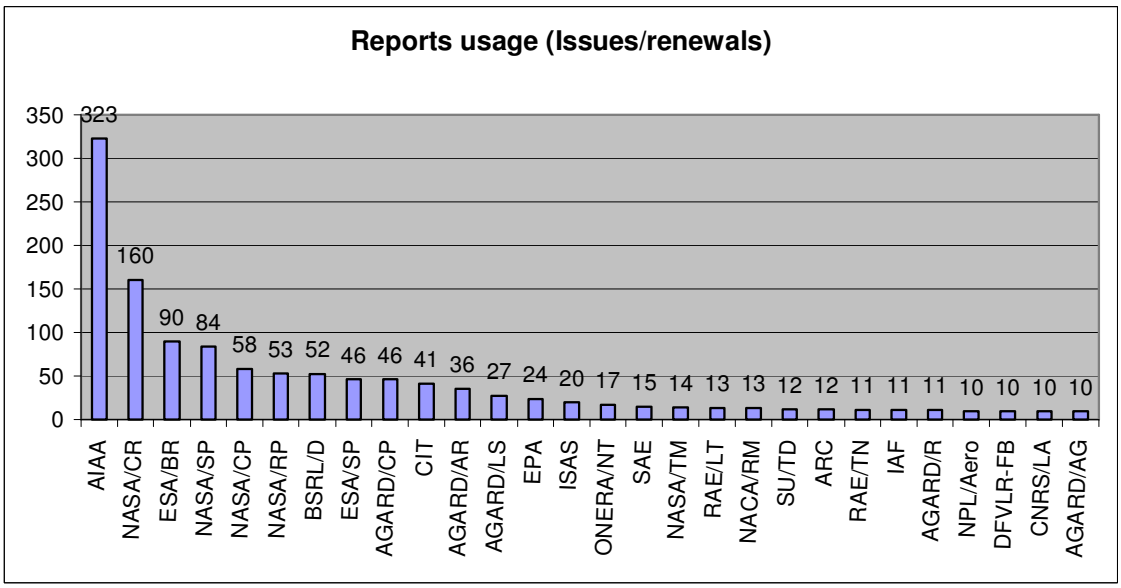

Figure 8-5 Heavily used series - issue and renew figures of 10 or higher. Sorted by number of issues (1999-2000)

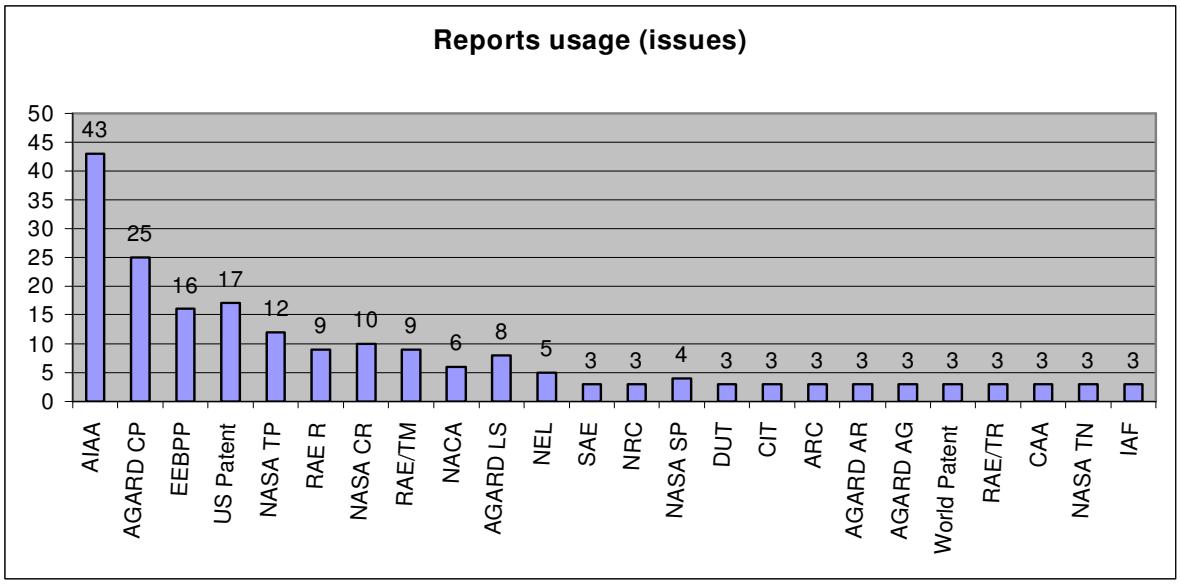

Figure 8-6 Heavily used series - issue figures of 3 or higher. Sorted by number of issues (1999-2000)

In 2000-2001 AIAA issues/renewals made up 20% of the total (figure 8-7), and 26% of the issue figures (figure 8-8).

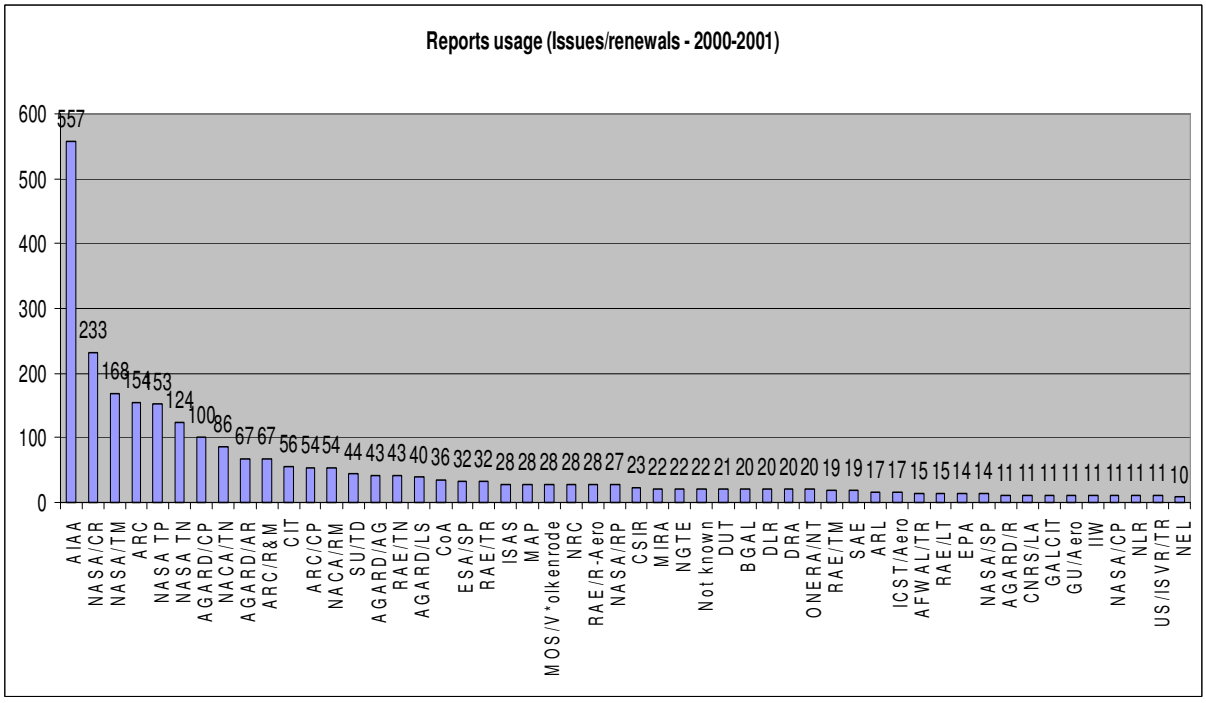

Figure 8-7 Heavily used series - issue and renew figures of 10 or higher. Sorted by number of issues (2000-2001)

In 1999-2000 the largest number of reports used from a single series also came from the AIAA (14 reports accounting for 43 issues; 26 reports accounting for 323 issues/renewals). This was also true the following academic year where 15 reports accounted for 47 issues and 37 reports accounted for 557 issues/renewals.

The next heavily used series in terms of just issues in both academic years was the AGARD CP series. The next heavily used series in terms of issued/renewed reports were the NASA/CR series and once again this was consistently the case over the two academic years studied.

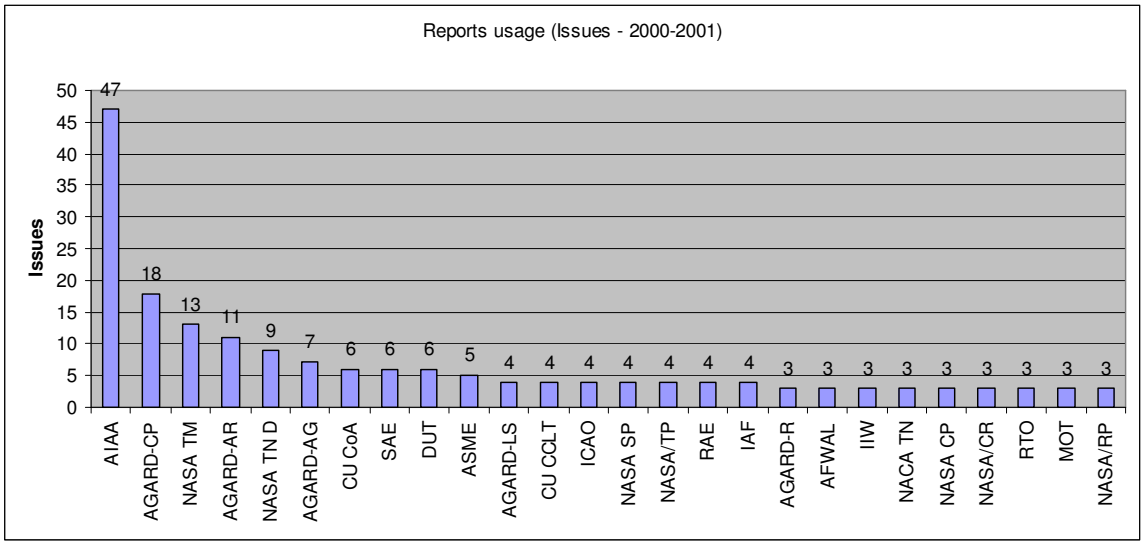

Figure 8-8 Heavily used series - issue figures of 3 or higher. Sorted by number of issues (2000-2001)

The ARC collections were used relatively little in 1999-2000 (12 issues/renewals by a single user, 3 issues throughout the year), and not at all in 2000-2001, but there would be a dual reason for digitisation here: not only improved access, but also preservation.

8.3.5. Snapshot data of items 'currently' on loan

In order to gain a general picture of the scale of loans within the library it is interesting to look at snapshot data showing the percentage of different types of material on loan at any one time.

Table 8-3 shows a fairly consistent picture of slightly over 2% of stock being on loan at any one time. Looking specifically at reports, the figures for the two separate days are 0.4% and 0.5%. The figures for journals on loan show a very similar profile to reports, confirming the findings in the literature review and studies undertaken by MAGiC, which showed that reports and journal articles were of similar importance to engineers.

Data from test server		**13-Jun-01**	
	Stock	**currently charged**	**%**
Books	65995	5363	8.1%
Journals	122282	442	0.4%
Reports	119757	594	0.5%
Theses	15945	733	4.6%
Working papers	4059	31	0.8%
	328038	7163	2.2%

Data from live server		**18-Oct-01**	
	Stock	**currently charged**	**%**
Books	80857	5663	7.0%
Journals	126351	637	0.5%
Reports	121261	467	0.4%
Theses	16701	517	3.1%
Working papers	2110	23	1.1%
Other	2488	45	1.8%
	349768	7352	2.1%

Table 8-3 Snapshot data on items currently charged

Though there is evidence that some report series are consistently more highly used than others, overall, the findings of this investigation have proved inconclusive.

Both this investigation and the previous investigation into citation analysis, which looked at quantitative indicators, have proved disappointing, and are likely to have limited general applicability in the creation of a collection analysis methodology. The next section examines the possible use of qualitative indicators.

8.4. A preliminary investigation into the use of "current and emerging trends" in selecting reports for digitisation.

8.4.1. Introduction

A possible selection criterion for prioritising the digitisation of engineering technical reports is to identify current/emerging trends of interest to engineers.

This investigation was carried out to see if this was a plausible method for the selection of reports. It was therefore interested in establishing how many technical reports would be identified by performing searches for selected trends in available collections of reports, and whether the numbers identified would be manageable.

8.4.2. Methodology

The reports collection in the Cranfield University library catalogue; reports held by the British Library - catalogued in SIGLE '99; and reports described in the Public Record Office catalogue, PROCAT, were chosen for analysis.

Table 8-4 shows the total number of reports in the Cranfield University (CU) library catalogue and the total number of reports from BL in the SIGLE database. Total figures for the number of reports in the PRO catalogue were not available, but they certainly number in the tens of thousands (see Appendix K).

Search	CU	SIGLE (BL)	PRO
All reports	*120918*	*85717*	-
All reports 1980-1999	*43729*	*83930*	-
All reports 1990-1999	*30168*	*54827*	-
All reports 1995-1999	*13882*	*26631*	-

Table 8-4 Total number of reports in each catalogue

Searches were performed for selected trends from various sources to see how many reports would be identified.

The Cranfield University library catalogue was searched using full search options, limited to format type 'report'.

The SIGLE database searches were limited to the document type 'report' with the national centre set to 'united-kingdom', which identifies records describing reports available from the British Library.

The PRO catalogue was searched using the default search (no other options available).

Example trends were chosen using the following sources:

- Engineers at ESDU;
- CSA Cambridge Scientific Abstracts – Hot topics (CSA, 2001);
- TRA3 Targeted Research Action in Aerodynamics (TRA3, 2001);
- Academic engineers at Cranfield University, College of Aeronautics
- Aerospace Manufacturing NAC Report (NACAM, 2001)

The trends identified by each source were as follows.

Consultation with engineers at ESDU:

- Ageing aircraft
- Elastic plastic fracture
- Crack growth or propagation
- Airships

CSA Cambridge Scientific Abstracts – Hot topics:

- Automotive Weight Reduction
- Bioceramics
- Plastic Highway Bridges
- Titanium

TRA3 Targeted Research Action in Aerodynamics:

- Advanced Experimental Methods
  - automatic balance calibration machines
  - wind tunnel balance development
  - wall corrections for full and half models
  - advanced non-intrusive flow visualisation and measurement techniques

- Noise
  - Airframe noise
  - Fan noise
  - Jet noise
  - Noise from rotors and helicopters

- Active and passive drag reduction for wings and nacelles

- Aerodynamics of rotorcraft
  - Blade-vortex interaction and icing

College of Aeronautics:

- Space debris mitigation
- Potential Impact of Near Earth Objects
- Nanosatellite formations or Distributed Systems

Aerospace Manufacturing NAC Report:

- Composites
- Composite materials

The full results returned from all the searches on the three catalogues are listed in the tables in Appendix L.

8.4.3. Results and discussion

There is a great deal of variation in the numbers of reports identified by different searches relating to the various topics. The search terms that returned the greatest numbers of reports overall are shown in Table 8-5; and those that returned the least are shown in Table 8-6.

Search terms	CU	SIGLE	PRO
Composite OR composites	1338	650	3000+
Composite materials	349	508	85
Crack AND (growth OR propagation)	381	117	162
flow AND measurement	319	43	90
Titanium	435	121	325
Noise	2046	430	
Jet AND noise	389	25	
(rotor OR rotors OR helicopter OR helicopters) AND noise	156	5	
(fan or fans) AND noise	151	3	
(reduction OR reductions) AND drag	157	4	
Airship OR airships	158	2	2687

Table 8-5 Trends yielding the greatest numbers of reports

Search terms	CU	SIGLE	PRO
Automotive AND weight AND reduction	5	0	0
Bioceramics	0	0	0
Plastic AND highway AND (bridge OR bridges)	0	0	0
automatic AND balance AND calibration AND machine	1	0	-
wind AND tunnel AND balance AND development	5	0	-
non-intrusive AND flow AND measurement	3	0	0
blade-vortex AND icing	0	0	
space AND debris AND mitigation	9	0	0
Potential AND Impact AND Near AND Earth AND Object	0	0	0
nanosatellite AND (formations OR constellations)	0	0	0

Table 8-6 Trends yielding the least number of reports

Once the example trends had been identified, the actual catalogue searches were quick and easy to carry out. In all cases, searches on the selected topics returned a small, or very small, proportion of the reports held in the three catalogues. If anything, many of the topics produced too few results by themselves to form the basis of a digitisation programme. It would be feasible, however, to combine the results of searches on several topics to adjust the numbers of reports to a desired level.

As expected, highly specific topics (‘automatic balance calibration machines’, ‘potential impact of near earth objects’) tended to return few if any reports, while less specific topics (‘noise’, ‘composites’. ‘airships’) tended to yield greater numbers of reports.

Furthermore, the selection of new, cutting edge trends (‘bioceramics’, ‘nanosatellites’) produced very few results due to the fact that, in many cases, the very latest reports on such topics are still in preparation, restricted as ‘commercial in confidence’ or security-classified, and thus not publicly available yet.

Where large numbers of reports are returned, there are two practical methods available to limit the search to reduce number of reports identified:

- The use of additional search terms to tighten focus, as shown in Table 8-7.
- Limiting the search to recent publication date, as shown in Table 8-8.

Search terms	CU	SIGLE	PRO
Noise	2046	430	
Jet AND noise	389	25	
Airframe AND noise	25	0	

Table 8-7 Limiting search using additional terms

Search terms	CU	SIGLE	PRO
Titanium	435	121	325
Titanium, pub. 1980-1999	91	117	-
Titanium, pub. 1990-1999	54	48	-
Titanium, pub. 1995-1999	20	35	-

Table 8-8 Limiting search by publication date

Both of these methods can result in a considerable reduction of the number of reports returned.

A problematical question is: what constitutes a manageable number of reports to digitise? The answer will vary greatly between organisations, depending on available manpower and financial resources.

If we assume that the average cost of digitising a report is £5 (a reasonable estimate, based on our own experiences) then a £1,000 budget would allow the digitisation of 200 reports, and a £5,000 budget would cover the cost of digitising 1,000 reports. In such cases, the use of current and emerging trends may have a place in prioritising reports for digitisation. It is, however, likely to be of little use when undertaking a large-scale digitisation, where a more appropriate methodology may be simply to scan whole report series at a time.

While the task of searching the catalogues is in itself quick and easy, a necessary first step is to identify sources of information pertaining to current and emerging trends, and then ascertain the trends themselves.

The identification of the sources of information used in this investigation, and the subsequent selection of 'hot topics' for closer examination, involved half a dozen people and took several weeks of elapsed time, though the actual time spent on the exercise amounted to just a few days.

8.4.4. Sources of emerging trends

There are many potential sources of information, covering a wide range of disciplines, indicating the latest trends and 'what's hot'. These include:

- alerting services;
- electronic discussion forums and mailing lists;
- sections of web-sites;
- academic experts and researchers;
- occasional reports produced by authoritative bodies and expert committees.

While the use of current and emerging trends to prioritise reports for digitisation shows some promise, the amount of effort needed to find, examine and extract the relevant information from these sources will vary according to circumstances. It is impossible to predict, in advance, how easy or difficult the task will be in any given case and this uncertainty makes unreserved recommendation of this technique difficult.

8.5. Conclusions and recommendations

The availability of catalogue records in electronic, hence searchable, format is of great importance for the management and resource discovery of reports. However, as described in the previous chapter, many libraries treat reports as serials and can say little, if anything, about individual reports.

Even where reports have been individually catalogued, there are still difficulties:

- Not all libraries are able to recognise reports as a separate category from other types of document;

- Generally reports are relatively slim volumes with an average page count of around 40 or 50 pages, often less. This means that there is liable to be a large amount of in-house use, which is not easily recordable;
- Past use of an individual report tells us nothing in itself about the likely future use of that report;
- Citation analysis seems too labour intensive to be practical;
- Analysis of circulation data has proved inconclusive.

Consequently in many circumstances it is impossible to gain any meaningful statistics of reports usage, at all.

These factors severely limit the applicability of quantitative indicators in the construction of a practical collection analysis methodology.

The use of qualitative indicators, through the identification of current and emerging trends, while more promising, is also subject to problems. The amount of time and effort needed to identify the trends themselves presents an unknown, and using the age of a report as a measure for digitisation is also difficult to justify.

In general, it is true that the most heavily used reports are those that have been published in the last three years, but there is also significant use of reports that are older. The fact that older reports are used signifies that they are important despite their age, whereas the importance of an up to date report may fade over a few years.

The use of highly specific topics leads to the selection of a very small number of reports, and the value of broad topics as a useful method of selection is debatable.

For these reasons, one conclusion that may be drawn is that there is no perfect way of identifying the most appropriate reports for digitisation. To make up for the deficiencies in the indicators we have examined, it is necessary to be pragmatic and to apply some common sense to the construction of a practical and usable collection analysis methodology.

In line with this philosophy, our recommendations are as follows:

Digitise whole report series. This approach is one that both NASA and Dstl are adopting in their own digitisation programmes. While usage figures for individual reports are inconclusive, some reports series are overall clearly more highly used and valued than others. Partial digitisation of a report series does little to aid collection rationalisation and could frustrate users who may well expect that if one report from a series is available electronically then the others will be as well. On the other hand, complete digitisation of a series does facilitate collection rationalisation and fully meets the needs of users.

Digitise on demand. The one time that it is possible to be certain that a report is wanted is when an end-user actually tries to obtain it. And, once a report is available digitally, the cost of provision of that report becomes restricted to the cost of storing the file on disk: the regular document supply chain no longer applies. As hard disk capacities soar, and costs per gigabyte diminish, disk space is becoming less and less of an issue in terms of availability and affordability. For these reasons, digitisation on demand is an eminently practical option that should always be considered.

Digitise reports that act as finding aids or 'signposts' for other reports within a series. As discussed in Chapter 7, making such reports available in digital format can significantly improve resource discovery, and aid collection management.

Digitise recent reports from the last 2 or 3 years, in general, usage diminishes quickly over time.

Digitise seminal reports which are consistently used over a long period of time - some reports contain the findings of fundamental research, the value of which does not change over time (e.g. the laws of aerodynamics are the same now as they were 70 years ago).

Digitise reports matching topics of current/emerging interest – this option may be feasible for small-scale digitisations provided that mechanisms for identifying current/emerging trends can be identified.

These recommendations offer practical solutions to the prioritisation of reports for digitisation.

Given the situation in the UK, where reports from numerous series are scattered in collections around the country, we suggest that the challenge of digitising whole report series should be addressed; and that the challenge may be met by undertaking collaborative digitisation programmes between establishments with shared interests to the benefit of collection managers and users alike.

We recognise that in the short term, due to prevailing reports cataloguing practices, the widespread adoption of any collection analysis methodology is likely to be restricted. However, in the mid- to long-term, the provision of the National Reports Catalogue, as a central repository of master metadata sets, will offer a standard against which libraries can measure their own reports collections and will enhance their ability to make rational decisions when considering undertaking a digitisation programme.

The following chapter examines the creation and population of the National Reports Catalogue.

9. National Reports Catalogue

9.1. Introduction

The research undertaken in the earlier chapters in this report:

- Confirmed our understanding of the information seeking habits of engineers, revealing their increasing reliance on the Internet as a source of information;
- Examined the use and uncovered evidence of the value of technical reports, noting that they are being produced electronically in ever increasing numbers;
- Exposed the complexities underlying the management and control of technical reports;
- Addressed the issues of identifying the production and location of reports in the UK with the intention of improving their use, access and visibility;
- And examined the possibilities of developing a collection analysis methodology in order to prioritise reports for digitisation, and unlock their potential, within a collection.

This chapter is the starting point for our solutions to the problems and issues that we identified in those earlier chapters.

The information derived from the research made it plain that a distributed National Reports Catalogue (NRC), based around Z39.50 parallel searching, was neither feasible nor desirable. What was needed was a system that overcame the three main problems, namely, that reports are dispersed in collections scattered across the country; reports series, as produced, are complex; and the cataloguing of reports is generally poor or inconsistent.

In response to this the MAGiC team suggested a system, based around the provision of an NRC that would hold harvested master metadata sets for reports series; remove the need for libraries to catalogue reports holdings in detail themselves; serve as a comprehensive reference point for the understanding of reports series; and offer a standard by which existing collections could be measured.

The findings of the research have been used to inform the design of such a prototype service - METReS, the core of which is comprised of the NRC and an associated full text archive, delivered via a web interface.

The design of METReS represents a considerable departure from the system originally envisaged, and it is important to recognise that it is a demonstration of a 'proof of concept'. It is not intended to function as a 'real-world' production system. It is, rather, intended to show that it is possible to bring together metadata describing corporate sources, reports series, reports, collections through the building of a stakeholder community and the process of metadata harvesting, with the benefit of improved management, access and use of technical reports.

Thematically Chapters 9 - 11 are closely related. This chapter details the design and creation of the NRC, while Chapter 10 covers the creation of the full text archive. Chapter 11 describes the demonstrator service – METReS, which binds together and provides a window into the NRC and the full text archive, though a web interface.

The issues addressed in this chapter are:

- Discussion of available approaches for the provision of the NRC;
- Discussion of relevant standards and technologies for managing and delivering the NRC;
- The design of the underlying database;
- Populating the NRC.

9.2. A review of possible solutions

This section discusses the overarching system architectures, which are available for the provision of a National Reports Catalogue, comparing centralised, distributed and metadata harvesting solutions.

9.2.1. A centralised system

In a centralised system, all management of bibliographic records and documents takes place in a central location. Its main strength is that it offers administrators total control over the system. Resources can be rationalised and managed consistently. However, information tends to be out of date by the time it is received and contributing organisations have to go to considerable effort to present documents and metadata as required by the central administrators. Such systems tend to be expensive.

Given the current lack of knowledge of reports collections and the fragmented nature of technical reports in the UK, such a system is unlikely to offer an improvement in the current situation.

9.2.2. Distributed parallel searching

In the case of distributed parallel searching, record sets are retrieved from bibliographic records stored on library catalogues and databases, which are interrogated in real-time, usually employing the Z39.50 protocol. Documents remain in disparate locations and are not transferred to a central facility. Distributed parallel searching has the advantage that information retrieved is always current. It has been shown to work well for a small number of servers, however, as the number of nodes to search grows, performance tends to become less satisfactory. There are a number of issues involved (Hammer, S. and Andresen, L., 2001):

- As the number of servers increases, there is increased likelihood that one of them will be slow, or fail entirely;
- Services place a load on an individual library catalogue (or other) system for which it was not designed;
- Due to the varying and variable responses from servers, it is often difficult, or impractical, to de-duplicate and merge record sets in real time.

In addition, parallel searching in itself contributes nothing to the management or rationalisation of scientific and technical literature, or its associated records. It is, therefore, not a suitable solution for achieving the goals of the project.

9.2.3. Metadata harvesting

Conceptually, metadata harvesting falls between the centralised and distributed systems, and offers a new model with potential for the communication and retrieval of engineering technical reports in the UK.

Contributing organisations carry on business as before, documents remain where they are, however, by agreement, those organisations expose (i.e. self publish) metadata, in a simple agreed format. The exposed metadata can be gathered, by an authorised agency, from those distributed sources and imported into a local database, at regular intervals, where it is used as the basis for building value-added services.

While it is possible to harvest records in any number of ways, employing diverse formats of metadata and proprietary solutions, and involving varying degrees of effort and involvement from contributing organisations, a much better solution is to adopt the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). OAI-PMH is easy to install and configure, and allows regular scheduled harvesting of machine-readable metadata, requiring little human intervention once up and running.

In the view of the MAGiC team, a metadata-harvesting model, based around OAI-PMH, offers the best possible option for establishing a low-cost, least-effort system for the management and promotion of technical reports.

9.2.4. Web services

Web services allow a wide range of applications to be embedded directly into web pages as services. Based on open industry standards, web services are described in XML, wrapped in a SOAP envelope (see 9.3.7 below), and communicated over the existing HTTP infrastructure. Legacy applications, such as mainframe-based computer modelling programs, can be repackaged as service components and run directly from a web interface.

By allowing the reuse of existing applications, and by standardising communications between organisations, this technology has great potential for simplifying business systems integration and creating closer business partnerships.

Although very much in their infancy, web services are rapidly gaining support from, and being adopted by, major organisations around the world. The enhanced possibilities of interoperability and reports dissemination raised by web services should therefore be considered in the context of any full-production system for reports management, resource discovery and document delivery.

9.3. Technologies and standards

Awareness of, and adherence to, emerging global open standards for metadata formats and transmission protocols forms a vital component of the development of any sustainable, interoperable system.

While the previous section provided an overview of system architectures available for the provision of the NRC, this section examines the constituent parts – the underlying technologies and standards - likely to be applicable to the management and delivery of the NRC.

9.3.1. HTML/HTTP

HTML, primarily used to format content conveyed between servers and browsers, is the global standard for publishing hypertext on the Web. It allows for the creation of visually pleasing page displays, but offers no control over the content of that page. HTTP is the underlying protocol, which enables servers and browsers to communicate. The meteoric rise of the Internet and its increasing use by engineers means that this protocol will be central to the delivery of the NRC and to its associated services.

9.3.2. XML

Endorsed by the World Wide Web Consortium (W3C, 2001), XML (Extensible Markup Language), unlike HTML, offers a great degree of control over document content, whether simple or complex. XML documents must obey strict rules and are designed to be machine readable, “making it easy for a computer to generate data, read data, and ensure that the data structure is unambiguous.”

A wide range of tools is available for creating and processing XML records, and there are well-defined mechanisms for transforming XML for display in web browsers. XML underpins both OAI metadata harvesting and web services.

Importantly, XML offers a long-term data format and is truly cross-platform, consequently, it is ideal for the transmission and processing of bibliographic records in the context of a UK engineering technical reports management system.

9.3.3. Z39.50

“Z39.50 is a network protocol which allows searching of (usually remote) heterogeneous databases and retrieval of data, via one user interface. It is most often used for retrieving bibliographic records, although there are also some non-bibliographic implementations” (Russell, R., 1998).

Z39.50 is a well-established library protocol, where multiple servers from many different organisations are involved, however, Z39.50 services can be complex to install and configure, and require a high level of support. Also, there are concerns about parallel searching performance, as noted above (9.2.2).

While, Z39.50 and distributed parallel searching, are not suitable for the purpose of creating and maintaining the NRC, for the sake of interoperability, and to maximise opportunities for use and re-use of the resources, the NRC itself can be exposed as a Z39.50 target. This would allow it to be cross-searched and incorporated into other Z39.50 compliant services.

9.3.4. Open Archives Initiatives

OAI was conceived to develop and promote interoperability standards, with the aim of facilitating the efficient dissemination of content" (OAI, 2002).

It is important to note, in the context of OAI, 'Open' refers to the architecture, which enables machine-readable interfaces, and it does not mean "free" or "unlimited" access to information repositories. Also, the term 'Archive' is not used in the traditional sense understood by professional archivists, rather it refers simply to a repository for stored information. (OAI, 2002)

OAI divides participants into two classes, 'data providers' and 'service providers' (OAI, 2002a).

- *Data Providers* administer systems that support the OAI-PMH as a means of exposing metadata;
- *Service Providers* use metadata harvested via the OAI-PMH as a basis for building value-added services.

The protocol mandates exposure of metadata in Dublin Core format wrapped in XML, though richer metadata formats, also expressed in XML, may be exchanged by agreement between data and service providers As such, it follows open standards and is particularly suited to the standardised transfer of STI bibliographic records.

The protocol does not deal with issues of access restriction and management of intellectual property in exposed metadata, which remain the responsibility of the data provider.

While earlier versions were experimental, OAI-PMH v2.0, which was released in June 2002, is a *production release*, meaning that future changes, if any, will be made with strict attention to backward compatibility issues (OAI, 2002).

Implementation

The protocol is intentionally designed to be easy to implement. It is designed to facilitate automatic scheduled, incremental updates. It has only six verbs, making it very easy to use, and, through the use of sets, allows selective harvesting.

For a contributing organisation (OAI, 2002), " … the generic task of configuring a web server to handle OAI-PMH requests and parsing out the arguments should involve less than a day of work for someone experienced with setting up Web servers and writing CGI scripts."

The amount of time and effort involved in exporting and exposing records, expressed as OAI XML/DC, will depend on the existing quality of bibliographic control, and underlying systems, employed by any given organisation. Fortunately, generic tools, to enable and simplify participation, are increasingly available in a number of open source implementations, including Java, Perl, VB and PHP (OAI, 2002b).

Extensive documentation, regarding the implementation of the OAI Protocol, is available on the OAI website at http://www.openarchives.org/.

OAI participants

Metadata harvesting is gaining global acceptance. A growing number of organisations are using the OAI to reveal and transfer metadata, including arXiv (2002), the Eprints initiative (2002), NASA, MIT, as well as many others.

NASA has provided OAI layers for several of its reports servers, including the NACA Reports Server (2002) and the Langley Technical Reports Server (2002), both of which provide links to online versions of reports.

AERADE (2002) is the UK Aerospace and Defence gateway, hosted and managed by Cranfield University, which provides access to a collection of key aerospace and defence resources on the Internet. Over a period of two years, information and subject specialists added 2,000 resources to the database. Using OAI metadata harvesting, in February 2002, it took less than two days to add 1,700 new records to the database, taken from the NASA Langley TRS. The use of a scheduled script, run from the AERADE server, allows the Langley server to be interrogated on a regular basis. If new reports have been mounted at Langley since the last time the script ran, it automatically incorporates the new metadata into the AERADE database.

Importantly, MAGiC has entered into an agreement with NASA to exchange electronic versions of NACA and ARC reports. This has resulted in the launch of the NACA UK mirror site (NACA UK, 2002). In this particular case, the OAI protocol is used as the basis for replication of both metadata and documents.

9.3.5. SOAP

Web services permit access from any program written in any language on any operating system, so, requests and responses must have a standard platform-independent format.

That format is the Simple Object Access Protocol (SOAP), which "is a lightweight protocol for exchange of information in a decentralised, distributed environment." XML based, it "defines a framework for describing what is in a message and how to process it, a set of encoding rules for expressing instances of application-defined datatypes, and a convention for representing remote procedure calls and responses." (W3C, 2000).

9.3.6. Dublin Core metadata

Dublin Core (DC) metadata consists of fifteen elements "useful for creating simple, easy-to-understand descriptions for most information resources." (Weibel, S. and Miller, E., 2000).

The fifteen elements are divided into three groups (Dublin Core, 1999):

- *Content* - Title, Subject, Description, Type, Source, Relation, Coverage;
- *Intellectual Property* - Creator, Publisher, Contributor Rights;
- *Instantiation*- Date, Format, Identifier, Language.

DC is widely used across many applications and disciplines, as a simple metadata set ideal for resource discovery and record sharing. It is also the only metadata format mandated by the OAI. As such, it is the obvious candidate for use in an initial implementation of a system to share UK engineering STI.

The Dublin Core Metadata Initiative, which oversees DC metadata standards and developments, holds extensive documentation regarding DC on its web-site at http://dublincore.org/.

9.3.7. MARC

MARC (**MA**chine-**R**eadable **C**ataloguing) is a format standard for the storage and exchange of bibliographic records and related information in machine-readable form. There are many flavours of MARC and the British Library has recently decided that MARC 21 will be the standard for data creation and processing of its bibliographic records. MARC 21 is likely to be implemented by the British Library in the early part of 2004 (British Library, 2001).

While Dublin Core offers an excellent, simple metadata set for resource discovery, it is regarded as too simple for the cataloguing needs of libraries. MARC 21 will almost certainly be the preferred metadata format to allow libraries to incorporate reports metadata from the NRC into their own catalogues to enhance their local services.

9.3.8. Collection level description metadata

The development of collection level descriptions (CLDs) has received a high level of attention in the UK over the past few years. CLDs are used "both as a means of supporting the requirements of users seeking information resources [and] as a tool for professional information managers to support collection management." (Robinson, B., 2002)

ISAD(G)/EAD

ISAD(G) (General International Standardised Archival Description) is a rich archival description schema, a data structure standard, which supports hierarchical multilevel descriptions. Its purpose is to provide collection-level records, which "identify and explain the context and content of archival material in order to promote its accessibility" (International Council on Archives, 2000). It is widely employed by archives in the UK and elsewhere to provide finding aids for resources.

EAD (Encoded Archival Description) is the data delivery format frequently employed to encode ISAD(G). EAD v1.0 is compatible with the new Extensible Markup Language (XML) applications being developed for the Web (Library of Congress, 2001).

RSLP Collection Level Description

The Research Support Libraries Programme (RSLP), which co-funded the MAGiC project, has supported initiatives that bring together both traditional and new forms of access to library information. An important RSLP strand has been the funding of a number of collaborative collection management projects, including the RSLP Collection Description Project which has developed a schema, the RSLP-CLD - "a collection description metadata schema and associated syntax using the Resource Description Framework (RDF)." (Powell, A., 2001) It is designed to be machine-readable and is intended to complement rather than replace ISAD(G)/EAD.

In the context of MAGiC, the provision of CLDs allows us to describe collections holding reports at a high-level – this is the first step in building up a comprehensive picture of who holds reports, and a necessary precursor to the task of detailed identification of which reports are where.

For the sake of interoperability with a wide range of other initiatives dealing with collection level descriptions, it will be important for a production version of the NRC to offer compatibility with both ISAD(G)/EAD and RSLP-CLD.

9.3.9. OpenURL

The OpenURL provides a mechanism for encoding a citation for an information resource, typically a bibliographic resource, as a URL. The OpenURL is, in effect, an actionable URL that transports metadata, or keys to access metadata, for the object for which the OpenURL is provided. The target of the OpenURL is an OpenURL resolver that offers context-sensitive services based on that metadata (Powell, A., 2001a).

OpenURL is based on the idea that links should lead a user to appropriate resources and has attracted significant interest and support from publishers and other service providers (SFX, 2002).

While, the OpenURL is currently undergoing the NISO fast-track standardisation process and may yet go through further changes, it is worthy of further consideration in the provision of a document supply service attached to the National Reports Catalogue.

9.3.10. Classification schemes

Our research found that, where they are applied at all, there are many and various schemes currently in use for classifying documents related to engineering. These range from general classification aids such as Dewey and UDC to specialised schemes such as Ei Thesaurus (Engineering Information, 2002), used to find documents and papers in the Ei Compendex® database, and the NTIS Subject Category Codes (NTIS, 2002) applied to the NTIS database.

