

CONNET: A GATEWAY TO EUROPE'S CONSTRUCTION INFORMATION

R. Amor¹, Z. Turk², J. Hyvarinen³, and C. Finne⁴

1 Building Research Establishment, Watford, UK

2 University of Ljubljana, Ljubljana, Slovenia

3 VTT Building Technology, Espoo, Finland

4 Building Information Institute, Helsinki, Finland

ABSTRACT: The EC funded project CONNET (Construction Information Service Network, at <http://www.connet.org/>) has developed a set of Internet-based information services. These services are linked through a demonstration European gateway for the construction industry which provides a "virtual technology park", accessible to the whole industry regardless of national boundaries. The gateway provides mechanisms to link all information services for the construction industry, and to establish national gateways to services which can then inter-operate across Europe. The CONNET consortium is moving to establish the existing services in all European nations, and to encourage further existing or planned information services to be linked.

This paper describes the infrastructure which has been developed for the European gateway and the benefits it can offer to linked services within a single nation, or across Europe. The virtual technology park infrastructure developed in CONNET provides for user identification, centralised user profiling and profile management, automated and periodic user profile servicing, classification system management and mapping, discussion groups, secure communication and service validation, etc. The way in which these technology park services are able to be used and adapted in independent, but linked, national services is highlighted in the paper. The five individual services are also described briefly, highlighting the benefits they offer to the European construction industry and the possibilities they offer in terms of ensuring national services are inter-operable across all of Europe.

KEYWORDS: Internet gateway, information services, technology transfer, virtual technology park.

1. INTRODUCTION

The construction industry plays a very important role in the economic well-being of the European Union, representing approximately 11% of Community GDP in 1996. In spite of a slow-down in the rate of increase of productivity, the construction industry remains the largest industrial sector in the Community, ahead of the foodstuffs and chemicals industries, and it is crucial in producing investment goods. Construction is the largest sector in terms of employment, providing jobs for 8.8 million people (7% of the working population), and gives rise to 2.5 million construction-related jobs, and 14.3 million other service sector jobs.

However, the structure of the construction sector provides unique challenges. Chief among these is the size of the industry. The construction industry is also perhaps the most geographically diverse industry, and one which involves a very large number of small to medium sized enterprises (SMEs). EC figures show that of the 2 million construction companies in Europe, 97% have less than 20 employees, and 93% have less than 10.

The industry is also very challenging, due to the diverse nature of participants. The range of professionals on a project can easily cover a dozen disciplines, from architecture,



engineering, construction through to facility management and demolition, all with very different information requirements. The training industry participants receive ranges from professional degrees, through to a very limited amount of formal training for many construction workers with. Yet any change in the industry can impact on a wide range of these industry participants. For example, the introduction of a new material may require changes in the construction process which need to be communicated to architects, engineers, facility managers as well as construction labourers responsible for the practical work.

1.1 Background to the project

The construction industry is perceived as being slow in its uptake of new technology and new processes. Certainly in the IT world this is borne out by recent surveys where IT spend per employee per year in construction (£453, ComputerWeekly 1999) is the lowest of any industry, and is considerably lower than the average (£2016). However, the use of IT is fairly high despite this, with only 1% of firms in the industry not using computers (Business and IT Survey 1999); 68% of architectural practices using CAD (AJ 1999); 57% of firms using the Internet for business (Business and IT Survey 1999).

The Internet has been identified as a major form of dissemination for the majority of research and publishing organisations in the construction industry. This results in, for example, the majority of the 220 construction-related publishers in the UK having their own web sites. However, there is no unifying system to tie these sites together and offer their resources to the industry. The use of global Internet search engines provides little help, with extraneous and low quality information being returned along with the important information. Recent analysis also shows that the best search engine only covers 16% of the Internet's estimated 800 million publicly indexable web pages (Lawrence and Giles 1999). The top 11 search engines together cover approximately 42% of the total, so are in no way comprehensive.

