

THE UK INDUSTRY KNOWLEDGE BASE FEASIBILITY STUDY

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ABSTRACT: The UK Department of the Environment (DOE) has funded a feasibility study into the concept of an electronic knowledge base for the construction industry. It is envisaged that this knowledge base would provide a single point of entry for the UK, creating a gateway to all information of relevance to the A/E/C industry. A wide range of commercial, social and technical issues have been investigated in the study, which provides a recommendation of the best way forward together with a marketing strategy. The results of the feasibility study are summarised in this paper.

KEYWORDS: Internet, knowledge base, gateway, feasibility study.

1. INTRODUCTION

There has been a high level of enthusiasm for making construction-related information available electronically. Most research establishments provide electronic information about their work and often publish the results of projects electronically. Manufacturers are very keen to put up electronic information about their products, seeing it as a new medium for advertising. Information providers also see a way of reaching a wider audience with their information (codes, standards, etc.) or of targeting more specialised audiences with relevant portions of their information.

However, there is little coordinated effort between the large number of institutions putting up information. This leads to a situation where there are many partial and overlapping collections of information which must be searched, through different search mechanisms, to ascertain whether a required piece of information is available. The notion of a construction industry gateway (CIG) which provides a single point of entry and a single search mechanism to all the information has drawn great interest. Several commercial systems provide smaller versions of what a CIG may become, and the DOE has previously funded a CIG demonstrator (CIG 1995) on the Internet. It is expected that many institutions will see the chance of high commercial gain, or market dominance, from running such a system, and will wish to position themselves as the gateway for the UK.

The objective of the Industry Knowledge Base (IKB) is to create and exploit information and knowledge to improve the effectiveness of the building industry. Specific objectives within this overall goal are:

- To improve the quality and efficiency of buildings and building projects by sharing information on standards and best practice.
- To improve the efficiency of the construction market by improving market communications.
- To reduce the cost and improve the quality of building design by sharing design knowledge.
- To provide news and information that will enable the construction industry to compete



more effectively.

To ensure that the requirements of the industry will be fairly served by whoever sets up a CIG the DOE feasibility study also addresses the following objectives:

- To provide guidance on policy for the 'Construct IT' (Construct-IT 1995) recommended knowledge base.
- To obtain an improved understanding of the available options for an industry knowledge base and how existing initiatives meet or don't meet these new paradigms.
- To establish the technical options available to achieve a gateway to a set of distributed databases.
- To gain an understanding of the potential barriers to establishing the industry knowledge base and how these may be overcome. These will include cultural aspects, commercial aspects and technical issues.
- Develop a way forward for implementation via jointly-funded innovation projects with the DOE.
- Identify innovators and early adopters that are keen to develop and use the industry knowledge base.
- Develop a strategy to market the industry knowledge base.
- Develop an understanding of how the knowledge base might interact with the 'Construct IT' recommended integrated project database and the problems and opportunities in this area.
- Develop a plan for the production and use of knowledge base(s) of intelligent building objects.

These objectives have been addressed after surveying the three following points:

User needs: including key potential users, classifications of user groups, examining what users want and need, and determining the appropriateness of their existing systems.

Technology options: covering types of connections to services, hardware and software requirements, auxiliary equipment requirements, and means of providing secure connections and services.

Current information providers: determining who they are, their target sectors, current services offered, willingness to participate in a gateway, and incentives required to encourage participation in the gateway.

Though the way forward may seem obvious, very little research has been focused directly at the ability to provide industry specific knowledge bases. The majority of computer science research in this area has looked at the provision of services which index everything on the Internet (AltaVista 1996; Yahoo 1996), or environments for better managing the development of consistent information resources to be published on the Internet (Hyper-G 1996). Recently, research tools have become available which allow a single resource set or domain area to be indexed (Bowman et al. 1994; GILS 1994; Weider and Faltstrom 1994). However, this provides only a very low level of functionality in the final system, roughly equivalent to that found in current paper-based 'yellow pages' directories.

