EXPERT SYSTEM MEETS HYPERTEXT: THE EUROPEAN CONFLICTS GUIDE

by

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Abstract:

This article describes an attempt to integrate an expert system with a hypertext database of relevant primary and secondary text materials. The domain of law represented is that of the Brussels Convention 1968. Three dimensions of system development are addressed. With regard to the legal dimension, the choice of domain and the representation of both knowledge and data are considered. On the technological dimension, the selection of software development tools and problems associated with keeping knowledge and databases up-to-date are discussed. Finally, particular attention is paid to the "Cinderella" dimension of legal expert system development: the user interface.

I. Introduction

Durham University's Centre for Law and Computing was set up in 1988 in the wake of a successful legal education software development project funded by UGC/Computer Board (Downes and Pritchard 1987). The role of the Centre is to concentrate practitioner know-how, academic knowledge and computing skills on appropriate projects. A substantial proportion of our time over the last three years has been spent on the development of rule-based legal expert systems for use both in law offices and in law schools (Widdison 1991).

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At the Fifth BILETA Conference at Warwick University in 1990 there was a split in the ranks of those interested in advanced computer applications for lawyers. Many delegates were smitten by the exciting prospects being uncovered by recent work on hypertext legal databases. Other delegates clung firmly to the belief that the future lay in legal expert system development. One lone voice was heard to claim, bravely (perhaps prophetically?) that expert system and hypertext technologies were not necessarily in competition with each other. Indeed, he suggested, they might even be complementary.

During 1991, Durham's Centre for Law and Computing busied itself exploring this hypothesis by developing a system that represented a harmonious partnership between an expert system component and a hypertext database component. We started by making a preliminary decision to work with the provisions of the Brussels Convention 1968. We then put together our research proposal and were fortunate enough to attract a grant of just under £7,500 from Durham University's Research & Initiatives Committee. The sum in question was sufficient to pay for half a research post for a period of nine months.

II. The Legal Dimension

A. Domain Selection

Having tentatively identified the Brussels Convention as a domain in which we believed we could make a useful contribution, our next step was to apply the list of thirteen selection criteria recommended by Professors Capper and Susskind (Capper and Susskind 1988) to confirm our preliminary choice. In undertaking this task, we were greatly helped by being able to follow in the footsteps of Edwards and Huntley at Strathclyde University (Edwards and Huntley 1990). The six selection criteria that convinced us that the Brussels Convention was a particularly suitable domain for expert system work are discussed below.

Firstly, Capper and Susskind recommend that system developers choose an area which is "identifiable and well-bounded". It was clear that the Brussels Convention, which comprises self-contained collections of procedural rules on choice of jurisdiction, and recognition and enforcement of civil and commercial judgments within the European Community, met this description.

Secondly, we considered whether the proposed domain was complicated enough to warrant an expert system approach. During its passage through the United Kingdom Parliament, legislators regarded the Brussels Convention, together with the Bill that enshrined it, with mixed horror and incredulity. They spoke of "this mind-boggling myriad of legal complexity", and commented that the law had the effect of "giving to the word 'complexity' a new dimension." Even the Lord Chancellor was moved to say of the Bill: "I rather feel that it should be accompanied by a Government health warning" (White and Currie 1982).

Thirdly, Capper and Susskind argue that it is advantageous to select a domain where there is a structured body of relevant knowledge already in existence, as this assists with the manageability of the project. In the case

of the Brussels Convention there is a plethora of such materials. There are not only clear, wellstructured, primary source documents and a developed body of case law, but also many official and unofficial interpretative texts. Furthermore, work had been done on encapsulating aspects of the Convention in paper-based flow charts (Mennie 1988). Finally, there had been at least one prior legal expert system project. Edwards and Huntley had built a practical system designed to apply the Convention rules on jurisdiction in a Scottish context, and we found their findings greatly assisted our work.