Clearly, it not reasonable or practical to expect a large number of organisations, producing and holding reports, to change the schemes they use and to adopt a single universal scheme. A much

more practical solution is to provide a series of crosswalks, mapping between various schemes - an approach in accord with the preferred option presented by the High-Level Thesaurus project, (HILT, 2001).

To demonstrate the possibilities of this approach for harmonising classification schemes, and thus facilitating resource discovery and enhancing interoperability, the project team has already produced a preliminary engineering classification crosswalk, mapping between the EEVL, NTIS and SIGLE classifications. (The document is available as a Microsoft Excel spreadsheet on the MAGiC project website at http://www.magic.ac.uk/docs/crosswalk.xls).

It should be noted, because the NRC will be created from a wide number of sources varying in detail and quality, that the adoption of any method of classification is problematic - and, at the level of individual reports, application of any such classification will be patchy. Consequently, the MAGiC team has not made any serious attempt to apply classifications in the demonstrator version of the NRC. However, a possible and partial answer to the challenge is to provide a coarse grain classification at the Report Series level, which can be over-ridden by the finer grain classification of individual reports where available.

9.3.11. System management and delivery

There are a large number of possible software options to choose from, to enable and enhance the management and delivery of engineering technical reports in the UK. These include a wide range of scripting languages, content management systems and knowledge management systems. It is beyond the scope of this document to examine these in any detail. However, regardless of the tools chosen, whether proprietary or 'open source', a key to sustainability and future interoperability, is to ensure that, where available, open standards are adopted in all cases.

In the case of the demonstrator service, the web interface to the database has been developed using PHP (2002), a simple scripting language, which offers the benefits of rapid development.

9.3.12. Authentication and authorization

It is recognised that authentication and authorisation are very important issues within the engineering community, for reasons of commercial confidence and security.

Authentication is "the act of verifying that an electronic *identity* (username, login name etc.) is being employed by the person to whom it was issued". *Authorisation* is the process of "verifying what attributes or roles are associated with that identity, whether the identity should be permitted access to a given resource" (JISC, 2002a).

Personal digital signatures are achieving prominence as a way forward. Particularly noteworthy are XML digital signatures, which are likely to be adopted, widely, for securing business to business web services, following the recent recommendation made by the IETF/W3C XML Signature Working Group (W3C, 2002).

This is an area that deserves further investigation, and should be considered for adoption, in the context of harvesting reports metadata and delivery of documents to authorised users, in a future production system.

9.3.13. Databases

Harvested metadata is usually stored in some kind of database for local processing. SQL-compliant relational database management systems and XML databases are the two types in general use. The import and export of metadata should always be in XML; however, there are several options for holding metadata in a database. In a relational database, the metadata can be held in a custom-defined format, or as XML, using vendor developed tools. Or, metadata can be held directly in a native XML database.

SQL (Structured Query Language) is an industry standard and SQL-compliant relational databases are a tried and trusted metadata storage solution. Database systems such as MySQL (2002), Oracle

(2002) and PostgreSQL (2002) offer high quality, fast information retrieval. The key benefit of a relational system is the ability to define complex relationships between metadata elements, allowing for the construction of sophisticated queries.

Native XML databases (NXDs) are growing in number, and undergoing a period of rapid change. NXDs are good at handling 'fuzzy' data, but are a less appropriate storage solution for highly structured data. NXDs have relatively unsophisticated update mechanisms and query building abilities, however, new tools are being developed all the time.

While this area needs further investigation, in the short term, a hybrid SQL/XML system may be the best solution, combining the immediate benefits of SQL with the long-term benefits of XML.

Having reviewed the available options - system architectures, technologies and standards - for the provision of the NRC, the next section deals with the application of the options we have chosen.

9.4. Database design

The original idea was to create "a distributed National Reports Catalogue ... by implementing a system architecture based around the Z39.50 protocol [to] give access to specifically identified library catalogues, other external databases and web resources" (MAGiC, 2000a).

As identified by the mapping exercise, our investigations have shown that the role of library catalogues in a MAGiC service is limited by existing report cataloguing practices. This has a significant implication for the shape and structure of the service - cross searching different catalogues in a distributed environment using Z39.50 simply is not feasible. There are also concerns over unresolved technical and performance issues associated with distributed searching. Additionally, the PRO catalogue is not Z39.50 compliant, so the PRO, with its major holdings of technical reports, would not be able to participate.

A solution where metadata resources are harvested offline and held locally for processing, has advantages over searching metadata distributed across library catalogues:

- It facilitates the possibility of collection rationalisation
- Users benefit from consistent resource descriptions, and faster searching and browsing
- Administrators benefit by gaining control over the quality and consistency of the metadata
- Ability to hold any metadata required and to create rich relationships between metadata, without the constraints of MARC imposed by library catalogues
- Interoperability, as a service provider, via Z39.50 and OAI-compliance, with the PRO, the JISC Information Environment and a wide range of other organisations
- Possible income source, as a data provider, by allowing organisations to harvest records from the master metadata sets to enhance their own local services

Figure 9-1 shows a simplified view of metadata relationships, which need to be expressed within the NRC, using two report series from the Aeronautical Research Council (ARC) and three collections of institutions in the UK.

In this scenario, the NRC would contain the master metadata for the corporate source, the report series and the individual reports within the series, with the reports metadata harvested from the Cranfield library catalogue.

The Institution of Civil Engineers (ICE) is shown as a typical example of a library that holds reports from the ARC/R&M series, but has not catalogued individual items. It is impossible to retrieve individual items using author, title and subject search terms in their library catalogue. However, once connected the ICE will be able to benefit from the central metadata store. This is illustrated with the example of Loughborough, which is shown as having matched its list of report numbers held against the metadata records for individual reports held in the NRC.

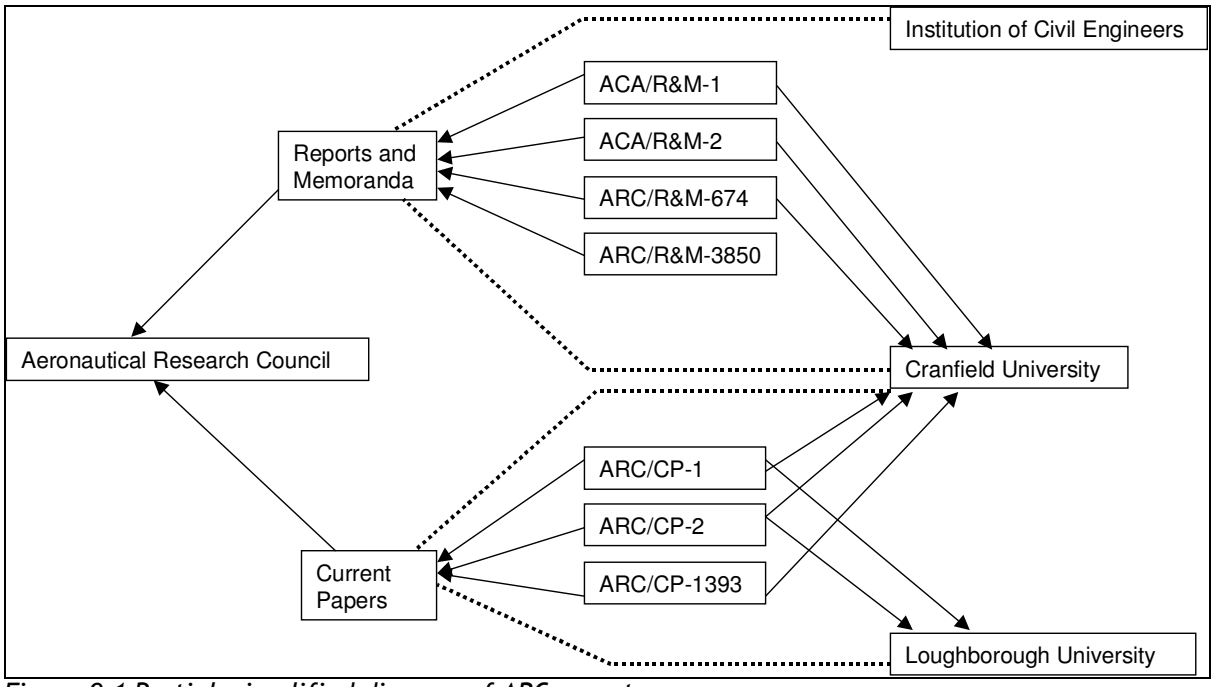

Figure 9-1 Partial, simplified diagram of ARC reports

Expanding this scenario to the more general case involving many corporate sources, reports series, reports and collections, the underlying database structure that is required is shown in figure 9-2.

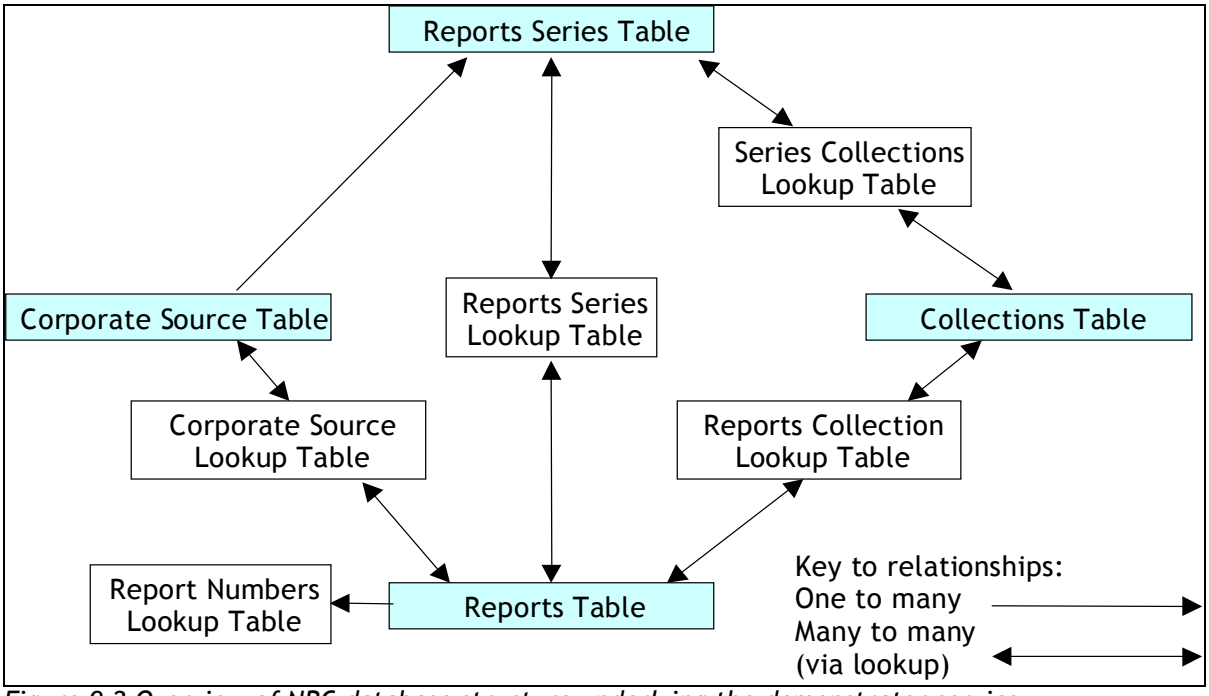

Figure 9-2 Overview of NRC database structure underlying the demonstrator service

While the structure depicted still offers only a simplified picture of the real world situation it purports to represent, it is never-the-less sophisticated enough to form the basis of a 'proof of concept' demonstrator service, for the management and discovery of engineering technical reports.

The NRC consists of a local metadata store holding details of corporate sources and "master sets" of series level descriptions and report descriptions linked to the locations of holdings. The metadata is held in four main tables:

- Corporate Sources
- Reports Series
- Reports
- Collections

Relationships between entries in these four tables can be expressed via several lookup tables.

A corporate source *may*:

- produce one or more reports series
- produce one or more reports

A report series *may*:

- have one corporate source
- contain one or more reports
- be held (partially or completely) in one or more collections

A report *may*:

- have one or more corporate sources
- be part of one or more series
- be held in one or more collections
- be identified by one or more report numbers

A collection *may*:

- hold all or part of a report series
- hold one or more reports

These relationships are flexible enough to allow the NRC to deal with a wide range of situations likely to be encountered in the real world, but not all. As the studies of ARC and DERA reports showed, in Chapter 8, organisations and reports series change – form, merge, rename, branch off - over time. This version of the NRC makes no real attempt to deal with these timelines of the reports; however, a second version of the database, centred on the Dstl/QinetiQ/DERA family of organisations does begin to address the timeline issues. This second database and suggestions for enhancing the capabilities of the NRC are discussed in Chapter 11.

Importantly, each main table is able to function 'standalone'. Entries can be added to each table, completely independently of entries in the other tables, and the relationships between them can be defined and activated at a later time. This tolerance of undefined relationships is essential where the metadata must be incorporated from many sources, in many different formats, over a number of years.

9.5. Creation and population of the National Reports Catalogue

In order to deliver the prototype NRC within the lifetime of the project, the MAGiC team decided to use a MySQL relational database. MySQL (2000) is an open source and free implementation of SQL, which is an industry standard. MySQL is easy to use and is the SQL software of choice employed by many services currently on offer or under development. Cranfield University library acquired a server running Linux, and the necessary software to run MySQL was downloaded, installed and configured.

Which metadata fields to hold in each table was decided jointly by the MAGiC team. While the internal format of metadata held does not conform to any standard, for interoperability and resource sharing, the fields are easy to map to Dublin Core, MARC and other formats.

9.5.1. Corporate Sources table

The purpose of the Corporate Sources table is to provide a brief description of organisations responsible for the contents of reports, and give current details regarding whom to contact, or where to look on the web, on matters relating to their reports. Each corporate source entered into the table is assigned an ID, which defines it uniquely. With the exception of the ID (CSID) and organisation name (CSOrgName), all of the fields are optional. The fields are shown in table 9-1.

Field	Type	Key
CSID	int(11)	PRI
CSOrgName	varchar(100)	
CSDept	varchar(100)	
CSAcronym	varchar(20)	
CSPreviousName	varchar(100)	
CSSuccessorName	varchar(100)	
CSStatus	enum('Active','Defunct')	
CSFrom	year(4)	
CSTo	year(4)	
CSDescription	text	
CSSector	enum('Academia','Industry','Government','Other')	
CSOtherSector	varchar(50)	
CSAddress	varchar(255)	
CSPostcode	varchar(10)	
CSCountry	varchar(50)	
CSPhone	varchar(20)	
CSFax	varchar(20)	
CSEmail	varchar(50)	
CSUrlHomepage	varchar(255)	
CSUrlPublications	varchar(255)	
CSContactTitle	enum('Mr.','Mrs.','Ms.','Miss','Dr.','Professor')	
CSContactName	varchar(50)	
CSJobTitle	varchar(50)	

Table 9-1 Fields in the Corporate Sources table.

The table has been populated with forty-five records (see appendix M), for the most part using the data obtained from returns to the preliminary reports producers questionnaire, though a few entries have been added from scratch, e.g. the Aeronautical Research Council. The data was added to the table manually, via an administrative web interface created as part of the demonstrator service (see Chapter 11).

Corporate Sources are related to Reports via the Corporate Source Lookup table (table 9-2), which links the Corporate Source ID (CSID) with the Report ID (RID). Taking the two fields together as the primary key prevents the entry of duplicates.

Field	Type	Key
CSID	int(11)	PRIMARY
RID	int(11)	

Table 9-2 Reports/Corporate Sources Lookup table

9.5.2. Collections table

The purpose of the Collections table is to provide a brief description of organisations that hold technical reports and to give current details regarding whom to contact, or where to look on the web, on matters relating to their reports. Each collection that is entered into the table is assigned an ID, which defines it uniquely. With the exception of the ID (CID) and organisation name (COrgName), all of the fields are optional. The fields are shown in table 9-3.

Field	Type	Key
CID	int(11)	PRI
COrgName	varchar(100)	
CDept	varchar(100)	
CAcronym	varchar(20)	
CContactTitle	enum('Mr.','Mrs.','Ms.','Miss','Dr.','Professor')	
CContactName	varchar(50)	
CJobTitle	varchar(50)	
CAddress	varchar(255)	
CPostcode	varchar(10)	
CCountry	varchar(50)	
CPhone	varchar(20)	
CFax	varchar(20)	
CEmail	varchar(50)	
CUrlHomepage	varchar(255)	
CSector	enum('Academia','Industry','Government','Other')	
COtherSector	varchar(50)	
CIndexed	enum('y','n')	
CCatalogue	enum('Electronic','Printed','Both','n/a')	
CObtainCatalogue	varchar(255)	
CHistory	text	
CCollectingPolicy	text	
CStrengths	varchar(255)	
CSize	varchar(255)	
CClassSchemes	varchar(255)	
CAvailableFor	enum('Issue','Reference only','Issue and reference','n/a')	
CAdmissionRegs	varchar(255)	
CFeatures	varchar(255)	
COpening	varchar(255)	
CConditions	varchar(255)	
CLibLoans	varchar(255)	

Table 9-3 Fields in the Collections table.

The table has been populated with twenty-six records (see appendix N), for the most part using the data obtained from returns to the preliminary reports holdings questionnaire, though a couple entries have been added from scratch. The data was added to the table manually, via an administrative web interface created as part of the demonstrator service (see chapter 11).

Collections are related to Reports via the Reports Collection Lookup table (table 9-4), which links the Collection ID (CID) with the Report ID (RID).

Field	Type	Key
CID	int(11)	PRIMARY
RID	int(11)	

Table 9-4 Reports/Collection Lookup table

Collections are related to Reports Series via the Series Collection Lookup table (table 9-5), which links the Collection ID (CID) with the Report Series ID (RSID).

Field	Type	Key
CID	int(11)	PRIMARY
RSID	int(11)	

Table 9-5 Series Collection Lookup table

9.5.3. Reports Series table

The purpose of the Reports Series table is to provide a brief description of distinct series produced by organisations. Each report series that is entered into the table is assigned an ID, which defines it uniquely. With the exception of the ID (RSID) and series name (RSName), all of the fields are optional. The fields are shown in table 9-6.

Field	Type	Key
RSID	int(11)	PRI
RSName	varchar(100)	
RSIdentifier	varchar(20)	
RSStatus	enum('Accruing','Closed')	
RSFrom	year(4)	
RSTo	year(4)	
RSReportNumRanges	varchar(255)	
RSClassification	varchar(255)	
RSDescription	text	
RSAccessDetails	varchar(255)	
RSAccessType	enum('Restricted','Non-restricted')	
RSDocType	varchar(20)	
RSFormat	varchar(20)	
CSID	int(11)	

Table 9-6 Fields in the Reports Series table.

The table has been populated with thirteen records (see appendix O), all created from scratch. The data was added to the table manually, via an administrative web interface created as part of the demonstrator service (see chapter 11).

Reports Series are related to Reports via the Reports Series Lookup table (table 9-7), which links the Report Series ID (RSID) with the Report ID (RID).

Field	Type	Key
RSID	int(11)	PRIMARY
RID	int(11)	

Table 9-7 Reports/Collection Lookup table

Reports Series are related to Collections via the Series Collections Lookup table (see table 9-5, above). Because we have assumed that a Report Series can have only one responsible Corporate Source, the Corporate Source ID (CSID) is directly embedded into the Report Series record.

9.5.4. Reports table

The purpose of the Reports table is to provide a bibliographic description of individual technical reports. Each report that is entered into the table is assigned an ID, which defines it uniquely. With the exception of the report ID (RID) and title (RTitle), all of the fields are optional. The fields are shown in table 9-8.

Most, but not all, of the fields correspond directly to UKMARC fields, and can easily be mapped to the simple Dublin Core format. Four of the fields are concerned with the availability and supply of the individual report: RRrequestHardcopy, RRequestBLDSC, RRequestPRO and RFTUrl. These have been included directly in the Reports table for simplicity and convenience in building the demonstrator service. In a real-world production system, it would be preferable to hold document supply options in a separate table, or to investigate the use of OpenURL to provide context sensitive resolution of appropriate options.

Field	Type	Key
RID	int(11)	PRI
RTitle	varchar(255)	
REdition	varchar(25)	
ROriginalTitle	varchar(255)	
RAuthor	varchar(255)	
RAuthorAffiliation	varchar(100)	
RDateOfPublication	date	
RPublicationYear	year(4)	
RFundingOrg	varchar(100)	
RContractNumber	varchar(50)	
RAbstract	text	
RAbstractIndicator	enum('y','n')	
RRequestHardcopy	varchar(255)	
RRequestBLDSC	varchar(255)	
RRequestPRO	varchar(20)	
RFTUrl	varchar(255)	
RFulltextIndicator	enum('y','n')	
RPagination	varchar(25)	
RPublisher	varchar(100)	
RConferenceDetails	varchar(255)	
RDocType	varchar(20)	
RFormat	varchar(20)	
RClassification	varchar(255)	
RKeywords	varchar(255)	
RISBN	varchar(20)	
RISSN	varchar(20)	
RLanguage	varchar(20)	
RNotes	varchar(255)	

Table 9-8 Fields in the Reports table.

As our investigations showed, a report may be associated with more than one report number and report numbers are entered inconsistently between different organisations, consequently report numbers are held in a separate Report Numbers Table related to the Reports table via the Report ID field (RID). This allows for a variety of report numbers and report number formats to be associated with an individual report (table 9-9).

Field	Type
RID	int(11)
RNSearchRptNo	varchar(30)
RNReportNumber	varchar(30)

Table 9-9 Report Numbers table.

Each Report Number (RNReportNumber) is also held in an alternative form (RNSearchRptNo), which consists only of alphanumeric characters and has all punctuation stripped out. This format is used internally by the demonstrator service when searching by report number to improve resource discovery capabilities (see Chapter 11).

The database currently holds 13,468 reports records from ten reports series. The initial population of the Reports table in the NRC, which has been carried out by harvesting metadata from project partners and the NACA OAI interface, is discussed below.

Cranfield University

Cranfield University library currently has more than 120,000 reports in over 1,400 series (see Appendix F) from over 300 different corporate sources (see Appendix G). Nearly all of these reports are individually catalogued and the records are held in the library OPAC in UKMARC format.

Harvesting has been carried out in a semi-automated fashion, by manually querying and exporting the MARC catalogue records from the library system. The resultant file then needs further manual intervention and processing by custom-written scripts, in PERL and PHP, to load into the NRC. Using this method, over 5,000 reports records have been added to the NRC, from the ARC Reports & Memoranda, the ARC Current Papers and the National Engineering Laboratory Reports series. The process is not trivial and requires rigorous checking and validation to identify and remove duplicate records.

British Library

The British Library holds millions of reports, many of which are not catalogued, however, BL contributes report records to the SIGLE database, which contains more than 100,000 UK reports records. These records are in a non-standard, custom format (see figure 9-3), nevertheless, the format is suitable to allow a semi-automated harvest to be carried out.

```
TI:  Studies of the flow of air in a model mixed-flow pump by laser Doppler
anemometry.  Part 2; velocity measurements within the impeller
AU:  Carey,-C.; Fraser,-S.M.; Rachman,-D.; Wilson,-G.
CS:  National Engineering Lab. (NEL), East Kilbride (GB). (05682B)
DP:  1985
PN:  82 p.
RN:  NEL-699
AV:  Available from British Library Document Supply Centre- DSC:6075.46(NEL-699)
DT:  R-Report
DE:  Primary: 01A-Aerodynamics; Secondary: 20E-Optics,-masers-and-lasers
TA:  Air behaviour in rotors
CN:  GB8631563
NC:  GB United-Kingdom.  See Guide.
PY:  1985
```

Figure 9-3 SIGLE database record for NEL-699

One advantage of using the SIGLE records is that they come with a subject classification provided from the SIGLE scheme, another is that it is possible to incorporate the BLDSC shelfmark into the NRC, providing a direct reference which is recognised by BL, thus facilitating document supply. Several hundred records have been added to the NRC from SIGLE, relating to the NEL report series and the Rolls-Royce Preprint series.

PRO

PROCAT, the PRO's bibliographic database (PROCAT, 2002), holds many thousands of report records. For test purposes, the PRO supplied a file relating to NEL reports in XML/EAD format, from this over 200 NEL records were generated. The records from the PRO are extremely 'thin', however in terms of resource discovery and collection management/rationalisation, 'thin' records are better than no records at all.

While, at first, it seemed that item level records are linked to records for the series to which they belong, on closer examination this is not always actually the case – the item level records are often a mixture of reports, minutes and other papers associated with a corporate source. Again rigorous checking and validation routines are required to gather only required records.

It is possible to embed the PRO 'piece reference' into the NRC providing a direct link back to a report at PRO for document supply purposes.

NACA OAI interface

Employing the Open Archives Initiative Protocol for Metadata Harvesting has significant advantages over other ad hoc methods of gathering records. Once scripts are established, they can be scheduled to run with little, if any, further human intervention required. This is a significant point with reference to series that are still currently being produced and for older, closed series which are undergoing digitisation over a period of time.

The team have added over 7,500 NACA records from five series to the NRC, employing the NACA OAI v1.1 interface at http://naca.larc.nasa.gov/oai. An example record is shown in figure 9-4.

```
<?xml version="1.0" encoding="UTF-8"?>
<GetRecord
xmlns="http://www.openarchives.org/OAI/1.1/OAI_GetRecord"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xsi:schemaLocation="http://www.openarchives.org/OAI/1.1/OAI_GetRecord
http://www.openarchives.org/OAI/1.1/OAI_GetRecord.xsd">
<responseDate>2002-08-21T15:10:23+00:00</responseDate>

<requestURL>http%3A%2F%2Fnaca.larc.nasa.gov%2Foai%2Findex.cgi%3Fverb%3DGetRecord%26
metadataPrefix%3Doai_dc%26identifier%3Doai%3ANACA%3A1917%3Anaca-report-
1</requestURL>

<record>
<header>
<identifier>oai:NACA:1917:naca-report-1</identifier>
<datestamp>2001-07-27</datestamp>
</header>
<metadata>
<dc xmlns="http://purl.org/dc/elements/1.1/"
               xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
               xsi:schemaLocation="http://purl.org/dc/elements/1.1/
               http://www.openarchives.org/OAI/1.1/dc.xsd">
<title> Report on behavior of aeroplanes in gusts </title>
<type> NACA Report 1 </type>
<creator> Hunsaker, J C Wilson, Edward Bidwell </creator>
<contributor> Massachusetts Inst. of Tech. (Cambridge.) </contributor>
<date> 1917 </date>
<identifier> http://naca.larc.nasa.gov/reports/1917/naca-report-1/</identifier>
<description> Part 1 presents the results of a wind tunnel test of a biplane model
with an 18 inch span. The lift, drift, and pitching moment were measured
for a series of angles of incidence corresponding to the maximum possible
changes of flight attitude. Only the discussion of symmetrical or
longitudinal changes is given. From the observed rate of variation of the
forces and pitching moment, it was possible to calculate the derivatives
needed in the complete theory of longitudinal stability in still air. The
damping of the pitching oscillation was also determined experimentally.
Part 2 presents a theoretical method for determining the effects of gusts
on aeroplanes in the following cases: (1) head-on gusts rising from 0 to j
feet per second with various degrees of sharpness, (2) up gusts of the same
type, (3) rotary gusts of the same type, (4) rear gusts and down gusts are
included by merely changing the sign of j.
</description>
</dc>
</metadata>
</record>
</GetRecord>
```

Figure 9-4 OAI XML/DC record from the NACA server for report NACA-Report-1

Other sources of metadata

There are many thousands of report producers globally and hundreds of reports collections in the UK, many of which are potential sources of reports metadata. For example:

- Dstl/QinetiQ have substantial holdings of reports from their predecessor organisations, many of which are catalogued and classified by subject;
- NASA produces, and provides bibliographic data for, thousands of reports produced each year;
- Abstracting and indexing agencies, such as NTIS create thousands of rich bibliographic records for reports each year, and indeed, NTIS have already expressed an interest in providing metadata for the NRC;

- The Council for the Central Laboratory of the Research Councils (CCLRC) holds over 40,000 reports, individually catalogued, many of which are directly or indirectly relevant to engineers.

To come up with bespoke solutions to the harvesting of metadata from each and every one of these sources is clearly impractical in terms of both cost and effort.

The application and take up of the Open Archives Initiative Protocol for Metadata Harvesting offers the best hope for developing an ongoing, low-cost, least-effort solution to the management and dissemination of engineering technical literature.

9.6. Conclusion

This chapter has dealt with issues relating to the creation of an engineering National Reports Catalogue underlying the MAGiC demonstrator service – METReS. For the sake of rapid development, the database has a somewhat simplified structure. It is however sophisticated enough to provide a vision of the possibilities in relating reports to their sources, series and locations, and has shown that OAI metadata harvesting offers the best available practical solution for populating the database.

The next chapter examines the creation of an associated full text archive.

10. Full text archive

10.1. Introduction

From the outset of the MAGiC project, an important objective was to enhance access to technical reports via electronic storage and document supply, by developing a core electronic archive of engineering report literature. In particular, we stated that we would significantly enhance the searchability of ARC reports, and make a subset of the most important of these available electronically as part of the development of the full-text archive (MAGiC 2000).

The validity of this objective has been confirmed by the MAGiC use and value studies, which found that the Internet is the primary source of information favoured by engineers; and by the literature review, which showed that once reports are available electronically, they receive greater use. Also born out is our initial assumption that increased access to full text documents is in line with user expectations.

This is in agreement with the findings of the Library Information Commission, which decided that improving access was the main priority for undertaking digitisation, and that the main reason for selecting a resource was its uniqueness (Library and Information Commission, 1998).

It should be noted that, during the course of the project, the electronic information landscape has changed considerably.

Increasingly, commercial and academic producers of reports are making their reports available electronically from their own web-sites.

The emergence of the OAI makes it very easy to build virtual collections pointing to resources in disparate locations, simply by selectively harvesting metadata from sources around the world.

Significantly, universities are adopting Eprints software, which is OAI-compliant, to create their own institutional archives holding technical reports (as well as journal pre- and post-prints, and other document types).

Consequently, the full-text archive developed as part of the MAGiC project, rather than becoming a central repository, will form part of a network of distributed repositories holding technical reports both in the UK and globally.

10.2. Data conversion options

When beginning a digitisation programme there are many issues to be considered, including:

- The available time scale;
- Number and nature of documents;
- Copyright issues;
- Available expertise and equipment;
- The purpose of the digitisation.

10.2.1. Copyright issues

Before beginning any digitisation exercise, it is necessary to determine the copyright status of the material under consideration. In the case of ARC reports, copyright was owned by DERA (the Defence Evaluation Research Agency). The MAGiC team duly obtained permission from DERA before the digitisations were carried out.

10.2.2. In-house vs. external bureau

Given the available time scale of the project, and our own lack of expertise in carrying out a digitisation programme, the team decided that it would preferable to use an external bureau, with existing expertise, to digitise documents rather than attempt the digitisation in-house.

The agency we chose to work with, initially, was the Higher Education Digitisation Service (HEDS), which provides "advice, consultancy, and a complete production service for digitisation and digital library development." (HEDS, 2002). HEDS is funded by the Joint Information System Committee (JISC 2002), and is staffed by professionals with several years' experience in the digital library field.

10.2.3. Data formats

Although there are many data format options to choose from, it quickly became apparent that, for the type of documents involved, i.e. technical reports, scanning to TIFF and subsequent conversion to PDF for delivery via the Web would be most appropriate.

The Tagged Image File Format (TIFF) is the most widely used cross-platform standard for image data capture, and the resulting high quality images make it suitable for archival purposes. In addition, it is relatively simple to convert from TIFF to other formats for subsequent delivery to end-users. It is possible to create TIFFs employing various compression methods to reduce resultant file sizes. While this is not always recommended when creating master image sets, one form of compression known as Group IV, originally used in fax transmissions, is frequently used by digital imaging projects for the creation of black and white images (Lee, S. D., 2001, 45-46).

MAGiC, on the recommendation of HEDS, chose to create Group IV TIFF images where pages were in black and white. In order to preserve their quality, pages with greyscale content (photographs etc.) were treated as exceptions, and scanned as Greyscale uncompressed TIFF.

PDF (Portable Document Format), although a proprietary format owned by Adobe (2002), is a de facto standard adopted around the world for web delivery of text documents. In order to read PDF files in a web browser, a plug-in (Acrobat Reader) is required, however this is widely available and already installed on many computers. PDF files come in a number of formats and may contain just scanned images, or scanned images with underlying OCR text. While the resultant file sizes are larger, the latter option means that the files may be used for keyword or natural language searching, which improves their value for resource discovery, and this was the option selected by the team.

When capturing documents, from hardcopy sources to PDF, the resulting file sizes can be large, however, at this time, there are very few alternatives. One such alternative format is DjVU (2002) which allows for much greater compression rates than PDF. Take-up of DjVU has not been very high, but it may be worthy of consideration in the future.

10.2.4. Storage options

Having created digital versions of technical reports, it is necessary to provide some kind of storage system to hold, and allow access to, those reports. The primary requirement is, quite simply, disk space in an Internet-accessible location. However, the MAGiC team has considered a number of archive options, including Hyperion (see below) and Eprints, which go beyond the provision of disk space and provide additional facilities.

The Hyperion Digital Media Archive is a tool, created and supplied by Sirsi for "organising, storing, maintenance, and accessing of non-book holdings in a digital format" (Sirsi, 2002). Hyperion is designed to provide access to full digital images with a web browser. It allows collections to be browsed or searched using full-text, plain English and can be tightly integrated with Sirsi's library catalogue systems.

The last two years have seen the emergence of institutional Eprints Archives (Eprints Initiative, 2002) particularly among universities. The Eprints software "has been created so that institutions can create OAI-compliant Archives quickly, easily and for free" and its primary purpose is "to help create open access to the peer-reviewed research output of all scholarly and scientific research institutions" (Eprints Initiative, 2002a). However, the system is equally capable of being used to store metadata about technical reports, and the web-site notes that the software can "help to maximise the access to -- and hence the impact of -- research output", which by definition includes technical reports.

Both Hyperion and Eprints are designed to facilitate the management of, and access to, electronic documents. While both have their merits, we believe that the system developed by the MAGiC team – METReS – offers the best solution for the comprehensive management and delivery of both electronic and legacy technical reports.

In the context of METReS, in effect we are creating a global virtual full-text archive of technical reports, by employing OAI metadata harvesting to gather records with pointers to reports, regardless of the locations of those documents, and this largely removes the need for further software capabilities.

In the end, we decided to hold copies of digitised reports in web-accessible directories on the UK mirror of the NACA server (see 10.5 below) and in Hyperion. In the mid- to long-term, this will enable us to compare the merits of using keyword searching of bibliographic records via METReS, against the full text, natural language searching available via Hyperion.

10.3. Populating the archive

The reports of the Aeronautical Research Council (ARC) are ideal for a trial digitisation for a number of reasons:

- They represent a unique set of reports describing the results of high quality research;
- The size of the reports series is well known;
- The reports are scattered in collections across the UK;
- Academic libraries have not catalogued the reports individually;
- The hardcopy reports are available and catalogue records exist for the majority of reports in the Cranfield library catalogue;
- Finding aids within the series provide the means to create skeletal records to fill gaps in the bibliography.

A further benefit of digitisation was identified as “the preservation of … rare and valuable material” (MAGiC 2000). This is, however, a more contentious issue than that of improved access. There are concerns about the longevity of digitised documents, even with emulation or migration systems in place. At the moment, the creation of microfilm still compares favourably over digitisation as a means of preservation. Nevertheless, digitisation can aid preservation, at least in the short term, by reducing the need to handle the original documents (Lee, S. D., 2001, 5-6).

10.3.1. ARC reports

Following consultation with HEDS, the MAGiC team decided to conduct a trial digitisation of 800 (approximately 26,000 pages) Aeronautical Research Council Reports and Memoranda (ARC/R&M).

To allow testing of some of the suggestions arising from the development of the collection analysis methodology, the reports selected comprised:

- The earliest 200 reports;
- The latest 200 reports;
- 200 reports satisfying current/emerging trends ;
- 200 reports selected randomly as a control group.

This trial digitisation, conducted by HEDS, was extremely successful, and the quality of the returned documents was very good, as illustrated by figures 10-1 and 10-2.