A few commercial ventures have set themselves up as providing an IKB for the A/E/C industry (AECNET 1996; AEC Access 1996; BIX 1996), though to date they have encompassed a very restricted set of the totality of information required in an IKB. There are two EC funded projects which are examining aspects of an IKB equivalent to the IKB as defined in this report. The Global Engineering Network project (GEN 1996) is about to attempt to establish the foundations for a similar system focused on the whole engineering community throughout Europe. The AlphaDIDO system has developed from the EU funded NEWCON project (Hutton 1994). Though this provides a framework for the provision of domain specific services, it relies upon the whole information base residing on a single system and being fully integrated into the system. This is not a possibility in the anarchic Internet world, and counter to the notions of information control and ownership held by many of today's institutions. The DOE has also funded a demonstration project (CIG 1995) to examine what could be provided to the industry currently. This demonstrator draws together global search strategies alongside the original information sources, coupled with commercial services and application interfaces, providing a taste of what an IKB could achieve.

2. PROBLEMS ON THE INFORMATION HIGHWAY

Though the amount of information available on the Internet is a minuscule proportion of the information that is currently available in paper form, or could conceivably be made available, many of the problems that will face an IKB have already manifested themselves. Several of the current problems facing those prepared to implement an IKB are detailed below:

Information Overload: There is a huge amount of information currently available, with few methods available to restrict searches to the exact topic required. For example, a naive search for departments of civil engineering with any of the major search engines will return over 300,000 resultant hits. Restricting the query to a single country, such as the UK, will reduce that number to around 70,000, still a little too much for most users. A skilled searcher using the advanced query languages offered by the current search engines would be able to further reduce this number of hits to around 70 for the UK. Though this is a searchable number for most users, it will still include many references to information not specific to a department of civil engineering. Even though you may know exactly what information you want, there is no way of getting directly to it, even if you have great expertise with the various search engines.

Domain Independent: Current search engines make no distinction between the various domains covered by their indexes. This can produce surprising results for searches for terms in very specific areas. For example, a search for information on 'lean construction' will produce many pages with very good information on previous conferences and ongoing research projects in the area. It will also find the page on 'Ladies Slim Cut Jeans and Sleeveless Chambray Shirts' which are produced utilising 'traditional lean construction'. An IKB would ensure that only information about the A/E/C domain would be returned for queries for information made through it.

Islands of Information: Though it may be possible to find all the information required about a particular topic on the Internet, it is not easy to draw together all areas of required

information into a single point. This necessitates multiple searches to obtain all required information. For example, separate sources of information on the Internet might allow the user to: find a particular product; determine whether the product has a BBA certificate; enquire about the financial health of the company; ascertain whether the company is ISO 9000 compliant; determine the proximity of the company to your work site; etc. However, there is no way to draw together all this inter-related information into a single point of access. Another example is the comparison of prices. Many companies might offer the same product for sale, but there is no simple way to determine which company will offer the cheapest price without visiting the Internet site for each sales house and hand-collating the required information.

Information Validity: Information on the Internet is not marked as to its accuracy, or the competence of the organisation which put it together. For example, there are business parks on the Internet who publish business news about the industry. However, would you trust this source to make investment decisions for your company? There is no easy method to validate the quality of information perused on the Internet or the organisation who published it.

Editorial Competence: The ability to retrieve small segments of information, in the form of pages, when searching for information loses the context in which the information would be couched if found in a paper publication. For example, finding a single news snippet on an unusual structural failure is likely to be treated differently if it is known that it was published by a major construction publisher rather than a newspaper such as 'The Sun'. However, as with the information validity, the editorial competence of the publishing organisation on the Internet is not specified, and given the small amounts of information retrieved, is not always able to be determined from its full published context.

Structure of Object Libraries: Many libraries of objects definitions are currently available. Most of the libraries comprise DXF format files, detailing the graphical representation of a specific component at a certain scale. The only way of determining the exact object and its many parameters is usually from reading the text accompanying the file with the object definition. As no industry-supported standards exist for the specification of component parameters, and no standard method of encoding this information has been adopted, even the current attempts at providing object libraries fall short of the range of information that they can encode along with the graphical object definitions. However, standard methods of encoding object parameters are being developed in this domain and the introduction of ISO STEP and IAI classes will allow many A/E/C components to be fully specified on the Internet. Indeed, examples of this technology are currently being demonstrated.

Wide Information Requirements: The range of information that would be required in an IKB is extremely broad. The obvious subjects include manufacturers' products, codes and standards, tenders, industry news, research projects, training institutes, etc. However, there are many less apparent areas which may be of use, for example, current weather data, foreign exchange rates, maps of towns and heavy traffic access routes.