Fourthly, "intensive coverage of a small legal domain" is recommended. The Brussels Convention already represents a relatively small domain. We further reduced the breadth of coverage by restricting ourselves to the "hub": the Convention itself together with its Protocols and the relevant European Court of Justice case law. If we were successful in developing this hub, later projects might then tackle the "spokes": modules representing the domestic codes of rules, such as the *Civil Jurisdiction and Judgment Acts*, designed to plug the Convention into the national jurisdictions of European Community member states.

Fifthly, Capper and Susskind enjoin system developers to avoid selecting domains that contain judgmental issues. Computers are much better at calculating than judging. With humans, of course, it tends to be the reverse. Examples of judgmental issues that computers find difficult include "reasonableness", "dishonesty" and "suitable employment" (Reed 1990). Our experience had taught us that areas of legal procedure tend to involve less judgmental questions than substantive law domains. Therefore, we believed that the Brussels Convention, which is essentially a collection of rules on legal procedure, would probably not cause insurmountable problems of this type.

Finally, we turned to the question of "pay off". However labyrinthine the Brussels Convention may be, there can be no doubt that it is an area of enormous importance.

Questions on jurisdiction and the recognition and enforcement of judgments in vast areas of civil and commercial law must now be channelled through the Convention. The advent of the Single Market makes it even more essential that practitioners, academics and law students become familiar with this domain. When the Lugano Convention 1988 comes into force, a parallel regime will extend to the EFTA Member States as well. We concluded that an accurate, efficient computer-based tool in this difficult area would be of widespread benefit.

B. Knowledge Representation

"Knowledge representation" is defined as:

> "The process of reorganising, restructuring, and formalising the knowledge and expertise of a particular domain so that it can be represented as data structures within computer memory in an expert system"(Capper & Susskind 1988).

Conceptually our expert system component has a modular design. There are three major modules: jurisdiction, recognition of judgments, and enforcement of judgments, each sub-divided into a number of sub-modules. This is broadly reflected in the technological structure of the system which consists of a number of separate but interlinked knowledge bases with details of earlier answers and deductions being carried between them. The compartmentalisation of a legal domain in this way clearly raises important jurisprudential questions (Susskind 1987). Our task was made much easier in this respect, however, by the fact that the Brussels Convention, for all its complexity, is already divided into discrete segments.

We, of course, sought to make our representation of the domain accurate. However, we were also concerned to make the expert system component *efficient,* in the sense of taking the user through the least number of questions possible (Capper and Susskind 1988). In pursuit of efficiency, we paid attention to two notions. The first was the desire to "funnel" the user through the system. This involved presenting a module of more general "scope" questions before moving into the more specific, detailed modules, in order:

1. to exclude cases that fell outside the Convention; and

2. to avoid the need to spend time answering questions that were irrelevant to the consultation.

The second notion was that efficiency could be improved by altering the order in which the modules with the specific, detailed questions were asked. The order might well be determined by:

1. the knowledge that one module (such as that on exclusive jurisdiction) might lead to a definitive conclusion faster than another module (such as that on special jurisdiction); or

2. the possibility that the system might be consulted more often on one particular type of problem (jurisdiction in relation to a consumer contract) than on another type of problem (jurisdiction in relation to an insurance policy).

There are a number of expert system development techniques used by systems designers (Reed 1990). The "traditional" approach to legal expert system design has been through rule-based reasoning techniques which reduce an area of law or legal procedure to an algorithm of interconnected rules. Contrasted with these rule-based techniques are two other families of techniques. Firstly, there are case-based reasoning techniques: approaches to legal expert system development involving the attempted solution of legal problems by the automated examination of a database of relevant case law, followed by the selection of relevant authorities according to predetermined criteria.

Secondly, there are neural network techniques: approaches which involve training up a neural network system using a set of existing, test cases. During this process, the system itself learns to identify generalised patterns from the set of specific examples that it is given. The system can

then be used to recognise these patterns in new cases which are presented to it.