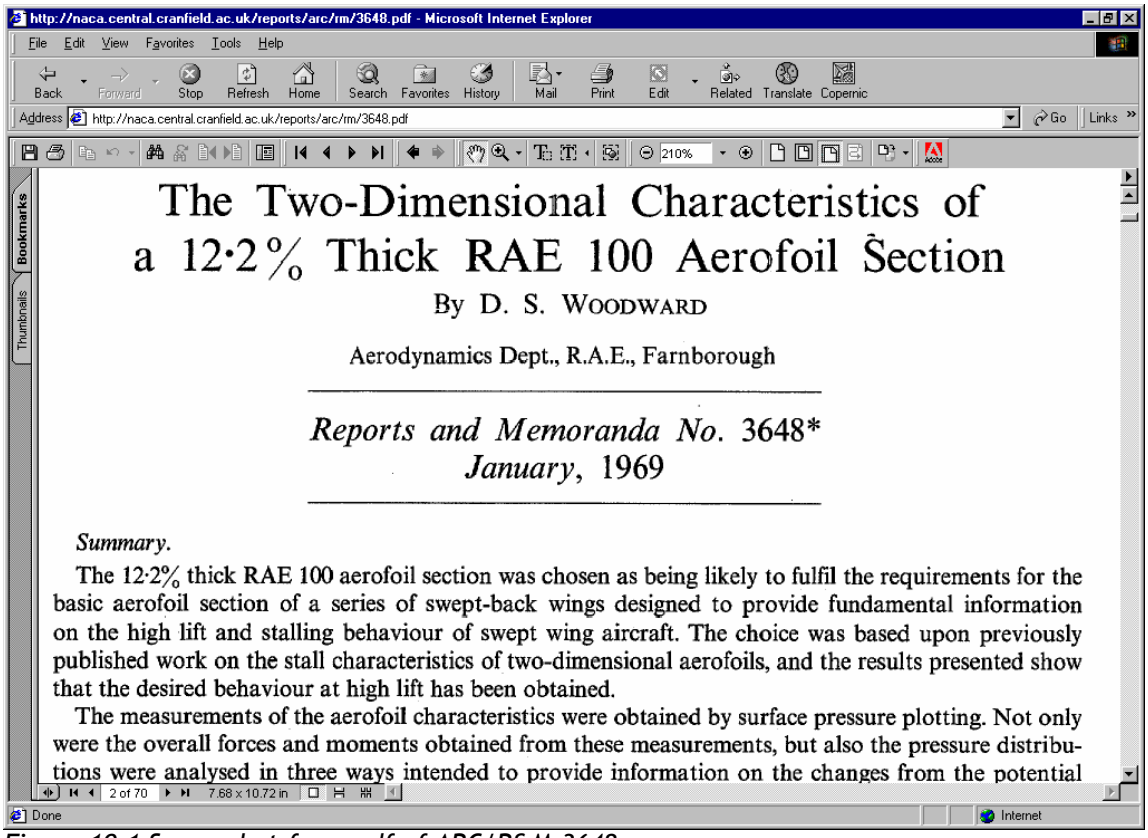

Figure 10-1 Screenshot from pdf of ARC/R&M-3648

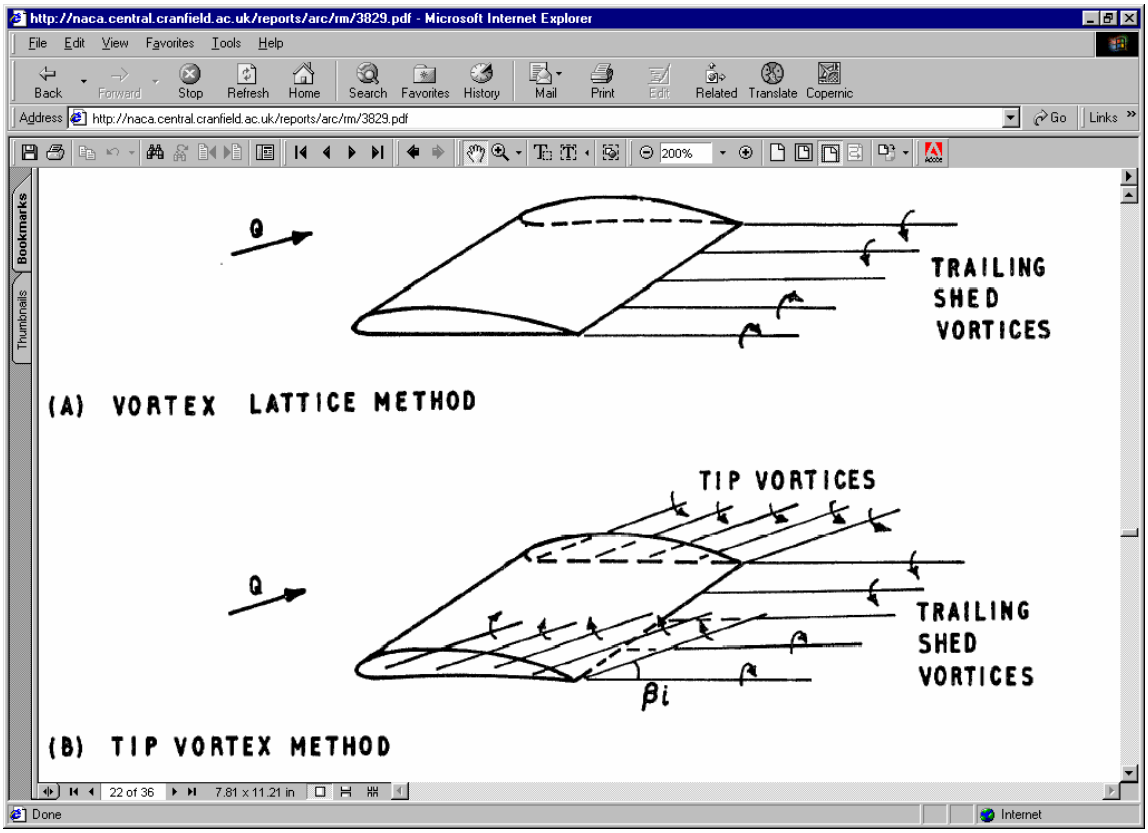

Figure 10-2 Screenshot from pdf of ARC/R&M-3829

So, with the initial test complete and assured that high-quality electronic reproduction of ARC reports was possible, we decided to go ahead with a second digitisation of ARC/R&Ms. Consequently, we selected a second batch of 800 reports, and these were also processed with very good results.

It is our intention to continue making further ARC/R&M reports available as electronic full text, until the whole series has been digitised, or until funds run out.

While it is possible to select reports for digitisation by number of criteria, a key suggestion in the collection analysis methodology is that whole series should be digitised. So, in keeping with this philosophy we also placed the task of digitising the complete ARC Current Papers series with Document Technologies (2002). Recommended by expert colleagues at Cranfield University, the company specialises in handling documents that require particular care.

Again, this exercise was very successful, and the entire ARC/CP report series is now available as electronic full text, held on the NACA server and accessible via METReS.

10.3.2. NACA reports

During the course of the project, the digitisation exercise (and the emergence of the OAI) led to an exciting opportunity for collaboration between MAGiC and NASA.

As NASA's predecessor organisation, the National Advisory Committee for Aeronautics (NACA) was chartered in 1915 and was operational from 1917 until 1958. NACA played an integral role in the development of the United States fledgling aeronautics industry as the main research body for a collection of federal, commercial and university interests. The main product of NACA's research was its multi-tiered reports series, comprising in excess of 25,000 reports.

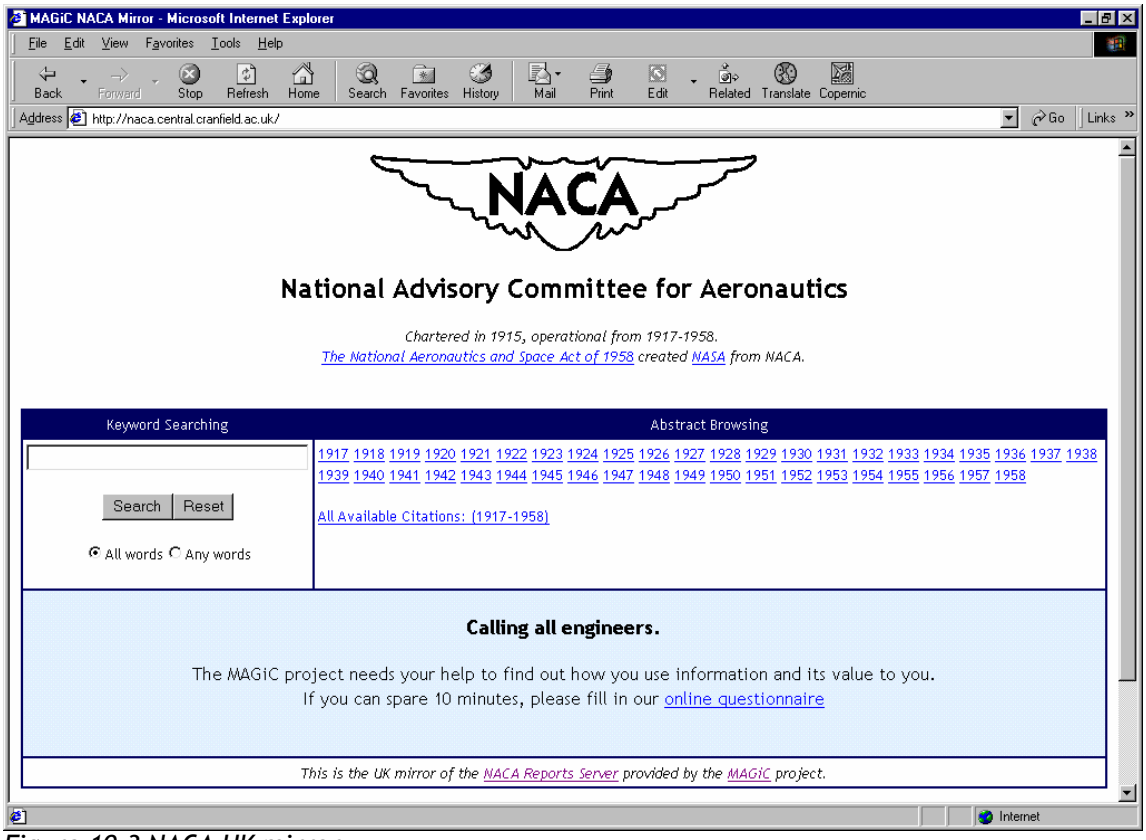

Figure 10-3 NACA UK mirror

The MAGiC team came to an agreement to exchange digitised ARC reports for digitised NACA reports, with document exchange at collection level rather than on a one-for-one basis (see Appendix P).

NASA and MAGiC have successfully employed OAI metadata harvesting to exchange metadata, and in this case the related documents themselves. So far, we have exchanged all 3,000 plus ARC/R&M and ARC/CP reports for over 7,500 NACA reports. Further exchanges will take place automatically, through the use of OAI, as more digitised reports are added on both sides of the Atlantic.

The exchange means that all the digitised ARC reports will shortly be available from the NASA Technical Reports Server. Agreeably, this will certainly mean that MAGiC has achieved the objective of making ARC reports more visible, searchable and widely accessible.

In fact, the agreement has also lead to the establishment of a full NACA Reports Server UK mirror (see figure 10-3 above), which is available at http://naca.central.cranfield.ac.uk/. Thanks to OAI metadata harvesting, maintaining the mirror is virtually effortless.

The NACA mirror server, purchased by Cranfield University, has in excess of 80Gb of disk space, and consequently was an ideal place to act as the store for the creation of the MAGiC full text archive.

10.4. Summary

The project has successfully made over 3,000 ARC reports available in electronic format, as well as reaching an important exchange agreement with NASA. This has lead to the achievement of the goal of increasing the visibility, searchability and accessibility of ARC reports. Significantly, it has demonstrated the importance of co-operation and collaboration in improving the availability of technical reports.

The last two chapters have described the creation of the National Reports Catalogue and the full text archive. The following chapter demonstrates the two in action.

11. METReS – the MAGiC Demonstrator Service

11.1. Introduction

This chapter describes the MAGiC Engineering Technical Reports Service (METReS) - the 'proof of concept' demonstrator service created by the MAGiC team. METReS is, in effect, the window looking into the NRC, which demonstrates the strength of using harvested records that are held locally but describe resources in many different locations. Figure 11-1 provides an overview of the main features of the service.

In keeping with our findings that the Internet is the preferred information source of engineers (and other user groups), METReS has been designed as a web-based service available at http://magic-reports.lib.cranfield.ac.uk/. The interface has been developed using PHP (2002), a simple to use scripting language which allows rapid development.

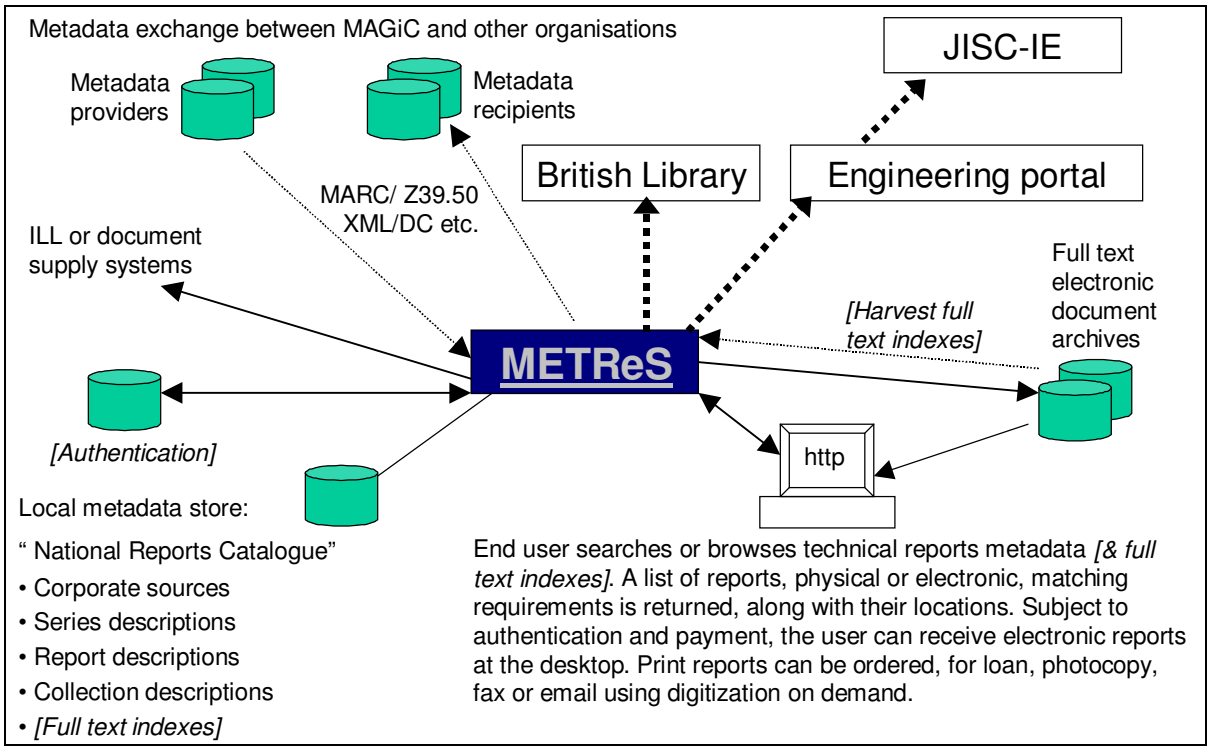

Figure 11-1 Overview of METReS architecture

METReS core service is the delivery of records, from the National Reports Catalogue (NRC), providing either links to documents in the full text archive or offering a hardcopy document supply option. Reports metadata is harvested from available sources and stored locally in the NRC, along with descriptions of reports series, corporate sources and holdings in various collections.

Additional services include news feeds, discussion forums and links to other resources relating to engineering technical reports. These are designed to provide a rich, 'sticky' environment of interest to engineers and others involved in the management of engineering information.

As described in Chapter 9, through the use of metadata harvesting, in a very short time it has been possible to populate the NRC with over 13,000 records describing reports. Each record provides links to information about:

- Obtaining the document, either a URL in the case of electronic full text reports, or a document supply option in the case of hardcopy reports;
- Collections where the report is held;

- The organisation responsible for the production of the report;
- The report series to which that report belongs.

As described in Chapter 10, through the digitisation exercise undertaken by MAGiC and the exchange agreement with NASA, the full text archive has been populated with over 10,000 digitised reports from the ARC and NACA.

While only a demonstration service, already METReS represents a powerful tool for resource discovery, document supply and collection management.

11.2. Searching the NRC

Facilities for searching the NRC are simple but effective. Using the 'Basic Report Search' on the home page it is possible to search on 'Title', 'Author' or 'Report Number' fields.

As discussed in Chapter 7, report numbers are catalogued inconsistently by libraries, with different combinations of slashes, dashes and other punctuation characters. Harvesting metadata from many sources means that records within the NRC will reflect these inconsistencies. Consequently, the 'Report Number' search has been designed to search on a 'normalised version' of a given report number which has all punctuation characters stripped out and the search is not case-sensitive. So, for example, a search entered, as 'ARC/R&M-3555' or 'ARC-R+M-3555' or 'ARC RM 3555', will be converted to 'arcrm3555' and the report record will found in all cases. Furthermore, the NRC has the capability of holding known variants of a report number, so that a search for either NACA-Report-1392 or NACA-R-1392 will successfully return the record for that report.

When searching by 'Title' or 'Author', by default METReS will search using all the words entered, but it can also be set to search for any of the words, or to perform a phrase search by putting search terms between inverted commas. The word search performs automatic stemming so a search for 'aero' will find 'aerofoil', 'aerodynamic' and so on. Again, the search is case insensitive. An example of a simple 'Title' search, from the home page (see figure 11-2), for 'analysis of lateral motion', returns four records (see figure 11-3).

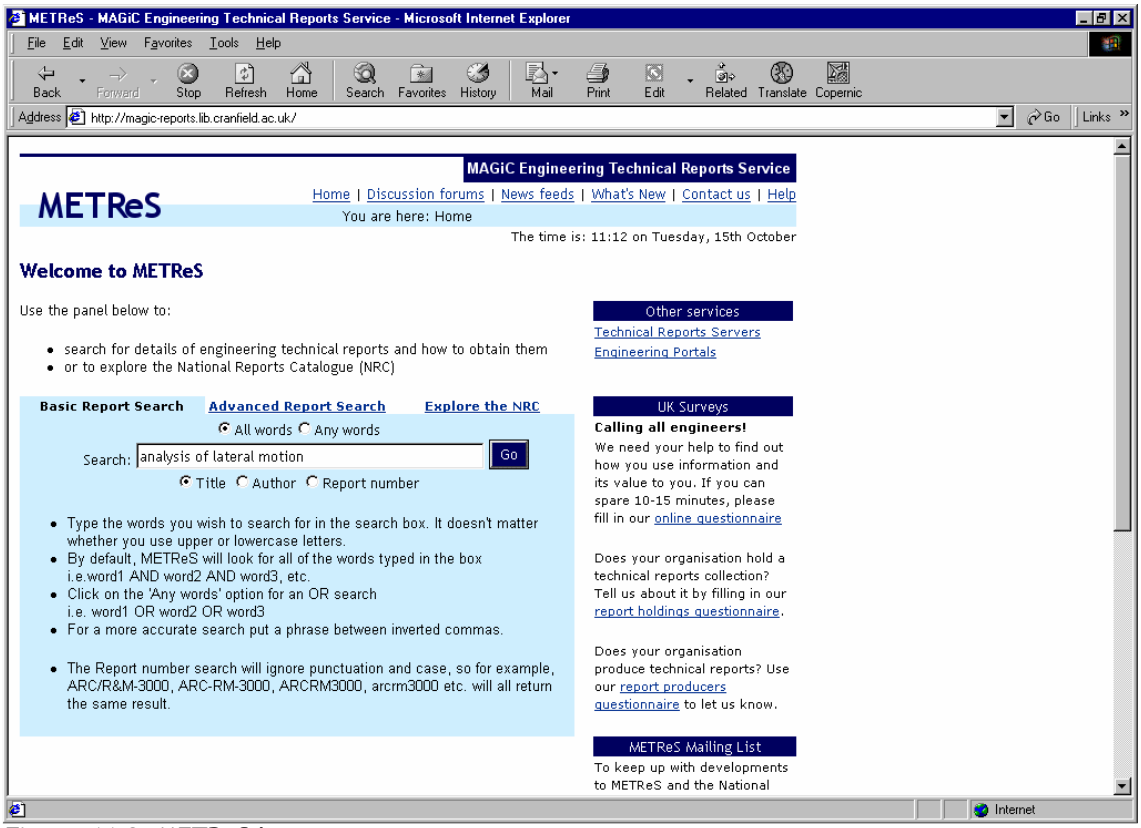

Figure 11-2 METReS homepage

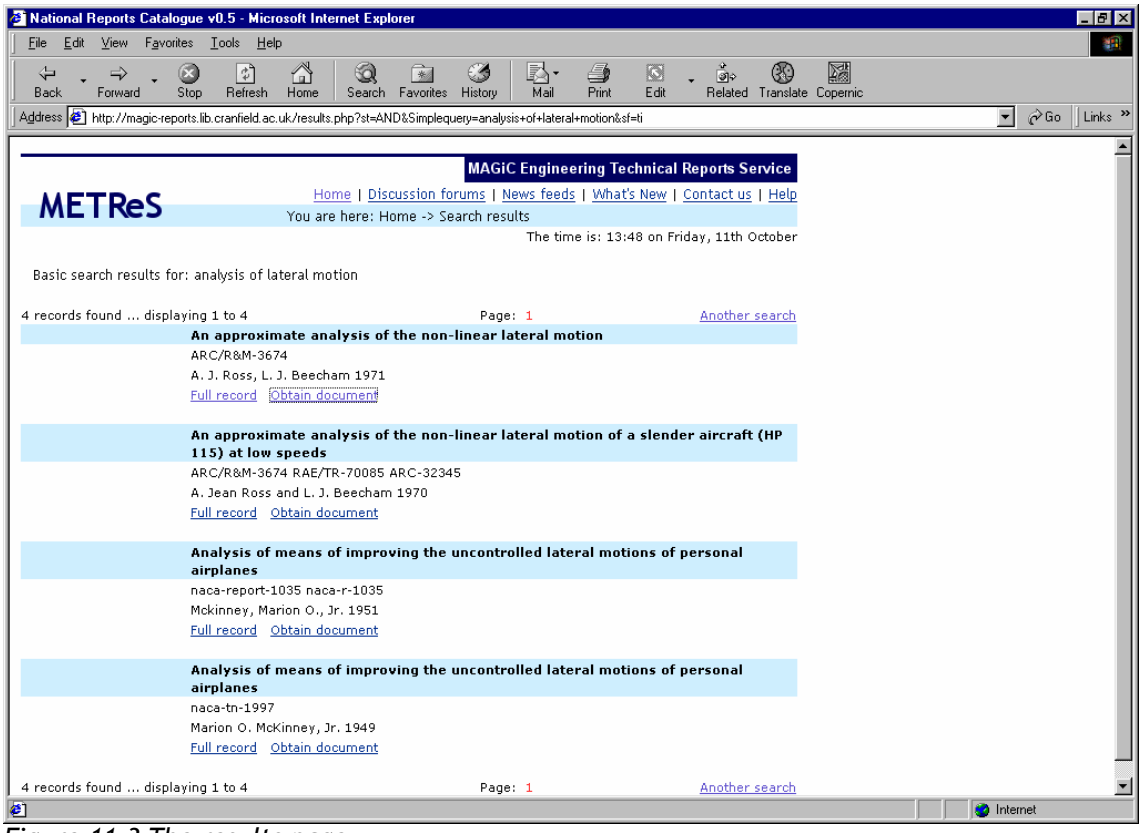

Figure 11-3 The results page

From this page, it is possible to examine the full record (see figure 11-4) and click through to a copy of the electronic full text document, if available (see figure 11-5).

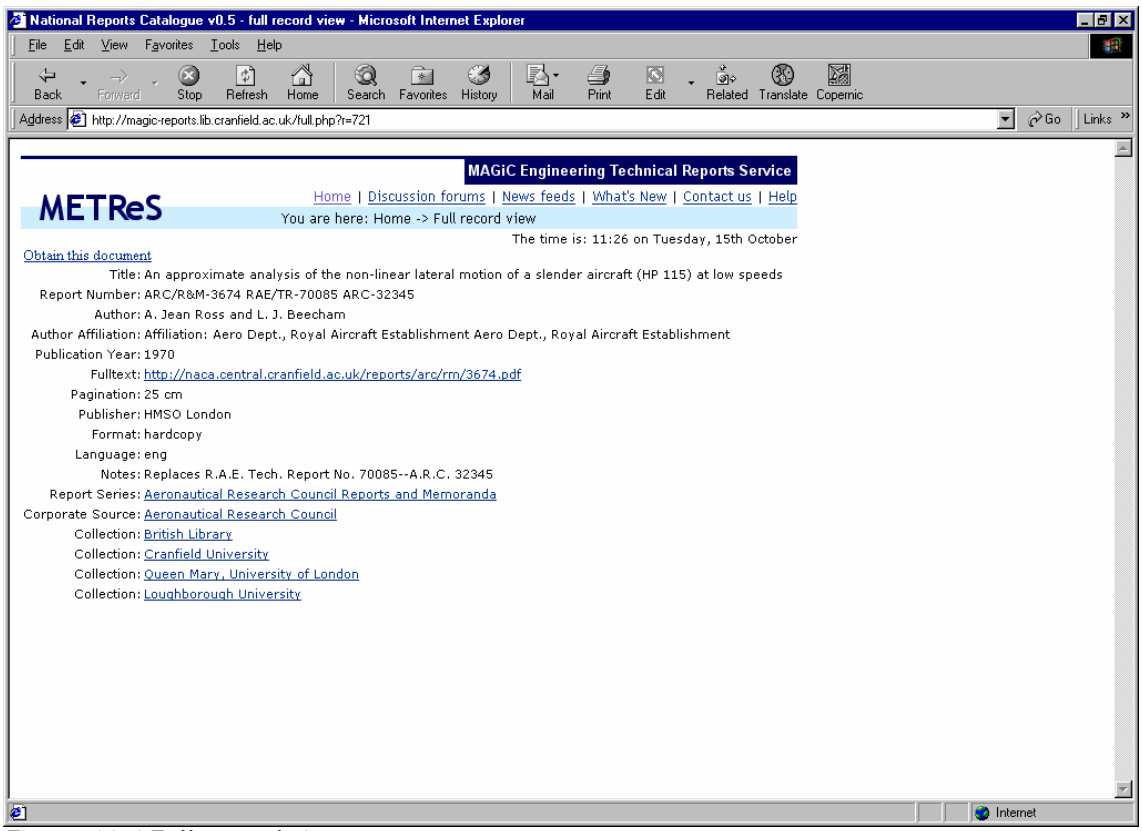

Figure 11-4 Full record view

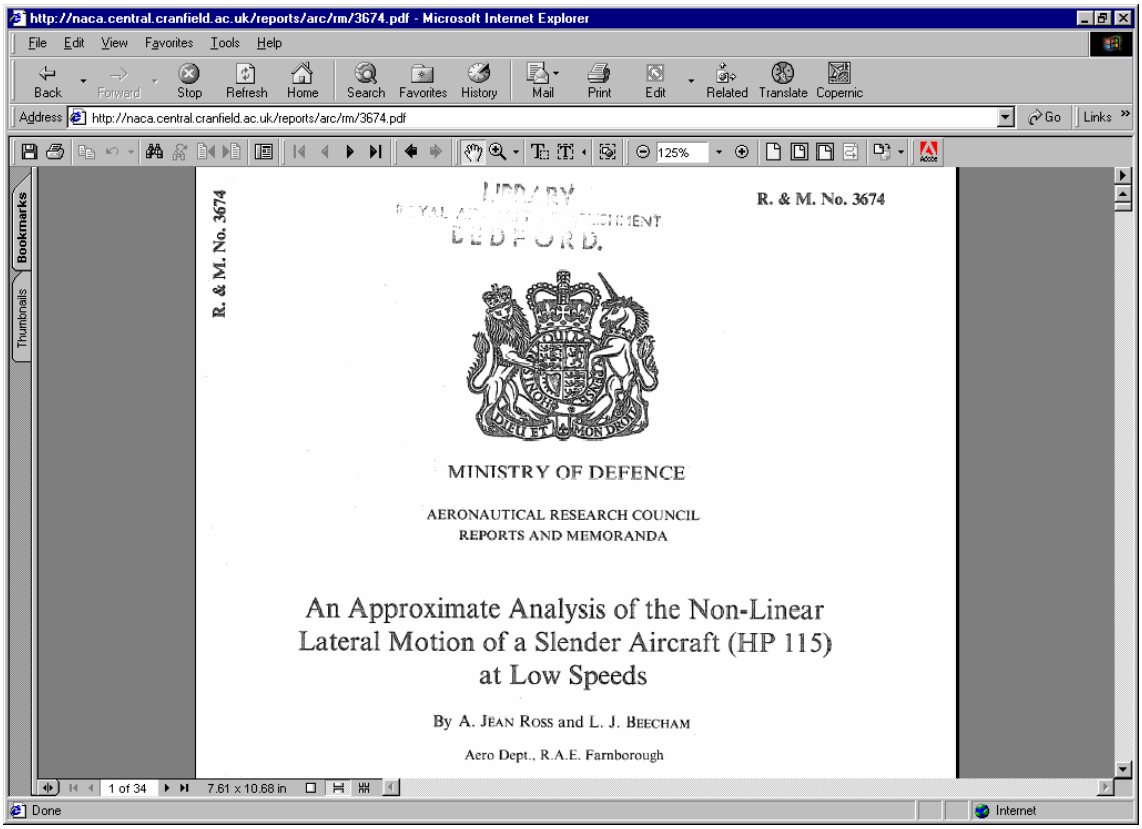

Figure 11-5 Screen shot of electronic full text ARC/RM report

By following the 'Obtain document' link, the user is taken through to a document supply page (see figure 11-6).

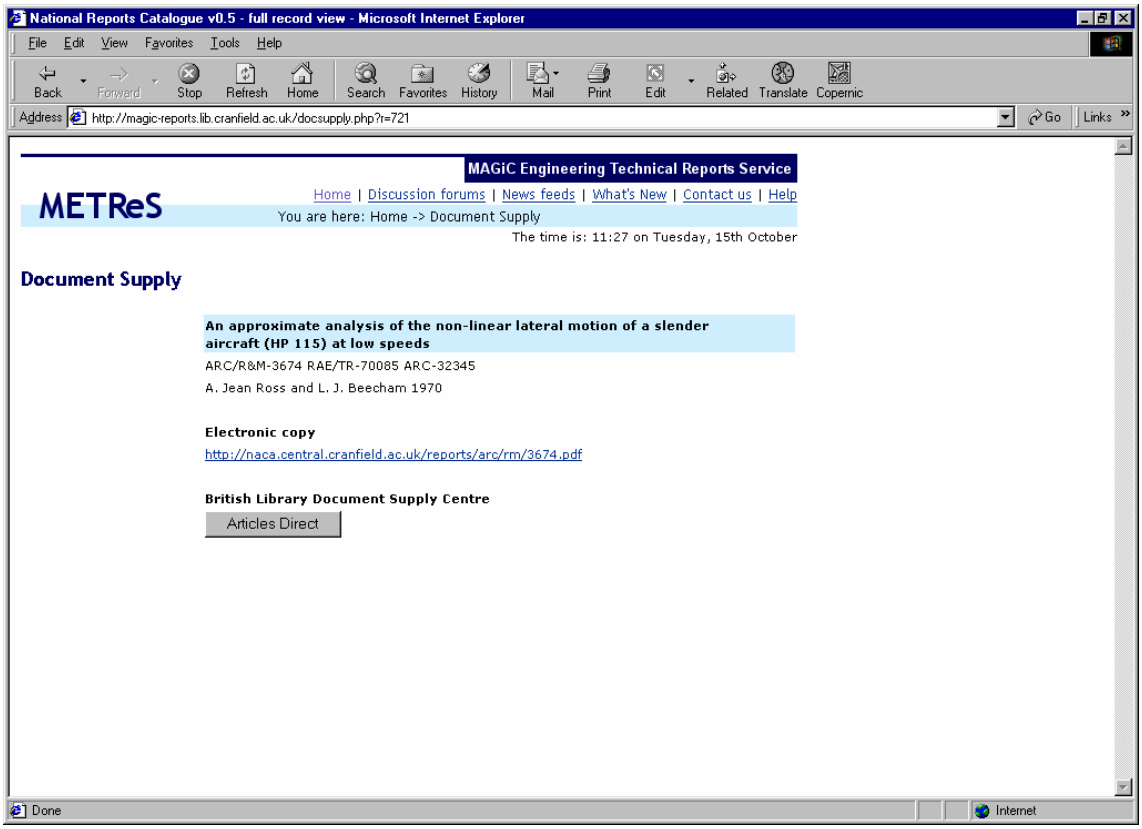

Figure 11-6 Document supply page

In this case the supplier is BLDSC, and clicking on the 'Articles Direct' button takes us through to the Articles Direct Order Form, automatically inserting the publication details (see figure 11-7).

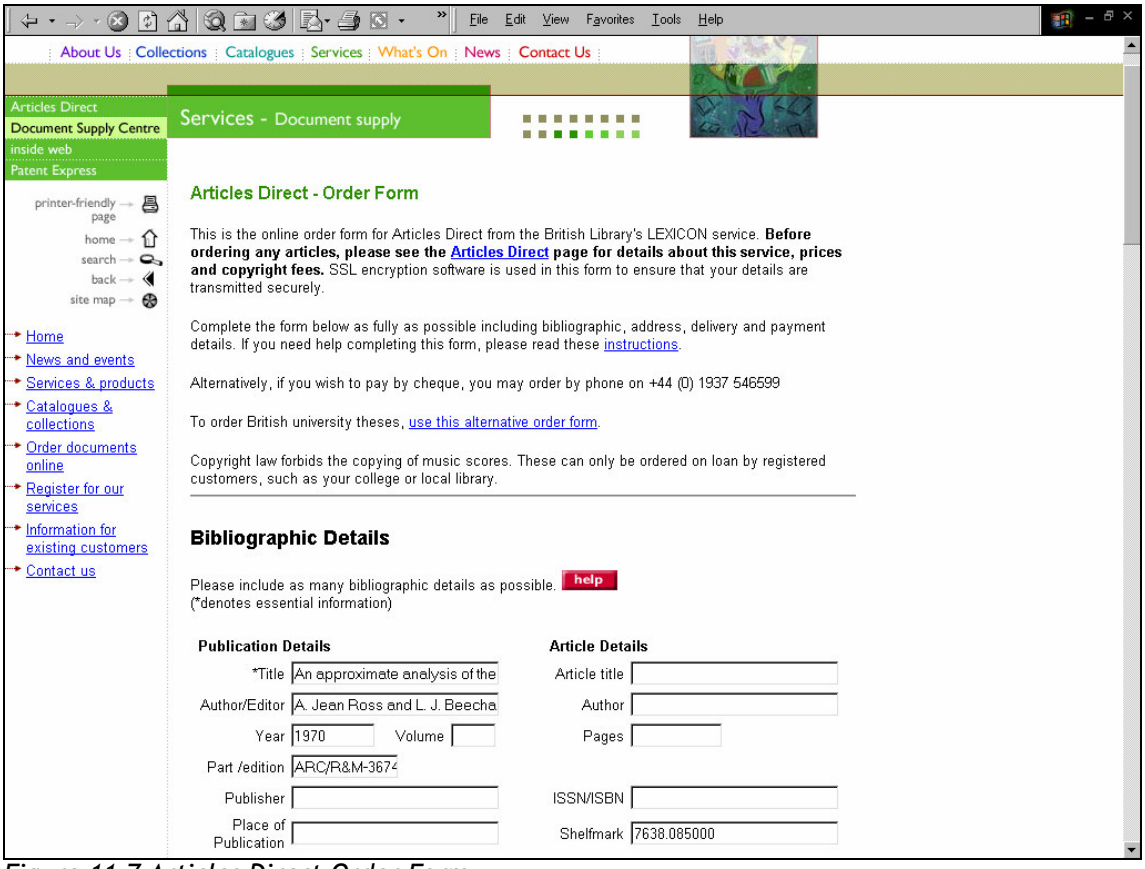

Figure 11-7 Articles Direct Order Form

The full record view (figure 11-4) also provides links through to information about the corporate source, the report series, and gives a list of known collections that hold the document. The record lists several collections where the report is held: the British Library, Cranfield University, Queen Mary College and Loughborough University. Of these institutions, only Cranfield University has all of its reports individually catalogued. A search in the catalogues of the other institutions would not have found the report. However, simply by supplying MAGiC with the report number ranges held in a given report series, those institutions have instantly increased the visibility of reports in their own collections.

11.3. Management and rationalisation

Significantly, holdings become visible not only to users, but also to collection managers. By using the advanced search page (see figure 11-8), it is possible to restrict searches to selected corporate sources, reports series or collections. Also, searches can be limited to return results only where the electronic full text of a report is available.

This allows reports production and holdings to be examined from a number of different angles and gives collection managers a standard against which to measure their own holdings, as well as offering the possibility for libraries to harvest records from the NRC to enhance their own local services.

It is these facilities that also make METReS a very powerful tool for collection management and rationalisation.

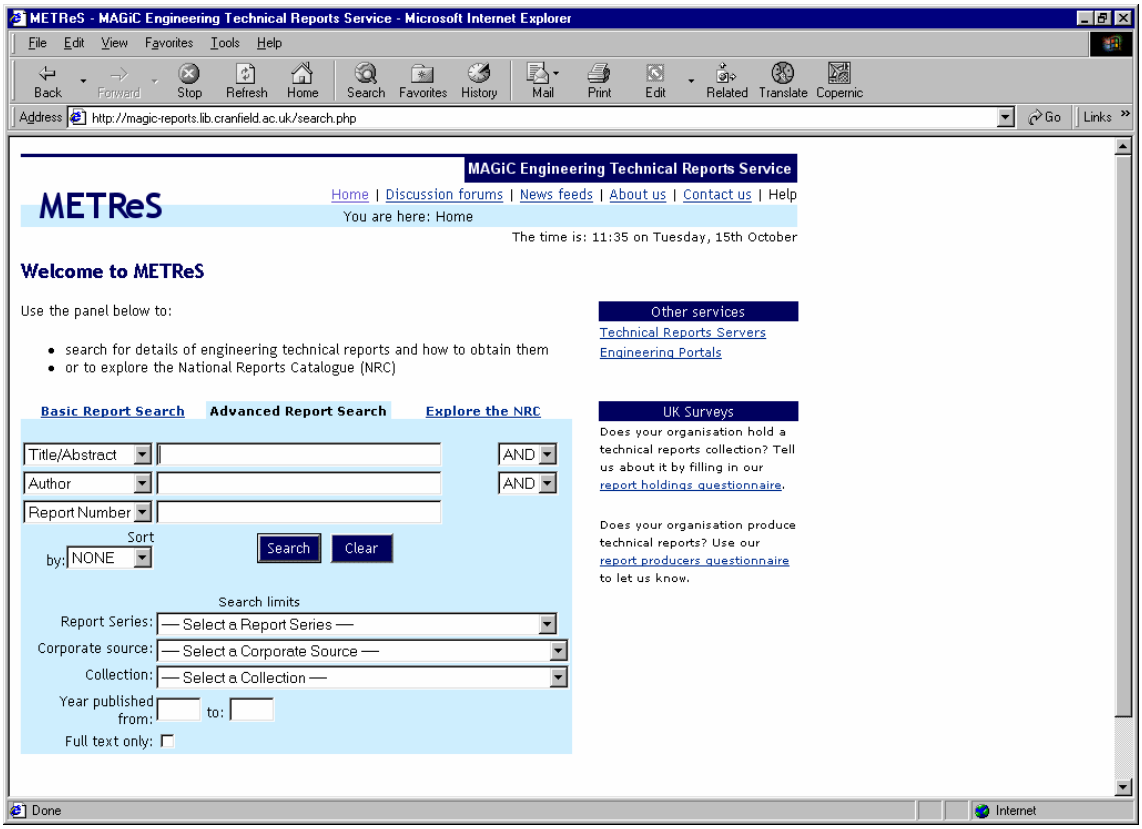

Figure 11-8 METReS Advanced Report Search

11.3.1. METReS capabilities

Three hypothetical scenarios serve to illustrate some of the capabilities of the system.

