# Australasian Virtual Engineering Library: Collaborative Development of a Global Resource

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Abstract

The Australasian Virtual Engineering Library (AVEL) is a gateway to quality WWW resources in the fields of engineering and information technology from sources from the Australasian region. AVEL complements similar gateways in engineering around the world, in particular EEVL in the UK and EELS in Sweden. It is a unique partnership between the library community and the engineering academic and professional communities scattered across Australia. The main lesson learnt in this virtual collaboration was the value of open and transparent communication and sharing of information. We established and articulated a clear set of policies on such things as a metadata schema and resource selection criteria. We maintained dynamic communication network to resolve issues as they arose. Some face-to-face meetings were essential. Equally important was the need to keep the library-based developers of the gateway in touch with the real information gathering needs and expectation of the engineering user community. AVEL is at http://avel.library.uq.edu.au

## I. Introduction

For many engineers, the Internet is becoming an increasingly significant source of information. However, most tend to use it only to browse and often waste much valuable time trying to locate the needed resources as most useful engineering resources are cleverly hidden and difficult to locate efficiently.

In his article on the information seeking habits of engineers, Pinelli [1] reports that engineers have defined information seeking behaviour. In selecting an information source, the decision is based on minimizing loss in terms of "effort (either physical or psychological, which must be expended in order to gain access to an information channel". Further, the accessibility of information is the most important factor influencing an engineer's decision to process that information. Particularly for engineers working in industry, colleagues and informal networks are popular starting points for producing or designing a product, process or system.

Ellis and Haugan [2] conducted a study on information seeking patterns of engineers and research scientists in an industrial environment. One of their conclusions is similar to Pinelli's findings regarding use of colleagues as first point of call for information:

> "When the engineers were confronted with a subject unfamiliar to them, they tended first to look for colleagues or other contacts within their personal network who possessed the knowledge.....…The engineers chose their information channels based on their own experience and knowledge through the consultation of personal contacts, or both methods." [3]

Researchers seeking information on the Internet are presented with a plethora of irrelevant material via existing search engines. These engines (eg. Alta Vista) or subject gateways (eg. Yahoo) use computer indexing of millions of Web pages, and using them to find relevant and evaluated information for research purposes is difficult and time consuming. The information that is available on the web is expanding rapidly and current trends in electronic publishing affect the location of quality information sources.

In addition to the vast quantity of freely available web-based resources, there is a growing amount of useful resources available to engineers for a fee or subscription on the Web. For example, Ei Compendex, INSPEC, NTIS and other databases provide bibliographic information for articles, conference papers and technical reports on this basis. Others, such as full-text journal articles, conference proceedings, product information, patents, standards, materials data sheets, occupational health and safety data, technical data, full-text technical reports, business intelligence and company information are also available on the Web, some for a fee and some free. Resource discovery can be difficult, frustrating and time consuming in terms of locating, filtering and accessing quality resources on the Web which is becoming increasingly a bottleneck in terms of transfer of information from computers to users more than ever before.

Managing emergent knowledge in every field of research depends critically upon effective and timely access to the quality sources of information. Researchers require a simple, easy to use tool to meet the following needs:

- to understand the integral role of information in the research process
- to access information from global sources in a cost effective manner
- to be able to find relevant information in fields outside their field
- to manage information for quick retrieval and accurate referencing
- to discriminate between useful and irrelevant information
- to extract and manipulate information to effectively support theories and arguments

Subject gateways have been developed to address these issues and needs. A number of national gateways exist for engineering and information technology (IT). These include AVEL (Australian Virtual Engineering Library), EEVL (Edinburgh Engineering Virtual Library, UK) and EELS (Engineering Electronic Library, Sweden).

In the document “A National Framework for the Development of Australian Subject Gateways”, it is stated that “there is no standard definition of a subject gateway but there is an emerging consensus that it is a Web-based mechanism for accessing a collection of high quality, evaluated resources identified to support research in a particular subject discipline”. [4] A WWW gateway allows users to search a database to find information resources. Most gateways organise resources from a field (or fields) usually with a regional focus. Gateways are similar to portals.