Rule-based approaches are easy to apply, commonly used and well developed. Both case-based and neural network techniques are at a considerably more experimental stage. Whilst rule-based methods may be unsuitable for many areas of substantive law, our chosen domain was an area of legal procedure. We felt, therefore, that there was less risk that we would do jurisprudential violence to our subject-matter by adopting a rule-based approach (Susskind 1987).

C. Data Representation

Here, we felt that the central question was whether to choose a full-text retrieval (keyword) searching technique or a hypertext technique of data representation. We had developed full-text retrieval software for use with legal text material (Downes and Pritchard 1987). We were, therefore, already familiar both with the strengths of such systems and with their weaknesses. Equations of words or phrases linked by boolean connectors to other words or phrases provides a powerful search method. It can be very dangerous, in semi- or unskilled hands, however. There are the difficulties associated with having to identify all possible synonymous expressions used by all the legislators and judges. There are the problems connected with users either being presented with unusably long citation lists full of irrelevant material, or trying to refine initial searches by introducing new search concepts and running the risk of "throwing the baby out with the bath water."

In addition to the abovementioned difficulties, full-text retrieval search techniques are completely alien to lawyers. These computer-based methods bear little resemblance to the traditional ways in which lawyers do their research. To respond that lawyers just have to learn new ways is not a satisfactory answer. There is no excuse for producing legal software whose workings are incomprehensible to users. Every effort should be made to produce, on screen, a close electronic analogy to traditional legal research tools and techniques.

For these reasons, we decided that we would look for a data representation technique that gave us enough flexibility to produce an environment that would be familiar to the legally trained user. We found such a possibility in hypertext. Hypertext is another approach to the representation of text materials in a database. It is not a new idea, but its potential for the storage of legal information is only now being fully realised by lawyers and researchers (Painter 1990) and (Wilson 1990). With hypertext, a document is presented to the user in a traditional form as a series of consecutive "pages". The document can read in the normal way, by moving forwards or backwards through the document one page at a time. Alternatively the user may skip forwards or backwards several pages at a time, or jump straight to the first or last page.

In addition, however, the user can move sideways. Every time he or she comes across a referenced item in a document, the user can select that item by clicking onto the relevant "button" in the document. He or she is then taken to the full text of the referenced item. If the user finds an

interesting reference in this second document, he or she can select the new item, and be taken to the full text of this document, and so on. When the user finds the sought-for information, or decides that a particular line of enquiry is fruitless, he or she can "collapse" the search and return to the starting point.

Hypertext techniques can also give rise to problems. Most notable is that of "hyperspaghetti" which is brought on by an excessive enthusiasm by the developer for electronic referencing. The user becomes lost in a tangle of references and begins to go round in circles. On balance, though, and inspired by recent Australian work in this area (Greenleaf Mowbray and Tyree 1991), we felt that a restrained application of the hypertext data representation technique would probably produce useful results.

III. The Technological Dimension

A. Choice of Expert System Development Software

We never envisaged building our own expert system development software. That was not the nature of our project. In terms of off-the-peg software, one package stood out as an obvious candidate for consideration. A number of expert systems including Capper and Susskind's *Latent Damage Adviser* and Edwards and Huntley's *Civil Jurisdictional Adviser* have been constructed using Intelligent Environment's *Crystal.* System compatibility is, of course, a major virtue in its own right. Much of our earlier work, including *The EC Competition Adviser* (Widdison and Pritchard 1990) was constructed using *Crystal.* So, by this stage, we were very familiar with the package. Our prior experience enabled us to confirm the claims made by Edwards and Huntley that the software made rule-based expert systems easy to construct and alter, and that it was particularly suitable for modularisation. As to modularisation, the ability to export the values of variables to a separate file makes it possible to conceive of each legal module as a small, discrete file in its own right. The developer can thus divide the actual assembly of the expert system into two clear stages:

1. the construction of a suite of small knowledge bases each accurately representing a single domain module; and

2. the development of appropriate pathways to link up these individual knowledge bases.