These aspects make the construction industry ideally suited to the provision of Internet-based, quality, information gateways. The European Technology Transfer Network (ETTN) as proposed by the EC (ETTN 1999) funded the CONNET project to perform this task for construction industries. There have been other EC initiatives in this area (e.g., GENIAL 1999, Leonard et al. 1998, SCENIC 1999), however, they have not yet led to commercially available infrastructures. The CONNET project was tasked with delivering commercially viable services at the end of its 12 month contract. These services, and the CONNET gateway, are described in detail in the remainder of this paper.

2. CONNET

The CONNET (Construction Information Service Network) project (Turk and Amor 2000) was established to encourage technology transfer among built environment industries. Quality information services were set up, which could be nationalised and inter-linked. These services were supported by CONNET-based user functions, such as automated notification of new information in a user's area of interest. The CONNET gateway and the five services which have been established initially are described briefly in this section.

2.1 CONNET gateways

The CONNET gateway provides services at two separate levels. The visible level is as an Internet-based gateway to European information sources. This is the interface for those in the built environment industries, allowing them to identify services across Europe, to navigate to them, to ask questions across any linked services, or to access the CONNET helpdesk, their user profiles, discussion fora, and technology observatory links. The less visible level is as the 'virtual technology park' for services, providing an inter-linking node and functions of

benefit to European information services. This level provides an API (application protocol interface) to classification tools, user profile services, service locations, etc. The range of services at the gateway level is further described in Section 3 of this paper.

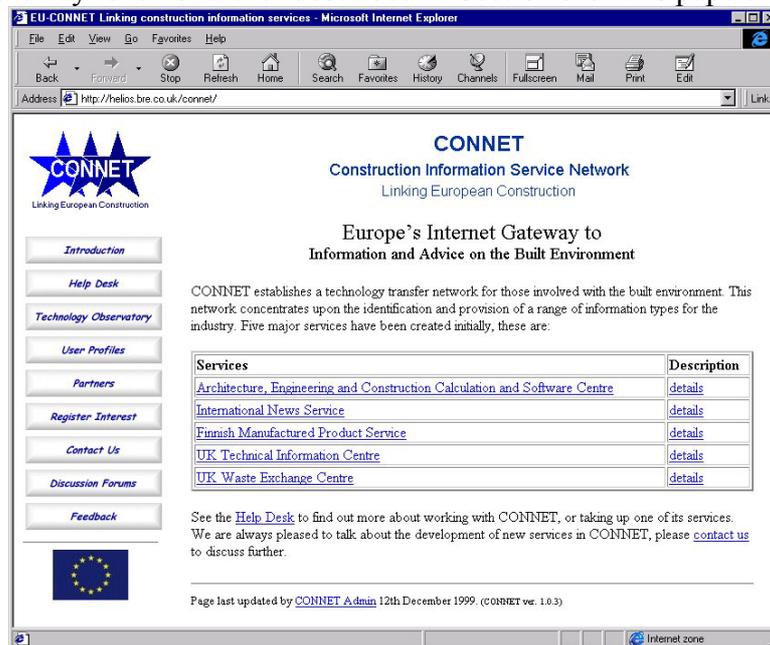


Figure 1. The CONNET Gateway

2.2 Information services

Attached to the CONNET gateway are the suite of five Internet based services which have initially been developed, comprising a technical information centre; a waste exchange centre; manufactured product services; a calculation and software centre; and an electronic news service.