Scenario 1

Queen Mary College library has a catalogue entry at series level for the ARC/R&M report series, which lists the report numbers held, but individual reports are not catalogued (see figure 11-9).

```
Title: Reports and memoranda / Aeronautical Research Council
Publication info: London : HMSO.
    General Note: Nos.1-649 issued in Technical reports / Aeronautical Research
                  Council
MAINLIB holdings: Shelves: n650-Vol. 3850,.
    Added Author: Aeronautical Research Council.
```

Figure 11-9 Queen Mary College library catalogue record for ARC/R&M reports

Wishing to enrich their local catalogue with individually catalogued reports records:

- The library supplies METReS with a list of report numbers held
- Employing scripts this information is incorporated into the NRC
- A query is run against the NRC, limited to the ARC/R&M report series and the Queen Mary collection, and the resultant records are exported in a format that allows Queen Mary to incorporate the metadata in their own catalogue.

This results in improved resource discovery for users of the Queen Mary College catalogue, and contributes to an enhanced understanding of reports in the UK through incorporation of information in the NRC.

Scenario 2

Dstl hold various reports from the ARC/CP report series at multiple sites. Unlike most academic libraries, the reports are catalogued individually. In order to reduce costs, they want to rationalise their holdings and keep only one complete hardcopy set of the series in one location for archival purposes, while at the same time giving improved access to the reports:

- Dstl gather the ARC/CP reports together from the multiple sites. From these they create one complete hardcopy set of reports which is located in their archival facility. Duplicate reports are disposed of, being no longer required.
- Some Dstl sites wish to incorporate ARC/CP metadata, complete with full text links into their library catalogues. A query is run against the NRC, limited to the ARC/CP report series and the resultant records are added to their catalogues.
- Other Dstl sites choose to make all the records in the NRC available to their users, and cross-searchable with other resources. This is accomplished either by using OAI metadata harvesting to gather the resources in a local database or by employing Z39.50 cross searching.

This results in collection rationalisation, improved access to reports and cost savings for Dstl.

Scenario 3

Cranfield University holds all the ARC/R&M reports individually catalogued. The reports are available for loan. The university wants to allow access to the contents of the reports but is becoming increasingly concerned about their preservation. The report series is part of an ongoing digitisation programme and some but not all of the reports are yet available as electronic full text:

- Employing the OAI layer exposing metadata from the NRC, the university sets up a script, which selectively harvests records for ARC/R&M reports available in digital format, and incorporates the full text link into the appropriate library catalogue records
- The script is set to run automatically four times a year. Each time it runs it only picks up the records that have changed since the last run, and now include a full text link. The new information is incorporated in the catalogue.
- At the same time the university introduces a strict policy that reports now available in full text will no longer be available for loan, thus achieving the aim of improving the preservation of the documents.

This contributes towards preservation of the reports, while enhancing their accessibility.

While METReS/NRC is capable of much more, the examples above at least give some indication of collection management and rationalisation possibilities raised by the system.

11.3.2. Exploring the NRC

So far the focus has been on reports records. However, in addition to the reports search facilities, there is also an 'Explore the NRC' page (see figure 11-10), which makes it possible to directly examine the records describing the corporate sources, reports series and collections.

The NRC currently holds details on:

- 45 corporate sources of reports;
- 13 reports series;
- 26 collections.

The information on corporate sources and collections has largely been gathered from the returns of preliminary questionnaires, which were discussed in Chapter 7. The report series entries have been created from scratch, using information from a number of sources. The descriptions of corporate sources, reports series and collections can all be entered as 'standalone' entries. However, over a period of time, the relationships between the entries can be added as details of those relationships are discovered.

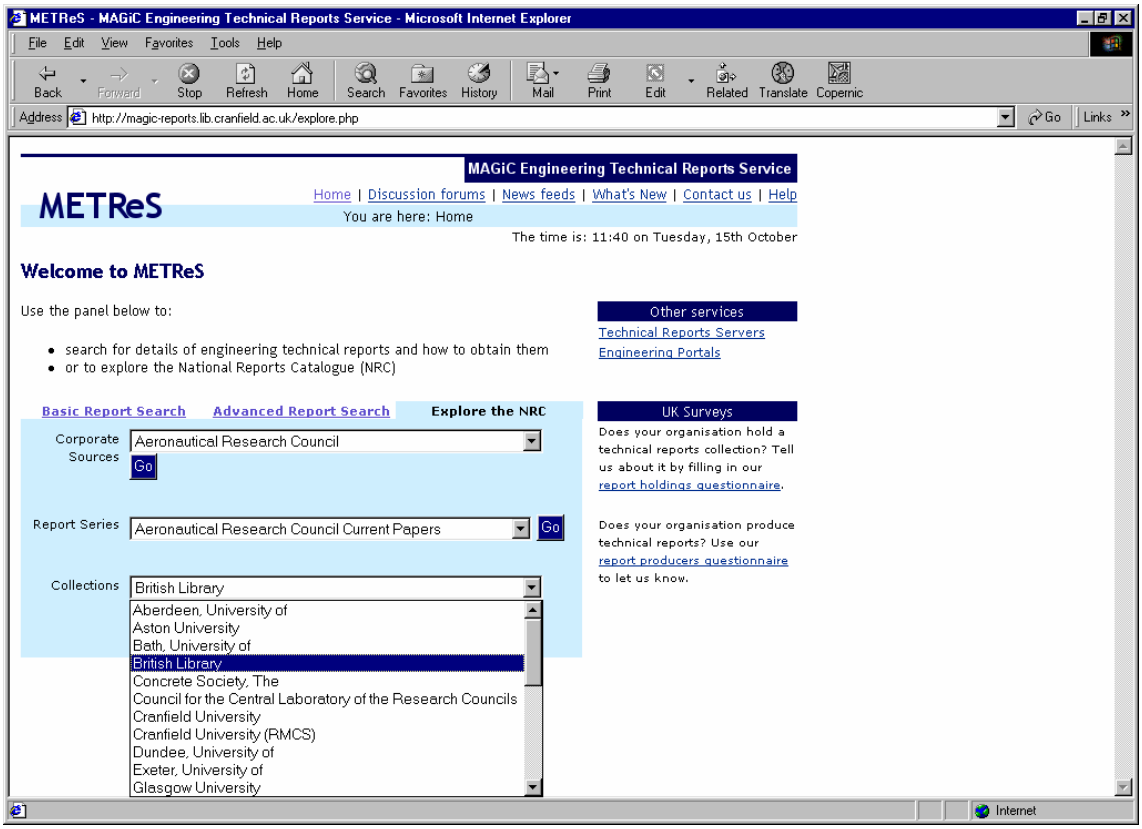

Figure 11-10 METReS 'Explore the NRC' page

So for example, the record describing the collection of the British Library (figure 11-11), already has links to nine reports series.

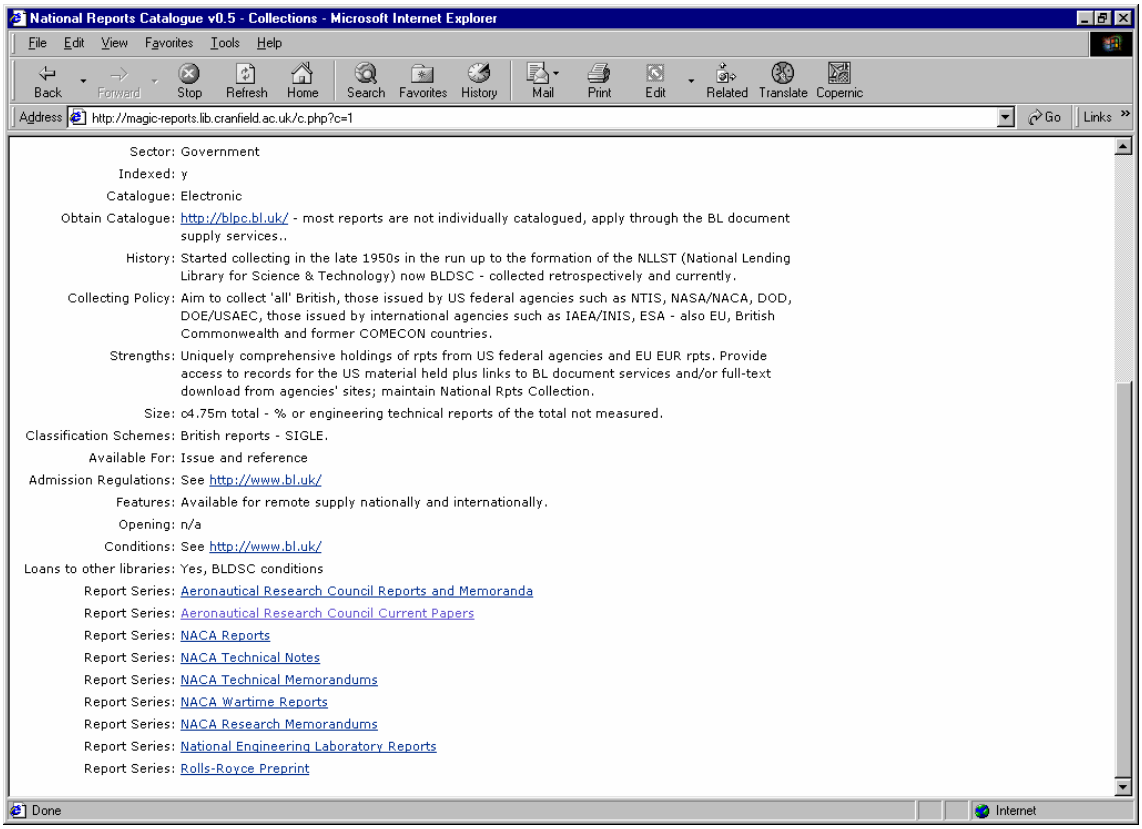

Figure 11-11 Description of the British Library Collection

As yet no details of series held by the University of Exeter are given (see figure 11-12).

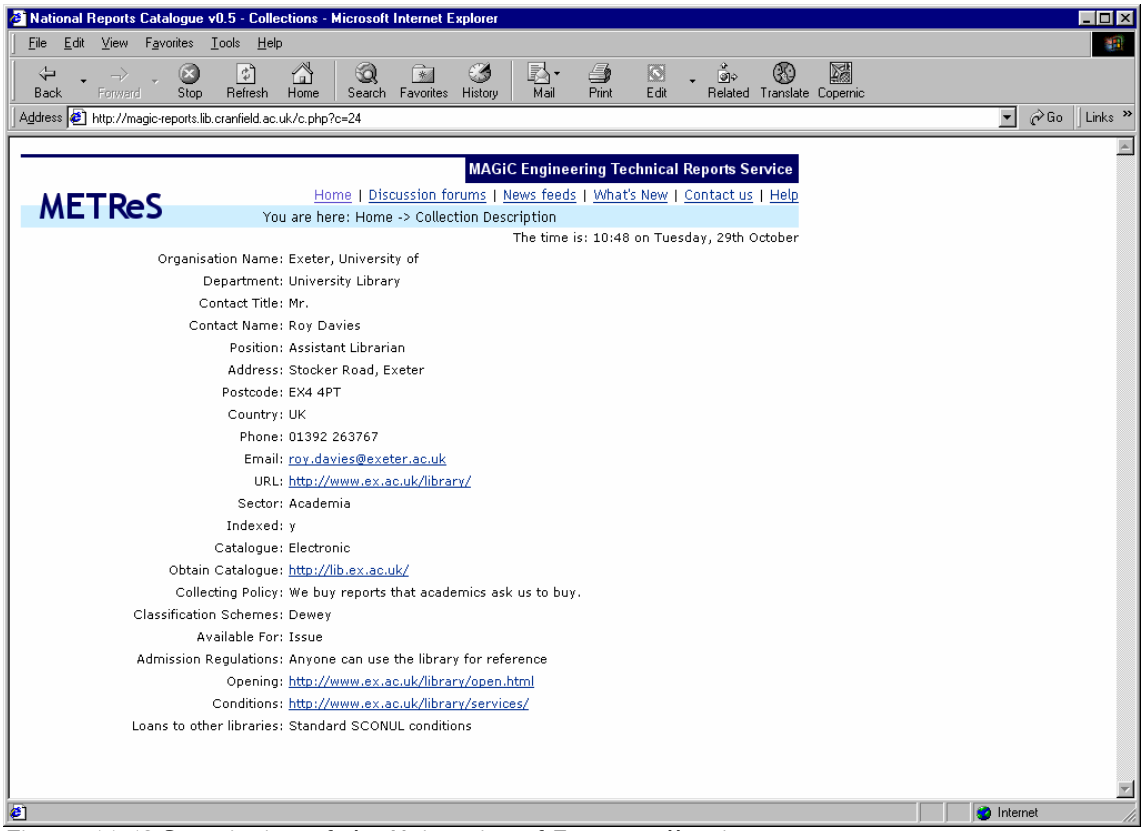

Figure 11-12 Description of the University of Exeter collection

While the details of the holdings of the University of Exeter are currently unknown, we do have the details of the appropriate person to contact for further information, and therefore have the means to gain further information on their holdings. The same is true of other incomplete entries in the database. The collaboration, co-operation and active participation of knowledgeable individuals across the UK forms an essential ingredient in making the system work.

Whereas reports records have been added directly to the database by employing metadata harvesting; the corporate sources, series and collections records have been entered using web-entry forms. Figure 11-13 shows the 'Add Corporate Source' screen.

This and other web-based administrative pages are not publicly available and are password protected for the sake of system security and integrity.

Additional administrative web pages also allow for existing database entries to be edited and updated (see figure 11-14).

While the MAGiC team has created these administrative pages for the demonstrator service, this area deserves further detailed examination for a full production system. There are many content management systems and scripting languages available for dynamically delivering databases via the Web, as well as various authentication technologies, such as digital signatures, for controlling access to resource sets.

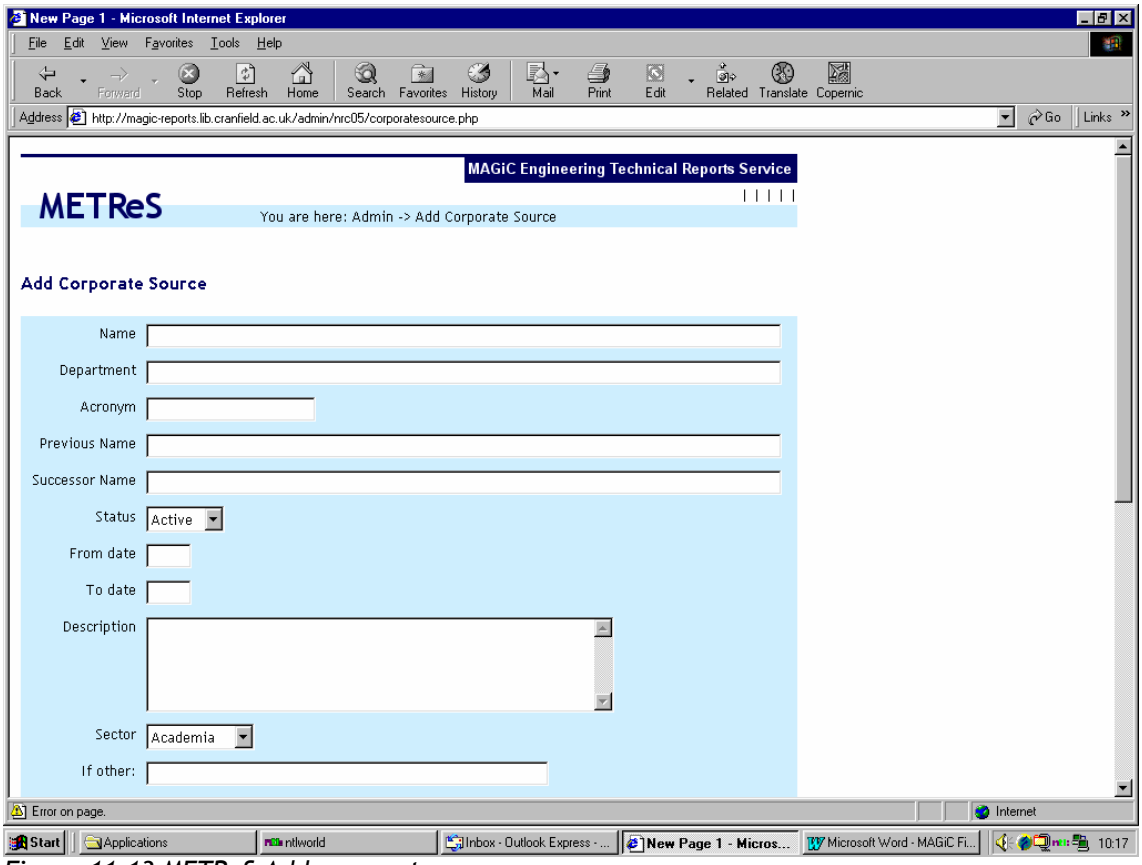

Figure 11-13 METReS Add corporate source screen

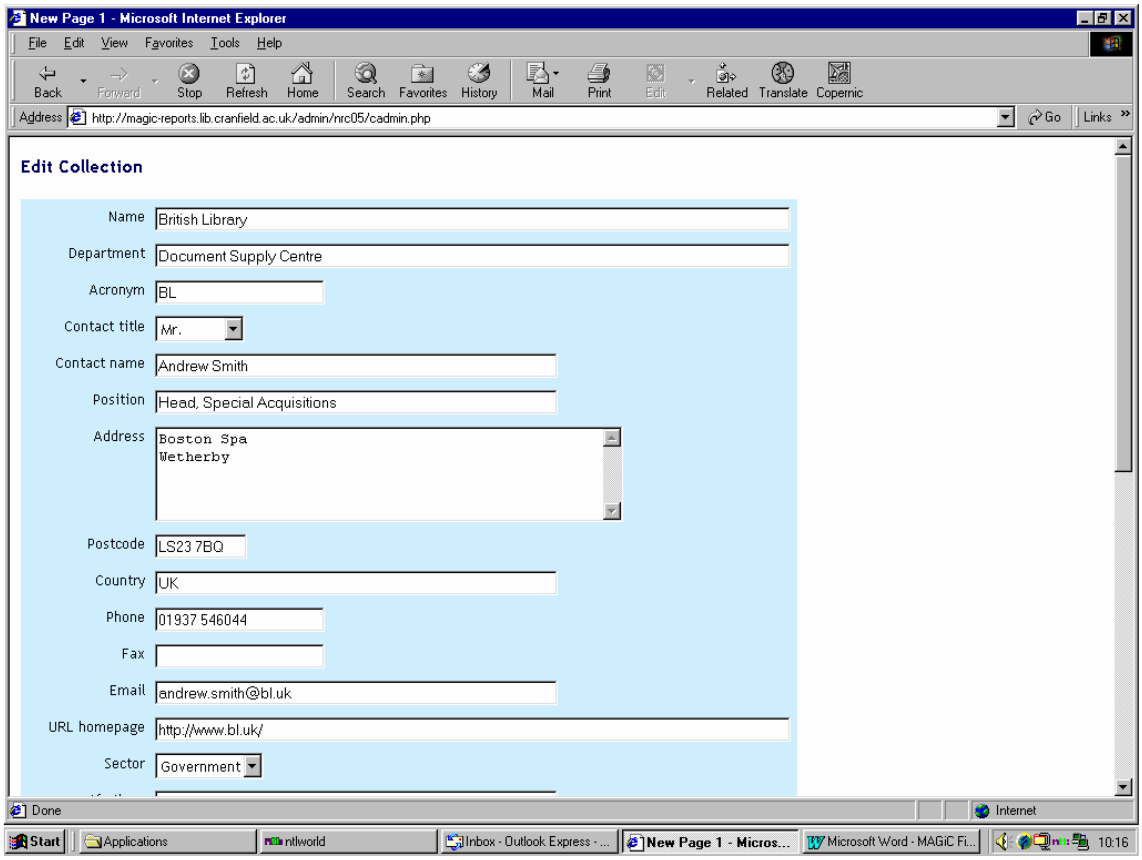

Figure 11-14 METREs Edit collection screen

11.4. Document supply

An important aspect of the service is to investigate document supply options. As shown above, METReS already demonstrates integration with full text documents where available and tight integration with the BLDSC document supply pages for the delivery of hardcopy.

It is just as easy to integrate other document suppliers. Figure 11-15 shows the document supply page for report NEL-685.

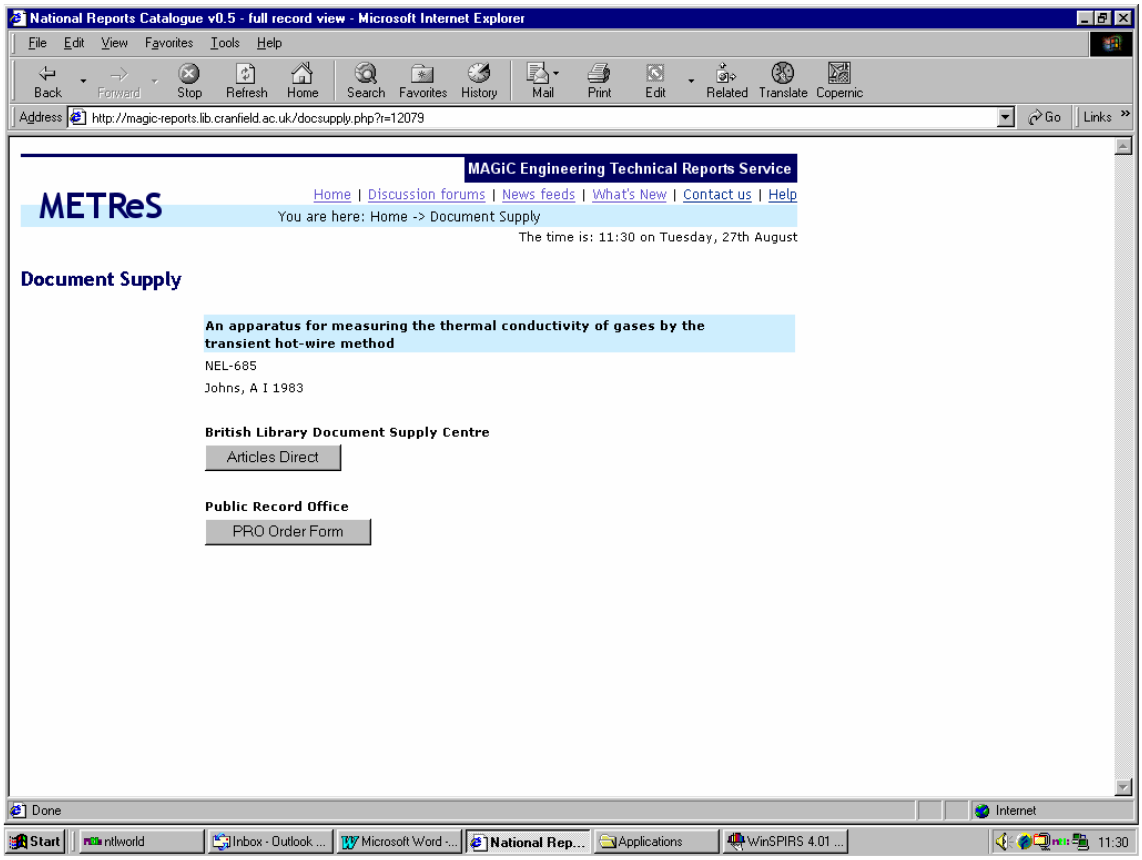

Figure 11-15 Document supply page for NEL-685

In this case, the report is available from the British Library and the Public Record Office. Clicking on the 'PRO Order Form' button takes us through to the PRO Estimate Order Form (figure 11-16), with the PRO 'piece reference', which uniquely identifies the document, already filled in.

Similarly, it will be possible to link individual reports to other document suppliers – in some cases these will be the organisations that originally produced the reports, and in other cases, intermediary agencies such as NTIS.

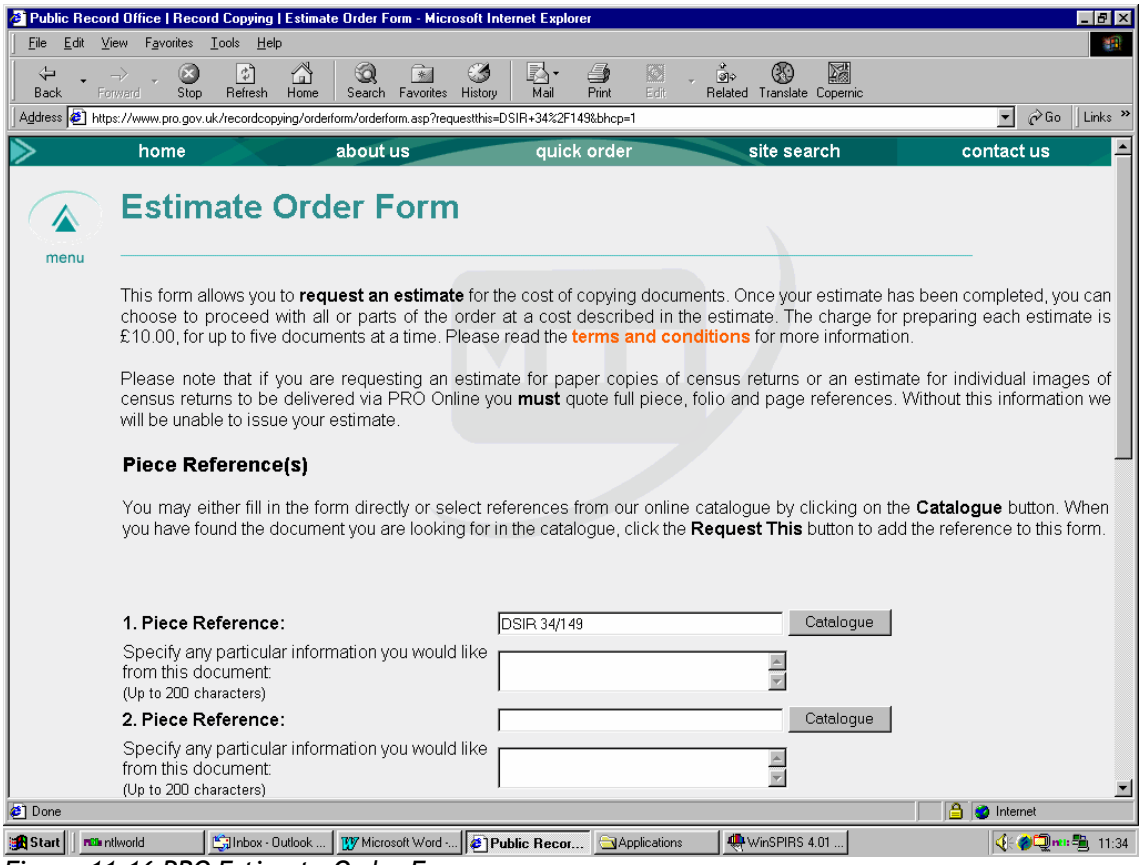

Figure 11-16 PRO Estimate Order Form

For a long time there have been questions as to whether a service based around the supply of grey literature can be commercially viable. While it is impossible to predict the value of a technical report in advance of its use, through its various studies, MAGiC has uncovered evidence that the right engineering technical report delivered at the right time can have high value. Furthermore, there is the possibility of generating income from the sale of the rich, comprehensive sets of metadata, which can be incorporated into other services.

METReS is a proof of concept and not a full production service. This is, therefore, an issue which requires further examination to identify the main cost elements associated with the development and subsequent running of a production service, as well as opportunities for cost reduction and areas of potential profitability to support pricing and investment management.

11.5. A demonstration of additional possibilities

As already stated, the NRC offers a somewhat simplified structure in its reflection of reality and the main demonstrator concentrates on linking corporate sources to reports series to reports to collections and document supply.

What METReS does not do, currently, is express the relationships *over time* between corporate sources, report series and collections. All of these are subject to change. Over time organisations and their associated reports series may merge, divide or be renamed. Without a good understanding of these temporal relationships, it is impossible to gain a complete picture of reports production and holdings. However, by the addition of a few further tables in the NRC, it is feasible to reveal these elaborate, changing relationships.

A second demonstrator focussing on reports produced by Dstl, QinetiQ and their predecessor organisations, begins to show some of the possibilities. The Dstl/QinetiQ family tree is complex and consists of at least sixty-five organisations, dating back to the Admiralty Experiment Works, which started producing reports in 1879.

The secondary database has an additional predecessors/successors table which links the IDs of the organisations that make up the Dstl/QinetiQ family tree and begins to show the history. The fields are shown in table 11-1.

Field	Type	Key
ParentID	int(11)	PRI
ChildID	int(11)	PRI

Table 11-1 Predessors/Successors Lookup table

By the addition of this simple table, it is easy to demonstrate the history of Dstl and QinetiQ. Figure 11-17 shows the home page of this second demonstration (available at http://magic-reports.lib.cranfield.ac.uk/Dstl/), which provides a list of the organisations in the family tree.

Clicking on the link to DERA in the list brings up a (skeletal) record for the organisation, which provides further links to its predecessors and successors (figure 11-18).

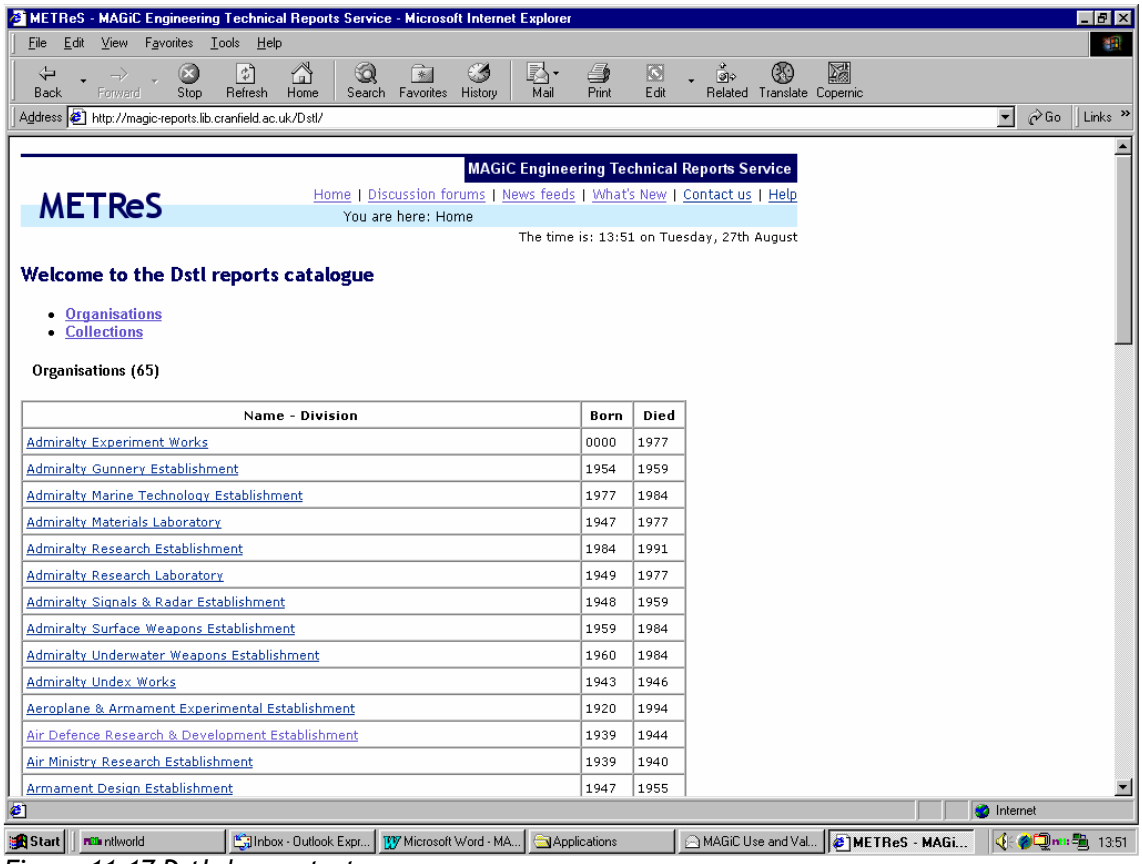

Figure 11-17 Dstl demonstrator

From this DERA record it possible to track back to its predecessors, e.g. the Defence Research Agency (DRA), as shown in figure 11-19, or equally to track forwards to the present.

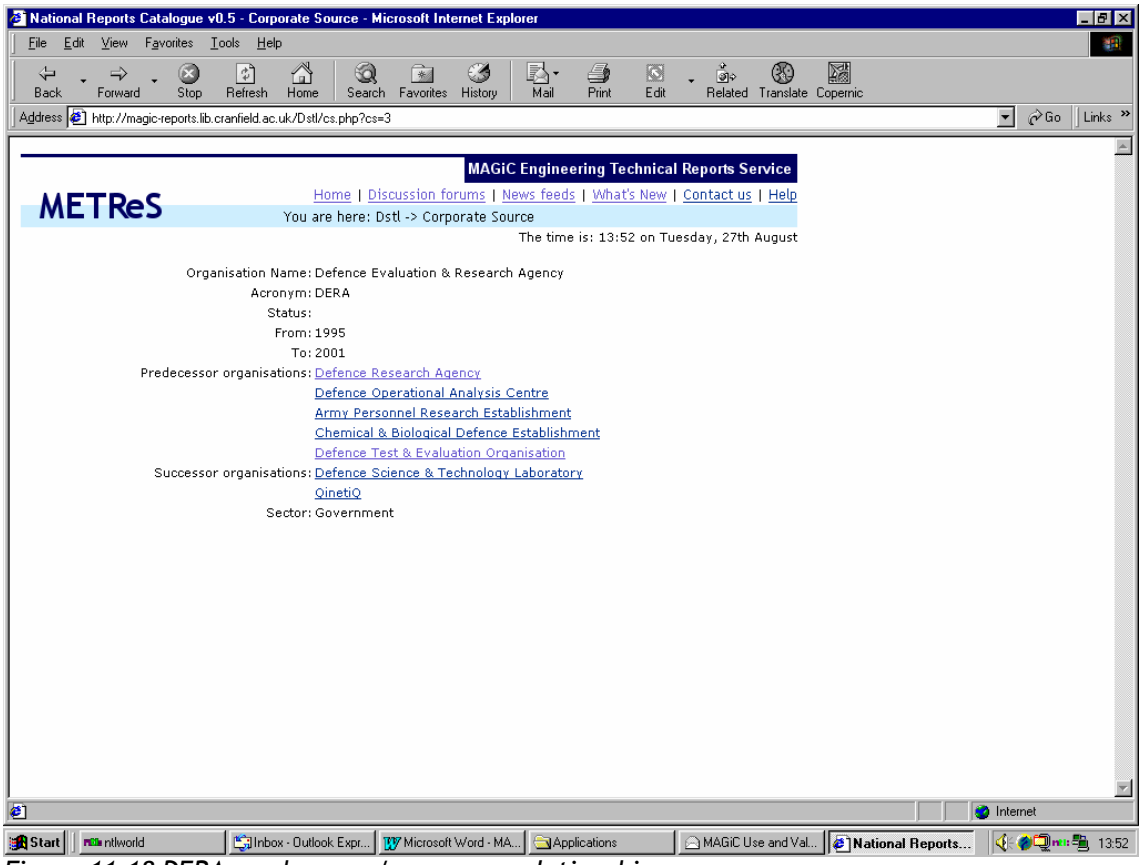

Figure 11-18 DERA predecessor/successor relationships

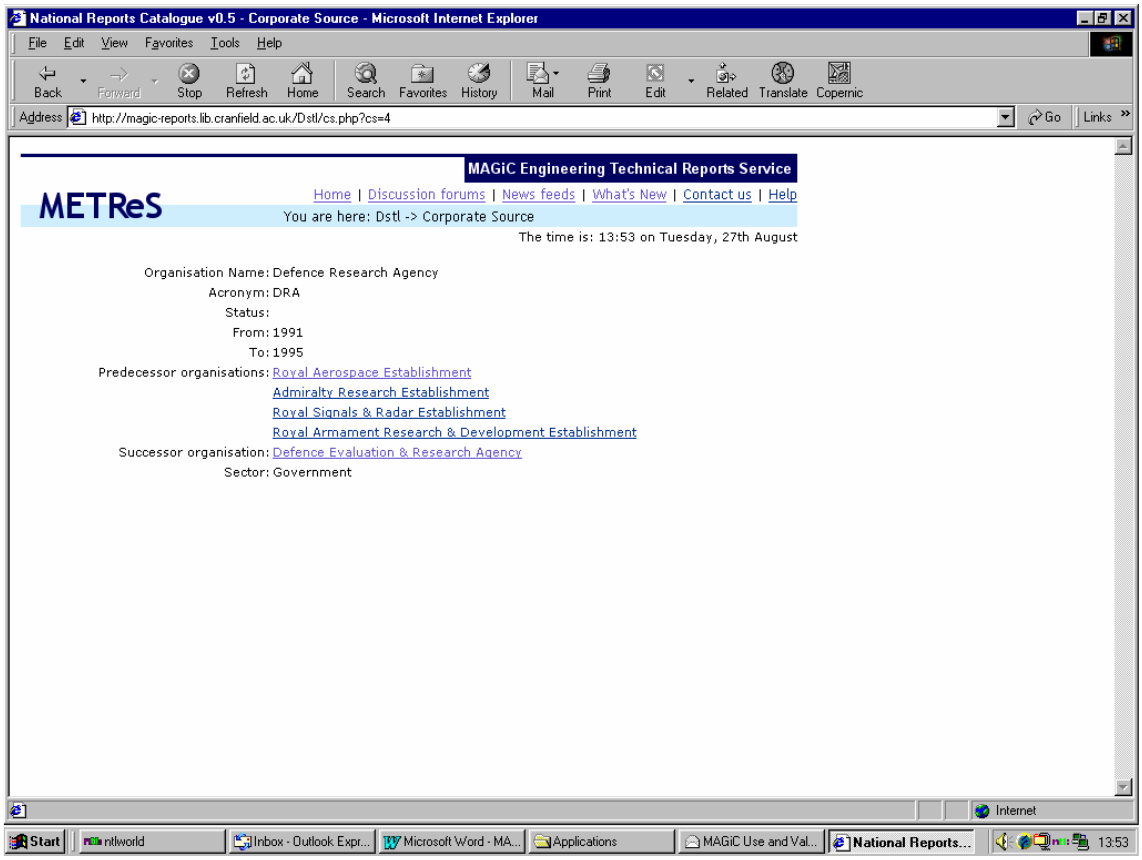

Figure 11-19 DRA predecessors/successors

This same principle can also be applied to collections and to reports series.