Historically, gateways have been funded by a government body and partner institutions involved. In the UK, the Joint Information Systems Committee (JISC) of Higher Education Funding Councils has provided financial backing to the development of subject gateways in many disciplines. Similarly, many of the Australian subject gateways have grown out of grants from the Australian government, in particular the Research Infrastructure Equipment and Facilities programme of the Department of Education, Training & Youth Affairs (DETYA). A defining characteristic of a gateway is the quality of the resources it locates. Resources are selected and included based on a defined selection criteria. The resources are described and organised using a standard national or international classification system (metadata). The most common metadata standard being used and adapted is the Dublin Core.

This paper describes a new gateway for Australasian sources on the web in the fields of engineering and information technology. We discuss the strategies adopted and the lessons learned in the creation of a subject gateway.

## II. Objectives of the AVEL Project

The Australasian Virtual Engineering Library (AVEL) has been established with initial funding from the DETYA. Development commenced in late 1998. It is a project involving several partner insititutions who have contributed financially and in-kind to the project. The partner institutions are:

- The University of Queensland
- The University of New South Wales
- The University of Melbourne
- Queensland University of Technology
- Monash University
- The Institution of Engineers, Australia
- Distributed Systems Technology Centre
- Centre for Mining Technology and Equipment

AVEL has been working in collaboration with the National Library of Australia. The AVEL team also has strong links with EEVL. AVEL and EEVL will contribute to the development of more efficient ways of harvesting, indexing and providing access to quality information in engineering, as well as leverage off the developments of these existing groups in Europe.

The aim of AVEL is to position itself as Australasia's premier engineering and information technology gateway. The objectives of AVEL are to provide engineers and information technology (IT) professionals in universities, research organisations and industry with:

- rapid and efficient access to relevant (quality) Australian WWW based materials,
- easy means of indexing and publishing their work on the WWW,
- increased exposure of their work and R&D capacity worldwide.

The benefits of AVEL for Australian engineering and information technology (IT) research and practice are:

- improved sharing of information between industry and university researchers,
- being a partner in a global network of WWW gateways to engineering and information technology (IT) resources, and
- building national, regional and global R&D networks between universities, industry and research establishments.

Development of a formative and open relationship with the prime user communities has been crucial from the beginning of the project. Some of the strategies employed to foster such communication included presentations for the Australasian Association for Engineering Education and the Australian Council of Engineering Deans both prior to and during the formative development of AVEL. A series of focus groups with potential user groups was conducted to ensure the system was designed to respond to their needs and expectations. The focus groups addressed the following issues;

- How do engineers and IT professional locate, use and evaluate information?
- How will a virtual engineering and IT library add value to the work of the target audience?
- How can AVEL make a difference to the efficiency of research and other work carried out by the potential user community?

## III. The Organisational Structure of AVEL

AVEL is organised around a team of university librarians, engineering and information technology educators, engineers, information technology professionals, metadata experts and subject specialist librarians. The AVEL team is a distributed network of participants, geographically dispersed around Australia. A core development team, based in Brisbane, Queensland, is responsible for much of the day-to-day work of establishing AVEL. This core team liaises with the wider network of librarians and subject specialists at universities and research establishments around the country. This layered network structure is designed to facilitate steady progress while simultaneously ensuring the widest possible participation by the stakeholders in the project.

The AVEL Team works in a virtual environment which enables team members to complete their contributions to the project anywhere, anytime. Pape [5] describes a virtual team as “any task-focussed group that meets without all members necessarily being in the same room or even working at the same time”. Many of the team members are involved in AVEL in addition to their regular responsibilities at their institutions so this flexibility is important. For example, the core development team consists of two senior engineering researchers, a metadata/Internet specialist, four library/information experts, and the project coordinator. For all, except the project coordinator, the contribution to the project is part of an in-kind arrangement with their respective organisations. Time must be found within their “normal” duties to contribute to the project.

The development and sustainability of a collaborative working relationship between geographically dispersed partners has been a key to AVEL's success. This was facilitated through the strategic use of phone, email, and WWW discussion groups, complemented by limited face-to-face meetings. Working with a variety of virtual media results in team members being more creative, more productive and better able to meet the challenges of the project.

Achieving a level of transparency and visibility was a key enabling strategy, made possible via an evolving web page.

A project web site has been in existence from the beginning of AVEL. This contains all the policy documents on such things as the metadata schema, the selection criteria and instructions on how to enter metadata, the thesuarus schema and areas of responsibility. The project web page includes the minutes of Core Group Meetings (held in Brisbane), quarterly progress reports, reports on workshops and focus group sessions. During the development of possible concepts for the user interface, several variants were posted to the web for comment, feedback and suggestions.