Although we were not particularly impressed by *Crystal's* rather rigid standard menu screens and help/explain facilities, we had long since been used to going behind these standard features. As a programming environment, *Crystal* does provide an easy-to-use and flexible tool which enables the developer to obtain working results quickly. Finally, *Crystal* provides some facilities for interfacing with other applications software and, at the time, we anticipated that we would need to use these facilities to enable us to integrate a database component with our expert system component.

One should bear in mind, however, that there are also disadvantages to using *Crystal* as a development tool. Distribution, including distribution to

other academic institutions, is hampered by the cost of the run-time systems that have to accompany each expert system. Furthermore both the development system and the run-time system are memory hungry, consuming a large proportion of the typical amount of RAM available. This creates problems for integrating other applications, such as a database of relevant text materials, with the expert system. However, despite our reservations, we concluded on balance that *Crystal* was the correct choice of working tool for our project.

B. Choice of Database Management Software

Generally, legal expert system developers accept that users must be able to access context-sensitive primary and commentary text during consultations (Edwards 1990). In our previous systems we had provided this text within the *Crystal* knowledge bases themselves. Obviously, this increased the size of the knowledge bases, but it enabled the user to obtain immediate access to the text in question, and assisted in maintaining the harmonious feel of the user interface throughout the system.

Early experiments with *The European Conflicts Guide* demonstrated that, given the amount of the primary and secondary text required, incorporation within the knowledge bases was impracticable. We decided, therefore, to look elsewhere for a suitable database management system. We drew up a list of suitability criteria and began our search.

An acceptable database management system should offer instant context-sensitive access to primary and secondary text from within a *Crystal* knowledge base. It should operate well in conjunction with the expert system development software and should lend itself to the harmonisation of its user interface with *Crystal.* Finally, it should be cheap to acquire and distribute.

The Law Technology Centre at Warwick University suggested a number of shareware or public domain hypertext packages and, after comparing each one with our suitability criteria, we decided to work with a public domain hypertext package called *Hyperrez* distributed by *Maxthink.* In addition to it being free to use and distribute, *Hyperrez* proved to have two other big advantages. Firstly, it was memory-resident, making interfacing with *Crystal* relatively easy. Secondly, it read ASCII data files, enabling us to put the database together quickly. Overall, the software offered instantaneous access to a far greater quantity of textual materials than we had ever been able to include in our previous systems.

However, there appeared to be two important disadvantages to *Hyperrez.* In the first place, it could only handle individual data files of a maximum length of about fifteen screens. Secondly there was limited control over the rather unsophisticated look and feel of the user interface. Our approach to this latter problem is discussed later. Despite these drawbacks, we felt that, on balance, use of *Hyperrez* would enable us to forge an integrated partnership between our expert system component and a database component.

C. The Updating Problem

Concern has been expressed that too little attention has been paid by legal expert system developers to ensuring that their systems are easy to update (Bratley Fremont Mackaay and Poulin 1991). Given that most areas of law and legal procedure are constantly evolving, expert systems tend to be too inflexible to permit easy adaptation. We decided to tackle these difficulties in three ways.

Firstly, in selecting our legal domain, we paid heed to the exhortation to select a stable legal domain, which is not subject to regular change or revision (Capper and Susskind 1988). The area of legal procedure covered by the Brussels Convention is by no means static. The Convention has been amended several times since 1968 but, by comparison with many other areas of law and legal procedure, the rate of change is relatively slow. It can be said that this domain is stable.