2.2.1 Technical Information Centre

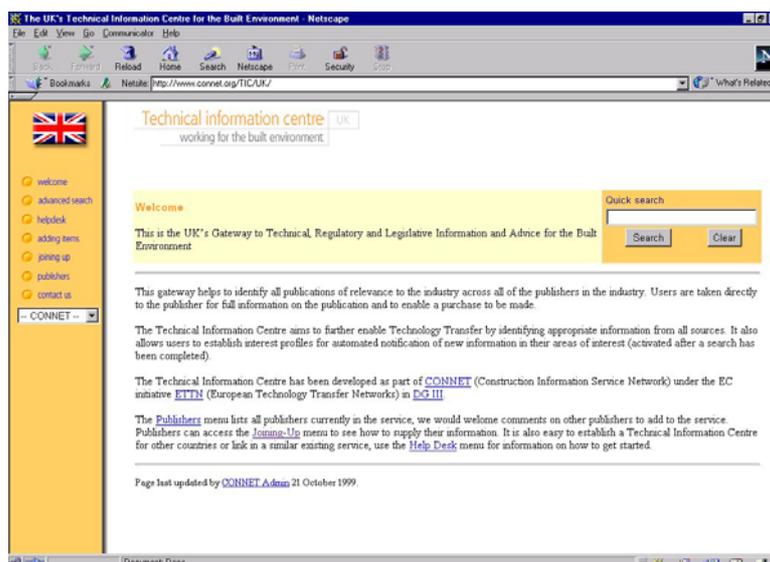


Figure 2. The Technical Information Centre

The Technical Information Centre (see <http://www.connet.org/TIC/UK/> or Amor and Hutchison 2000) provides a gateway to technical, regulatory and legislative information and advice on the built environment. This gateway helps to identify all publications of relevance

to the industry across all of the publishers in the industry. Currently 20 of the major UK publishers are linked in, with another 200 (mostly minor) publishers identified to bring into the system in the future. The system provides a quick search across all publication information, or a more detailed search against specific fields. The CONNET thesaurus tool is integrated to enable search terms to be expanded to cover associated terms. The service provides on-line access for publishers to enter their information (password controlled), or a manual method for handling large files of publications from a publisher's database. Links with CONNET enable users to store any number of their searches to be periodically checked automatically and results sent by email. Users can also route search requests to other CONNET information services (activated after a search has been completed).

There are over 25,000 publications in the system, comprising the complete set of publications from 20 major UK (and one Dutch) publishers. The centre aims to further enable technology transfer by identifying appropriate information from all sources. Users are taken directly to the publisher for full information on the publication and to enable a purchase to be made. Users can establish interest profiles for automated notification of new information in their areas of interest. The commercial business plan for this centre will see a full E-Commerce interface launched at the end of March 2000, allowing any publication to be purchased from the system, with the publisher fulfilling the actual order to the customer.