Documents in progress are distributed and are available from the project webpage. During the initial stage of the project, the core development team drafted critical documentation and posted it to the web. The AVEL Team members physically located in other states view the documentation and suggest additions or enhancements via a discussion list. This process keeps team members up-to-date with the project in an efficient and effective manner. The webpage is the focal point for the team members. It acts as a central repository for work in progress as well as work completed. This virtual environment facilitates dynamic membership. New team members can come up to speed relatively quickly as they have access to a comprehensive history of the project, including its purpose, objectives, infrastructure, and fellow team members.

In addition to the webpage, the AVEL Team communicate via several discussion lists. Each list has a unique purpose. The first is a list for the entire AVEL partner network to distribute general news about the AVEL project. Second, a discussion list has been established for those members of the core development team to discuss issues, and generate and develop new ideas. The other discussion list is for record creators. The list provides a medium for discussion on technical issues, the suitability of the metadata schema and details about records.

The Team meets face-to-face where possible. The executive, consisting of the Chief Investigator, the Project Coordinator, and Manager Dorothy Hill Physical Sciences & Engineering Library, The University of Queensland meet to plan and look at new directions on a weekly basis. The core development team meet on a monthly basis to brainstorm new services in terms of their suitability and technical requirements. To review the progress of the project towards the end of the first year, a majority of the AVEL Team participated in a project workshop.

The Workshop was held in Brisbane and team members flew in from around the country. The aim of the AVEL Workshop was to encourage team members to become more involved in AVEL, to provide an opportunity for team members to better understand the AVEL infrastructure and their role in the project. The amount of information exchanged during the two days was significant. While the virtual environment is the only environment for an extended team network such as AVEL, the workshop revealed the importance of meeting face-to-face. After the workshop, the team dynamics shifted. Team members were more willing to raise issues and contribute to discussions.

## IV. Meeting User Expectations

The evolving relationship between developers and users drove the development of policies and processes in AVEL. A key to success was being able to manage the possible differences between the perspectives, needs and expectations of the complementary communities involved in AVEL: the librarians who were creating it and the engineers and IT professionals who would use it. Focus groups and in-depth interviews were conducted with engineering researchers at the University of Queensland and with a group of engineers working in industry.

It was found that engineers feel unable to discriminate and distinguish useful information suitable to their needs among millions of individual documents in the ever-increasing volume of information available through digital networks. Information overload has become a real issue for engineers. As engineering discipline moves towards linking with inter-disciplinary areas, both problem solving and keeping current are becoming difficult. Many engineers are now working in areas with environmental, social, biological, health, economical, financial, political and IT implications. Relying on one's personal networks and colleagues will cease to be sufficient in the long term.

Focus group sessions with academic staff and postgraduate students from the School of Engineering and IT at the University of Queensland were held to determine the information seeking needs of the target audience of AVEL and then accommodate these needs within the gateway. The groups stated the importance of locating expertise and contact information for colleagues. They claimed that a critical component of engineering research was keeping up-to-date with breakthroughs and the discoveries of groups undertaking similar research.

Two more focus group session were held by The University of Queensland Library to determine the information needs of high achieving research staff who are at early stages of their careers and their post-graduate students. These researchers stated that they felt overwhelmed by the amount of information available and needed to locate reliable information in an efficient and personalized manner.

These focus group sessions were complemented by a series of workshops held at the Australasian Association for Engineering Education annual conference in 1999. These workshops gave delegates an opportunity to trial a beta version of AVEL. As potential users of AVEL, they provided much valuable feedback and ideas on how to enhance and improve the system.

As most of these focus groups, and workshops were held during the formative stages of AVEL, this also gave us the opportunity to get feedback on prototype versions of the user interface; the home page and the search screens. Through a process of trial and evaluation, a simple opening screen with limited graphics was chosen to minimize bandwidth requirements for accessing the system.