As discussed earlier, in Chapter 7, the Aeronautical Research Council Reports and Memoranda report series, often casually spoken of as a single series, is in reality composed of three contiguous sub-series:

• Advisory Committee on Aeronautics	1909-1920	ACA/R&M	nos 1-673
• Aeronautical Research Committee	1920-1945	ARC/R&M	nos 674-2041
• Aeronautical Research Council	1945-1980	ARC/R&M	nos 2042-3850

By introducing a further table to the database, employing the concept of group IDs, it becomes possible to handle a wide range of situations encompassing virtual and composite series. It should be noted, however, while complete expression of all the complex relationships involved in reports management is desirable, in practice, it is likely to be limited by the amount of effort and time the exercise can take.

11.6. Interoperability - exposing and sharing NRC resources

While METReS can function as a standalone web-site its own right, it is important to recognise that the creation of yet another a resource discovery web-site may contribute to the problem of portal proliferation. It may be preferable to utilise METReS as a point of focus for the UK engineering information community to manage engineering grey literature. The resources from the NRC can be embedded into existing web-sites with which users are already familiar, by employing technologies such as OAI, Z39.50 and web services.

To demonstrate the ease with which an OAI layer can be set up, to allow sharing of NRC resources, a test OAI interface has already been created on the MAGiC reports server at http://magic-reports.lib.cranfield.ac.uk/oai/repository/. This has been successfully tested against the Repository Explorer (see figure 11-20), which is a tool provided to test and validate OAI repositories (OAI, 2002c).

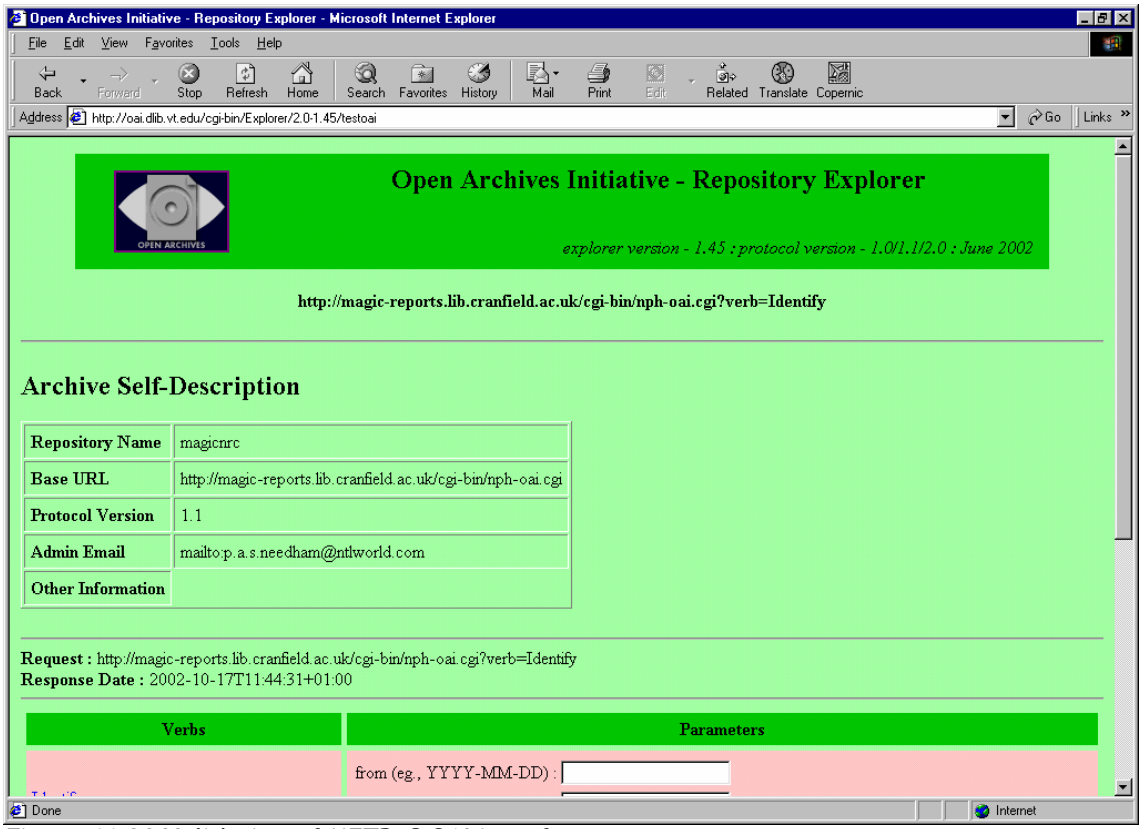

Figure 11-20 Validation of METReS OAI interface

Z39.50 capabilities have not yet been added to METReS, but it is not a difficult task and, given the historical importance of Z39.50 to the library community, should be considered for a full production service to maximise the interoperability of the service.

Furthermore the emergence of web services, described earlier in Chapter 9, offers great promise for widespread sharing and embedding of resources in a wide range of services. These new technologies are worthy of further investigation.

11.7. Transferability

While the MAGiC project has focussed particularly on access to engineering technical reports, the work carried out by the project can be applied to a number of disciplines besides engineering, and to document types other than technical reports.

This report itself is yet another piece of grey literature which forms part of, and belongs to, the British Library Co-operation and Partnership Programme (BLCPP) series of research reports. The series is relatively new and consists, by and large, of 'born digital' reports, covering research on library and information issues – a subject area far removed from engineering.

As an illustration of the transferability of the system devised by MAGiC to other disciplines, we have:

- created a corporate source record for the BLCPP (see figure 11-21),
- created a report series record (see figure 11-22),
- begun entering the individual reports in the series (see figure 11-23).

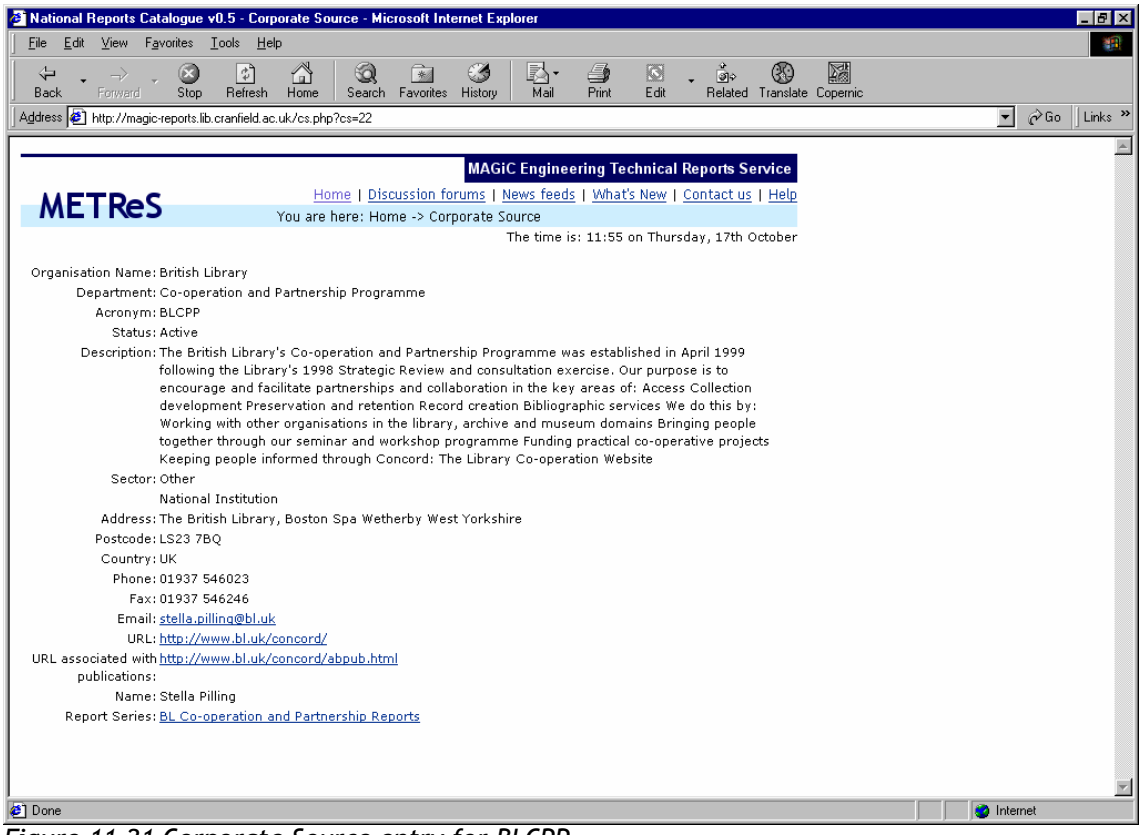

Figure 11-21 Corporate Source entry for BLCPP

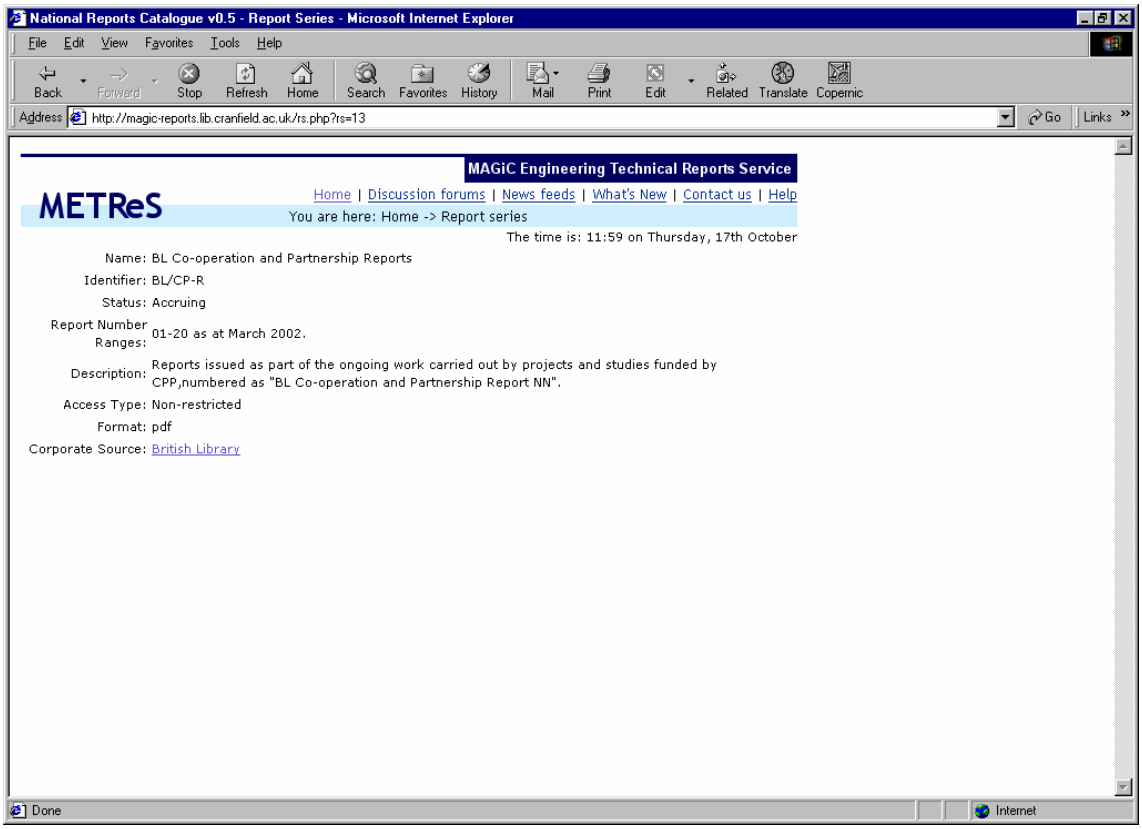

Figure 11-22 Report Series entry for BLCPP

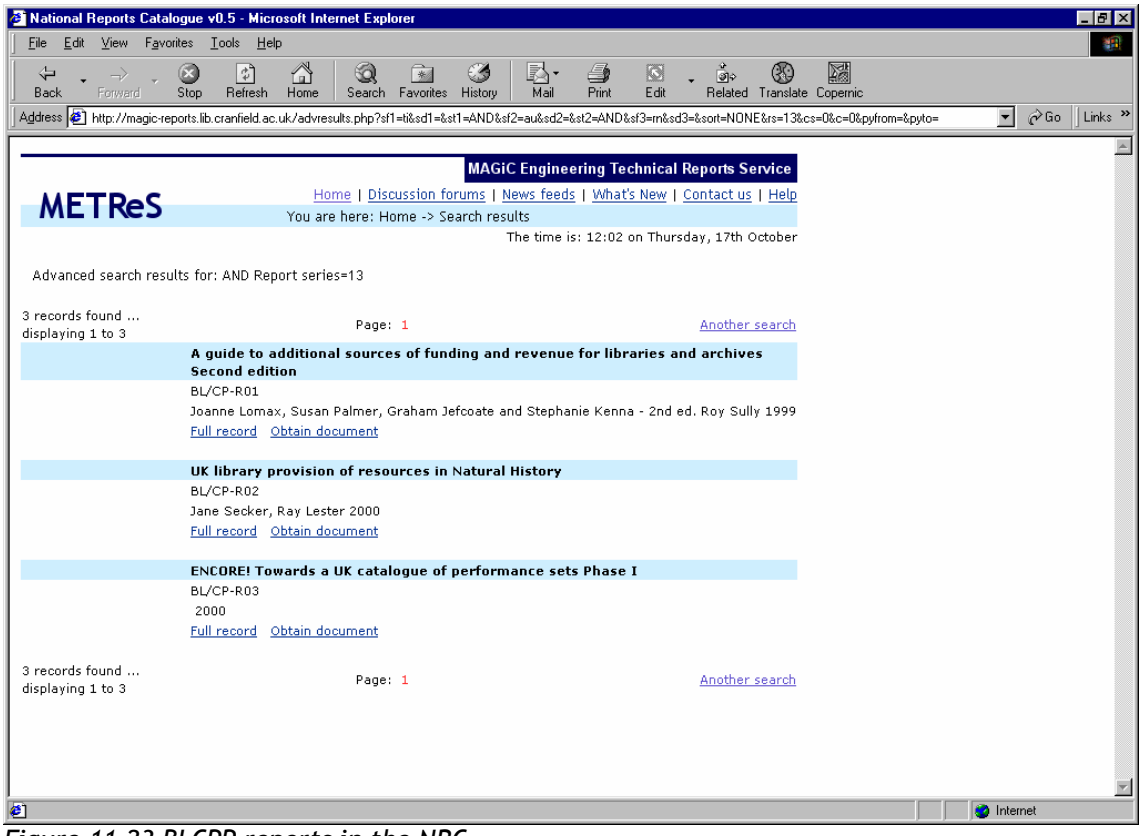

Figure 11-23 BLCPP reports in the NRC

Eventually, of course, this report will be added formally to the BLCPP report series – and may itself become available through METReS and the NRC!

11.8. Summary

By necessity the project team has had to develop a somewhat different underlying architecture than that originally envisaged for the demonstrator service. However this not only offers a solution to the problem of the paucity of the national report cataloguing resource but also enables us to exceed the original goals of the project.

The current NRC presents a simplified picture of reality, for demonstration purposes. Further steps are needed to take the work of the MAGiC project from a 'proof of concept' to a full production service, which will need to have the capability to handle millions of reports already in existence and thousands of new reports being produced each year (British Library, 2002).

Fortunately, the necessary technologies and standards are in place, or now emerging, that can ensure the mid- to long-term sustainability and interoperability of a system for the management and discovery of reports literature. Of particular importance in this respect is the OAI Metadata Harvesting Protocol.

At this stage, the future of METReS and the NRC is unclear, and there are questions as yet unanswered. Should METRES emerge as a service in its own right, or as a plug-in to subject based service like the JISC engineering subject portal, or as part of a document supply service like BLDSC?

What is more certain is that the system enhances the access, use and visibility of technical reports, simultaneously providing comprehensive control and management facilities, by linking the entire lifecycle of technical reports - corporate sources, report series, reports, reports collections and users - together in a single database for the first time. And, importantly, offers an achievable low-maintenance, low-cost solution to the management of technical reports in the UK and beyond.

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Appendix A - End of project Seminar

A.1. Introduction

The purpose of this appendix is to present the findings of the MAGiC end of project seminar on the "Use and Value of Engineering Grey Literature", which was held at the British Library, St Pancras on 24th July 2002. The seminar was planned to be an integral part of the project and was attended by representatives from a diverse range of UK organisations. There were delegates from all sectors – commerce, government, industry and others - representing both producers and holders of reports, with Dstl and the British Library both particularly well represented (For a full list of attendees, see A.5, below).

The seminar provided an opportunity to:

- disseminate the findings of the MAGiC project;
- present the MAGiC demonstrator service, METReS, incorporating the prototype National Reports Catalogue and full text archive;
- launch the NACA Reports UK mirror site;
- gain feedback from delegates on a number of key issues.

A.2. Aims and objectives of the seminar

The primary aim of the seminar was to facilitate a two-way exchange of information on a whole range of issues relating to the study. It provided an invaluable opportunity to promote and disseminate information about the MAGiC study to key individuals involved with technical grey literature in the UK. The team felt that is was important to get feedback on the issues raised, to ensure the views of delegates would be incorporated into the final report. It was hoped that the seminar would assist the process of laying the foundations of the National Reports Catalogue.

A.3. Format of the seminar

The programme schedule for the seminar is shown in section A.6 below.

The event was introduced by Stella Pilling, from the British Library Co-operation and Partnership Programme (CPP), who spoke of the work being carried out by the CPP before introducing the MAGiC project.

The presenters were:

- Steve Thornton, of Dstl Knowledge Services, who talked about the nature and history of engineering technical reports in the UK;
- Andrew Smith, from the British Library Document Supply Centre, who described the processes involved in the control and supply of technical reports (pre-MAGiC);
- Katy Sidwell, from Leeds University, who outlined the work undertaken by the MAGiC team on improving the understanding of the use and value of technical reports;
- Paul Needham, the MAGiC Research Officer, who gave two presentations. The first described the work undertaken by MAGiC on collection management and development. The second described the work involved in laying the foundations of the National Reports Catalogue (NRC) and showed the fledgling NRC in action through the MAGiC demonstrator service, METReS. The presentation also saw the official launch of the NACA Reports UK mirror website – an additional exciting outcome of the project.

Following the presentations, a group discussion was held, which was chaired by John Harrington of Cranfield University. The discussion session is described in detail in section G.4, below. Hazel Woodward, from Cranfield University, made the concluding remarks which ended the proceedings.

Following the conclusion of the seminar, a number of delegates went on a guided tour around the engineering collections of the BL's science reading rooms, lead by Paul Allchin of the British Library.

A.4. Summary and analysis of the points raised in the group discussion

Three themes central to the focus of MAGiC were used to initiate and generate discussion. The themes used in the discussions were as follows:

- Theme 1: Collection management issues and challenges;
- Theme 2: The value of grey literature, and engineering technical reports in particular;
- Theme 3: Who should "own" the NRC, and possible business models.

The findings for each theme are presented below:

A.4.1. Theme 1: Collection management issues and challenges

The majority of the attendees have collections of technical reports. Jonathan Walker of Huddersfield had to get rid of a whole series of NEL (National Engineering Laboratory) reports due to space pressures. He was therefore very interested in the concept of the NRC, particularly as his institution now has links with teaching company schemes and small businesses. Steve Thornton confirmed that reports do take up a lot of space, for example, the unclassified AGARD reports series alone takes up 28.6m of shelf space. If they were available electronically one set could be kept physically and the rest disposed of – although this may cause problems if not all the reports are digitised.

Co-operation could help organisations make savings if it was decided that different organisations agree to keep different parts of series. This raised several questions – if collections are rationalised, who will keep a central collection, and who will pay for it? Decisions like these must be made at the outset, otherwise decisions would be made on the basis of individual business circumstances.

Steve Thornton believed that the BL and PRO are obvious candidates to hold central collections – one set held in a place of deposit could be the answer. Andrew Smith said that if collections were held at the BLDSC they could be lent out and lost, but if they were held in London they would be very well looked after.

The question was raised - is there an opportunity for financial savings made through space savings to be ploughed back into a resource? In the ensuing discussion, it was felt that this assumption could not be made.

Is there a point in all of us cataloguing a report – wouldn't just one catalogue record be sufficient? One attendee from Dstl wondered if there is a system similar to OCLC for books, whereby if a book has been catalogued the record is shared, and if it hasn't, the cataloguer creates a record that can be used by others. Andrew Smith confirmed that there is a shared cataloguing scheme between the copyright libraries, but reports are not included due to technical issues. He did, however, note that the BL's records should be available soon.

John Harrington from Cranfield pointed out the complexity of the current situation. Cranfield has all its AGARD reports catalogued separately, but doesn't receive RTO (AGARD's successor organisation) reports physically, so they are catalogued on to AERADE. This means that there are several places to check for availability, which customers don't have the knowledge or patience for.

A.4.2. Theme 2: The value of grey literature and engineering technical reports

The value of reports is very subjective – a particular report can only be valuable at the right time, in the right setting, to the right person. In addition, the value of a particular report cannot be pre-guessed. Steve Thornton mentioned an occasion when 6 reports saved £6 million. If you don't know that a technical report exists, cost savings cannot be made, this is the danger of disposing of technical reports.

This means that a way to improve the visibility of, access to, and certainty of getting hold of technical reports must be found. The BL tries to be comprehensive and collect all UK report series. In contrast, it was suggested that it is cheaper for the US to provide technical reports free on the

web – people do their own supplying by visiting the site and downloading the report they want – so the provider pays less. If easily accessible metadata is provided, then customers will expect the full text of the report to be available electronically – we must ensure that people do not come across brick walls and provide some kind of document delivery facility.

A.4.3. Theme 3: Who should "own" the NRC, and possible business models

The question was raised - should the BL, or a subject portal like the one the EEVL team are working on, own the NRC? Paul Needham suggested that the NRC could be expanded to cover several subjects, so parts of it could be fed through to other more relevant services.

Linda Kerr from EEVL agreed that customers like a subject-based view of resources, which is something that EEVL would like to provide. She sees the way forward in the form of a collaborative business model, encompassing those involved in digitisation, document supply etc.

Another representative from Dstl wondered how we are to encourage other institutions to participate in such a scheme – what would be the benefit to them? John Harrington replied that so far the project has concentrated on those who have expressed an interested, in the hope that the momentum gained would encourage others to join. Paul suggested that the BL and PRO have a lot of contacts and goodwill. In addition, currently the NRC is only a project, it may be easier to attract others if it was to become a fully-fledged service.

Participation would not be no cost, but would certainly be low cost. It is simple for organisations to provide their metadata in an OAI compliant form, the full text of a document doesn't move, it sits where it is created. Hopefully the ease of use of the system will encourage participation, as should the fact that currently OAI is a key technology.

A.5. List of Delegates

1. Abbott, Kathy	Queen Mary, University of London
2. Aitken, Kerry	Dstl Knowledge Services
3. Allchin, Paul	British Library
4. Bevan, Simon	Library, Cranfield University
5. Brackenbury, Simon	Hartley Library, University of Southampton
6. Brennan, Niamh	Trinity College Library, Dublin
7. Campbell, Jenny	Robinson Library, Newcastle University
8. Freeman, Julie	QinetiQ Ltd
9. Greenhalgh, Mavis*	Rutherford Appleton Laboratory
10. Greig, Ms A	Dept. Engineering Science, Oxford University
11. Haigh, Mrs Ellen*	The Library, Imperial College of Science, Technology & Medicine
12. Harrington, John**	Cranfield University
13. Heale, Susan	Learning & Information Services, University of Hertfordshire
14. Kerr, Linda	EEVL, Riccarton Library
15. Kerrison, Dr Geoff*	QinetiQ Ltd
16. Kwan, Ida*	Cavendish Campus Library, University of Westminster
17. McDonach, John	Dstl Knowledge Services
18. McGeachy, Ann	Dstl Knowledge Services
19. Nagle, Jeremy	British Library
20. Needham, Paul**	MAGiC Research Officer, Cranfield University
21. Orton, David	British Library
22. Parker, Mrs Lydia	Information Centre, Health and Safety Executive
23. Picken, David*	Institution of Electrical Engineers
24. Pilling, Stella**	British Library
25. Sidwell, Katy**	Library, Leeds University
26. Smith, Andrew**	British Library
27. Stocken, Julia	Technology and Innovation Information Services, British Library
28. Strutt, Sally	Cataloguing, The British Library
29. Thornton, Steve**	Dstl Knowledge Services
30. Trevett, Peter	Dstl Knowledge Services
31. Turner, Emma	Kings Norton Library, Cranfield University

32.	Wakeford, Richard	British Library
33.	Walker, Jonathan	Main Library, University of Huddersfield
34.	White, Dr Barry	John Rylands University Library of Manchester
35.	Whitehead, Philip	British Grey Literature Team, British Library
36.	Woodward, Hazel**	Cranfield University

* Going on tour of engineering collections in reading rooms
** Speakers/presenters

A.6. Seminar programme

MAGiC Managing Access to Grey Literature Collections

"Use and Value of Engineering Grey Literature"
A MAGiC Seminar

The Conference Centre Auditorium, British Library, St Pancras
Wednesday 24th July 2002, 10.30 am – 3.30 pm.

Seminar Programme

10.30am **Coffee and Registration in the foyer**

10.50am **Opening address**
Stella Pilling, British Library Co-operation and Partnership Programme

11.00am **Nature and history of engineering technical reports in the UK**
Steve Thornton, Technical Manager, dstl Knowledge Services

11.30am **Control and supply of technical reports (pre-MAGiC)**
Andrew Smith, Special Materials Access Manager, British Library

12.00pm **MAGiC - use and value of technical reports**
Katy Sidwell, Faculty Team Librarian (Science & Engineering), Leeds University

12.30pm **MAGiC Collection Management and development**
Paul Needham, MAGiC project Research Officer, Cranfield University

1.00pm **Buffet Lunch**

1.50pm **METReS - the MAGiC demonstrator service.**
Paul Needham, MAGiC project Research Officer, Cranfield University

2.30 - 3.15pm **Discussion session on use and value, management, access and preservation of engineering technical reports**
Chair: John Harrington, Information Services Manager, Cranfield University

3.15pm **Concluding remarks**
Hazel Woodward, MAGiC project Director, University Librarian, Cranfield University

3.30 - 4.00pm **Guided tour around the engineering collections of the BL's science reading rooms**
Paul Allchin, British Library

Appendix B

Interview schedule for impact study of Cranfield technical reports

Interviewer:
Date/time of initial contact: _____

Date/time of interview: _____

Details of interviewee:

Name: _____

▯ Staff ▯ PhD/DEng ▯ MSc/MRes

School/department: _____

Course: _____

Introduction

Hello, my name is --------- and I'm phoning from Cranfield library. I'm contacting you because we are doing some research into the use of technical reports. We noticed that you recently returned/renewed a technical report from the library and would like to ask you some questions about how useful it was to you. It will take between 5 and 10 minutes, and we can either do it now, or arrange a convenient time to telephone or meet up. Would you mind answering some questions? Would you like to answer them now or arrange a more convenient time?

Technical report details:

Title: _____

Corporate source: _____ Year: _____

Do you remember this report? [*If no, give more details*]

Can I confirm some details before we begin? Are you a ---*PhD/MSc/member of staff*--- in the ---*school/dept/course*---?

Details of interviewee (if different from above):

_____

Thank you. I'm going to ask you seven questions. If you need clarification of anything at any point, please interrupt and ask me.

1) ***This question is about the different ways people find out about technical reports.***

How did you find out about the report? Was it:

- recommended by a member of staff
- recommended by someone else [who? _____]
- referred to in an article or book
- found in the library catalogue
- found in a subject database
- found on the Internet
- other, please specify

_____

2) ***This question is about the different reasons people seek out and use technical reports.***

Why did you decide to borrow the report? Was it:

- relevant to current research
- relevant to coursework
- relevant to a design project
- for the methodology it contained
- for the data it contained
- for the references at the end
- as an introduction to the subject
- because no other information could be found on the subject
- to investigate a new research area
- because it was available immediately
- other

_____

3) ***This question is about how reports are used in practise, and which parts of a report are read the most.***

Did you read the report:

- fully
- partially

  Can you remember which parts you read?

  - Abstract
  - Introduction
  - Methodology
  - Results
  - Conclusions
  - References
- not at all

  Why didn't you read it?

  _____

4) ***This question is to determine if what people expect from technical reports is actually what the report gives them.***

You said you decided to borrow the report because ---*reasons from Q2*---. Did the contents of the report meet this need or expectation:

- fully
- partially
- not at all
- might in the future

5) ***This question is about the ways in which the report helped you.***

How did the report help you? Did it:

- give new knowledge
- refresh your memory of details or facts
- substantiate a hypothesis
- save time
- help solve a problem
- didn't help me at all
- other:_____

6) ***This question is about how relevant and how useful the report was to your current work.***

Was the subject matter of the report relevant to your work (research, project, assignment)?

- Yes

- No

Was the report useful to you?

- Yes, to my current work
- Yes, to future work
- No

7) ***This question is about the importance of technical reports as a source of information in comparison with other sources of information you might use.***

Please rank the following sources in terms of how important they are to your **current work** on a scale of 1 to 10, with 1 representing little importance and 10 representing very important.

Books	1	2	3	4	5	6	7	8	9	10
	N/A									
Journal articles	1	2	3	4	5	6	7	8	9	10
	N/A									
Conference papers	1	2	3	4	5	6	7	8	9	10
	N/A									
This technical report	1	2	3	4	5	6	7	8	9	10
	N/A									
Technical reports in general	1	2	3	4	5	6	7	8	9	10
	N/A									
Standards	1	2	3	4	5	6	7	8	9	10
	N/A									
Patents	1	2	3	4	5	6	7	8	9	10
	N/A									
Theses	1	2	3	4	5	6	7	8	9	10
	N/A									
Internet	1	2	3	4	5	6	7	8	9	10
	N/A									

Is there anything else you would like to say about technical reports before we finish?

Thank you very much for participating in this study. Would you like to know the results when the study is completed?

Appendix C – Dstl/QinetiQ predecessor organisations

Name	From	To
Admiralty Experiment Works	1879	1977
Admiralty Gunnery Establishment	1954	1959
Admiralty Marine Technology Establishment	1977	1984
Admiralty Materials Laboratory	1947	1977
Admiralty Research Establishment	1984	1991
Admiralty Research Laboratory	1949	1977
Admiralty Signals & Radar Establishment	1948	1959
Admiralty Surface Weapons Establishment	1959	1984
Admiralty Underwater Weapons Establishment	1960	1984
Admiralty Undex Works	1943	1946
Aeroplane & Armament Experimental Establishment	1920	1994
Air Defence Research & Development Establishment	1939	1944
Air Ministry Research Establishment	1939	1940
Armament Design Establishment	1947	1955
Armament Research & Development Establishment	1955	1961
Armament Research Establishment	1947	1955
Army Operational Research Establishment	1962	1965
Army Operational Research Group	1948	1962
Army Personnel Research Establishment	1965	1995
Bawdsey Research Station	1936	1939
Chemical & Biological Defence Establishment	1991	1995
Chemical Defence Establishment	1970	1991
Chemical Defence Experimental Establishment	1948	1970
Chemical Defence Experimental Station	1930	1948
Defence Evaluation & Research Agency	1995	2001
Defence Operational Analysis Centre	1991	1995
Defence Operational Analysis Establishment	1965	1991
Defence Research Agency	1991	1995
Defence Science & Technology Laboratory	2001	
Defence Test & Evaluation Organisation	1995	1996
Director-General, Test & Evaluation	1994	1995
Experimental Bridging Establishment	1919	1946
Explosives Research & Development Establishment	1948	1977
Fighting Vehicle Design Establishment	1948	1952
Fighting Vehicle Proving Establishment	1942	1952
Fighting Vehicles Research & Development Establishment	1952	1970
HM Anti-Submarine Experimental Establishment - Fairlee	1941	1960
HM Anti-Submarine Experimental Establishment - Portland	1946	1960
Military Experimental Engineering Establishment	1946	1970
Military Vehicles & Engineering Establishment	1970	1985
National Gas Turbine Establishment	1946	1983
Naval Construction Research Establishment	1946	1977
Proof & Experimental Establishments		
Propellants, Explosives & Rocket Motor Establishment	1977	1985
QinetiQ	2001	
Radar Research & Development Establishment	1944	1953
Radar Research Establishment	1953	1957
Rocket Propulsion Establishment	1958	1977
Royal Aerospace Establishment	1988	1991
Royal Aircraft Establishment - Farnborough	1918	1988
Royal Aircraft Establishment - Bedford	1946	1988
Royal Aircraft Establishment - Rocket Propulsion	1946	1958

Royal Armament Research & Development Establishment	1985	1991
Royal Armament Research & Development Establishment - Fort Halstead	1961	1985
Royal Naval Physiological Laboratory	1942	1977
Royal Radar Establishment	1957	1976
Royal Signals & Radar Establishment	1976	1991
Services Electronics Research Laboratory	1945	1976
Signals Experimental Establishment	1917	1943
Signals Research & Development Establishment	1943	1976
Telecommunications Research Establishment	1940	1953
Torpedo Experimental Establishment	1939	1959
Underwater Detection Establishment	1941	1959
Underwater Weapons Establishment	1959	1960
Underwater Weapons Launching Establishment	1942	1959

Appendix D – Preliminary reports producers questionnaire

A General information about the reports you produce

A.1 Does your organisation *currently* produce technical reports?

Yes No

If you answered 'Yes' go to A.5. If you answered 'No' go to A.2

A.2 Has your organisation produced technical reports in the past?

Yes No

If you answered 'Yes' go to A3. If you answered 'No' go to Section C

A.3 When did you stop producing reports?

A.4 Why did you stop producing reports?

A.5 Average number of reports produced each year?

<20 20-100 100-500 > 500

A.6 Are your reports indexed, catalogued or listed?

Yes No

If you answered 'Yes' go to A.7. If you answered 'No' go to A.9

A.7 If yes, is the format?

electronic printed both

A.8 How may we obtain/access a copy?

A.9 Do you have a library or other facility where you retain copies of your reports?

Yes No

If you answered 'Yes' go to A.11. If you answered 'No' go to A.10.

A.10 What happens to the reports?

A.11 Do you make any of your reports available externally?

Yes No

If you answered 'Yes' go to A.12. If you answered 'No' go to Section B.

A.12 Does your organisation supply reports on request?

Yes No

B Additional information

B.1 We would like to add details of your organisation to the National Reports Catalogue. May we contact you for further information?

Yes No

B.2 Please use this space for any additional comments you may wish to make.

C Organisation Contact Details

C.1 Organisation

C.2 Department

C.3 Title (Dr, Mr, Mrs etc.)

C.4 Name

C.5 Job title/Position

C.6 Postal Address

C.7 Post code

C.8 Telephone Number

C.9 E-mail Address

C.10 URL

C.11 Sector

- Academia
- Government
- Industry
- Other

If other, please specify

D Survey submission

Thank you for taking part in our preliminary survey of reports producers. Please return the completed questionnaire using the attached envelope to:

Paul Needham, MAGiC Project Officer
FREEPOST 463, Kings Norton Library, Cranfield University, Cranfield, Bedfordshire, MK43 0AL

Appendix E – reports producers covering letter

Dear [Mail merge]

We would be very grateful if you would help us with our research by completing the enclosed questionnaire, which should take approximately 10 minutes. The questionnaire is aimed specifically at any staff involved in the production, management and dissemination of reports generated by their organisations, and forms part of a research project called MAGiC (Managing Access to Grey Literature Collections), which aims to map the locations of key collections of engineering reports in the UK.

Technical reports provide valuable information for engineers, but are often difficult to identify, locate and access because they are often not catalogued separately, and cannot be searched remotely. Ultimately, the research project aims to lay the foundations for the creation of a National Reports Catalogue, which will make report literature far more accessible to engineers.

This project is being funded by the British Library Cooperation and Partnership Programme and the Research Libraries Support Programme, and Cranfield University is one of a number of partners undertaking the research.

Thank you for taking the time to participate in our research. For more information about the project and its partners, or to fill in the questionnaire online, please visit the MAGiC website at http://www.magic.ac.uk/producers.html. Otherwise, please return the completed questionnaire using the attached envelope to:

Paul Needham, MAGiC Project Officer, FREEPOST 463, Kings Norton Library, Cranfield University, Cranfield, Bedfordshire, MK43 0AL

Yours sincerely,
Paul A S Needham

Explanatory notes:

In the context of the MAGiC project:

- **Corporate source** means the organisation(s) identified in a report as being responsible for its contents.
- **Report series** refers to a distinct group of reports sharing a common prefix. This usually identifies the issuing organisation and department, or indicates some other common theme between the reports; e.g. NASA produce reports series such as
- NASA/TP – NASA Technical Papers
- NASA/CR - NASA Contractors Reports
- A **technical report** is “a document which gives the results or the progress of a research and/or development investigation. Where appropriate it draws conclusions and makes recommendations, and it is initially submitted to the person or body for whom the work was carried out. Commonly a report bears a number which identifies both the report and the issuing organisation”.