2.2.2 Waste Exchange Centre

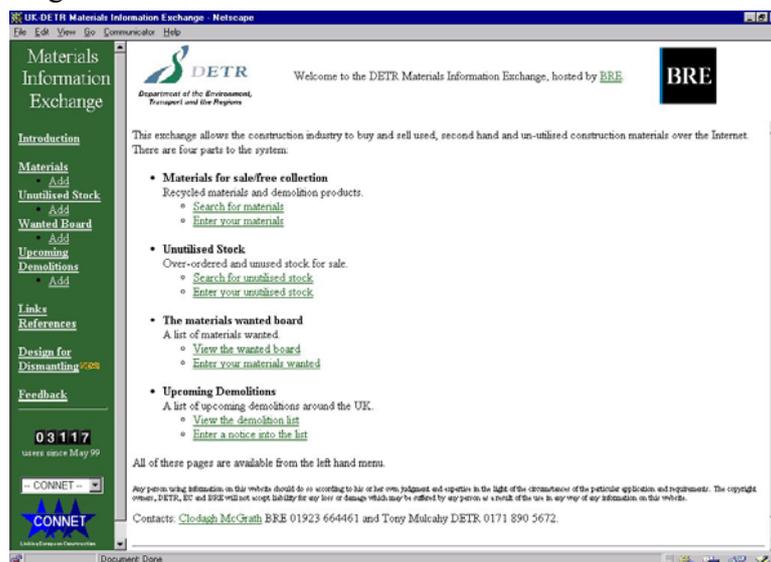


Figure 3. The Waste Exchange Centre

The Waste Exchange Centre (<http://www.connet.org/WEC/UK/>) provides a trading post for second hand and unutilised construction materials over the Internet. The Waste Exchange Centre is established in a national context (as required by EC restrictions on transport of waste across national borders), though it can also be tailored for an individual organisation's internal trading with links through to the national system. The Waste Exchange Centre allows the identification of sources of materials based on their type, the location available, and the period available. Contact details enable sellers and potential buyers to come together. Construction firms looking for a particular type of material can also advertise their requirements through the exchange. The Centre can be tailored for various regions in a country and for differing types of waste through the adaptation of location and waste-type tables inside the system. The major categories of waste and excess material which are handled by the exchange are:

- Recycled materials and demolition products

- Over-ordered and unused stock
- Materials wanted
- Upcoming demolitions

2.2.3 Manufactured Product Service



Figure 4. The Manufactured Product Service

The Finnish Manufactured Product Service (<http://www.connet.org/MPS/Finland/>), provides information about building materials and products manufactured in Finland available for the export market. These are classified according to the Finnish product classification "Construction 90", and are searchable by the name of the product or the manufacturer, and also by the properties of the product (e.g., find doors that are 1000 mm wide).

The service uses a Construction 90 classification tree to allow users to navigate to the product group they are interested in. Clicking on the appropriate group produces a search frame listing all products in that group, and presents the user with a choice to search the products by any property or combination of properties that have been used in the group.

As a result, the user gets a list of all the products in that group that meet the search criteria. Clicking on the name of the product opens up links to further information, e.g. the corresponding RT-net product sheet. The product sheet can present detailed information about the product, and there is more information in the attached PDF version of the original RT-document. Other files may also be attached, such as picture files, text documents or CAD drawings.

The database consists of some 17,000 products and 2,500 manufacturers, and includes the classification of the product and contact information for the manufacturer/distributor. A tool has been developed to ease the manufacturers' process of entering manufactured product data into the system. BII has started populating the service with data captured from product sheets and the BII Manufactured Products database. All data will be entered by BII (not directly by manufacturers) to ensure the integrity of the data.

A new service for the Finnish home market, based on the same technology, will be implemented during the year 2000.