Secondly, bearing in mind the advice of Bratley *et al*, we sought to maintain a link between our knowledge bases and the primary text: the Convention. To achieve this aim, we adopted an "isomorphic" knowledge representation technique. Isomorphism involves ensuring throughout the development process that "the structure of the knowledge base reflects the structure of the source documents from which the knowledge base is derived" (Bench-Capon and Coenen 1991). As we tuned our system to be more efficient and easy to use, the knowledge bases began to reflect the structure of the Convention less closely. Despite this, however, we kept isomorphism as our guiding light.

Finally, it appeared to us that the case law in our chosen domain tended to serve the limited purpose of clarifying and refining the interpretation of the legislative provisions. We felt justified, therefore, in separating out the less volatile Convention provisions from the more volatile case law. Representation of the case law could then be confined to the context-sensitive commentary text screens whilst the Convention provisions were represented in the algorithmic "roots and branches" of the system itself. By this means, we have sought to limit much of the updating required to the making of alterations in the commentary text boxes. It is hoped that more labour-intensive re-engineering of the knowledge base algorithms will be required less often.

IV. The User Interface Dimension

A. Importance

Great emphasis is placed, quite properly, on jurisprudential integrity in the construction of legal expert systems. However, based on feedback both to *The EC Competition Adviser* project (Widdison and Pritchard 1991) and to our earlier work in this field, we believe that too little attention is paid to the "Cinderella" of expert system design: the user interface. A legal practitioner, used to assuming a heavy responsibility for any advice given, reacts badly to the sense of disorientation and powerlessness engendered by many legal expert systems. Systems should not only be made more "user friendly", they should, in our opinion, acquire a look and feel which more

closely reflects that of traditional legal research tools. Success in system development depends on more than the production of systems that embody domains of law and legal procedure accurately and efficiently. Developers need to ensure that their software has a familiar and reassuring feel. Failure to pay attention to this third dimension of system development will result in systems that are unused.

B. Look and Feel

We believe that, as far as possible, the structure of the law encapsulated in an expert system should be-recognisable to anyone who has any acquaintance with the domain in question. Recognition will engender a feeling of confidence in the user. With this in mind, we adopted an isomorphic approach, consciously striving to ensure that the expert system component of our system reflected as much of the structure and feel of the Brussels Convention as possible (Bench-Capon and Coenen 1991).

There is always a difficult balance to be struck between the number of questions asked on the one hand, and the complexity of questions on the other. Other things being equal, a user prefers to answer as few questions as possible. Equally, questions that demand a great deal of reading and reflection before being answered can give an expert system an oppressive feel. The correct balance can only be arrived at by experimentation, and will, in any event, vary from one class of user to another. We have tried to achieve this balance in *The European Confl icts Guide* but it is for others to judge whether we have been successful.

More specifically, we sought to pay attention to the impact that each screen of the component would have on the user. Question, comment or conclusion screens may appear off-putting not only because of their number and content, but also because of their appearance. We believe that squashing questions and other text into dense monochrome blocks in overcrowded screens should be avoided. Developers should make full use of available screen space and screen painting facilities to optimise the presentation of question, comment and conclusion screens.

On the look and feel of the database component of our system, adopting a hypertext data representation technique gave us enough flexibility to enable us to make our database an electronic analogy of a paper-based looseleaf legal encyclopedia. The user is presented with a series of electronic pages which can be accessed, read and skipped through in the normal way. Furthermore, these electronic pages are designed to look much like their paper-based equivalents, and are apparently referenced in a conventional way. Finally, the user can access, on screen, such familiar navigational aids as the contents page, case list, glossary, bibliography and index.

Finally, it was important to ensure that, as far as possible, the user interfaces of the expert system component and the database component were harmonised. It was unreasonable to expect the user to cope with two different interfaces in the same application. One of the drawbacks of *Hyperrez* was that control over the design and appearance of the user interface was limited. To some extent, this problem could be mitigated by using *Crystal's* relatively sophisticated screen painting facilities to make the expert

system look more like the database component. However, we found no way to automate the *Hyperrez* "hot key" to permit access to the database from a menu item in the expert system, and there seemed to be no way of softening the rather unsightly appearance of the hypertext "buttons". As a result, we do not feel that we have been able to achieve as much harmony between the user interfaces as we would have liked.