Appendix F - List of series prefixes for report series held at Cranfield University Library

1. A.T.KEARNEY/M
2. AAA
3. AAEE
4. AAEE/M
5. AAEE/N
6. AAEE/RES
7. AAEE/TR
8. AAR
9. AARC/ACA
10. AASU
11. ACA
12. ACA/MISC
13. ACA/R&M
14. AEDC/TDR
15. AEDC/TN
16. AEDC/TR
17. AEI/RS
18. AER
19. AERE
20. AERE/BIB
21. AERE/M
22. AERE/R
23. AERE/TM
24. AERE/TP
25. AERE/TRANS
26. AF/AFOSR
27. AFAL/TR
28. AFFDL
29. AFFDL/TR
30. AFGZ/SL
31. AFOSR
32. AFOSR/SR
33. AFOSR/TN
34. AFOSR/TR
35. AFUSR/TR
36. AFWAL/TR
37. AGARD
38. AGARD/AG
39. AGARD/AR
40. AGARD/BIBLIOGRAPHY
41. AGARD/CP
42. AGARD/CPP
43. AGARD/LS
44. AGARD/MAN
45. AGARD/MISC
46. AGARD/PUB
47. AGARD/R
48. AGARD/SPECIFICATION
49. AGARD/TIL/AG
50. AGARD-INDEX
51. AGARDOGRAPH
52. AIAA
53. AIVC/MISC
54. AIVC/TN
55. AM/AP
56. AM/AR
57. AM/DTD/AS
58. AM/DTD/GE
59. AM/DTD/GS
60. AM/DTD/INST
61. AM/DTD/MS
62. AM/DTD/PS
63. AORB/OR/NOTE
64. AQD/D
65. AQD/EL
66. AQD/EQD
67. AQD/GW
68. AQD/NDT
69. AQD/U
70. AQD/XNDT
71. AQD/Y
72. ARA
73. ARA/LIB/TRANS
74. ARA/M
75. ARA/M/AERO
76. ARA/MISC
77. ARA/N/MODEL TEST
78. ARA/TM
79. ARA/TN/M
80. ARAP
81. ARC
82. ARC/ATP
83. ARC/CP
84. ARC/MISC
85. ARC/R&M
86. ARCC/ACA
87. ARDE/M-(B)
88. ARDE/R-(B)
89. ARDE/R-(M)
90. ARDE/R-(MX)
91. ARDE/R-(P)
92. ARI
93. ARL
94. ARL/A
95. ARL/A/N
96. ARL/A/R
97. ARL/A/TM
98. ARL/AERO
99. ARL/AERO/R
100. ARL/AN
101. ARL/AP/R
102. ARL/E/N
103. ARL/E/R
104. ARL/ENG/FAC/N
105. ARL/ENG/FAC/TM
106. ARL/F/N
107. ARL/F/R
108. ARL/F/TM
109. ARL/FLIGHT-MECH/R
110. ARL/FLIGHT-MECH/TM
111. ARL/FM
112. ARL/GN
113. ARL/GR
114. ARL/GW/N
115. ARL/HE/N
116. ARL/HE/R
117. ARL/HSA/R
118. ARL/HSA/TN
119. ARL/I/N
120. ARL/I/TM
121. ARL/M
122. ARL/MAT/N
123. ARL/MAT/R
124. ARL/MAT/TM
125. ARL/ME/N
126. ARL/ME/R
127. ARL/ME/TM
128. ARL/MET/B
129. ARL/MET/N
130. ARL/MET/R
131. ARL/MET/TM
132. ARL/MISC
133. ARL/PROP/R
134. ARL/RR
135. ARL/SM
136. ARL/SM/B
137. ARL/SM/M
138. ARL/SM/N
139. ARL/SM/R
140. ARL/SM/TM
141. ARL/SM/TN
142. ARL/SM/TRANS
143. ARL/STRUC/N
144. ARL/STRUC/R
145. ARL/STRUCT/R
146. ARL/STRUCT/TM
147. ARL/SYS/N
148. ARL/SYS/R
149. ARL/SYS/TM
150. ARL/TN
151. ARL/TR
152. ARR
153. ARR/ATM
154. ARR/RR
155. ARS
156. ASAE/P
157. ASAE/TP

158. ASCE/P
159. ASD/TDR
160. ASME/GT
161. ASME/HT
ASME/LUB
162. ASME/ICT
163. ASME/MISC
ASME/WA
ASME/FE
164. ASRI
ASTIA/AD
ASTM PREPRINT
165. ASTM STP
166. AU/EES/BUL
167. AUWE/TN
168. AVA/B
169. AVA/FB
170. AVA/J
171. AVCO/RN
172. AVCO/RR
173. AWAL/AER
174. AWAL/ASR
175. AWAL/R
176. AWAL/R.D.BALL
177. AWAL/R.T.R
178. AWAL/T.R.R
179. AWAL/TRR
180. AWRE
181. AWRE/FDN
182. AWRE/LN
183. AWRE/MISC
184. AWRE/TRANS
185. AWS
186. AWS/MISC
187. BAC
188. BAC/ACV/TN
189. BAC/GEM/TN
190. BAC/GWD
191. BAC/MISC
192. BAC/TN
193. BACL/ID
194. BACL/LR/MET
195. BACL/R
196. BACL/TOR
197. BACL/TR
198. BAE/AXR
199. BAE/KGT
200. BAE/R&D
201. BAE/YAD
202. BAL
203. BAL/MISC
204. BAL/TR
205. BAR/MISC
206. BBN
207. BBN/TR
208. BC/BCS/TPP
209. BC/BCS/TR
210. BC/DRAFT
211. BC/MISC
212. BG/MRS/E
213. BG/R
214. BGA/FTDD
215. BGAL/NOTE
216. BHRA/BIB
217. BHRA/MISC
218. BHRA/P
219. BHRA/PR
220. BHRA/RR
221. BHRA/SP
222. BHRA/T
223. BHRA/TN
224. BICERA/IR
225. BICERA/RR
226. BL/R&D
227. BLRIC
228. BLRIC/RR
229. BMBW/FB/W
230. BMFT/FB/M
231. BMFT/FB/T
232. BMFT/FB/W
233. BMV/LF/FB
234. BMWF/FB/W
235. BMWP/FB/W
236. BP/INT/DS
237. BP/MISC
238. BP/MP
239. BP/TB
240. BP/TB/TS
241. BP/TP
242. BPA/TR
243. BRE/BCT/ITCS
244. BRE/BPG
245. BRE/CP
246. BRE/DIGEST
247. BRE/EPP
248. BRE/GBG
249. BRE/GPG
250. BRE/GRG
251. BRE/IP
252. BRE/LT
253. BRE/MISC
254. BRE/R
255. BRE/TRIP/CS
256. BRE/TRP/CS
257. BRS/CP
258. BRS/DIG
259. BRS/RS
260. BRS/TN
261. BSEL
262. BSEL/AP
263. BSEL/MISC
264. BSEL/RD/P
265. BSEL/RD/R
266. BSEL/RD/RR
267. BSEL/RJD/R
268. BSRIA
269. BSRIA/AG
270. BSRIA/BEMS/DLP
271. BSRIA/COP
272. BSRIA/CQF
273. BSRIA/CQF/ME
274. BSRIA/CQF/MISC
275. BSRIA/GN
276. BSRIA/LB
277. BSRIA/MISC
278. BSRIA/PR
279. BSRIA/RG
280. BSRIA/SPEC
281. BSRIA/SR
282. BSRIA/TA
283. BSRIA/TM
284. BSRIA/TN
285. BSRIA/TR
286. BSRL
287. BSRL/D
288. BSRL/TR
289. BU/DAM/TR
290. BU/DOE/TR
291. BU/MISC
292. BVL/B
293. BWRA
294. BWRA/CR
295. BWRA/FE
296. BWRA/FM
297. BWRA/FR
298. BWRA/LM
299. BWRA/LR
300. BWRA/M
301. BWRA/PR
302. BWRA/RB
303. BWRA/REP
304. BWRA/RT
305. BWRA/TR
306. CAHI/TRANS
307. CAL/AD
308. CAL/AF
309. CAL/AG
310. CAL/MISC
311. CAMBRIDGE
UNIV.EDP
312. CAP
313. CARDE/TN
314. CARDE/TR
315. CCA/MISC
316. CCA/TR
317. CCA/TRA
318. CCSRAM/MON
319. CDC/TRG
320. CEGB/RD/B
321. CEGB/RD/M
322. CEUD/C-
DESIGN/TR
323. CIRIA
324. CIRIA/C
325. CIRIA/MISC
326. CIRIA/PG
327. CIRIA/PR

328. CIRIA/R
329. CIRIA/SP
330. CIRIA/TN
331. CIT
332. CIT/AERO M
333. CIT/ASAE
334. CIT/CCLT/DP
335. CIT/COA
336. CIT/COA/AERO
337. CIT/COA/AERO NOTE
338. CIT/COA/DES
339. CIT/COA/M
340. CIT/COA/NOTE
341. CIT/COA/R
342. CIT/COA-NFP
343. CIT/COA-UNNUMBERED
344. CIT/CTS
345. CIT/CTS/MISC
346. CIT/DEAS
347. CIT/DEAS/PUB
348. CIT/E&C
349. CIT/ESRU-MISC
350. CIT/FEU
351. CIT/FEU/TR
352. CIT/JPL
353. CIT/JPL/P
354. CIT/JPL/PR
355. CIT/KLFMJP/HL
356. CIT/LIBRARY
357. CIT/M
358. CIT/M&P
359. CIT/MAT
360. CIT/MATHS
361. CIT/MISC
362. CIT/NMHC
363. CIT/SIMS/TR
364. CIT/SME
365. CIT/SME/DTEM/TR
366. CIT/SME/MISC
367. CIT/TN
368. CMU/CS
369. CMU/RI/TR
370. CNRS/LA
371. COA
372. COA REPORT
373. COA/AERO
374. COA/AERO NOTE
375. COA/E&C
376. COA/M
377. COA/M&P
378. COA/M/AERO
379. COA/M/ASAE
380. COA/M/E&C
381. COA/M/MAT
382. COA/MAT
383. COA/MISC
384. COA/N
385. COA/N/E&C
386. COA/N/M&P
387. COA/N/MAT
388. COA/NOTE
389. COA/PD/JP
390. COA/R
391. CPA/TB
392. CPDA/MISC
393. CSIR
394. CSIR/AERO/A/N
395. CSIR/AERO/A/R
396. CSIR/AERO/A/TM
397. CSIR/AERO/E/N
398. CSIR/AERO/E/R
399. CSIR/AERO/I/N
400. CSIR/AERO/I/R
401. CSIR/AERO/SM/N
402. CSIR/AERO/T
403. CSIR/ARR/ACA
404. CSIR/MEG
405. CSIR/MEMO
406. CSIRO/DMP/TP
407. CSU/COE/TR
408. CTI/TN
409. CU/AERO/RM
410. CU/COA
411. CU/COA/R
412. CU/DCE/TN
413. CU/MISC
414. CU/SIMS/EI/RR
415. CU/SIMS/R
416. CU/SIMS/RR
417. CUED/A/AERO
418. CUED/A/AERO/TR
419. CUED/A/ARC/TR
420. CUED/A/NUCL/TR
421. CUED/A/THERMO/TR
422. CUED/A/TURBO/TR
423. CUED/B/ELECT/TR
424. CUED/C/EDC/TR
425. CUED/C/MATS/TR
426. CUED/C/MECH/TR
427. CUED/C/SOILS/TR
428. CUED/D/SOILS/TR
429. CUED/D/STRUCT/TR
430. CUED/D/SURVEY/TR
431. CUED/E/MANUF/TR
432. CUED/E/MS/TR
433. CUED/F/CAMS/TR
434. CUED/F/INFENG/TR
435. CUED/MISC
436. CUED/SOILS/TR
437. CUED/TR/AERO
438. CUED/TR/CAMS
439. CUED/TR/ELECT
440. CUED/TR/MATS
441. CUED/TR/MECH
442. CUED/TR/NUCL
443. CUED/TR/SOILS
444. CUED/TR/STRUCT
445. CUED/TR/THERMO
446. CUED/TR/TURBO
447. CWC
448. CWRU/FTAS/TR
449. DAC
450. DAC/AD
451. DAC/MDC
452. DFL/B
453. DFL/INST/AERO
454. DFVLR/FB
455. DFVLR/IB
456. DFVLR/INST/AERO
457. DFVLR/MISC
458. DFVLR/MITT
459. DFVLR/S
460. DFVLR/TM
461. DLR
462. DLR/FB
463. DLR/MITT
464. DLR-FB
465. DLR-MITT
466. DME/NAE
467. DMIC
468. DMIC/MEMO
469. DOD/MIL-STD
470. DOE/BPP/GPCS
471. DOE/CUEP/PP
472. DOE/EE/BPP-MISC
473. DOE/EEBPP/ECG
474. DOE/EEBPP/GIL
475. DOE/EEBPP/GIR
476. DOE/EEBPP/GPCS
477. DOE/EEBPP/GPG
478. DOE/EEBPP/NPFR
479. DOE/ETBPP
480. DOE/ETBPP/CH
481. DOE/ETBPP/EG
482. DOE/ETBPP/FP
483. DOE/ETBPP/GC
484. DOE/ETBPP/GG
485. DOE/ETBPP/NC
486. DOE/NWC
487. DOT/AAIB/AAR
488. DOT/AIB/AAR
489. DOT/AIB/CAAR
490. DOT/AIB/CAP
491. DRA/A&P/TM
492. DRA/AS/A&P/CR
493. DRA/AS/A&P/TR
494. DRA/AS/HWA/CR
495. DRA/AS/HWA/TR
496. DRA/AS/LBA/TR
497. DRA/CHS/A&N/CR
498. DRA/DWS/WX7/TR
499. DRA/LT
500. DRA/NRSC/SP
501. DRA/PLSD
502. DRA/TM/AERO

503. DRA/TM/AERO/PROP
504. DRA/TR
505. DRIC/S
506. DRIC/S&T/MEMO
507. DRIC/T
508. DTI/CB
509. DTI/ETSU/MISC
510. DTMB
511. DUT/HL
512. DUT/LEM
513. DUT/LMS/MISC
514. DUT/LR
515. DUT/LTM
516. DUT/MEMORANDUM/M
517. DUT/MISC
518. DUT/REPORT/LR
519. DVL
520. DVL/B
521. DVL/F
522. DVLR/FB
523. EA/SD
524. EECL/LA.T.
525. EEO
526. EEO/BPP/ECG
527. EEO/BPP/FP
528. EEO/BPP/FPR&D
529. EEO/BPP/GIL
530. EEO/BPP/GIR
531. EEO/BPP/GPCS
532. EEO/BPP/GPG
533. EEO/BPP/MISC
534. EEO/BPP/NPFR
535. EEO/BPP/NPIP
536. EEO/ECG
537. EEO/ED
538. EMI/DP
539. EMI/RM
540. EPA
541. EPA/AP
542. ERA/MISC
543. ESA/BR
544. ESA/BSSC
545. ESA/CR
546. ESA/F
547. ESA/HSR
548. ESA/INT
549. ESA/ISY
550. ESA/MISC
551. ESA/PD
552. ESA/PSS
553. ESA/SM
554. ESA/SN
555. ESA/SP
556. ESA/SR
557. ESA/STM
558. ESA/STR
559. ESA/TM
560. ESA/TN
561. ESA/TR
562. ESA/WPP
563. ESRC/GCEP
564. ESRO/CR
565. ESRO/SM
566. ESRO/SN
567. ESRO/SP
568. ESRO/SR
569. ESRO/STM
570. ESRO/TM
571. ESRO/TN
572. ESRO/TR
573. FAA/ADS
574. FAA/AR
575. FAA/MISC
576. FAA/RD
577. FAA/SDR/MISC
578. FFA
579. FFA/AE
580. FFA/AU
581. FFA/HE
582. FFA/HU
583. FFA/M
584. FFA/M/PE
585. FFA/TN
586. FFA/TN/AE
587. FFA/TN/AU
588. FFA/TN/AX
589. FFA/TN/HU
590. FFM/B
591. FLR/FB
592. FOA
593. FPRC
594. FPRC/M
595. GAEC
596. GAEC/ADR
597. GAEC/MPD
598. GALCIT
599. GALCIT/HWT/M
600. GALCIT/M
601. GALCIT/P
602. GAO/NSIAD
603. GAO/RCED
604. GAO/T/RCED
605. GASL/TR
606. GCC/ARD/TR
607. GDC/CSRL/RN
608. GDC/CSRL/RR
609. GDC/CSRL/ZA
610. GEC/CRD
611. GEC/RDC
612. GEC/RL
613. GEC/SSL
614. GEC/SSL/MISC
615. GIT/EES
616. GIT/EES/REP
617. GMR/RP
618. GRA/NT
619. GRA/RT
620. HAL/AERO
621. HAL/DD/R
622. HAL/HYDRO
623. HAL/R&D
624. HEFCE
625. HI/TR
626. HPD/ES
627. HPD/STUDY
628. HPD/SURVEY
629. HPD/SURVEY/MISC
630. HRR
631. HRS/EX
632. HRS/IT
633. HSA/APG
634. HSA/DHD/RR
635. HSA/MISC
636. HSA/MR
637. HSA/R
638. HSA/RES
639. HSA/RFP/R
640. HSA/WT/R
641. HSA/YAD/N
642. HSA/YMM/TN
643. HSA/YMM/TR
644. HSA/YMT
645. HSA/YWT/N
646. HSD/ARL
647. HSD/WT/TM
648. IAA
649. IAC/P
650. IAF
651. IAR/AN
652. IAS
653. IBM/RC
654. IC/AER
655. IC/TN/AERO
656. ICAO
657. ICAO/CIRC
658. ICAO/DIG
659. ICAO/DOC
660. ICAO/MISCVOL
661. ICAO/UG
662. ICAS
663. ICI/MD/TR
664. ICOA/CIRC
665. ICST
666. ICST/AERO
667. ICST/AERO/TN
668. ICST/AR
669. ICST/DOA/TN
670. ICST/ME
671. ICST/ME/TN
672. ICST/MISC
673. IEA
674. IFA/MITT
675. IFS
676. IHSP/MISC
677. IIS/FM

678. IIT
679. IIT/DOM
680. IIW
681. IIW/DOC
682. IIW/MISC
683. IME/AD/P
684. IME/AD/PROC
685. IME/AMG/P
686. IME/AMG/PROC
687. IME/CEG/P
688. IME/ESD/PROC
689. IME/ETG/P
690. IME/HPMG/P
691. IME/HPMG/PROC
692. IME/ICEG/L
693. IME/ICEG/P
694. IME/ICEG/PROC
695. IME/MISC
696. IME/P
697. IME/PEG/P
698. IME/PROC
699. IME/RD/PROC
700. IME/SOURCEBOOK
701. IME/SPG/P
702. IME/TFMG/P
703. IP/MISC
704. ISAS
705. ISAS/REPORT
706. ISAS/SP
707. ISVR
708. ISVR/TR
709. ITA/NI
710. ITA/RP
711. ITA/S
712. JHU/APL
713. JIB/DSI
714. JIB/DSI/TRANS
715. JISC/JTAP
716. KTH/TN/AERO
717. KU/FE/MISC
718. KU/MISC
719. LA
720. LAPPEENRANTA/RP
721. LCT/AAE/MISC
722. LRWE
723. LRWE/TN
724. LUT/RP
725. LUT/TT
726. MA
727. MAP/DDTE
728. MAP/DTD/MISC
729. MAP/DTD/MS
730. MAP/DTD/PS
731. MAP/FRL
732. MAP/TM
733. MAP/V-108/T
734. MAP/VG-1/35/T
735. MAP/VOLKENRODE
736. MAP/VOLKENRODE/R &T
737. MAV/V
738. MCGILL
739. MCGILL/TR
740. MCMU/CRL
741. MDA
742. MDA/BST
743. MDA/NT
744. MINISTERE DE L'AIR
745. MIRA
746. MIRA/AIC
747. MIRA/AIS
748. MIRA/EA
749. MIRA/IR
750. MIRA/MISC
751. MIRA/TRANS
752. MIRA/VA
753. MIRA/VBA
754. MIT/AL/TR
755. MIT/ASRL/TR
756. MIT/DAA/FTL
757. MIT/DAE
758. MIT/DAE/FML
759. MIT/DME/FML
760. MIT/FDRG
761. MIT/FTL
762. MIT/FTL/M
763. MIT/FTL/TM
764. MIT/GT&PDL
765. MIT/GTL
766. MIT/HL
767. MIT/HL/TR
768. MIT/LAI
769. MIT/LL/TR
770. MIT/MISC
771. MIT/NSL/TR
772. MIT/RLE/TR
773. MITSUBISHI/MTB
774. MOA/AIB/CAP
775. MOA/AIB-MISC
776. MOA/DMRD
777. MOA/DMS
778. MOA/MISC
779. MOA/S&T/M
780. MOA/S&T/MEMO
781. MOAMISC
782. MOD/RARDE
783. MOD/RARDE/MEMO
784. MOD/S&T/MEMO
785. MOS/AFEE
786. MOS/APD/TR
787. MOS/CLC-MISC
788. MOS/S&T/MEMO
789. MOS/TIB/TRANS
790. MOS/V
791. MOS/VOLKENRODE
792. MOT/DMRD
793. MOT/DMRD/AV
794. MOT/MD
795. MOT/S&T/M
796. MOT/S&T/MEMO
797. MPI/AVA/M
798. MPI/M
799. MPI/MISC
800. MPI/MITT
801. MRC
802. MSU/AERO/RN
803. MSU/AERO/RR
804. MU/SST/RR
805. MVEC/RS
806. N
807. NACA
808. NACA/ACR
809. NACA/ARC
810. NACA/ARR
811. NACA/CB
812. NACA/CMR
813. NACA/MEMO
814. NACA/MISC
815. NACA/MR
816. NACA/OCR
817. NACA/PDR
818. NACA/PR
819. NACA/R
820. NACA/RB
821. NACA/RM
822. NACA/RN
823. NACA/TIB
824. NACA/TIL
825. NACA/TM
826. NACA/TN
827. NACA/TR
828. NACA/WR
829. NACETT
830. NAE
831. NAE/AN
832. NAE/LR
833. NAE/LTR/ST
834. NAGTE/NT
835. NAL/AE/TM
836. NAL/ARC/TN
837. NAL/ARC/TR
838. NAL/ICA/BIB
839. NAL/ICA/TRANS
840. NAL/SR
841. NAL/SR/AE
842. NAL/TM
843. NAL/TN
844. NAL/TR
845. NAL/TT
846. NASA
847. NASA/CP
848. NASA/CR
849. NASA/MEMO
850. NASA/MISC
851. NASA/RE
852. NASA/RELEASE

853. NASA/RM
854. NASA/RP
855. NASA/SP
856. NASA/TM
857. NASA/TN
858. NASA/TP
859. NASA/TR
860. NASA/TT
861. NAVORD
862. NBS
863. NBS/PR
864. NCHRP-IDEA
865. NCR
866. NDA/MISC
867. NEL
868. NEL/FM/FN
869. NEL/FM/FR
870. NEL/HEAT
871. NEL/LDR
872. NEL/MECHMET
873. NEL/MEMO-X
874. NEL/MM
875. NEL/PL/PR
876. NEL/REPRINT
877. NERDDP/CS
878. NGTE/M
879. NGTE/MISC
880. NGTE/NT
881. NGTE/PJ/BIB
882. NGTE/PJ/CN
883. NGTE/PJ/M
884. NGTE/PJ/MRN
885. NGTE/PJ/R
886. NGTE/PJ/SR
887. NGTE/R
888. NIAST
889. NIAST/MISC
890. NIREX
891. NIREX/MISC
892. NLL
893. NLL/M
894. NLL/MP
895. NLL/S
896. NLL/TM/F
897. NLL/TM/M
898. NLL/TN/F
899. NLL/TN/G
900. NLL/TN/M
901. NLL/TN/S
902. NLL/TN/V
903. NLL/TR/A
904. NLL/TR/F
905. NLL/TR/G
906. NLL/TR/M
907. NLL/TR/MP
908. NLL/TR/RB
909. NLL/TR/S
910. NLL/TR/V
911. NLR/MISC
912. NLR/MP
913. NLR/PAPER
914. NLR/SP
915. NLR/TN
916. NLR/TN/F
917. NLR/TN/G
918. NLR/TN/M
919. NLR/TN/S
920. NLR/TN/T
921. NLR/TN/V
922. NLR/TN/W
923. NLR/TP
924. NLR/TR
925. NLR/TR/F
926. NLR/TR/G
927. NLR/TR/M
928. NLR/TR/MP
929. NLR/TR/S
930. NLR/TR/T
931. NLR/TR/V
932. NLR/TR/W
933. NMI/R
934. NMI/TM
935. NOL
936. NOL/TR
937. NOLTR
938. NPL/AC
939. NPL/AERO
940. NPL/AERO REPORT
941. NPL/AERO/M
942. NPL/AERO/N
943. NPL/AERO/SR
944. NPL/COM-SCI
945. NPL/DITC
946. NPL/DMA
947. NPL/DSIR/N
948. NPL/HU
949. NPL/HU/MISC
950. NPL/HU/TM
951. NPL/HU/TN
952. NPL/M/AERO
953. NPL/MISC
954. NPL/ML
955. NPL/MS/TM
956. NPL/N/AERO
957. NPL/NAC
958. NPL/QM
959. NPL/SHIP
960. NPL/SHIP/TM
961. NRC
962. NRC/ACACT/TR
963. NRC/AERO/LR
964. NRC/AN
965. NRC/DME
966. NRC/LM/ST
967. NRC/MA
968. NRC/MB
969. NRC/MC
970. NRC/MD
971. NRC/ME
972. NRC/MF
973. NRC/MH
974. NRC/MI
975. NRC/MISC
976. NRC/MK
977. NRC/ML
978. NRC/MM
979. NRC/MP
980. NRC/MR
981. NRC/MS
982. NRC/MT
983. NRC/TRB/TRR
984. NRC/TRC
985. NRC/TT
986. NRCC/MA
987. NRL
988. NRL/MISC
989. NRL/MR
990. NRT/MT
991. NTIS/MISC
992. NU/SE
993. NVL/S
994. NYU/AA
995. NYU/IMS/CAMC
996. NYU/IMS/MF
997. OFWAT
998. OFWAT/MISC
999. OI
1000. ONERA
1001. ONERA/MISC
1002. ONERA/MT
1003. ONERA/NT
1004. ONERA/P
1005. ONERA/PB
1006. ONERA/PUB
1007. ONERA/RT
1008. ONERA/TN
1009. ONERA/TP
1010. ONR/ACC/TR
1011. ONR/ESN
1012. ONR/FD
1013. ONR/MISC
1014. ONR/TR
1015. ORNL
1016. OTNO/PML
1017. OTNO/TL
1018. OU/MISC
1019. OUEL
1020. PERA
1021. PERME/TR
1022. PHILIPS/SEPARAAT
1023. PHILIPS-SONDERDRUCK/A
1024. PIBAL
1025. PT/IAMA/MG
1026. PT/IMAAG/ESTRAT TO
1027. PT/IMMA/PUB

1028. PTLA
1029. PTLA/ESTRATTO
1030. PTRC
1031. PTRC/P
1032. PU/DAE/MEMO
1033. PU/DAE/R
1034. PU/DCE/TR
1035. PU/DES/TR
1036. PU/R
1037. PU/SAES
1038. PU/SME/TR
1039. PWA/INST
1040. RAE/AD
1041. RAE/AERO
1042. RAE/AERO/SD
1043. RAE/ARM
1044. RAE/BA
1045. RAE/BIB
1046. RAE/CH
1047. RAE/CHEM
1048. RAE/CN/MA
1049. RAE/CPM
1050. RAE/E
1051. RAE/E&I
1052. RAE/E/E
1053. RAE/EL
1054. RAE/EXE
1055. RAE/FA
1056. RAE/GAS
1057. RAE/GW
1058. RAE/IAP
1059. RAE/IL/TD
1060. RAE/INST
1061. RAE/INSTN
1062. RAE/K
1063. RAE/L/E
1064. RAE/LIB BIB
1065. RAE/LIB MEMO
1066. RAE/LT
1067. RAE/MAT
1068. RAE/MECH ENG
1069. RAE/MET
1070. RAE/MISC
1071. RAE/MS
1072. RAE/MT
1073. RAE/NAVAL
1074. RAE/NRSC/SP
1075. RAE/PAPER
1076. RAE/RPD
1077. RAE/SME
1078. RAE/SPACE
1079. RAE/STRUCTURES
1080. RAE/TM/AERO
1081. RAE/TM/AVIONICS
1082. RAE/TM/AW
1083. RAE/TM/BLEU
1084. RAE/TM/CAADRP
1085. RAE/TM/CHEM
1086. RAE/TM/DES
1087. RAE/TM/DIR
1088. RAE/TM/EL
1089. RAE/TM/EP
1090. RAE/TM/FM
1091. RAE/TM/FS
1092. RAE/TM/FS/B
1093. RAE/TM/FS/F
1094. RAE/TM/GENERAL
1095. RAE/TM/GW
1096. RAE/TM/IAP
1097. RAE/TM/IN
1098. RAE/TM/INSTN
1099. RAE/TM/IR
1100. RAE/TM/IT
1101. RAE/TM/M&S
1102. RAE/TM/MAT
1103. RAE/TM/MAT/STR
1104. RAE/TM/MATHS
1105. RAE/TM/ME
1106. RAE/TM/MET
1107. RAE/TM/MS
1108. RAE/TM/NAVAL
1109. RAE/TM/P
1110. RAE/TM/RAD
1111. RAE/TM/RAD/NAV
1112. RAE/TM/RPD
1113. RAE/TM/SPACE
1114. RAE/TM/STRUCTURES
1115. RAE/TM/TD
1116. RAE/TM/WE
1117. RAE/TN
1118. RAE/TN/ADW
1119. RAE/TN/AER
1120. RAE/TN/ARM
1121. RAE/TN/BLEU
1122. RAE/TN/CHEM
1123. RAE/TN/CPM
1124. RAE/TN/CW
1125. RAE/TN/E
1126. RAE/TN/EL
1127. RAE/TN/ENG
1128. RAE/TN/GAS
1129. RAE/TN/GW
1130. RAE/TN/IAP
1131. RAE/TN/IEE
1132. RAE/TN/INST
1133. RAE/TN/INSTN
1134. RAE/TN/IR
1135. RAE/TN/MATH
1136. RAE/TN/ME
1137. RAE/TN/MECH ENG
1138. RAE/TN/MET
1139. RAE/TN/MET/PHYS
1140. RAE/TN/MS
1141. RAE/TN/NA
1142. RAE/TN/NAVAL
1143. RAE/TN/RAD
1144. RAE/TN/RPD
1145. RAE/TN/SME
1146. RAE/TN/SPACE
1147. RAE/TN/STRUCTURES
1148. RAE/TN/TD
1149. RAE/TN/VIB
1150. RAE/TN/WE
1151. RAE/TR
1152. RAE/TRANS
1153. RAE/VIB
1154. RAES/MISC
1155. RAF/IAM
1156. RAL
1157. RAND/MISC
1158. RAND/N
1159. RAND/P
1160. RAND/R
1161. RAND/RM
1162. RARDE
1163. RARDE/MEMO
1164. RARDE/R
1165. RAS/MISC
1166. REPORT
1167. RIAM/MISC
1168. RIAS/TR
1169. RIT/KTH/AERO
1170. RIT/KTH/AERO/M
1171. RIT/KTH/AERO/TN
1172. RL/A
1173. RL/S
1174. ROLLS-ROYCE/MISC
1175. ROLLS-ROYCE/PNR
1176. ROLLS-ROYCE/RCR
1177. RPE
1178. RPE
1179. RPE/MEMO
1180. RPE/TM
1181. RPE/TN
1182. RPE/TR
1183. RPE/TRANS
1184. RPI/MATHREP
1185. RPI/TR/AE
1186. RRE/M
1187. RRL
1188. RRL/LR
1189. RTI/KTH/AERO/TN
1190. RTO/AG
1191. RTO/EN
1192. RTO/LS
1193. RTO/MISC
1194. RTO/MP
1195. RTO/TP
1196. RTO/TR
1197. RU/AAR
1198. RU/MAE/TR
1199. RWC/AM
1200. SAAB/TN
1201. SAE
1202. SAE/MISC
1203. SAE/SP

1204. SAE/TP
1205. SBH/RT
1206. SBH/TN
1207. SC/CR
1208. SC/DR
1209. SC/M
1210. SC/R
1211. SC/RR
1212. SI/NAM
1213. SI/PUB
1214. SIT/DL
1215. SIT/LA
1216. SM
1217. SME/TP/EM
1218. SME/TP-MS
1219. SME/TR-MRR
1220. SRDE
1221. SRI
1222. SSC
1223. SSC-INDEX
1224. SU/AA
1225. SU/AMS/TR
1226. SU/DAM
1227. SU/DEM/TR
1228. SU/DME/TR
1229. SU/DME/TR-LG
1230. SU/IAU
1231. SU/ISVR/TR
1232. SU/ME
1233. SU/ME/TM
1234. SU/SEL
1235. SU/SLAC
1236. SU/TD/HMT
1237. SU/TD/MD
1238. SU/TD/PD
1239. SU/TD/TF
1240. SU/TD/TR-FM
1241. SU/TD/TR-LG
1242. SU/TD/TR-TF
1243. SU/TD/TR-TF
1244. SUDAAR
1245. SUDAER
1246. SUFFIELD/SP
1247. SUFFIELD/TN
1248. SUFFIELD/TP
1249. TAE
1250. TAE/MISC
1251. TAR/TN
1252. TAR/TR
1253. TCEA/MISC
1254. TCEA/TM
1255. TCEA/TN
1256. TFB/VTI/R
1257. TH/DELFT
1258. TH/DELFT/NO
1259. THLR/LR
1260. THLR/MEMO
1261. THLR/MISC
1262. THLR/VTH
1263. THLV
1264. TRB/CONFERENCE
1265. TRB/NCHRP
1266. TRB/NCTRDP
1267. TRB/NHCRP
1268. TRB/TCRP
1269. TRB/TCRP/SYNTHESIS
1270. TRB/TRC
1271. TRB/TRR
1272. TRC
1273. TRC/AEL
1274. TRC/SRL
1275. TRC/T
1276. TRL
1277. TRL/CR
1278. TRL/PR
1279. TRL/R
1280. TRL/RR
1281. TRL/TD/TP
1282. TRR
1283. TRR/LR
1284. TRRL
1285. TRRL/CR
1286. TRRL/LR
1287. TRRL/ORN
1288. TRRL/R
1289. TRRL/SR
1290. TRRL/TN
1291. TT
1292. TU DELFT/LR
1293. TUD/DCAMM
1294. TVS/CV
1295. TWI
1296. TWI/MISC
1297. UAC/RD
1298. UAC/RES
1299. UAC/RES/METEOR
1300. UAC/RL
1301. UAC/UTC/TM
1302. UB
1303. UB/MISC
1304. UC
1305. UC/AMES/TR
1306. UC/IMS
1307. UC/LA
1308. UC/RL
1309. UCC/ND/CTC
1310. UCLA/ENG
1311. UND/EE/TR
1312. UND/MISC
1313. UNI. NEWCASTLE-TORG
1314. UNIV MINN/CS/TR
1315. UNIV/VICTORIA/DM
1316. UNIVERSITAT STUTTGART
1317. UO/DES
1318. UOC/AS
1319. UOC/COE/TP
1320. UOC/DOE
1321. UOC/DOE/R
1322. UOC/ERG/EDP
1323. UOC/FM
1324. UOC/HE
1325. UOC/HEL/TR
1326. UOC/IER/MD
1327. UOC/IER/SERIES
1328. UOF/COE/BUL
1329. UOF/COE/TP
1330. UOH/CSS/MISC
1331. UOH/CSS/RM
1332. UOI/AED
1333. UOI/CES
1334. UOI/CSL
1335. UOI/DCCE
1336. UOI/EES/BUL
1337. UOI/T&AM
1338. UOL/DFM-MISC
1339. UOL/DME-A
1340. UOL/DME-B
1341. UOL/DME-FM
1342. UOL/DME-MISC
1343. UOL/R
1344. UOL/TR
1345. UOL-TR
1346. UOM/CAR/TR
1347. UOM/IOT/TR
1348. UOM/MISC
1349. UOM/SAFHL/PR
1350. UOM/TN-BN
1351. UON/DCE/BUL
1352. UON/DOM/RR
1353. UON/ME
1354. UOS/FTCE
1355. UOS/MISC
1356. UOT/DRL
1357. UOW/DER
1358. UPFI/P
1359. US/AA
1360. US/AA/M
1361. US/AA/MISC
1362. US/ISVR
1363. US/ISVR/M
1364. US/ISVR/TR
1365. USAA
1366. USAA/M
1367. USAA/YR
1368. USAA/YR/TN
1369. USAF/AFOSR
1370. USCAE
1371. USCEC/R
1372. UT
1373. UT/NIT/DSE
1374. UTIA
1375. UTIA/REP
1376. UTIA/REV
1377. UTIA/TN
1378. UTIAS

1379. UTIAS/MISC
1380. UTIAS/R
1381. UTIAS/REV
1382. UTIAS/TN
1383. UTIS/R
1384. UW/DME
1385. UW/RR
1386. UWM/SSRI/MISC
1387. VKI/IN
1388. VKI/LS
1389. VKI/MISC
1390. VKI/PR
1391. VKI/PREPRINT
1392. VKI/RAPPORT
1393. VKI/REPRINT
1394. VKI/SARTRYCK
1395. VKI/TM
1396. VKI/TN
1397. VOLKENRODE/R&T
1398. VTI
1399. VTI/EC/RESEARCH
1400. VTI/M
1401. VTI/MISC
1402. VTI/RAPPORT
1403. VTI/SARTRYCK
1404. WADC/TN
1405. WADC/TR
1406. WAL/FAD/ML
1407. WAL/MISC
1408. WB/MISC
1409. WB/TAG/TN
1410. WB/TP
1411. WHL/RP
1412. WHO/MISC
1413. WI
1414. WI/MISC
1415. WI/P
1416. WI/RR
1417. WORKING PAPERS
1418. WP/AFFDL/TR
1419. WP/WADC/MISC
1420. WP/WADC/TN
1421. WP/WADC/TR
1422. WP/WADD/TN
1423. WPAFB/AFFDL
1424. WPAFB/AFFDL/TR
1425. WPAFB/AFML/TR
1426. WPAFB/ARL
1427. WPAFB/ASD/TR
1428. WPAFB/FDL/TDR
1429. WPAFC/AFFDL/TR
1430. WPRL/REP
1431. WRA/TIR
1432. WRA/TM
1433. WRA/TP
1434. WRC/BULL
1435. WRC/ER
1436. WRC/ESSL/TR
1437. WRC/MISC
1438. WRC/PRS
1439. WRC/PRU
1440. WRC/TM
1441. WRC/TR
1442. WRE/HSA
1443. WRE/R
1444. WRE/SPEC
1445. WRE/TN
1446. WRE/TN/EID
1447. WRE/TN/HSA
1448. WRE/TN/SAD
1449. WRE/TR
1450. WRE/TR/HSA
1451. WSRL/TR
1452. YNU/FE
1453. ZWB/FB
1454. ZWB/UM