2.2.4 Calculation and Software Centre

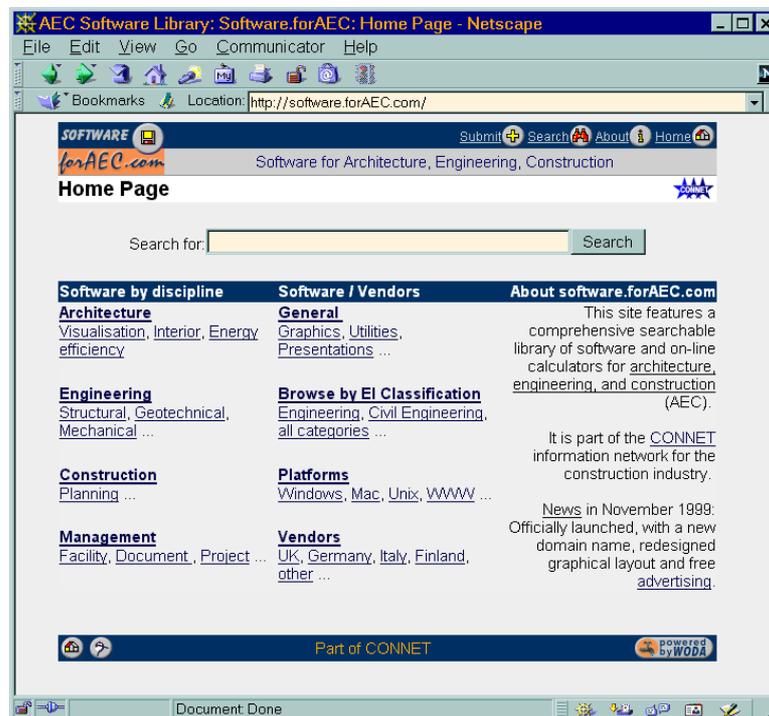


Figure 5. The Calculation and Software Centre

The Calculation and Software Centre (see <http://www.connet.org/CSC/CivilEng/> or Turk and Cerovsek 2000) for Architecture, Engineering and Construction provides a comprehensive library of commercial and freely available software from throughout the world. This covers approximately 4000 items of software that can be purchased, downloaded or even used on-line, drawn from over 1500 software producers.

To develop the service, two studies were conducted. The first looked at the technology and knowledge-base related to services similar to the one planned in the Calculation and Software Centre, i.e., standards for meta-data on the Internet, inter-information server communication technologies, robots, spiders and database technologies. The second study looked at the state of the art in the field, and critically examined similar services on the Internet. On top of this, both standard and proprietary classification and keyword systems were implemented.

The main development for this service was the creation of robots and agents to scan various A/E/C software-related information sources on the Internet, and consolidate the data gathered into a unified data structure. Some 3000 pieces of software from over 1000 vendors were discovered. This was largely done automatically. A substantial effort followed, to check the data manually and retrieve missing data from the Web. In particular, contact addresses of vendors were sought so that they could be contacted by users.

The information was set up as a Web service, implemented using the WODA database platform. End user and information provider interfaces, password protection, security etc. were also set up.

2.2.5 News Service

The News Service (see <http://www.connet.org/NS/Intl/> or Amor et al. 2000) provides a searchable index of the contents of Internet sites relevant to the built environment. The News Service is a continuously updated collection of web sites for commercial organisations in construction, including sites from the UK and other English-language sites around the world.

Over 19,000 sites are indexed in detail. To provide the greatest range of sites for the built environment, the News Service utilises the lists collated by a wide range of more domain-specific indexes already on the web (e.g., EEVL, CEL, Yahoo). This allows the News Service to provide a more comprehensive index for the whole industry. The News Service collates sites, which are then classified as to the type of information they contain, the type of organisation which provides the information (quality measure), as well as keywords about the site.