Security of Information: There is a perception that the Internet is not secure and many firms would be concerned about sending sensitive information across the Internet. This is an area where

there are known solutions which can more than adequately ensure the security of any information. These techniques allow: information to be sent that can only be read by the specified recipient; the determination that a particular document has not been altered; attesting that two or more parties have agreed to the same document, etc.

Monetary Transactions: None of the current monetary transaction systems offered on the Internet are perfectly safe, though most have far higher security and fraud detection rates than paper-based technologies such as cheques. There are several initiatives undergoing investigation to enable secure monetary transactions to be enacted upon the Internet and this paper makes the assumption that this problem is solved.

3. REQUIREMENTS OF AN INDUSTRY KNOWLEDGE BASE

During the feasibility study the information requirements of the major categories of professionals and groups in the industry were surveyed. Along with this survey, the users' satisfaction with current information provision was requested. The collated comments leads to the following chart:

Importance	Satisfaction with current delivery
Standards: Very important, relevant to all users	The content is not as clear and accurate as it used to be. There are problems with electronic delivery, the electronic format is generally two months out of date in comparison to the hard copy.
Technical Information: Very important, relevant to all users	Generally very good and easy to use. Problem with keeping it up-to-date.
Best Practice Guides: Very important, mostly to contractors and consulting engineers	Problem with the very varied quality of the documents.
Manufacturers' Product Literature: Level of importance varies among user types from moderate to very important	Some improvements were made by manufacturers, producing more design and technical information.
Tender Information: Vital for contractors, less relevant for others	Delivery is satisfactory but expensive.
Case Law: Very important, relevant to all users	The search mechanisms are improving, but difficult to keep up-to-date. Calculation Methods/Services: More valuable for small practices
Journals: Very important, relevant for all users	A very good source of information(especially case studies) used by all.

Market Information and Forecasts: Needs Very costly, lack of published market vary, usually required on ad-hoc basis information.

For the IKB to work in the UK it must have the backing of the information originators as well as the support of current information resellers against whom the IKB must be seen not to compete. The attitudes of these two groups towards an IKB is detailed below, followed by user requirements.

3.1 Information Originators

The current information originators find the information available in commercial databases provided by resellers to be very limited. They consider the rekeying of published information into these databases can have a detrimental effect on the resultant quality. They also worry about the frequency with which the keyed data is updated, and the poor management of old and obsolete data. To this extent they are very interested in the possibility of an IKB through which they see a possibility to have more control over the quality of information that they produce. Most originators consider the IKB would be a complementary route to conventional publishing methods and would not be a substitute. The originators feel the following issues must be addressed by an IKB: that quality standards are ensured; that security and safety are guaranteed; that strict control is maintained; and that the gateway is managed by a neutral body that represents the information originators.

3.2 Information Resellers

Though there are only a handful of electronic information resellers, with a fairly small share of the total information market, they provide a source of experience with the problems of electronic information provision as a commercial activity. The resellers are each convinced of the merits of their own service and critical of those of their competitors. The resellers were also positive about joining an IKB, seeing the inevitability of such a service and the opportunities presented by a larger potential audience as outweighing the potential threats such as increased competition. The resellers would see the IKB mainly as marketing tool, providing a path to their services rather than making their services available through the IKB. The resellers would prefer the IKB to be a quality organisation with restricted membership to access only 'quality resellers' (there was no consensus as to who constituted the quality resellers).

3.2 User Group Requirements

When the possibilities of an IKB were described to potential users and user groups a great deal of enthusiasm was perceived. The users see an IKB as improving the quality and availability of information as well as reducing barriers to its access and being responsive to their requirements. The requirements that they currently believe the IKB to need are:

- The contents of the IKB to be quality approved
- Direct access to the actual information
- Substantially improved search mechanisms
- Substantially improved indexing of information
- The fast provision of both textual and graphical information
- The ability to incorporate IKB information directly into documents or design tools
- The provision of access to sources and services outside of the construction industry (e.g., the British Library, Company House).
- The provision of high levels of security
- The provision of pay-as-you-go charging rather than initial lump sum payments

Taking these sets of requirements into account, a series of scenarios were proposed for an IKB and

aired at meetings of interested groups for refinement. The refined proposals are described in the following section.