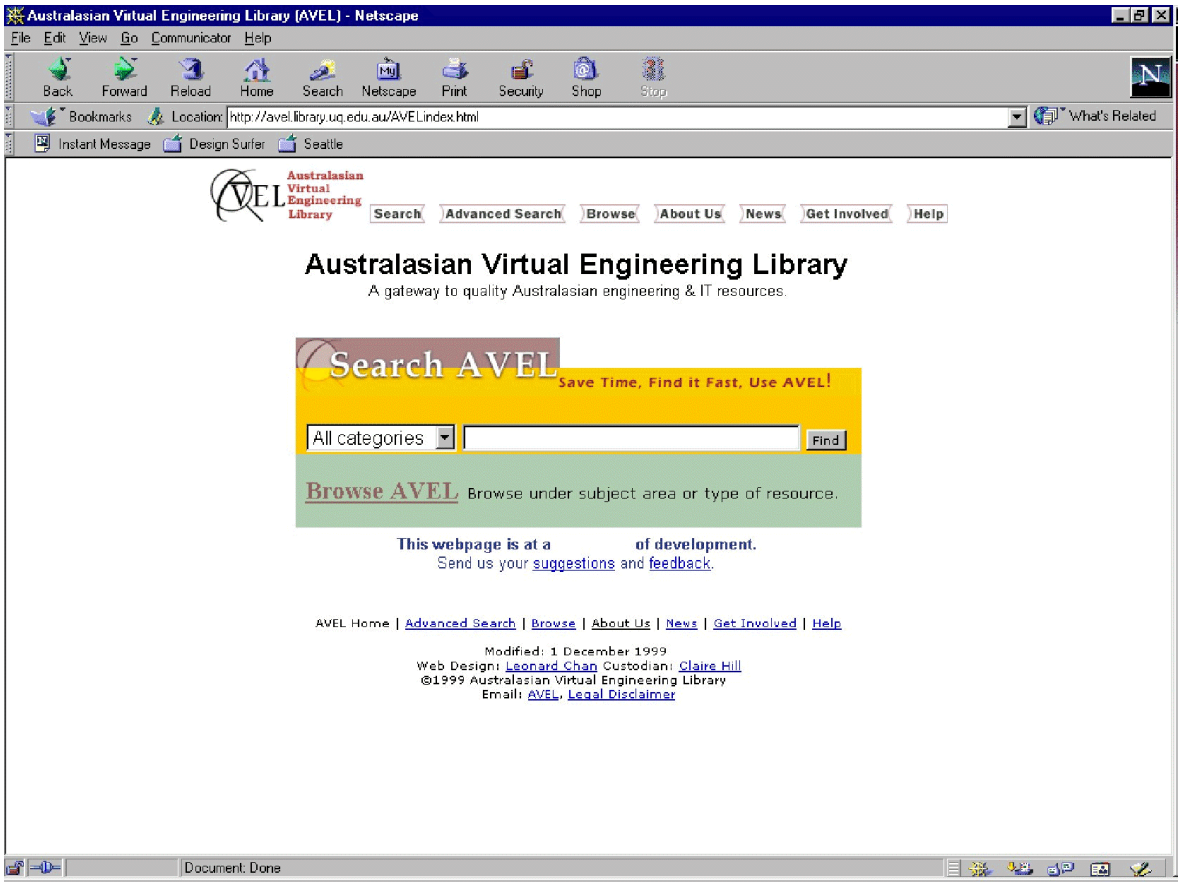


Figure 1 AVEL Search Screen

## V. AVEL database and Metadata

Subject gateways rely on metadata to index resources. In essence metadata is a "structured set of data which describes the key defining characteristics of a resource". [6] This might include the tile of the resource, who created it, when it was created, where it is located, its format, and so on. Metadata can be applied in a number of ways. Currently the AVEL Team is creating metadata records from scratch. Some webmasters include metadata within the coding of their sites. The existence of comprehensive metadata within a site enables it to be catalogued and indexed in a quasi-automatic fashion. By having sufficient and appropriate metadata available within a site, web robots (programs that trawl the WWW searching for documents that match particular values in a set of search fields) can more effectively locate relevant information. This information harvesting is only as good as the descriptions in the original documents.

The field of metadata is still in a state of flux. While some standards (e.g. Dublin Core) have emerged, this field is rapidly changing. Other creators of national or subject gateways are creating new databases while simultaneously working on related metadata problems. For example the eLib Project in the UK which includes EEVL (Edinburgh Engineering Virtual

Library) has ROADS (Resource Organisation and Discovery in Subject-based services). The DESIRE Project in the EU which includes EELS (Engineering Electronic Library, Sweden) is partnering with ROADS to run WP3 (Work Page 3) a program concerned with resource discovery and indexing issues.