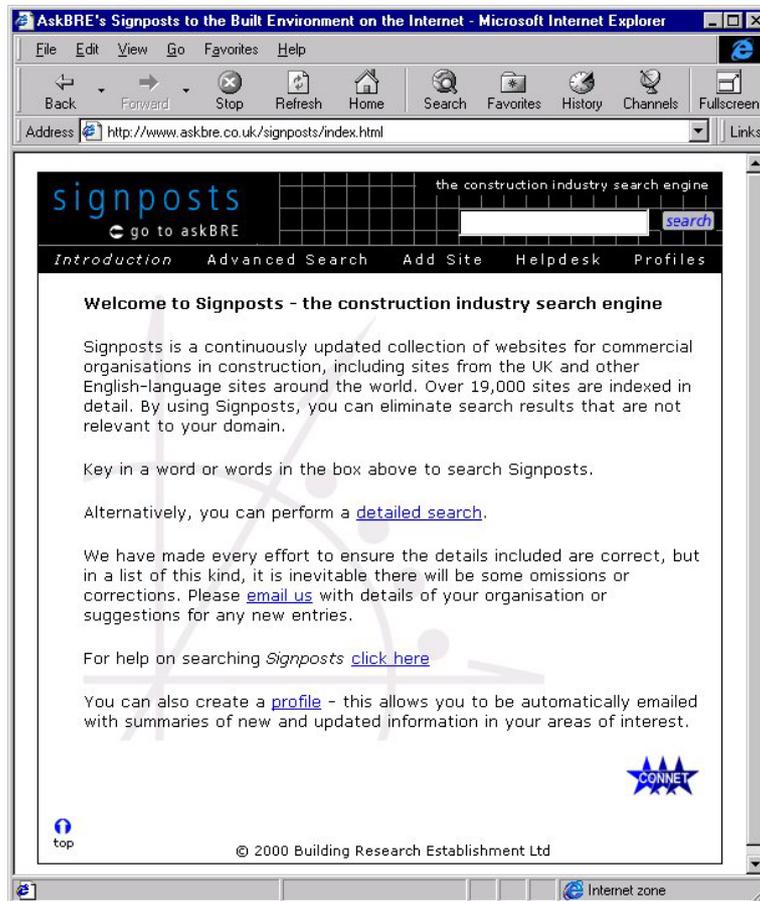


Figure 6. The New Service

The service is fully integrated with CONNET tools, utilising the thesaurus to expand user searches, as well as the user profile system to enable search profiles to be stored and periodically run automatically to inform users of news in their areas of interest. New sites are added daily to the service, increasing its coverage.

3. INFRASTRUCTURE SERVICES

CONNET provides a range of services, the majority of which are invisible to users, which, in total, are equivalent to the infrastructure services one would expect when taking a place in a physical technology park context. The five services linked into the CONNET gateway to date all utilise the provided infrastructure to some extent. The technical information centre, for example, has the highest use of the infrastructure with discussion fora being the only technology park service not linked to provide its information service. CONNET has developed with the aim of providing the core infrastructure services that could be used by any linked information service. The following section provides a run-down of the services which have been provided to date.

3.1 Virtual technology park

The CONNET gateway is a 'virtual technology park', and to this extent provides a range of technology park services as well as industry specific services. The available technology park services are:

- Provision and maintenance of the required infrastructure. This manages the machinery and software provided for the CONNET services. It ensures that the software components are usable by all potential users of CONNET as well as those offering services through CONNET.
- Management of security services. This includes installation and monitoring of security systems and ensuring that the correct level of security is available for users and service providers in CONNET. Security for services offers and utilises IP-based security between CONNET compatible services (i.e., CONNET will only respond to a known machine's request for information). This is planned to be extended to encompass certificate-based security for all services.
- Provision of a help desk. The helpdesk is a point of contact for potential service providers wishing to become involved in CONNET, giving advice on what can be achieved, in what time-frame, and at what cost. For users, the helpdesk provides a point of contact for problem resolution.
- Provision of an information broker role. This enables transparent access to information in the CONNET services. Each service draws together a single information type (e.g., technical information) from many disparate sources and makes it available through one source. CONNET draws all the services together to provide transparent access to a wide range of information types.
- Implementation and integration of the software required for the use of the services supported on the node. CONNET ensures that users can manipulate information provided through the services through the provision of software components appropriate for the task.
- Provision of a technology observatory service. CONNET provides a service which references the leading edge of technology as well as current and best practice in the construction industry.
- Management of an electronic editing service. CONNET provides tools and skills to enable the transfer of information from content providers into the formats required in the various services it offers.
- Promotion of services and contact to the user industries. CONNET provides an electronic news service to the construction industry through the use of push-technology to inform on the progress of the CONNET services as well as promoting the technology park and ETTN initiative.
- Management of a user identification system. This uniquely identifies a user who has previously interacted with any CONNET service or system. Each service requests this identification the first time they serve a page to a user of their service.
- Provision and maintenance of user profiles. There is a centralised database of all users of any CONNET service (whether registered or not). This allows any service to uniquely identify a return user and to record their usage patterns inside their service. The profiling service also allows users to record their interest in receiving information from a service (e.g., newsletters, periodic news on their areas of interest, etc). As all of a user's profiles are maintained centrally over all services it also allows them to manage all their profiles from a single point. This includes running a profile immediately, and deleting a named profile for any of the CONNET-linked services with which the user has registered their requirements. The system is structured in four parts:

1. Core information on the known user: this is personal information on name, organisation, country, occupation, how long with CONNET, profession, etc.
 2. Service-specific information for the known user: this includes e.g., for Manufactured Product Service: product group interested in; project type; location; last update of profile.
 3. User-specified interest profile for a particular service: the user's list of terms/keywords for which they wish to have notification from a service, along with notification frequency.
 4. User tracking: what the user searches for, what they open or load, what they subscribe to.
- Provision of classification code support. This is provided through a generic database of classifications (currently Building 90 and UNICLASS). This service allows navigation through a classification code hierarchy and global search for codes across a whole classification system (e.g., based on keywords). There is also a very simple code translation system between any two codes based on keywords in a code's title.
 - Provision of thesaurus tools which allow any system to find related words for a set of user-specified words; currently only in the English language.
 - Provision of standard code tables for services to incorporate. This includes the ISO tables for countries, languages, and currencies. All services are encouraged to upload their national or specialist tables in order that other services can look for similarities or re-use their systems.
 - Management of discussion fora through a database driven system. This allows new topics to be created and for either facilitated or open discussions to be held on the topic. Discussions are managed in a hierarchical response format and can be rolled up into a summary document for archival purposes.
 - Management of inter-service communication. CONNET maintains directories of all services which are linked in. This allows all comparable services to be identified and for a message to be passed from one service to another service to answer (for equivalent services in other countries or other domains).
 - Provision of across-service communication. CONNET provides services with the means to identify and send queries to other types of services which provide related information types (e.g., from technical information to software).
 - Monitoring of nodes. CONNET collects simple up-time information through an automated request mechanism for each CONNET service. Unanswered requests are notified to the CONNET helpdesk to rectify.

3.2 National gateways

The current CONNET system shows only a single gateway, all that is required for five information services. This will evolve into the European gateway as the project proceeds (see Section 4). However, the CONNET infrastructure has been established to provide a multi-level approach. This means that there is a concept of national gateway, providing information services within a single nation, but which can expand its scope to Europe through the European CONNET gateway. Each of the national gateways will provide access to their nation's services in a form best suited for that nation, including the local language(s). CONNET has been set up to allow multiple national gateways to co-exist, as many organisations may try to establish competing national services (see the UK for example). Our vision is that at least one gateway will exist to serve each nation within Europe, and they will all be able to inter-operate through the European gateway. It is assumed that national users are most likely to use one of their local gateways as their first point of call for information services, and then utilise the pan-European functionality provided through CONNET to

broaden searches as required. The whole CONNET infrastructure (as described in Section 3.1) is available to establish distinct national gateways, and will be licensed to interested parties.

3.3 European gateway

This gateway will provide the top level navigation point for European users wishing to identify their national service(s), or to dispatch questions to all of the European gateways to pass to their connected information services. Its main function, however, will be to provide the inter-operation between services in different nations which are fielding user queries across Europe.

4. FUTURE WORK IN I-SEEC

An extended consortium has succeeded in winning an EC funded project called I-SEEC (Information Services to Enable European Construction Enterprises) running in the financial year 2000/01. The I-SEEC project has partners in seven European countries (UK, Spain, Italy, The Netherlands, Finland, Iceland, and Slovenia) to ensure European take-up. I-SEEC aims to enhance the CONNET system by expanding the virtual technology park for construction, by Europeanising the services that already exist, and by adding a number of services which may already exist (though are not electronically accessible), or which are currently being developed by organisations located in EU member states or associate states. There are three main aspects to this project: it will further Europeanise all current CONNET services (including adaptation for new technologies and inclusion of further user functionality); it will create at least three new services; and it will offer greater classification and language support for European Internet construction initiatives. The details of the three main aspects are:

4.1 Europeanise CONNET

CONNET, in its current form, provides a demonstration of linkages between a small suite of viable information services. However, many of them are national in focus, and it can not be claimed that CONNET provides a true European suite of services. The aim of this part of the I-SEEC project is to identify existing national services, or encourage the establishment of national services, which are comparable to four of the five services currently in CONNET (excluding the manufactured product service). This will aim for the provision of the same quality information services in all European nations.