4. RECOMMENDATIONS ON THE WAY FORWARD

Four main options for the design of an IKB have been proposed. They are described in order of increasing sophistication below:

Standards Only: A do nothing option where no physical gateway is established. Rather, integration is attempted using Internet services and adoption of common standards. It is envisaged that information suppliers would share lists of links where there is a mutual synergy in their information services. Information providers would be encouraged to publish information utilising specified formats to enable greater automatic data extraction by user applications.

Information Signpost: A gateway is established which acts as a 'signpost' to construction information resources. The signpost would comprise addresses of information originators and resellers arranged in logical sequences. A condition of registration on the signpost could be conformance to an agreed set of standards. This option would be relatively cheap to establish and could be migrated to a more sophisticated system as needs require.

Value Added Gateway: This option would act as a real gateway to a closed user group of information originators and resellers. The closed user group would offer the user a single logon to the services paid for and would track usage to provide a single per usage charge. As each user would be registered on the gateway, it could provide additional services such as targeted news and tailored information service. A key function would be one or more classification schemes that could be used across a range of information databases, providing rapid and effective searches across several databases.

Database Host and Gateway: The gateway is able to act as a host for some of the construction information databases and has sufficient resources to act as a host for interactive services. The key aspect of the host gateway approach lies in improving all aspects of the quality, security and performance of the information delivery service. Users and suppliers would be encouraged to use the same Internet provider to reduce the problems of poor Internet performance and security problems. By hosting databases (as originals or mirrors), the host gateway can provide better network performance. The host gateway would enable niche publishers to use a shared, managed service and gain easy access to the construction information market. The information content and much of the context would remain the responsibility of the information originator or reseller.

The database host and gateway has been put forward as the preferred option for the IKB, though in consideration of the higher initial setup costs and setup time it has been recommended that a signpost should be offered initially, and extended gradually towards the database host and gateway option as required.

To gain funding from the originators and resellers three charging options were considered:

Franchise: The information originators and resellers pay a franchise for space or services or a

pointer to their site. They obtain an agreed percentage of the revenue based on a negotiated scale.

Surcharge: The information originators and resellers pay nothing initially but are subject to a higher scale of surcharge.

Purchase: The information originators and resellers sell or lease rights to their information to the gateway.

The three payment arrangements vary in the degree of risk sharing and commitment demanded. The franchise option is felt to share the risk equitably and is the preferred option.

To establish the IKB, representative bodies of the construction industry and the government have a role to play in ensuring its commercial success. The following tasks are considered essential:

- To create an industry body representing the key information originators, resellers, and users that can provide direction for the IKB.
- To ensure that the commercial and contractual arrangements for the gateway do not alienate any key sector of the industry.
- To select a technical service provider that is competent to provide this gateway service and to avoid 'reinventing the wheel'.
- To provide incentives for information originators and resellers to enter and convert data into the new systems.
- To manage the risk and provide the capital for rolling out the service based on per usage payment.

5. CONCLUSIONS

It is believed that an IKB can play a vital role in equipping the UK construction industry to compete in the UK and abroad. Business competitiveness depends increasingly on the exploitation of knowledge. The gateway will enable UK industry to realise the value of its intellectual assets. It will also stimulate the development of knowledge and learning, improve information dissemination, and support the sharing of design knowledge as object-oriented design models.

It is recommended that an IKB in the form of a database host and gateway be established. It is considered that a system providing less functionality will not be able to gain the support of the construction industry and will compare unfavourably with rival services. A well-supported information gateway will protect existing information providers from predation by large media organisations currently outside the industry. It will also ensure that the requirements of users are fully considered.

It is felt that the best way to achieve industry support is to offer per-usage access to information users and to offer revenue sharing franchises to information suppliers (originators and resellers).

A host gateway will be a significant undertaking. The best way to launch it will be as a 'signpost' system that can acquire additional functionality as it grows. The gateway should be funded by a consortium of industry shareholders.

The gateway must address existing and future industry information needs. The gateway will need a

management board that allocates resources and sets and amends its information publishing policy.

Electronic publishing is a new and difficult skill. The IKB management should appoint an existing electronic publisher who will provide the technical resources and expertise needed to make the gateway a success.

A well-planned resources marketing plan will help to ensure the success of the gateway. Even more important will be a broad spectrum of support for the gateway across the construction industry. The first task of implementation is to garner this support.

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