C. System Facilities

Browsing is an essential but much underrated legal research technique. It involves a free, relaxed and somewhat whimsical approach to research. A browsing method enables the researcher to explore an area of law by selecting lines of inquiry intuitively and pursuing them until either they yield up an answer or it becomes evident that the answer lies elsewhere. Conceptually, browsing can be contrasted with an intense, highly-focused, purposeful approach to research. We maintain that both methods, used separately or in conjunction, provide invaluable research techniques for practitioners and academics. Although many legal expert systems and database management systems claim to permit browsing, this claim is often not borne out in practice. Many expert systems offer a "one-way ticket", geared only to the second, more purposeful research technique. In developing legal expert systems, it is our view that the user should be given as much freedom to roam as the technology will allow.

In our system, users are encouraged to step backwards through the system as readily as they can step forwards. We believe that this feature is absolutely vital, not only to enable the user to correct errors, but also to browse: to enable him or her to alter existing input for the purpose of exploring other possible "what if..." outcomes. If a legal expert system cannot back-track, we feel that its use and value are correspondingly restricted.

We have found that one of the strengths of *Crystal* is that it supports back-tracking techniques well. It is relatively easy, using the "global restart" and "restart rule" functions, to implement this system feature. Where a previous question is compulsory in nature, our system steps back to that question, and the user can address it afresh. Where the previous question or group of questions is conditional on the answer to an earlier "pivotal" question, the system steps back to that earlier question. Concern has been expressed that a back-tracking facility makes knowledge bases significantly larger than they would otherwise be. Whilst this is true, we feel that this is a small price to pay for an essential system feature.

On its own, back-tracking is of limited value unless the user is given ready access to an up-to-date overview of the state of the consultation. We have, therefore, provided the user with a recapping facility which can be accessed at any stage of the consultation. This feature enables the user to obtain an instant "audit trail" of all previous questions asked and answers entered, thereby reducing the "short-term memory load" on the user (Capper and Susskind 1988). It is our belief that this feature is vital to effective system navigation and also helps to allay the user's feelings of disorientation and powerlessness.

A third feature that we have incorporated is a consultation saving facility. At any stage, the user can interrupt a consultation, save all answers entered to date and then reload them into the system later. This feature is particularly useful if the user discovers that more information is required part-way through a consultation. He or she can save the consultation so far, obtain the additional information, and then resume that consultation at any time in the future.

Finally, in view of the substantial input of time and energy that the user has made, he or she requires some permanent record of the consultation to take away. Our system provides two types of permanent record. Firstly, the system offers an electronic record in ASCII format which can be merged into a letter or other document that is being word processed. Secondly, the user may obtain a paper-based report of the consultation. These reports contain:

1. identifying information such as the name of the client, and the date and time of the consultation;

2. a summary of all the questions asked and the answers entered; and

3. all the conclusions arrived at by the system.

V. Conclusion

On the legal dimension, we confirm Edwards and Huntley's view (Edwards and Huntley 1990) that the Brussels Convention provides a fruitful domain for expert system development. We also discuss aspects of the representation of both knowledge and data in our system and the desirability of developing a harmonious partnership between an expert system and a database of relevant text materials. With reference to the technological dimension, we explain why we chose *Crystal* as our expert system development tool and *Hyperrez* as our database management software. We also set out the ways in which we sought to make our system easy to update. Finally, we pay particular attention to the "third estate" of legal expert system development: the user interface dimension. We report that many users experience feelings of disorientation and powerlessness when using such systems. We make recommendations designed to lessen the occurrence of these feelings. These recommendations concern both the look and feel of legal expert systems, and the inclusion of such facilities as back-tracking, summarising, consultation saving and report production.

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