4.2 New services

Three further information services will be sourced or established for the nations taking part. The three services to be added in the next year are:

- Who's who in construction for individual European nations. This will identify the most important organisations within a nation, and linking through to them to provide contacts in terms of the professionals with services to offer.
- Equipment suppliers and specialist facilities of various nations. This will identify unique facilities across Europe (e.g., strong floored test facilities), and the purveyors of specialist services to the industry (e.g., large scale VR facilities).
- National Best Practice initiatives. These will be identified and linked. This reflects the fact that best practice is applicable in any European country and the resources identified by these initiatives (e.g., site visits and guides) will be of benefit across Europe.

4.3 New infrastructure

As national CONNET gateways and services are established there will be a greater requirement on the CONNET infrastructure in terms of support for national foci. No perfect

solutions exist for many language problems, but some simple approaches will provide a starting point for national interoperability. The following infrastructure extensions are planned:

- Classification tool extensions to allow multiple language variants of classification codes to be loaded along with thesauri for different languages. The current cross-classification mapping will be extended to allow across language mapping as well.
- Multiple language support at the level of queries across European services. This will look at simple translation tools to allow search terms to be moved from one language base to another. The EC's online EuroDic tool is seen as a potential candidate to support this functionality (<http://eurodic.ip.lu/cgi-bin/edicbin/EuroDicWWW.pl>).

ACKNOWLEDGEMENTS

The authors would like to acknowledge the financial support of the EC, under the ETTN (European Technology Transfer Networks) initiative, in the development of this service.

REFERENCES

- AJ (1999). CAD's model performance, *The Architects' Journal*, 12/19 August, pp. 45.
- Amor, R. and Hutchison, A. (2000). The UK Technical Information Centre, Proceedings of the UK National Conference on Objects and Integration, Watford, UK, 13-14 March, pp. 74-83.
- Amor, R., Marsh, R. and Hutchison, A. (2000). Electronic News Service for the European Construction Industry, accepted for presentation at Construction Information Technology 2000, CIB W78, Reykjavik, Iceland, 28-30 June.
- Business and IT Survey (1999). Business and IT Survey 1998/9, The Chartered Institute of Building, UK.
- ComputerWeekly (1999). Key Associates IT Spend Report 1999, Computer Weekly, UK, 9 September, pp. 24-28.
- ETTN (1999). European Technology Transfer Network, EC, <http://etttn.jrc.it/>.
- GENIAL (1999). Global Engineering Networks: Intelligent Access Libraries, <http://www.gen.uni-paderborn.de/GENIAL/>.
- Lawrence, S. and Giles, C.L. (1999). Accessibility of Information on the Web, *Nature*, No. 6740, July 8, pp.107-109.
- Leonard, C.D., Radeke, E., Buckley, E., Carpentier, G., Debras, P., Kesteloot, P., Salminen, V., Schurmann, F.G. and Seifert, L. (1998). Global Engineering Networking Intelligent Access Libraries – a construction company's perspective, Proceedings of the 2nd European Conference on Product and Process Modelling, Watford, UK, 19-21 October, pp. 317-326.
- SCENIC (1999). Website, <http://scenic-europe.cstb.fr/>.
- Turk, Z. and Amor, R. (2000). Architectural foundations of a construction information network, *International Journal of Construction Information Technology*, 7(2), pp. 85-97.
- Turk, Z. and Cerovsek, T. (2000). CONNET Software Centre: A Section of the Construction Technology Park, accepted for presentation at the 8th International Conference on Computing in Civil and Building Engineering, Stanford, USA, 14-17 August.