AVEL is based on Dublin Core and consists of nineteen elements. Dublin Core elements supported by AVEL are as follows;

| | | | |
|---|---|---|---|
| DC.Identifier | DC.Title | DC.Creator | DC.Subject |
| DC.Description | DC.Publisher | DC.Contributor | DC.Date |
| DC.Type | DC.Format | DC.Language | DC.Coverage |
| DC.Relation | DC.Rights | | |

In addition AVEL supports the AGLS element, AGLS.Availability and the EDNA element EdNA.Review. These elements act as fields within the record and can be searched similar to the fields in a traditional database. The metedata elements are also used to organise a browse facility and to offer tailored services.

In addition to resource specific data, administrative metadata is useful to designate information about the creation and availability of other sets of metadata. The objective of administrative data is to provide simple authentication to verify the integrity and provenance of information retrieved from networked resources. These elements are utilised to associate date and creator information about metadata. It is important to recognise that they are a "container" metadata element set as opposed to a "content" metadata element set - its purpose is to describe metadata instances. These elements can be used by systems and users to determine the currency of metadata, expired metadata, and how to contact creators of metadata.

AC.Creator AC.DateCreated AVEL.Comments

Ideally, metadata should be created using a purpose-built tool, so that cataloguers need not be concerned with the syntax of the metadata. The AVEL Project has chosen Reg, the metadata creation tool developed by the Distributed Systems Technology Centre (DSTC) at the University of Queensland. It has been customised to include all the elements supported by the AVEL Project. The software facilitates metadata entry into an online form, a database repository, and interface for searching/browsing database records. As discussed above, metadata allows for web-base resources to be organised. Its application is similar to the traditional process of cataloguing a book. The difference, in the AVEL context, is that the HotMeta software allows AVEL Team members to catalogue web-based resources from their desktops around Australia. This distributed cataloguing provides a means of rapidly populating the database.

## VI. Resource Selection and Classification in AVEL

Subject librarians and engineers from all participating AVEL institutions use a set of selection criteria to identify and select the resources. When resources are investigated for inclusion in AVEL, a number of criteria are considered including:

- information content (Does the content fall into AVEL's areas of interest?),
- provenance (Who is the owner of the information),
- authority (Does the information come from a reputable source?),
- usability (Is there online help? or contact details?)
- durability (Will the information date quickly and only of transient interest?),
- reliability of access (Is the method of access commonly available? Is access restricted?)
- uniqueness within the context of the overall collection.

Resources that meet these criteria are then described using the DC metadata elements and entered in the database for discovery. A periodic review is done of resources to ensure that the items are still meeting the selection criteria. Items which are out of date, inappropriate, strictly local in context or are no longer available are filtered out.

Geographic areas covered in order of emphasis are (a) Australia, (b) New Zealand and Papua New Guinea and (c) other parts of the Asia Pacific region. The core fields covered include Engineering, Information Technology, and the Built Environment with an emphasis on major areas of research by participating institutions.

These core fields include the following subject areas: Bioengineering, biomedical engineering, chemical engineering, civil engineering, electrical, electronic and computer/software engineering, engineering general, engineering design, environmental engineering, information technology, mechanical and manufacturing engineering, materials engineering, petroleum and offshore engineering, mining engineering, minerals processing and metallurgical engineering

The types of materials included in AVEL are:- engineering publications, databases, research projects, theses, technical reports, electronic journals, pre-prints, technical data, physical property data, software, patents, standards, directories, conferences, online teaching modules, product information, companies, research centres and laboratories, educational institutions, professional associations and societies, government departments, newsgroups, links to library catalogues, links to document delivery services, links to printed resources

The subject area(s) used to describe each resource in AVEL is selected from a controlled thesaurus. The use of thesauri has many benefits for information description and discovery. Thesauri have an important part in the application of consistent AVEL Metadata. A subject thesaurus captures the intellectual content of a resource - what the resource is about. A function thesaurus captures the role of the resource - what business activity the resource relates to.

Initially we used the thesaurus from EEVL, in part so that records in AVEL would be compatible with those in EEVL, to facilitate possible cross-searching between the two databases. However due to the different coverages of the two gateways (AVEL includes a strong IT resource component), it was decided to create an AVEL thesaurus. The AVEL thesaurus is an amalgamation of the EI thesaurus for engineering and the ACM (American Computing Machinery) thesaurus for computer science and IT.