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1. Aeronautical Research Association of Princeton (ARAP) – 1970
2. Aeronautical Research Committee/Council (ARC) – 1935 to 1980
3. Aeronautical Research Institute, Tokyo (ARI) – 1970's to 1980's
4. Aeronautical Research Laboratories, Melbourne (ARL) – 1950 to 1992
5. Aeroplane and Armament Experimental Establishment (AAEE) – 1960 to 1970
6. Advisory Group for Aerospace Research & Development (AGARD) – 1950 to 1997
7. Aircraft Research Association (ARA) – 1950 to 1970
8. American Gas Association (AGA) – 1985 to 1987
9. American Institute of Aeronautics & Astronautics (AIAA) – 1963 to …
10. Aerodynamishe Versuchsanstalt (AV) – 1958 to 1964
11. Air Infiltration & Ventilation Centre (AIVC) – 1993 to 1998
12. Admiralty Underwater Weapons Establishment (AUWE) – 1966 to 1968
13. Air Force Systems Command-US (AFSC) – 1971 to 1975
14. Air Ministry (AM) – 1920's to 1930's
15. American Rocket Society (ARS) – 1957
16. American Society of Mechanical Engineering (ASME) – 1954 to …
17. American Society of Civil Engineers (ASCE) – 1960's
18. American Society of Agricultural Engineers (ASAE) – 1960's

19. American Society of Testing Materials (ASTM) – 1960's
20. Arbeits-und Forschungsgemeinschaft (AF) – 1957 to 1967
21. Armament Research Department (ARD) – 1940's
22. Armament Research & Defence Establishment (ARDE) – 1956 to 1960
23. Arnold Engineering Development Center (AEDC) – 1954 to 1971
24. Associated Electrical Industries (AEI) – 1963 to 1970
25. Atomic Energy Research Establishment (AERE) – 1950 to 1967
26. Air Force Office of Scientific Research (AFOSR) – 1961 to …
27. AT Kearney Incorporated (ATKEARNEY) – 1990 to 1995
28. Atomic Weapons Research Establishment (AWRE) – 1960's
29. Aviation Operational Research Board (AORB) – 1968 to 1969
30. Aeronautical Quality Assurance Directorate (AQAD) – 1960's to 1970's
31. Admiralty Research Laboratory (ARL) – 1970 to 1975
32. Auburn University (AU) – 1964 to 1965
33. Australian Council for Aeronautics (ACA) – 1944 to 1954
34. Australian Road Research Board (ARRB) – 1980's
35. Australian Space Research Institute (ASRI) – 1990's
36. Bell Aerosystems Company (BAC) – 1960's
37. Ben Gurion University (BGU) – 1975 to 1976
38. British Hydromechanics Research Association (BHRA) – 1950 to 1970
39. BHRA Fluid Engineering Centre (BHRA) – 1970 to 1978
40. Blackburn & General Aircraft Limited (BGA) – 1950's
41. Boeing Company (BC) – 1970's to …
42. Boeing Scientific Research Laboratory (BSRL) – 1959 to 1980
43. Bold, Beranek & Newman Incorporated (BBN) – 1964
44. Bristol Aircraft Limited (BAL) – 1960's
45. Bristol Airplane Company (BAC) – 1960's
46. Bristol Siddeley Engines Limited (BSEL) – 1960 to 1970
47. British Aerospace (BAe) – 1983 to 1987
48. British Aircraft Corporation (BAC) – 1960's to 1970's
49. British Internal Combustion Engine Research Association (BICERA) – 1959 to 1964
50. British Library (BL) – 1976 to …
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52. British Rail (BR) – 1970's
53. British Steel (BS) – 1970's
54. British Welding Research Association (BWRA) – 1965 to 1986
55. Brown University (BU) – 1950's to 1980's
56. Building Research Establishment (BRE) – 1973 to …
57. Building Research Station (BRS) – 1965 to 1970

58. Building Services Research & Information Association (BSRIA) – 1976 to …
59. Bundesministerium for Bildung und Wisserischaft (BMBW) – 1966 to 1978
60. California Institute of Technology (CIT) – 1960 to …
61. Cambridge University: Engineering Department (CUED) – 1983 to …
62. Canadian Air Transport Administration (CATA) – 1970's to 1980's
63. Canadian Armament Research & Development Est (CARDE) – 1970 to 1985
64. Carnegie-Mellon University (CMU) – 1970's to 1990's
65. Case Western Reserve University (CWRU) – 1966 to 1978
66. Cement & Concrete Association (CCA) – 1961 to 1981
67. Central Aeronautical Hydrodynamic Institute (CAHI) – 1923 to 1936
68. Centro Consultivo Studi e Ricerche dell Aeronautica Militaire (CCSRAM)–1956 to 1976
69. Central Electricity Generating Board (CEGB) – 1960's to 1980's
70. Centre National de la Recherche Scientifique (CNRS) – 1968 to 1977
71. Chrysler Corporation – 1975 to 1976
72. Construction Industry Research & Information Association (CIRIA) 1978 to …
73. 73) City University (CU) – 1968 to 1985
74. Civil Aeronautical Board (CAB) – 1964 to 1966
75. Clay Pipe Development Association (CPDA) – 1973 to 1975
76. 76) College of Aeronautics (CoA) – 1953 to 1970
77. Cranfield Institute of Technology (CIT) – 1970 to 1993
78. Cranfield University (CU) – 1993 to …
79. Central Mechanical Engineering Research Institute (CMERI) – 1966 to 1969
80. Colorado State University (CSU) – 1973 to 1975
81. Commission on 3rd London Airport – 1960 to 1970
82. Concrete Pipe Association (CPA) – 1972 to 1974
83. Control Data Corporation (CDC) – 1960 to 1966
84. Copper Development Association (CDA) – 1951 to 1972
85. Cornell Aeronautical Laboratory (CAL) – 1951 to 1970
86. Cornell University (CU) – 1960 to 1970
87. Council for Scientific & Industrial Research (CSIR) – 1940 to 1987
88. David Taylor Model Basin (DTMB) – 1951 to 1967
89. Defence Materials Information Center (DIMIC) – 1958 to 1960
90. Defence Metals Information Center (DMIC) – 1959 to 1961
91. Defense Research Agency (DRA) – 1991 to …
92 Defense Research Information Centre (DRIC) – 1972 to 1992
92. Delft University of Technology (DELFT/DUT) – 1949 to …
93. Department of the Environment (DoE) – 1978 to …
94. Deutsche Forshungsanstalt fur Luftfahrt (DFL) – 1959 to 1964
95. Deutsche Forschungs-und Versuchsanstalt fur luft-und Raumfahrt (DFVLR)–1978 to 1992

96. Deutsche Luft-und Raumfahrt (DLR) – 1964 to …
97. Department of Defense (DoD) – 1970 to …
98. Department of Trade (DoT) – 1975 to …
99. Department of Trade & Industry (DTI) – 1997 to …
100. Douglas Aircraft Company (DAC) – 1958 to 1970
101. Defence Research Establishment, Ottawa (DREO) – 1972 to 1981
102. 103) Department of Scientific & Industrial Research (DSIR) – 1960 to 1978
103. Defence Research Establishment, Valcartier (DREV) – 1969 to 1972
104. Defence Research Board of Canada (DRBC) – 1950 to 1976
105. Defence Research Medical Laboratory (DRML) – 1953 to 1960
106. Deutsche Versuchsanstalt fur Luftfahrt EV (DVL) – 1955 to 1965
107. Economist Intelligence Unit (EIU) – 1974 to 1985
108. Electricity Council (EC) – 1963 to 1987
109. EMI Electronic Limited (EMI) – 1959 to 1975
110. Energy Efficiency Office (EEO) – 1990 to …
111. English Electric Company (EEC) – 1956 to 1958
112. Environment Agency (EA) – 1980's
113. Environmental Protection Agency (EPA) – 1975 to …
114. European Research Agency (ERA) – 1975 to 1995
115. Eurocontrol – 1974 to 1991
116. European Space Research Organization (ESRO) – 1968 to 1970
117. European Space Agency (ESA) – 1970 to …
118. Eurospace – 1963 to 1964
119. Economic & Social Research Council (ESRC) – 1990
120. Federal Aviation Agency (FAA) – 1970 to 1997
121. Flygtekniska Forsoksanstalten (FFA) – 1946 to 1979
122. Flugwissenschaftliche Forschungsanstalt EV Munchen (FFM) – 1960 to 1963
123. Flying Personnel Research Committee (FPRC) 1957 to 1966
124. Fokker Aircraft Company (FAC) – 1962 to 1980
125. Forsvarets Forkningsanstalt (FoA) – 1969 to 1982
126. Ford Motor Company (FORD) – 1974 to 1976
127. Guggenheim Aeronautical Laboratory – CIT (GASCIT) – 1935 to 1976
128. General Accounting Office (GAO) – 1991 to …
129. General Applied Science Laboratories (GASL) – 1960 to 1965
130. General Dynamics Company (GDC) – 1958 to 1961
131. General Electric Company (GEC) – 1967 to 1980
132. General Motors Research Laboratory (GMRL) – 1973 to 1985
133. Georgia Institute of Technology (GIT) – 1963 to 1968
134. Giannini Controls Corporation (GCC) – 1961 to 1966

135. Glasgow University (GU) – 1968 to …
136. Grumman Aircraft Engineering Corporation (GAE) – 1962 to 1964
137. Groupement des Recherches Aeronautiques (GRA) – 1939 to 1947
138. Hawker Aircraft Limited (HAL) – 1947 to 1962
139. Hawker-Siddeley Aviation Limited (HASL) – 1960 to 1975
140. Heating & Ventilation Research Association (HVRA) – 1964 to 1973
141. HP Drewry (Shipping Consultants) Limited (HPD) – 1972 to 1985
142. Higher Education Funding Council for England (HEFCE) – 1993 to 1994
143. Highway Research Board (HRB) – 1967 to 1973
144. Hunting Aircraft Limited (HAL) – 1954 to 1962
145. 146) Hydro-OG Aerodynamisk Laboratorium (HOAL)
146. Hydraulics Research Station (HRS) – 1971 to 1982
147. Hydronautics Incorporated (HI) – 1962 to 1972
148. Illinois Institute of Technology (IIT) – 1964 to 1972
149. Imperial Chemical Industries Limited (ICI) – 1959 to 1962
150. Imperial College of Science & Technology (ICST) – 1961 to …
151. Indian Institute of Science (IIS) – 1969 to 1977
152. Institute Applica Calcolo (IAC) – 1960 to 1965
153. Institut fur Aerodynamik (IFA) – 1946 to 1961
154. Institut du Transport Aerien (ITA) – 1956 to 1975
155. Institute de Mathematique (IDM) – 1967 to 1987
156. Institute of Fluid Science (IFS) – 1990 to …
157. Institute of High Speed Mechanics (IHSM) – 1951 to 1988
158. Institute of Marine Engineers (IME) – 1980 to 1990
159. Institute of Petroleum (IP) – 1973 to 1984
160. Institute of Space & Aeronautical Science (ISAS) – 1972 to …
161. Institution of Mechanical Engineers (IME) – 1957 to …
162. International Aeronautical Federation (IAF) – 1994 to 1995
163. International Air Transport Association (IATA) – 1968 to 1980
164. IBM Corporation (IBM) – 1987 to 1989
165. International Civil Aviation Organization (ICAO) – 1959 to …
166. International Energy Agency (IEA) – 1983 to 1988
167. International Institute of Welding (IIW) – 1977 to …
168. Jet Propulsion Laboratory (JPL) – 1961 to 1976
169. Johns Hopkins University (JHU) – 1953 to 1963
170. Joint Intelligence Systems Committee (JISC) – 1996
171. Joint Intelligence Bureau (JIB) – 1958 to 1959
172. Kanazawa University (KU) – 1985 to …
173. Kodak Photographic (KODAK) – 1968 to 1972

174. Kyoto University (KU) – 1967 to …
175. Laboratoria NV Philips Gloeilampenfabrieken (LPG) – 1958 to 1965
176. Lappeenranta – (Finland) (LAPPEENRANTA) – 1980 to …
177. Loughborough University of Technology (LUT) – 1971 to …
178. Long-Range Weapon Establishment (LWRE) – 1948 to 1953
179. Luftfahrt-Forschungsbericht Helft (LFH) – 1961 to 1964
180. Massachusetts Institute of Technology (MIT) – 1961 to 1964
181. McGill University (MU) – 1962 to 1985
182. McMaster University (MU) – 1979
183. Max-Planck Institute (MPI) – 1950 to …
184. Ministere de l'Air (MDA) – 1931 to 1967
185. Ministry of Aviation (MoA) – 1962 to 1970
186. Ministry of Defence (MoD) – 1963 to 1985
187. Ministry of Supply (MoS) – 1946 to 1960
188. Ministry of Technology (MoT) – 1966 to 1969
189. Meji University (MU) – 1992 to …
190. Metropolitan-Vickers Electrical Company (MVEC) – 1955 to 1959
191. Mississippi State University (MSU) – 1960 to 1965
192. Mitsubishi Limited (MITSUBISHI) – 1979 to 1989
193. Monash University (MU) – 1970 to 1972
194. Motor Industry Research Association (MIRA) – 1964 to …
195. Mullard Ltd (MULLARD) – 1974 to 1977
196. National Advisory Committee for Aeronautics (NACA) – 1919 to 1958
197. National Advisory Council for Education & Training Targets (NACETT) – 1998 to …
198. National Aeronautical Laboratory (NAL) – 1931 to 1967
199. Nagoya University (NU) – 1983 to …
200. National Aeronautics & Space Administration (NASA) – 1958 to …
201. National Bureau of Standards (NBS) – 1950 to 1966
202. Nationaal Luchtvaartlaboratium (NLL) – 1923 to 1965
203. Nationaal Lucht -En Riumtevaartlaboratium (NLR) – 1965 to …
204. National Engineering Laboratory (NEL) – 1961 to 1991
205. National Gas Turbine Establishment (NGTE) – 1946 to 1979
206. National Maritime Institute (NMI) – 1979 to 1980
207. National Physical Laboratory (NPL) – 1960 to 1997
208. National Research Council (NRC) – 1951 to …
209. National Transportation Safety Board (NTSB) – 1971 to 1982
210. Naval Ordnance Laboratory (NAVORD/NOLTR) – 1946 to 1973
211. Naval Research Laboratory (NRL) – 1949 to 1963
212. Naval Postgraduate School (NPS) – 1965 to 1984

213. National Technical Information Service (NTIS) – 1976 to 1977
214. New York University (NYU) – 1961 to 1966
215. Northrop Aircraft Incorporated (NAI) – 1955 to 1958
216. Office of Water Services (OFWAT) – 1993 to …
217. Oceanics Incorporated (OI) – 1964
218. Open University (OU) – 1978
219. Oak Ridge National Laboratory (ORNL) – 1963 to 1969
220. Office of Naval Research (ONR) – 1959 to 1975
221. Office of Scientific Research & Development (OSRD) – 1941 to 1946
222. Office National d'Etudes et de Recherches Aerospatiales (ONERA) – 1958 to …
223. Osaka University (OU) – 1998 to …
224. Patents – ie. EP, UK, US etc – 1950's to …
225. Planning & Transport Research & Computational Int. Assoc. (PTRC) – 1968 to …
226. Polytechnic of the South Bank (PSB) – 1976
227. Polytechnic Institute of Brooklyn (PIBAL) – 1950 to 1972
228. Polytechnic of Turin (PT) – 1958 to 1977
229. Princeton University (PU) – 1955 to 1986
230. Production Engineering Research Association (PERA) – 1956 to 1989
231. Propellants, Explosives & Rocket Motor Establishment (PERME) – 1978 to 1982
232. Purdue Research Foundation (PRF) – 1958 to 1969
233. Ramo-Woolridge Corporation (RWC) – 1955
234. Rand Corporation (RAND) – 1970 to …
235. Research Institute for Advanced Studies (RIAS) – 1961 to 1972
236. Rensselaer Polytechnic Institute (RPI) – 1960 to 1065
237. Rice University (RU) – 1965 to 1978
238. Royal Aircraft Establishment (RAE) – 1945 to …
239. Royal Air Force (RAF) – 1974 to 1990
240. Rolls-Royce plc – 1961 to …
241. Royal Armament Research & Development Establishment (RARDE) – 1961 to 1966
242. Royal Aeronautical Society (RAS) – 1961 to 1963
243. Royal Canadian Air Force (RCAF) – 1953 to 1965
244. Royal Institute of Technology, Sweden (RIT) – 1948 to …
245. Royal Military College of Science (RMCS) – 1974 to …
246. Rutherford Appleton Laboratory (RAL) – 1969 to 1984
247. Rocket Propulsion Establishment (RPE) – 1964 to 1974
248. Royal Radar Establishment (RRE) – 1954 to 1973
249. Research & Technology Organization (RTO) – 1998 to …
250. Royal Technical Publishers (RTO) – 1938 to 1946
251. Rutgers State University (RU) – 1969 to 1970

252. Saab Motor Company (SAAB) – 1951 to 1970
253. Sandia Corporation (SAND) – 1977 to …
254. Scuola di Ingegneria de Torino (SIT) – 1929 to 1938
255. Scientific & Technical Research (S&T) – 1949 to 1979
256. Science & Engineering Research Council (SERC) – 1979 to 1985
257. Shell Petroleum (SHELL) – 1970 to 1978
258. Ship Research Institute (SRI) – 1964 to 1982
259. Ship Structures Committee (SSC) – 1959 to 1980
260. Short Brothers & Harland Limited (SBH) – 1950 to 1957
261. Signals Research & Development Establishment (SRDE) – 1956 to 1959
262. Simon Fraser University (SFU) – 1962 to 1965
263. Smithsonian Institute (SI) – 1962 to 1965
264. Society of Automotive Engineers (SAE) – 1959 to …
265. Society of Experimental Test Pilots (SETP) – 1975
266. Society of Manufacturing Engineers (SME) – 1975 to 1988
267. Software Sciences Limited (SSL) – 1986
268. Southwest Research Institute (SRI) – 1964 to 1972
269. Stanford University (SU) – 1958 to 1973
270. Stevens Institute of Technology (SIT) – 1961 to 1973
271. Suffield Institute (SUFFIELD) – 1968 to 1975
272. Sylvania Electric Products Incorporated (SEPI) – 1955 to 1960
273. Technion Aeronautical Engineering (TAE) – 1961 to …
274. Therm Advanced Research (TAR) – 1960 to 1967
275. Technology reports Center (TRC) – 1972 to 1980
276. Thornton Research Center (TRC) – 1946 to 1956
277. Tohoku Imperial University (TIU) – 1933 to 1978
278. Training Center for Experimental Aerodynamics (TCEA) – 1958 to 1960
279. Transportation Research Board (TRB) – 1974 to …
280. Transportation Road Research Laboratory (TRRL) – 1974 to …
281. Transportation Technical Research Institute (TTRI) – 1955 to 1961
282. Technical University of Denmark (TUD) – 1970 to 1980
283. Union Carbide Corporation (UCC) 1950 to 1972
284. United Aircraft Corporation (UAC) – 1959 to 1964
285. United Kingdom Atomic Energy Authority (UKAEA) – 1969 to 1976
286. UK Nirex Limited (NIREX) – 1987 to 1988
287. United States Air Force (USAF) – 1961 to 1972
288. United States Dept. of Health, Education & Welfare (USHWE) – 1969 to 1970
289. Universite de Compiegne (UC) – 1982
290. University of Alabama (UA) – 1970 to 1975

291. University of Alberta (UA) 1979
292. University of Bristol (UB) – 1970 to 1980
293. University of California (UoC) – 1955 to 1970
294. University of Cardiff (UC) – 1974 to 1980
295. University of Columbia (UC) – 1962 to 1967
296. University of Conneticut (UC) – 1971 to 1972
297. University of Denver (UD) – 1971 to 1985
298. University of Edinburgh (UE) – 1970 to 1984
299. University of Florida (UoF) – 1964 to 1970
300. University of Hull (UoH) – 1995 to …
301. University of Illinois (UoI) – 1966 to 1995
302. Universite Laval (UL) – 1980 to 1983
303. University of Leicester (UoL) – 1964 to 1979
304. University of Liverpool (UoL) – 1971 to 1977
305. University of London (UoL) – 1979 to 1990
306. University of Maryland (UoM)
307. University of Melbourne (UoM) 1968 to 1969
308. University of Minnesota (UoM) – 1962 to 1965
309. University of Newcastle (UoN) – 1980 to 1982
310. University of Newcastle, New South Wales (UoN) – 1978 to 1980
311. University of New Mexico (UNM) – 1962 to 1972
312. University of Oxford (UO) – 1965 to 1976
313. University of Pisa (UP) – 1960 to 1979
314. University of Salford (UoS) – 1970 to 1975
315. University of Sheffield (UoS) – 1972 to 1985
316. University of Southampton (UoS) – 1960 to 1975
317. University of Southern California (USC) – 1962 to 1966
318. University of Stuttgart (US) – 1980 to 1995
319. University of Texas (UoT) – 19565 to 1966
320. University of Trondheim (UoT) – 1966 to 1988
321. University of Toronto, Institute of Aerophysics (UTSIAS) – 1952 to ///
322. University of Victoria (UoV) – 1977
323. University of Waterloo (UoW) – 1973 to 1982
324. University of Wichita (UoW) – 1958 to 1960
325. University of the Witwatersrand, South Africa (UoW) – 1959 to 1987
326. Universities Transport Study Group (UTSG) – 1960 to 1980
327. Volkenrode M&P (VOLKENRODE) – 1940 to 1960
328. Von Karman Institute (VKI) – 1968 to …
329. Vag-och Trafik Institutet (VTI) – 1975 to …

330. Water Pollution Research Laboratory (WPRL) – 1973
331. Water Research Association (WRA) – 1970 to 1974
332. Water Research Center (WRC) – 1972
333. Weapons Research Establishment (WRE) – 1956 to 1979
334. Weapons Systems Research Laboratories (WSRL) – 1976 to 1980
335. Welding Institute (WI) – 1978 to …
336. Welding Research Council (WRC) – 1972 to 1986
337. Wissenschaftliche Geselleschaft fur Luft-und Raumfahrt (WGLR) 1963 to 1965
338. Westland Aircraft Limited (WAL) – 1961 to 1964
339. Westland Helicopters Ltd (WHL) – 1976 to 1977
340. World Bank (WB) – 1980 to 1988
341. World Health Organization (WHO) – 1957 to 1976
342. World Meteorological Organization (WMO) – 1985
343. Wright-Patterson AFB (WP) – 1956 to …
344. Miscellaneous Reports – 1980 to …
NB Contains an estimated 100+ obscure and minor series

Appendix H – preliminary holdings questionnaire

A General information about your reports holdings

A.1 Does your organisation have holdings of technical report series?

Yes No

If you answered 'Yes' go to A2. If you answered 'No' go to Section D.

A.2 Are your holdings indexed or catalogued?

Yes No

If you answered 'Yes' go to A3. If you answered 'No' go to A7.

A.3 Are the reports indexed/catalogued?

individually as serials/periodicals

A.4 Can you identify reports as a separate category?

Yes No

A.5 Is the catalogue/index?

electronic printed both

A.6 How may we obtain/access a copy?

A.7 Please describe briefly your library's history in engineering technical reports.

A.8 Please give a brief description of your present collecting policy relating to engineering technical reports.

A.9 Please note any particular or unique strengths in your engineering technical reports holdings.

A.10 Size of holdings. If you can supply them, we should be grateful for even approximate figures indicating the size of your holdings of engineering technical reports.

A.11 What classification scheme(s), if any, do you use for engineering technical reports?

B Access information

B.1 Are your technical reports available for

issue reference only both

B.2 What are your admission regulations?

B.3 Please note any special features of the location and availability of your reports holdings

B.4 What are your opening times and any regular closed periods?

B.5 Please describe allowed users and any attached conditions, charges, etc.

B.6 Do you make loans to other libraries? If so, on what conditions? (e.g. standard SCONUL conditions)

C Additional information

C.1 We would like to add details of your organisation to the National Reports Catalogue. May we contact you for further information?

Yes No

C.2 In addition to having holdings, does your organisation produce technical reports?

Yes No

C.3 MAGiC may be able to offer sets of downloadable bibliographic records for reports series, to enhance your local services. Would you be interested in such a service?

Yes No

C.4 Please use this space for any additional comments you may wish to make.

D Organisation Contact Details

D.1 Organisation

D.2 Department

D.3 Title (Dr, Mr, Mrs, etc)

D.4 Name

D.5 Job title/Position

D.6 Postal Address

D.7 Post code

D.8 Telephone Number

D.9 E-mail Address

D.10 URL

D.11 Sector Academia ○

Government ○

Industry ⬭

Other ⬭

If other, please specify

E Survey submission

Thank you for taking part in our preliminary survey of technical reports holdings. Please return the completed questionnaire using the attached envelope to:

Paul Needham, MAGiC Project Officer
FREEPOST 463, Kings Norton Library, Cranfield University, Cranfield, Bedfordshire, MK43 0AL

Appendix I – preliminary holdings covering letter

Dear Sir/Madam

We would be very grateful if you would help us with our research by completing the enclosed questionnaire, which should take approximately 10 minutes. The questionnaire is aimed specifically at any staff involved in the acquisition and management of report collections, and forms part of a research project called MAGiC (Managing Access to Grey Literature Collections), which aims to map the locations of key collections of engineering reports in the UK.

Technical reports provide valuable information for engineers, but are often difficult to identify, locate and access because they are often not catalogued separately, and cannot be searched remotely. Ultimately, the research project aims to lay the foundations for the creation of a National Reports Catalogue, which will make report literature far more accessible to engineers.

This project is being funded by the British Library Cooperation and Partnership Programme and the Research Libraries Support Programme, and Cranfield University is one of a number of partners undertaking the research.

Thank you for taking the time to participate in our research. For more information about the project and its partners, or to fill in the questionnaire online, please visit the MAGiC website at http://www.magic.ac.uk/holdings.html. Otherwise, please return the completed questionnaire using the attached envelope to:

Paul Needham, MAGiC Project Officer, FREEPOST 463, Kings Norton Library, Cranfield University, Cranfield, Bedfordshire, MK43 0AL

Yours faithfully,
Paul A S Needham

Explanatory notes:

In the context of the MAGiC project:

- **Corporate source** means the organisation(s) identified in a report as being responsible for its contents.
- **Report series** refers to a distinct group of reports sharing a common prefix. This usually identifies the issuing organisation and department, or indicates some other common theme between the reports; e.g. NASA produce reports series such as
- NASA/TP – NASA Technical Papers
- NASA/CR - NASA Contractors Reports
- A **technical report** is "a document which gives the results or the progress of a research and/or development investigation. Where appropriate it draws conclusions and makes recommendations, and it is initially submitted to the person or body for whom the work was carried out. Commonly a report bears a number which identifies both the report and the issuing organisation".

Appendix J - Citation analysis references

Table containing the report references searched upon (in the format that they appeared in the database) and their total citations in the Science Citation Index. Those in bold are cited more than once within volume 213, and so appear twice in the table.

REPORT	YEAR	AUTHOR (1ST)	TOTAL CITATIONS
06 VKI LS	1983	DENTON JD	1
AGARD LECT SERIES	1994	DENTON JD	2
NACATN3802	1956	DUNAVANT JC	1
1185VDI	1995	JANSEN M	1
2974 ARC R M	1957	AINLEY DG	1
3843 ARC R M	1980	HERBERT MW	2
TN2546 NASA	1964	KATSANIS T	3
D3742 NASA TN	NO DATE	KOFSKEY MG	2
D6605 NASA TN	NO DATE	KOFSKEY MG	2
AGARCCPP282	1980	RODGERS C	1
D4384 NASA TN	NO DATE	ROHLIK HE	2
6956 USAAVLABS	1969	RUNSTADLER PW	1
VIB4 RAE	1945	SHANNON JF	1
2045 VDI	1973	VDI	1
AGARD LECT SERIES	1994	CASEY MV	6
AGARDCP571	1995	DAWES WN *	1
AGARD LECT SERIES	1994	DENTON JD *	2
AGARD LECT SERIES	1985	DENTON JD *	1
VKI LECT SERIES	1979	DENTON JD *	1
175 AGARD AR	1981	HIRSCH CH	11
3509 ARC R M	1968	MARSH H	1
TN2302 NACA	1951	WU CH	1
CP537 AGRAD	1994	BELAYGUE P	1
LS195 AGARD	1994	CASEY MV	6
VKI LECT SERIES CENT	1984	CONNOR WA	1
3843 ARC R M	1980	HERBERT MV	2
CPP282 AGARD	1980	HERBERT MV	1
D2546 NASA	1964	KATSANIS T	1
TN186	1975	RUNSTADLER PW	2
CP537 AGARD	1994	SEHRA AK	1
2421 NACA	1951	STANITZ JD	1
VKI LECT SERIES SECO	1997	HALLER BR	1
3550 NASA	1992	TAYLOR AM	1
TM104472 NASA	1991	ZAMAN KBM	2

REPORT	YEAR	AUTHOR (1ST)	TOTAL REFS
227 NEL NAT ENG LAB	1966	TIMMS C	1
AGARDCP351	1983	CALVERT WJ *	1
745 AGARD	1987	CETIN M	1
3775 R M AER RES COU	1975	DENTON JD	1
355 AGARD	1998	DUNHAM J	2
AGARD LECT SERIES	1989	FOTTNER L	2
175 AGARD	1981	HIRSCH C	11
2913 NACA	1953	ROSHKO A	1
199433 VONK I	1994	WATERSON NP	1
199521 VONK I	1995	WATERSON NP	1
R403PR RAND CORP	1962	COLES DE	6
3626 NASA	1982	MARK WD	1
1458 NASA	1979	TOWNSEND DP	1
SYCON9004 RUT U	1990	LAFFERRIERE G	2
SYCON9102 RUT U	1991	SUSSMANN HJ	2
25 U BATH DEP MECH E	1998	CHOCHIA GA *	1
321593 CALTECH JET P	1974	LIKINS PW	1
390 AGARD CP	1985	EPSTEIN AH	1
106252 NASA TM	1993	NG D	1
107150 NASA	1996	NG D	1
165 AGARD	1973	SCHULTZ D	84
4068 ROYAL ARM RD ES	1968	WOOD NB	1
SAND858240UC401	1993	KEE RJ	18
NASA SP	1969	LEISSA AW	752
535 NAT ENG LAB	1972	CHISHOLM D	3
308 NAT ENG LAB	1967	GRAHAM EJ	6
ANL6754	1963	VOGRIN JA	1
19890927 CHALM U TEC	1989	HANSSON H	2

Appendix K - Public Records Office (PRO): Engineering Technical Reports Holdings

Class	Title	Description	Size & Dates
AB	**Records of the United Kingdom Atomic Energy Authority and its predecessors**		
2	Department of Scientific and Industrial Research and successor: Directorate of Tube Alloys and successor: Anglo-Canadian Joint Project Reports	This series contains technical and progress reports, lectures and papers written by members of the Anglo-Canadian Joint Project at Montreal and Chalk River, reports of visits to other scientific establishments, and progress reports of the project's various decisions. The reports in this series were written by the Montreal Team, beginning in February, 1943, and continuing until September, 1946, when Dr. Cockcroft handed over his responsibilities to Mr. W.B. Lewis and the Joint Project ended. At the end of the list is a miscellaneous selection of unnumbered papers and lectures which have not been found on subject files. As committees discussed the same reports under different references, an index of cross-references is included together with notes on the prefixes used in the report numbers as AB 2/873. AB 2/874-915 forms a small supplementary list. The collection of reports is not complete. In some reports, code numbers have been used for the chemical elements; these numbers are a combination of the last figure of the atomic number and the last figure of the mass number, e.g. 92U233 = 23, 94PU239 = 49.	924 files 1941-1946
4	Ministry of Aircraft Production and related bodies: Second World War Atomic Energy Research in Britain, Technical Reports	This series consists of a collection of technical reports describing various aspects of the research and development work in the field of atomic energy carried out in Britain during the years 1939-1945. The reports fall generally into two groups: • 1. Descriptions of experimental and theoretical work undertaken by laboratories, including the Cavendish Laboratory, Cambridge, Birmingham University and the National Physical Laboratory. This covered nuclear physical studies, the development of analytical methods and investigations of the chemical and physical properties of uranium and its compounds. • 2. Development work undertaken in industry aimed at the achievement of an industrial process for the production of high purity uranium metal. Extensive work was also carried out on the development of methods for the separation of uranium isotopes, with supporting work on the manufacture and properties of uranium hexafluoride. This included the development of electrolytic cells for the production of fluorine; the study of fluorocarbon compounds to serve as lubricants; the development of instruments, particularly in relation to vacuum testing. Other reports discuss methods for separating heavy water from ordinary water and the extraction of thorium metal from its ores. Some technical reports by the MAUD Committee are included.	1033 files 1939-1945
7	United Kingdom Atomic Energy Authority and predecessors: Northern Groups: Reports and Memoranda	This series includes reports and memoranda on various aspects of research, discussions, proceedings etc carried out by parts of the Northern Group, and related work carried out by other bodies and private companies. The majority of the reports are from the Risley Reports Library Series.	24518 files and vols 1944-1980

15	United Kingdom Atomic Energy Authority and predecessors: Atomic Energy Research Establishment, Harwell: Reports and Memoranda	These reports and memoranda include those produced by the ten divisions of the Harwell Atomic Energy Research Establishment, extramural reports submitted by commercial contractors and universities, and conference reports. Also included are some copies of reports of the National Physical Laboratory, the Chemical Research Laboratory and the Radiochemical Centre, Amersham, in addition to some bibliographies prepared by the Information Office. The numbering system of the Atomic Energy Research Establishment's documents in report and memoranda series was introduced in 1947 with the report series starting at number 100. The numbering of reports in a single series was controlled from a register in the main library and copies were automatically deposited in the library by the Reproduction Section; the divisions each numbered their own memoranda and as many did not go through the Reproduction Section, this series is not complete before 1958. Until 1958 the divisional prefix was inserted before the R or M number: since that time the memoranda numbering has also been controlled by a library register and the divisional prefixes have been dropped. • The prefixes are as follows: • C Chemistry • CE Chemical Engineering • D Director • E Engineering • EL Electronics • G General Physics • H Health • M Medical • N Nuclear Physics • T Theoretical Physics • X Extramural The Extramural reports are mainly progress reports submitted by various contractors and some were catalogued in the report series while others were catalogued in a miscellaneous series and given the prefix HaR; in 1951 this type of report was given an X/PR reference. In this list, all reports submitted by external organisations have been listed together under the name ot the organisation concerned: piece nos 186 to 192 are documents which were issued without any individual reference numbersUntil January 1949 the Electronics Division was based at the Telecommunications Research Establishement and piece nos 1 to 13 are a mixture of AERE and TRE references.During 1947-49, AERE/TRE Malvern took up the series of numbers AERE G/M 100 to AERE G/M 119.	7054 files and vols 1940-1971
29	United Kingdom Atomic Energy Authority: Atomic Energy Establishment, Winfrith: Reports and Memoranda	This series consists of files containing scientific papers from the Winfrith Atomic Energy Estabishment on various aspects of research and development regarding different types of nuclear reactor. Topics include both theoretical and experimental work, marine investigation and health and safety factors.	244 files and vols 1959-1980
81	United Kingdom Atomic Energy Authority: Culham Laboratory and predecessors: Reports and Memoranda	This series contains reports and memoranda from Culham Laboratory, which was the United Kingdom Atomic Energy Authority's centre for thermo-nuclear fusion research.	7 files 1958-1961
ADM	**Records of the Admiralty, Naval Forces, Royal Marines, Coastguard, and related bodies**		
204	Admiralty: Admiralty Research Laboratory: Reports and Notes	Quarterly and half-yearly progress reports, and reports and notes relating to experiments and investigations in the field of physical research, including underwater ballistics and acoustics, produced by the Admiralty Research Laboratory (ARL).	3235 files and vols 1920-1973

213	Admiralty: Admiralty Centre for Scientific Information and Liaison: Reports	This series consists mainly of reports from Admiralty Research Establishments, with scientific reports from other sources, including foreign countries, of interest to the Royal Navy.	1142 files 1926-1956
220	Admiralty: Admiralty Surface Weapons Establishment and predecessors: Records	Reports, technical notes, papers, minutes and correspondence of the Admiralty Surface Weapons Establishment and its forerunners HM Signal School, the Admiralty Signal Establishment and the Admiralty Signal and Radar Establishment.	2201 files and vols 1921-1968
226	Admiralty: Admiralty Experiment Works: Reports	Reports and related papers on vessel design and performance. Aspects covered include propellor design, manoeuvrability and seakeeping behaviour.	957 files and vols 1874-1968
227	Admiralty: Admiralty Engineering Laboratory: Reports, Technical Notes and Memoranda	Reports, technical notes and internal memoranda in numbered series for each department of the Admiralty Engineering Laboratory. They are concerned with the testing and development of engines and mechanical and electrical equipment, and work on chemicals and metals.	2705 files and vols 1920-1972
247	Admiralty: Admiralty Chemical Advisory Panel and related bodies: Minutes and Reports	The series contains minutes and reports of sub-groups, and reports from the Gas Absorption Working Party and the Marine Propulsion Committee.	258 files 1944-1957
248	Admiralty: Chemical Department, Portsmouth: Reports	Reports of the Admiralty Chemical Department, Portsmouth, and its successor, the Central Dockyard Laboratory, Portsmouth. The reports in this series are mainly in three sub-series, dealing with tests and trials of lubricants, metals and paints.	47 files 1939-1959
249	Admiralty and Ministry of Defence: Admiralty Corrosion Committee and successors: Reports, Minutes and Papers	Reports and minutes of the Admiralty Corrosion Committee and its Navy Department successors, the Committee for Prevention of Corrosion and Fouling and the Ship Hull Corosion Committee, dealing with research into corrosion and marine fouling. Reports and minutes of sub-committees and panels are also included.	1667 files and vols 1941-1979
251	Admiralty: Admiralty Development Establishment: Reports	Reports of the Admiralty Development Establishment, Barrow, concerning submarine propulsion machinery and equipment, and dockside facilities for nuclear vessels.	168 files 1945-1958
252	Admiralty and Ministry of Defence: Admiralty Materials Laboratory: Reports	Reports of the Admiralty Materials Laboratory, which was responsible for research into metallurgy, rubber, plastics and chemicals for naval use.	641 files, microform and vols 1947-1972
253	Admiralty: Mine Design Department and Mining Establishment: Reports and Papers	Progress and other reports and technical notes of the Admiralty Mining Department, then Establishment, and their successor the Underwater Countermeasures and Weapons Establishment. They include reports of trials at HMS *Vernon*. They deal with such subjects as mines, torpedoes, acoustics, and degaussing.	870 files and vols 1922-1958
254	Admiralty: Central Metallurgical Laboratory: Reports and Papers	Records of the Admiralty Central Metallurgical Laboratory, mainly concerning investigation of the failures of particular items of equipment.	163 files and vols 1943-1956
256	Admiralty: Naval Ordnance Department and Weapons Department: Technical Reports and Papers	Monthly records of principal questions dealt with by the Director of Naval Ordnance between 1888 and 1911, technical reports on weapons, including a large series of reports of trials of naval weapons at sea, proceedings of the Remote Position Control Panel, and *Titbits*, a summary of design and development work in hand. The series also includes technical reports by the Director General, Weapons, successor to the Director of Naval Ordnance.	142 files and vols 1888-1967

257	Admiralty: Naval Ordnance Inspection Department, later Division: Laboratory Reports	Reports of laboratories operating under the auspices of the Naval Ordnance Inspection Department in particular the Bragg Laboratory in Sheffield and the laboratory at Caerwent. They relate to chemical and metallurgical testing undertaken in connection with weapons and ammunition for the fleet. Some of the reports are the copies sent to Admiralty Centre for Scientific Information and liaison (ACSIL).	158 files and vols 1940-1969
258	Admiralty: Underwater Countermeasures and Weapons Establishment and predecessors: Reports and Papers	Papers of the Underwater Countermeasures and Weapons Establishment, the successor of the Admiralty Mining Establishment, and like it concerned with mines, torpedoes and other underwater weapons.	345 files and vols 1929-1968
259	Admiralty: Anti-Submarine Experimental Establishment, later Underwater Detection Establishment: Technical and Progress Reports	The series contains technical and progress reports of the Underwater Detection Establishment and its predecessor.	695 files and vols 1930-1961
260	Admiralty: Underwater Weapons Launching Establishment: Reports and Papers	Trial and progress reports and technical memoranda of the Underwater Weapons Launching Establishment dealing with aspects of submarines and torpedoes.	113 files 1945-1959
263	Admiralty: Admiralty Gunnery Establishment: Reports and Papers	A collection of reports and technical notes, assembled from various sources, of the Admiralty Gunnery Establishment, which was responsible for Army and Navy gunfire control work between 1943 and 1959. The reports deal with ordnance material and equipment.	215 files and vols 1944-1961
272	Admiralty and Ministry of Defence: Co-ordination of Valve Development Department: Reports and Registered Files (CVD and other Series)	Reports and other papers of the Co-ordination of Valve Development Department (CVD), dealing with the development of thermionic valves, research into solid state and neutron generation devices, lasers, and low temperature physics for the armed services and other government departments. The series also contains records of two laboratories established by CVD to provide technical support: the Services' Electronics Research Laboratory (SERL) and the Services' Valve Testing Laboratory (SVTL).	268 files and vols 1949-1978
277	Admiralty: Directorate of Miscellaneous Weapon Development: Reports and Papers	Files of the Directorate of Miscellaneous Weapon Development, dealing with the trials and development of various unconventional weapons.	40 files 1940-1945
279	Admiralty: Advisory Panel on Underwater Explosion Research (UNDEX): Reports and Minutes	Minutes of meetings and reports of the Admiralty Advisory Panel on Underwater Explosion Research, reports presented to it by the Naval Construction Research Establishment, and other papers.	114 files 1942-1969
280	Admiralty and Ministry of Defence: Underwater Explosion Research Establishment, later Naval Construction Research Establishment: Reports	This series consists of reports of the Naval Construction Research Establishment (NCRE) and predecessor, set up to research into underwater and surface warship structures and possible improvements thereto.	825 files and vols 1944-1977
281	Admiralty: Naval Construction Department, later Ship Department, Naval Construction Division: Reports	Progress and other reports produced or received by the department and concerning various aspects of warship design and construction. There are also reports of visits to other countries to investigate their naval construction methods.	188 files and vols 1914-1972
282	Admiralty: Directorate of Research Programmes and Planning, later Directorate of Research and Development Services: Reports	Translations (two only) of Italian and German war-time technical papers, compendia of Admiralty war-time research issued in 1950, and lists and directories associated with post-war research programmes.	29 files 1939-1970

283	Admiralty: Department of Scientific Research and Experiment, and Admiralty Computing Service: Reports	A collection of reports, assembled from various sources. Most were produced by the Admiralty Computing Service set up by the Nautical Almanac Office in 1943; others deal with projectiles, torpedoes etc. The series also contains one registered file of the Department.	64 files and vols 1923-1948
284	Admiralty Ship Welding Committee and Admiralty (later Navy) Advisory Committee on Structural Steel: Reports, Minutes and Papers	Reports produced or received by the Admiralty Ship Welding Committee and Admiralty (later Navy) Advisory Committee on Structural Steel.	139 files and vols 1947-1975
285	Admiralty: Directorate of Physical Research, later Naval Physical Research: Reports	This series contains reports in the DPR series, which includes an NRP sub-series on underwater noise reduction.	77 files 1945-1971
287	Admiralty: Directorate of Aeronautical and Engineering Research and successors: Reports	Created in 1946, the Directorate of Aeronautical and Engineering Research (DAER) carried out research into chemistry and metallurgy as well as aeronautics and engineering and was responsible for the Admiralty Experimental Station, Welwyn from 1946-1951.	64 files and vols 1947-1963
289	Admiralty and Ministry of Defence: Admiralty Oil Laboratory: Reports	This series consists of reports of the Admiralty Oil Laboratory, set up to improve the quality control on fuels and lubricants. The series also contains annual reports of the Admiralty Fuel Experimental Station.	182 files and vols 1948-1974
290	Admiralty: Royal Navy Torpedo Factory and Torpedo Experimental Establishment: Reports and Technical Notes	A collection of reports and technical notes, gathered from various sources, reflecting the Torpedo Factory, Greenock, and the Torpedo Experimental Establishment's responsibility for research into all aspects of torpedoes except launching gear.	655 files and vols 1930-1960
291	Admiralty and Ministry of Defence: Materials Laboratory, later Naval Aircraft Materials Laboratory: Reports	Reports of the Materials Laboratory and its successor the Naval Aircraft Materials Laboratory, dealing with metallurgical and chemical problems affecting naval aircraft.	143 files 1949-1966
292	Admiralty: Admiralty Underwater Weapons Department: Reports and German Torpedo Documents	This series consists mainly of translations of German torpedo documents from the Admiralty Underwater Weapons Department.	221 files and vols 1930-1957
293	Admiralty: Board of Invention and Research: Minutes and Reports	This series contains minutes of Board and Committee meeting and technical and other reports.	21 files 1914-1919
295	Admiralty: Central Dockyard Laboratory, Portsmouth: Reports and Technical Memoranda	Reports and technical memoranda of the Central Dockyard Laboratory, which provided a range of laboratory services to Fleet and Shore Establishments, including metallurgy, chemistry, biology, paint technology and reactor chemistry.	35 files and vols 1957-1973
297	Admiralty: Admiralty Experimental Station, Welwyn: Reports	Reports of the Admiralty Experimental Station (AES), Welwyn, dealing mainly with the development of hydrogen peroxide as a propellant.	24 files and vols 1947-1951
302	Admiralty and Ministry of Defence: Underwater Weapons Establishment, later Admiralty Underwater Weapons Establishment: Reports and Technical Notes	Progress and other reports and technical notes of the Admiralty Underwater Weapons Establishment and its immediate predecessor, the Underwater Weapons Establishment, relating to the design, development and testing of underwater weapons and countermeasures.	595 files and vols 1959-1974
309	Admiralty and Ministry of Defence: Admiralty Fuel Experimental Station later Admiralty Marine Engineering Establishment: Reports	Reports and technical memoranda of the Admiralty Fuel Experimental Station dealing with the design and testing of boilers and furnaces. They cover such subjects as igniters, fire-fighting equipment, and other furnace components. In 1966 the establishment changed its name to reflect the extension of its function to testing all types of auxiliary naval machinery.	54 vols 1955-1970

317	Admiralty and Ministry of Defence: Yarrow Admiralty Research Department: Project Reports and Specifications	This series contains reports from the Yarrow Admiralty Research Department on and specifications for various projects connected with naval progression, mainly concerning steam turbines and later, nuclear propulsion.	104 files and vols 1948-1972
AIR	**Records created or inherited by the Air Ministry, the Royal Air Force, and related bodies**		
52	Office of Scientific Research and Development: United States National Defence Research Committee: Reports & Memoranda	The records contain reports and memoranda of various technical committees on subjects relating to British research being undertaken at the same time and were received in accordance with wartime agreements for the exchange of scientific and technical information.	157 files 1941-1946
57	Air Ministry and Ministry of Defence: Flying Personnel Research Committee: Reports and Papers	This series contains an incomplete set of reports and memoranda of the RAF Flying Personnel Research Committee, and some indexes.	131 files and vols 1938-1980
77	Air Ministry, Department of the Scientific Adviser, and Ministry of Defence, Department of the Chief Scientist (Royal Air Force): Reports	Contains reports and memoranda of the Department of the Scientific Adviser, Air Ministry (SAAM), later Department of the Chief Scientist (Royal Air Force) CS(RAF) relating to research and development work including operational research for the Air Ministry, later Ministry of Defence, Air Force Department. Organised by report number within headquarters branch.	604 files and vols 1945-1984
AN	**Records created or inherited by British Transport Commission, British Railways Board, and related bodies**		
101	British Railways Board: Technical Reports	Reports submitted by various chief officers of the British Railways Board and relating mainly to engineering matters.	8 files 1963-1968
139	British Railways: Research Department, Engineering Division: Reports	Numbered research reports of British Railways' Engineering Division at Derby.	556 files & vols 1951-1973
143	British Railways: Research Department, Vehicle and Track Division: Reports	Numbered research reports of British Railways' Vehicle and Track Division at Derby.	30 vols 1954-1960
144	British Railways: Research Department: Technical Research Reports	N/A	N/A N/A
145	British Railways: Research Department, Physics Division: Reports	Numbered research reports of British Railways' Physics Division at Derby. **Former Reference:** Ph and F file series	59 vols 1951-1960
146	British Railways: Research Department: Reports	Numbered research reports issued by the Chief of Research and the Director of Research Planning of British Railways.	3 vols 1964-1965
147	British Railways, Electrical Research Division: Reports	Numbered research reports of British Railways' Electrical Research Division. **Former Reference:** EL file series	82 vols 1963-1970
148	British Railways: Research Department, Chemical Research Division: Reports	Numbered research reports of British Railways' Chemical Research Division, issued mainly by the Chemical Research Laboratories, Muswell Hill, London. **Former Reference:** CR file series	54 vols 1962-1971
149	British Railways: Research Department, Chemistry Division and Scientific Services Division: Reports	Numbered reports issued by British Railways' assistant director, chemical services, the Chemistry Division and the Scientific Services Division. **Former Reference:** C file series	111 vols 1952-1971
150	British Railways: Research Department, Electrical Research Division: Reports	Numbered research reports of British Railways' Electrical Research Division, most of which are described as technical notes. **Former Reference:** ELD file series	193 files 1965-1971
152	British Railways: Research Department, Metallurgy Division: Reports	Numbered research reports of British Railways' Metallurgy Division. **Former Reference:** M file series	50 vols 1952-1959
163	British Transport Commission and British Railways Board: Design Panel: Reports	Reports on technical and aesthetic design used, or commissioned, by the British Transport Commission and British Railways Board's Design Panel.	97 files and vols 1936-1984

166	British Railways Board: Reports, Memoranda and Papers	N/A	N/A N/A
AT	**Records created or inherited by the Department of the Environment, and related bodies**		
14	Central Water Planning Unit: Publications	This series consists of reports and technical notes of the Central Water Planning Unit. The reports cover water supply and resources, water quality, effluent disposal and pollution prevention.	42 vols 1974-1980
19	Department of the Environment: Water Engineering Division: Water Undertakings, Engineering 100 Reports	This series consists of Engineering 100 documents, which were statistical reports required by the Secretary of State under the Water Act 1973 from water undertakings describing water supplies, distribution and quality for the twenty years prior to the Act.	247 files 1941-1976
AVIA	**Records created or inherited by the Ministry of Aviation and successors, the Air Registration Board, and related bodies**		
5	Air Ministry and successors: Civil Aviation Accident Reports and Technical Memoranda	Reports containing brief descriptions of accidents involving civil aircraft; details on the aircraft; names of owners, pilots and passengers, opinions as to the cause of the accidents; and recommendations regarding defective design, etc. Some of the reports contain photographs of the aircraft accidents and some reports in pieces contain maps of the accident areas.	43 files 1919-1949
6	Ministry of Defence and predecessors: Royal Aircraft Factory, later Royal Aircraft Establishment: Reports	The documents in this series consist of technical reports and notes created by the various departments of the Royal Aircraft Establishment (RAE) Farnborough from the first report issued by the Assistant Engineer (Physics) of the Royal Aircraft Factory in September 1912. AERO REPORTS 2258: Cancelled Reference Chapter 255: Not issued Reference Chapter 260: Not issued Reference Chapter 299-301: Not issued Reference Chapter 339: Not issued Reference Chapter 413: Not issued Reference Chapter 425: Not issued Reference Chapter 427: Not issued Reference Chapter 340-399: Numbers omitted in error Reports were given serial numbers, prefixed in most cases by an abbreviation of the name of the issuing department. Large gaps appear in the numbering of the earlier series of reports because it was the practice to assign blocks of numbers to sections of a department and not all of these were used. From August 1964 all series of Technical Reports and Technical Notes were consolidated into a single RAE Technical Reports Series.	24831 files and vols 1916-1980

18	Air Ministry and successors: Aeroplane and Armament Experimental Establishment: Reports and Notes	Reports, and notes of a technical nature, on various tests carried out on aircraft, their armament and equipment, including acceptance tests. The reports in this series, which commence in 1924, consist of the following groups: • Report prefix ATO/A, B,...; created by the Aeroplane and Armament Experimental Establishment at Boscombe Down when under Ministry of Aircraft Production control • Report prefix M A & A E E; reports with prefix 'M' created by A & A E E at Martlesham Heath when under Air Ministry control and continued by those prefixed 'A & A E E' following the move to Boscombe Down in 1939. Reports from 1940 to 1946 created when under Ministry of Aircraft Production control; those from 1946 when under Ministry of Supply Control. • Report prefix F; created at Martlesham Heath when under Air Ministry control. From 1948 reports formerly held in the Admiralty Centre for Scientific Information and Liaison (ASCIL), the Naval Scientific and Technical Information Centre (NASTIC) and the Defence Research Information Centre have been added to this series.	2529 files and vols 1924-1975
20	Admiralty and successors: Royal Airship Works and successors: Reports	Reports of the Research and Development Establishment and its predecessors, the Royal Airship Works and the Balloon Development Establishment. The records are arranged in the following manner: • KB series AVIA 20/1-149, 175-267, 635 • C series AVIA 20/150-174, 268-467 • M series AVIA 20/468-563 • O series AVIA 20/564-634	635 files and vols 1915-1947
23	War Office and successors: Signals Experimental Establishment, later Signals Research and Development Establishment: Reports, Technical Notes and Memoranda	Reports of the Signals Experimental Establishment of the War Office and Ministry of Supply and the Signals Research and Development Establishment of the latter. The numerical sequence in use since their inception was continued after the Establishment's name was changed in 1941.	1070 files and vols 1919-1980
26	Ministry of Technology and predecessors: Royal Radar Establishment and predecessors: Reports and Memoranda	This series consists of reports, memoranda and technical notes prepared by the Royal Radar Establishment (RRE) and its predecessors the Air Defence Research and Development Establishment (ADRDE), the Radar Research and Development Establishment (RRDE) and the Telecommunications Research Establishment. No records of the Services Valve Life Testing Establishment 1936-1952 appear to have survived	2120 files and vols 1940-1976
28	Ministry of Aviation and predecessors: National Gas Turbine Establishment and predecessors: Reports	This series consists of reports, technical notes and memoranda, including reports and papers of Power Jets Ltd and Power Jets (Research and Development) Ltd, and reports, technical notes and memoranda of the National Gas Turbine Establishment at Pyestock in Farnborough, Hants.	3866 files 1939-1971
37	Ministry of Supply and Ministry of Aviation: Chemical Research and Development Department, later Explosives Research and Development Establishment: Reports and Memoranda (CRDD and ERDE Series)	Reports and memoranda on the technical properties of explosives, propellants and other materials prepared by the ERDE, formerly the Chemical Research and Development Department.	1385 files and vols 1946-1975

39	Operations and Technical Radio Committee (Watson-Watt Committee): Sub-committee for Investigation of German Electronics and Signals Organisation: Reports and Memoranda	Reports and memoranda on German radar, communications and electronics work investigated by the Sub-committee for Investigation of German Electronics and Signals Organisation, a British inter-service sub-committee of the Operations and Technical Radio Committee.	86 files 1945-1946
45	Ministry of Supply: Tropical Testing Establishment, Nigeria: Reports and Memoranda	Reports and memoranda on the susceptibility of equipment and materials to deterioration under tropical conditions, and quarterly reports on the work of the Tropical Testing Establishment from 1948 to 1958.	811 files 1945-1968
68	Ministry of Supply and Ministry of Aviation: Rocket Propulsion Establishment: Reports and Technical Memoranda	This series consists of a series of technical memoranda and a series of technical notes on rocket development and fuel research which ran concurrently from the inception of the establishment in 1958; the series also includes half yearly progress reports.	97 files 1958-1972
72	Ministry of Supply and Ministry of Aviation: Directorate of Materials and Explosive Research and Development: Reports and Technical Notes	The records in this series consist mainly of technical reports from the Directorate of Materials and Explosive Research and Development on the properties of various plastics, adhesives, rubbers and other materials.	100 files and vols 1949-1967
80	Ministry of Aviation: Scientific Research (Air) and Future Aircraft Division: Technical Development, Project Records	N/A	N/A N/A
AY			
2	Department of Scientific and Industrial Research: Water Pollution Research Board: Reports	This series consists of the Water Pollution Research Board's numbered papers (otherwise in DSIR 13), mainly comprising reports on investigations made under the direct supervision of the Director of Research, or indirectly through other organisations. In particular these include the Rothamsted Experimental Station, the London School of Hygiene and Tropical Medicine, the Marine Biological Association and the Freshwater Biological Association. It includes some papers of the River Tees Survey Committee and the River Mersey Committee. Former reference numbers refer to the paper numbers	1127 files 1915-1965
6	Department of Scientific and Industrial Research: Fuel Research Station: Reports and Papers	This series comprises reports and papers on scientific investigations, tests and experiments carried out at the Fuel Research Station, including photographs of apparatus and diagrams and graphs of results. There are also reports on visits to other institutions, exhibitions mounted for the public and staff reports. A few of the later items are reports of the Warren Spring Laboratory, and the series also includes a set of Fuel Research Board papers, 1923-1958. For laboratory reports from Warren Spring Laboratory see FV 12.	179 files and vols 1919-1959
22	Department of Industry: National Maritime Institute: Technical Memoranda (TM Series)	Reports on research undertaken by the National Maritime Institute into the performance, handling and safety of ships and off-shore structures. **Former Reference:** TM file series Technical memoranda are not for general publication.	50 vols 1976-1980
BD			

	Welsh Office and predecessors: Local Government and Sewerage Division and predecessors: Returns of Water Undertakings (ENG 100)	This series comprises unregistered folders created by the Ministry of Housing and local government and the Welsh Office containing Returns of Water Undertakings (Engineering (Eng.) 100 forms), carrying returns of information relating to water quality and quantity supplied by water undertakings, and related maps, correspondence and local water acts and orders. The returns relate to Welsh local authorities and water boards, and provide an inventory of the sources of supply, treatment and pumping plant and balancing and service reservoirs, together with details of relevant local enactments, the statutory area of supply with population and the quantity of water supplied daily. The folders containing each form also contain one or more 1-inch Ordnance Survey sheet sections showing the locations of the various installations and the watermain network. Also in the folders are various reports by the Departments' Engineering Inspectorate, miscellaneous correspondence and copies of local water acts and orders. In the mid-1960s the details shown on the individual 1-inch map sheets were plotted on to a series of 21 standard 1-inch OS sheets for the whole of Wales and these sheets are included in the series.	81 files and flat sheets 1942-1976
BT	**Records of the Board of Trade and of successor and related bodies**		
242	Ministry of Technology and successors: Concorde Project: Minutes of Meetings and Technical Reports		1357 files and vols
CM	**Records created or inherited by the Property Services Agency**		
2	R H Lovell Collection: Bedford and Farnborough Wind Tunnels		121 files & vols
DEFE	**Records of the Ministry of Defence**		
15	Ministry of Defence and predecessors: Royal Armament Research and Development Establishment and predecessors: Technical Reports and Memoranda	The series contains technical reports and memoranda and some administrative records of the Royal Armament Research and Development Establishment and its predecessors.	1776 files, rolls and vols 1808-1972
37	Ministry of Defence: Amphibious Warfare Establishments and Trial Detachments: Reports	This series contains reports of various amphibious warfare establishments and their trial detachments. The reports are mostly from equipment trials and many contain photographs. The establishments involved include the Amphibious Warfare Experimental Establishment (AWXE) and its successor the Amphibious Experimental Establishment (AXE) as well as the trials detachments of the Joint Services Amphibious Warfare Centre (JSAWC) and the Amphibious School Royal Marines.	20 files 1953-1966
DR			
14	Civil Aviation Authority and predecessors: Air Traffic Control Evaluation Unit and predecessors: Notes, Memoranda and Reports	This series contains notes, memoranda and reports prepared by the Air Traffic Control Evaluation Unit, and its predecessor the Air Traffic Control Experimental Unit concerning air traffic systems.	558 files and vols 1951-1983
DSIR	**Records created or inherited by the Dept of Scientific and Industrial Research, and related bodies**		
23	Department of Scientific and Industrial Research: Aeronautical Research Council: Reports and Papers	Reports and papers in the 'T' and plain numbers series, relating to research, trials, examination of foreign work in aeronautics and administrative matters, and of various sub-committees and panels.	40640 files and vols 1909-1977

33	Department of Scientific and Industrial Research: National Engineering Laboratory: Research Summaries	Summaries of research carried out by the National Engineering Laboratory for government or the private sector; intended for internal information in the Laboratory.	126 files 1958-1977
34	Department of Scientific and Industrial Research: National Engineering Laboratory Reports	This series consists of of reports that were issued by the Laboratory. An index to National Engineering Laboratory Publications 1981-1983 is in DSIR 34/159. Searchers wishing to inspect earlier reports should communicate with the National Engineering Laboratory at Glasgow.	163 vols 1973-1985
36	Department of Scientific and Industrial Research and related bodies: Records Bureau Files	This series contains a large collection of reports which were housed in the former Department of Scientific and Industrial Research Library, and cover an extensive range of scientific and technological research. They relate to such matters as structure and properties of materials, atmospheric pollution, water pollution, research into safety measures and civil defence, chemical substances and explosives, metals, industrial products and processes, building materials and equipment, natural resources, fuel and power, agricultural produce and foods, dentistry and medical subjects, meteorology and hydrography, aeronautics and transport.	4530 files and vols 1884-1957
55	Department of Scientific and Industrial Research: Warren Spring Laboratory: Research Reports (RR Series)	N/A	12 vols 1959-1960
58	Department of Scientific and Industrial Research: Warren Spring Laboratory, Chemical Engineering and Process Development Division: Research Reports (RR/CE Series)	N/A	6 vols 1960
68	Department of Scientific and Industrial Research: National Engineering Laboratory: Staveley Machine Tool Project, Unregistered Papers	Unregistered folders of correspondence and papers, ring binders containing test results by the National Engineering Laboratory and a series of "Technical Notes" by the Staveley Research Department.	26 vols 1961-1968
ES	**Records of the Atomic Weapons Research Establishment**		
9	Atomic Weapons Research Establishment: Reactor (R) Reports		56 files
POWE			
2	Board of Trade, Industrial Power and Transport Department, Water-Power Resources Committee	Minutes of meetings, minutes of evidence, reports, memoranda and papers on many aspects of water-power resources in the United Kingdom; and documents relating to the Severn Tidal Power Scheme and Commonwealth developments.	52 files 1906-1925
RAIL	**Records of the pre-nationalisation railway companies, pre-nationalisation canal and related companies, the London Passenger Transport Board, and successors**		
792	London, Midland and Scottish Railway Company and British Railways: Research Department: Engineering Reports	The technical reports in this series deal with research into materials of construction and the behaviour of locomotives, rolling stock, track, canals and buildings.	1057 files and vols 1931-1951

Appendix L – Searches carried out on selected trends

Searches based on trends identified by ESDU engineers

Search terms	CU	SIGLE	PRO
(ageing OR aging) AND aircraft	16	2	1
Elastic AND plastic AND fracture	12	4	1
Crack AND (growth OR propagation)	381	117	162
Crack AND (growth OR propagation), pub. 1980-1999	136	116	-
Crack AND (growth OR propagation), pub. 1990-1999	55	45	-
Crack AND (growth OR propagation), pub. 1995-1999	23	23	-
Airship OR airships	158	2	2687
Airship OR airships, pub. 1980-1999	18	2	-
Airship OR airships, pub. 1990-1999	8	2	-
Airship OR airships, pub. 1995-1999	2	2	-

Searches based on trends identified by Cambridge Scientific Abstracts

Search terms	CU	SIGLE	PRO
Automotive AND weight AND reduction	5	0	0
Bioceramics	0	0	0
Plastic AND highway AND (bridge OR bridges)	0	0	0
Titanium	435	121	325
Titanium, pub. 1980-1999	91	117	-
Titanium, pub. 1990-1999	54	48	-
Titanium, pub. 1995-1999	20	35	-

Searches based on trends identified in TRA3 Targeted Research Action in Aerodynamics

Search terms	CU	SIGLE	PRO
automatic AND balance AND calibration AND machine	1	0	-
wind AND tunnel AND balance AND development	5	0	-
wall AND correction	24	2	4
flow AND measurement	319	43	90
air AND flow AND measurement	28	3	17
non-intrusive AND flow AND measurement	3	0	0
Noise	2046	430	
Airframe AND noise	25	0	
Jet AND noise	389	25	
Jet AND noise, pub.1980-1999	107	25	
Jet AND noise, pub.1990-1999	74	16	
Jet AND noise, pub.1995-1999	37	7	
Supersonic AND jet AND noise	54	0	
Subsonic AND jet AND noise	25	0	
(fan or fans) AND noise	151	3	
(fan or fans) AND noise, pub.1980-1999	62	3	
(fan or fans) AND noise, pub.1990-1999	36	3	
(fan or fans) AND noise, pub.1995-1999	23	2	
(rotor OR rotors OR helicopter OR helicopters) AND noise	156	5	
(rotor OR rotors OR helicopter OR helicopters) AND noise, pub.1980-1999	78	5	
(rotor OR rotors OR helicopter OR helicopters) AND noise, pub.1990-1999	40	4	
(rotor OR rotors OR helicopter OR helicopters) AND noise, pub.1995-1999	20	1	
(reduction OR reductions) AND drag	157	4	
(reduction OR reductions) AND drag AND (wing OR wings)	30	0	
blade-vortex AND interaction	36	0	
blade-vortex AND icing	0	0	

Searches based on trends identified by engineers at the College of Aeronautics

Search terms	CU	SIGLE	PRO
space AND debris AND mitigation	9	0	0
Potential Impact of Near Earth Objects	0	0	0
nanosatellite AND (formations OR constellations)	0	0	0

Searches based on trends identified in the ▫ Aerospace Manufacturing NAC Report

Search (Aerospace Manufacturing NAC Report)	KNL	SIGLE	PRO
Composite OR composites	1338	650	3000+
Composite materials	349	508	85

Appendix M – Corporate Sources in the National Reports Catalogue

ID	Organisation Name
1	Aeronautical Research Council
36	Air Accident Investigation Branch - Information Room
22	British Library - Co-operation and Partnership Programme
11	British Water
3	BSRIA Ltd - Library & Information
33	BTexact Technologies - Information Services
13	Cambridge University Engineering Department - Library
6	Civil Aviation Authority - Research Management
10	Concrete Society, The - Publications
38	Construction Industry Training Board - Research
7	Council for the Central Laboratory of the Research Councils - Rutherford Appleton Laboratory
37	Cranfield University - Kings Norton Library
21	Department for Environment, Food and Rural Affairs - Flood Management Division
41	E A Technology
42	E2V Technologies
23	Edinburgh, University of - Laboratory for Foundations of Computer Science
17	Electricity Association - Engineering
24	English Nature - Enquiry Service
35	ERA Technology Ltd - Information Services
9	European Process Industries Competitiveness Centre
32	IEA Clean Coal Centre - Publications
15	Imperial College of Science, Technology & Medicine - Aeronautics
8	Institution of Diesel and Gas Turbine Engineers, The
28	Institution of Gas Engineers & Managers - Information Service
34	International Marine Contractors Association
29	Maritime & Coastguard Agency - Maritime Information Centre
2	National Advisory Committee for Aeronautics
14	National Air Traffic Services - Analysis and Research
19	National Engineering Laboratory
12	National Physical Laboratory - Main Library
5	Nirex Ltd - Corporate Communications
25	Parliamentary Office of Science & Technology - Clerk's Dept
27	Queen Mary, University of London - Computer Science
20	Rolls-Royce plc.
30	Royal Holloway, University of London - Mathematics
45	Salford University - School of Accounting, Economics and Management Science
44	Scottish Universities Environmental Research Centre
4	Serco Assurance 39 Sheffield Hallam University Press - Learning Centre
26	Southampton Oceanography Centre - National Oceanographic Library
31	Southampton Oceanography Centre - Inter-Agency Committee on Marine Science and Technology
16	Southampton, University of - Institute of Sound and Vibration Research
40	Trinity College Dublin - Computer Science
18	TRL Limited - Information & Publishing Services
43	Warwick, University of - Computer Science

Appendix N – Collections in the National Reports Catalogue

21	Aberdeen, University of
23	Aston University
9	Bath, University of
1	British Library
4	Concrete Society, The
15	Council for the Central Laboratory of the Research Councils
2	Cranfield University
14	Cranfield University (RMCS)
22	Dundee, University of
24	Exeter, University of
3	Glasgow University
7	Institute of Marine Engineering, Science and Technology
25	Institution of Chemical Engineers
10	Institution of Civil Engineers
8	Institution of Electrical Engineers
18	King's College London
11	Kingston University
19	Loughborough University
5	Northampton, University College
20	Public Record Office
6	QinetiQ
16	Queen Mary, University of London
12	Royal Aeronautical Society
26	Salford, University of
17	Southampton, University of
13	TRL Limited

Appendix O – Reports Series in the National Reports Catalogue

ID	Name
2	Aeronautical Research Council Current Papers
1	Aeronautical Research Council Reports and Memoranda
13	BL Co-operation and Partnership Reports
12	Concrete Society Technical Reports
9	Daresbury Laboratory Technical Reports
3	NACA Reports
7	NACA Research Memorandums
5	NACA Technical Memorandums
4	NACA Technical Notes
6	NACA Wartime Reports
10	National Engineering Laboratory Reports
11	Rolls-Royce Preprint
8	Rutherford Appleton Laboratory Technical Reports

Appendix P – NASA letter proposing collaboration

National Aeronautics and
Space Administration

Langley Research Center
100 NASA Road
Hampton, VA 23681-2199

Reply to Attn. of: 124

July 20, 2001

Mr. Paul Needham
MAGiC Research Officer
Kings Norton Library, Cranfield University
Cranfield, Beds, MK43 0AL, United Kingdom

Mr. Needham:

This letter is a follow-up to our meeting at the UKOLN sponsored Open Archives Initiative meeting in London, July 11 2001. I am very interested in working with you and the MAGiC program to jointly establish mirrors between our digital libraries. In particular, we will mirror the contents of the Aeronautical Research Council (ARC) reports, and you will mirror the contents of the National Advisory Committee for Aeronautics (NACA) reports. The ARC reports, once scanned, will be available from http://www.magic.ac.uk/, and the NACA reports will be available from http://naca.larc.nasa.gov/.

It is our mutual intention to use the Open Archives Initiative metadata harvesting protocol as a basis for our replication services. Furthermore, we will research the mutual use of "bucket" technology to create automatically replicating data objects.

We look forward to working with you in this project.

Sincerely,

Dr. Michael L. Nelson
m.l.nelson@larc.nasa.gov

Appendix Q - Circulation data at Cranfield Library

Date	No. of rpts	Issues/renewals
1999	2	31
1998	2	29
1997	4	68
1996	6	140
1995	8	99
1994	5	59
1993	5	68
1992	2	21
1991	7	87
1990	3	48
1989	3	43
1988	1	10
1987	2	24
1985	2	33
1982	3	34
1981	1	15
1980	2	35
1979	1	23
1978	3	44
1977	1	15
1976	2	26
1975	1	12
1974	2	49
1972	2	30
1971	1	11
1970	1	10
1968	1	13
1965	3	72
1964	1	23
1960	1	11
1959	1	10
1954	1	11
1953	1	13
1937	1	12
All	82	1229

Date	No. of rpts	Issues/renewals
1996	6	140
1995	8	99
1991	7	87
1965	3	72
1997	4	68
1993	5	68
1994	5	59
1974	2	49
1990	3	48
1978	3	44
1989	3	43
1980	2	35
1982	3	34
1985	2	33
1999	2	31
1972	2	30
1998	2	29
1976	2	26
1987	2	24
1979	1	23
1964	1	23
1992	2	21
1981	1	15
1977	1	15
1968	1	13
1953	1	13
1975	1	12
1937	1	12
1971	1	11
1960	1	11
1954	1	11
1988	1	10
1970	1	10
1959	1	10
All	82	1229

Table Q-1 Age of reports - issues/renewals (1999-2000)

Date	No. of rpts	Issues/renewals
2000	3	32
1999	3	37
1998	9	191
1997	8	123
1996	7	92
1995	6	89
1994	9	103
1993	2	32
1992	3	66
1991	1	10
1990	1	13
1989	3	62
1988	4	72
1987	6	80
1986	1	19
1984	5	65
1983	2	30
1982	3	94
1981	3	40
1980	5	71
1979	3	55
1978	2	31
1977	6	108
1976	5	90
1975	3	43
1974	3	56
1973	2	28
1972	5	78
1971	2	43
1970	5	61
1969	2	26
1968	3	54
1967	1	11
1966	1	22
1965	3	62
1964	2	28
1962	2	49
1960	1	20
1959	3	33
1958	2	33
1957	2	34
1956	1	22
1955	2	24
1953	1	11
1952	3	50
1951	3	39
1948	2	25
1947	3	42
1946	1	14

Date	No. of rpts	Issues/renewals
1998	9	191
1997	8	123
1977	6	108
1994	9	103
1982	3	94
1996	7	92
Not known	6	91
1976	5	90
1995	6	89
1987	6	80
1972	5	78
1988	4	72
1980	5	71
1992	3	66
1984	5	65
1965	3	62
1989	3	62
1970	5	61
1974	3	56
1979	3	55
1968	3	54
1952	3	50
1962	2	49
1971	2	43
1975	3	43
1947	3	42
1981	3	40
1951	3	39
1999	3	37
1957	2	34
1958	2	33
1959	3	33
1993	2	32
2000	3	32
1978	2	31
1983	2	30
1964	2	28
1973	2	28
1969	2	26
1948	2	25
1955	2	24
1945	2	23
1942	1	22
1956	1	22
1966	1	22
1936	1	20
1960	1	20
1934	1	19
1986	1	19

1945	2	23	1928	1	15
1944	1	14	1944	1	14
1942	1	22	1946	1	14
1937	1	11	1990	1	13
1936	1	20	1937	1	11
1934	1	19	1953	1	11
1928	1	15	1967	1	11
Not known	6	91	1991	1	10
All	172	2728	**All**	172	2728

Table Q-2 - Age of reports - issues/renewals (2000-2001)

Year	No. of rpts	issues	Year	No. of rpts	issues
1999	6	18	1996	6	20
1998	2	7	1999	6	18
1997	2	8	1982	4	15
1996	6	20	1994	4	13
1995	3	9	1992	3	12
1994	4	13	1971	3	10
1993	2	6	1995	3	9
1992	3	12	1944	3	9
1990	2	6	1997	2	8
1986	1	3	1998	2	7
1985	2	6	1993	2	6
1983	1	3	1990	2	6
1982	4	15	1985	2	6
1979	1	3	1978	2	6
1978	2	6	1975	2	6
1977	1	3	1973	2	6
1976	1	3	1972	2	6
1975	2	6	1965	1	4
1974	1	3	1986	1	3
1973	2	6	1983	1	3
1972	2	6	1979	1	3
1971	3	10	1977	1	3
1965	1	4	1976	1	3
1964	1	3	1974	1	3
1963	1	3	1964	1	3
1951	1	3	1963	1	3
1945	1	3	1951	1	3
1944	3	9	1945	1	3
1943	1	3	1943	1	3
All	62	200	**All**	62	200

Table Q-3 - Age of reports - issues (1999-2000)

Year	No. of rpts	issues	Year	No. of rpts	issues
2000	6	21	1995	7	25
1999	2	7	2000	6	21
1998	2	6	1992	5	16

1997	3	9	1990	3	13
1996	3	9	1972	3	11
1995	7	25	1997	3	9
1994	1	3	1996	3	9
1993	1	3	1991	3	9
1992	5	16	1974	2	8
1991	3	9	1999	2	7
1990	3	13	1975	2	7
1988	1	3	1998	2	6
1986	1	3	1971	2	6
1983	1	4	1983	1	4
1982	1	3	1965	1	4
1975	2	7	1944	1	4
1974	2	8	1994	1	3
1972	3	11	1993	1	3
1971	2	6	1988	1	3
1966	1	3	1986	1	3
1965	1	4	1982	1	3
1962	1	3	1966	1	3
1944	1	4	1962	1	3
1942	1	3	1942	1	3
All	**54**	**183**	**All**	**54**	**183**

Table Q-4 - Age of reports - issues (2000-2001)

Cranfield University

CERES Research Repository **https://dspace.lib.cranfield.ac.uk/**

Cranfield PSU and Library Services Staff publications - Cranfield Library

The MAGiC Final Report

Needham, Paul A. S.

2002-12

http://hdl.handle.net/1826/58

Downloaded from CERES Research Repository, Cranfield University