## VII. Future Directions

Collaborative technologies assist knowledge-sharing and re-use of information as they provide a sophisticated means of communication "not just a mechanism for exchange of information (such as email), but a mechanism for creating a knowledge repository and a mechanism for accessing a knowledge repository". [7] AVEL may look to implementing this kind of technology in the future to bring the participation of individual team members to a new level.

The vision for AVEL is to develop it into an Integrated Resources Network (Figure 2). This will combine support for searching across multiple gateways, with an educational component to assist in information problem solving.

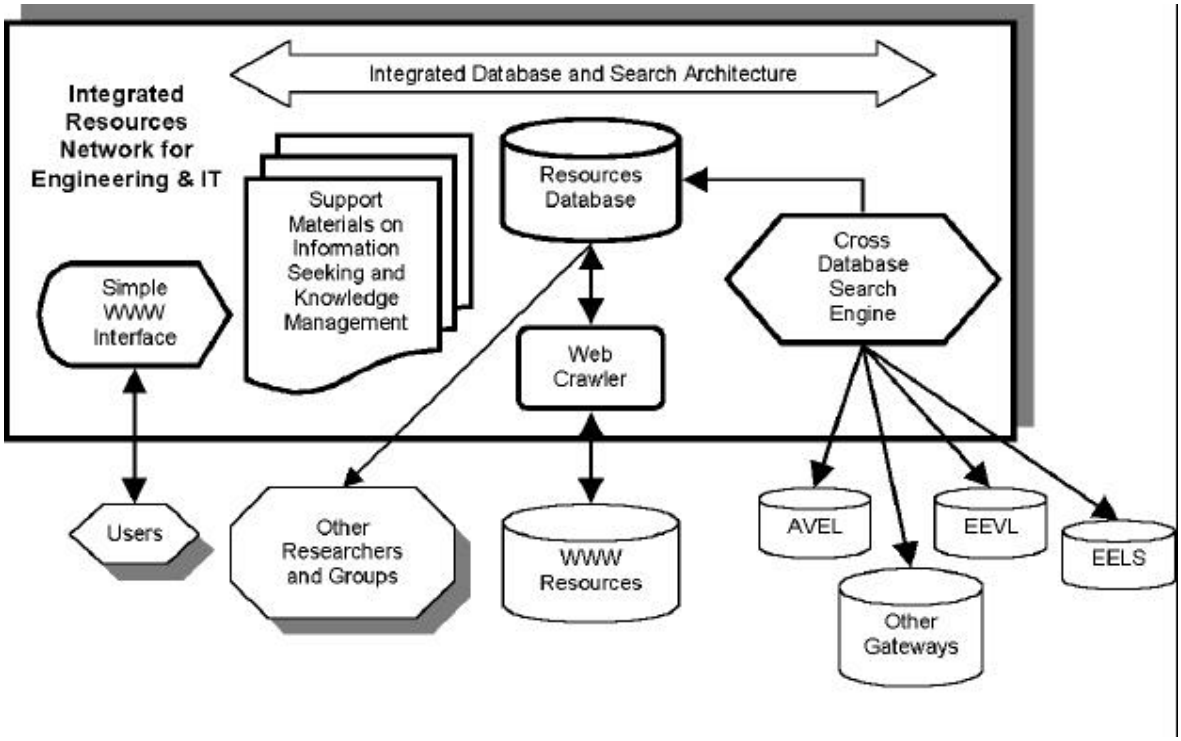


Figure 2 Proposed Integrated Resources Network (IRN)

This unique combination will benefit users by improving their ability to discover, locate, select, manage and use information, from a wide variety of global resources. This extended capability will improve the balance between analysis and synthesis of information vis-a-vis locating it and keeping abreast of emergent resource types and search strategies

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Claire Hill is currently the Project Coordinator for AVEL (Australasian Virtual Engineering Library). For the past 2 years she has been working at the Dorothy Hill Physical Sciences & Engineering Library, The University of Queensland. Claire has been involved in many projects to support research and teaching for the engineering departments at the University of Queensland. She created a web-based instructional course, using WebCT for all first year engineering students. The evaluation of these classes within an action research framework was a focus of her study towards a Master of Information Technology. In 1999, Claire was awarded the Peake Prize 1999 for her paper outlining practical applications of information technology for libraries and kindred institutions.