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The Cybernauts have Landed: a practitioner's guide to expert systems

• *Richard Wright*

Director of the Law Reform Commission, Victoria

Introduction

Expert Systems as they are known have made major inroads into fields such as health, engineering, production, control, finance and even space exploration. Applications are also developing in the law.

By their nature, expert systems appear to appeal to the covert side of business activity.[1] They have the potential to change fundamentally the basic economic and organisational structure of law firms as they presently exist. Why is this so? What is an expert system? How does it work? I examine the current and potential applications of the technology to the practice of the law, and its implications for how practitioners will conduct their business in the 1990's and beyond as a consequence. No attempt is made to enter into the jurisprudential implications of these systems, a fascinating subject in its own right.

A Little Bit of Economics

The so-called "neo-classical" view in economics of the way the world works, deals with the impact of changes in relative factor prices (the costs of labour services and the costs of capital goods, such as machines) in an uncompromising way. If the cost of labour services becomes relatively more expensive than the cost of capital, a producer will substitute machinery for people. The effect of this, in popular parlance, is "labour shedding".

Over the last decade the power of computers has risen spectacularly, both in the laboratory and on the desktop. One major vendor boasts of a 50% per annum gain in its

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price-performance ratio in recent years. This means that the amount of "bang" for a buyer's computer "buck" doubles every two years. Thus a machine of a given power is either 50% cheaper from one year to the next, or a buyer can purchase a 50% more powerful machine for a given dollar amount of the same period.

A result of this plummet in computer prices and boost in computer power is that software applications which in the past were too processor power-hungry are now within range of the desktop machine or the general office computer. One class of software applications which became more accessible were those associated with expert systems.

At the same time, there was a massive development in the software to run expert systems. Although the legal profession has been relatively slow to take up these types of advances, the promise of expert systems presents a different potential.

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From the Editor's Desk:

This issue is devoted to the uses of artificial intelligence and expert systems in law.

'Why should I be interested in such an experimental application?' you may well ask. Artificial intelligence (AI) and its subset, expert systems (ES), represent one of the cutting edges of current computer research. Even as a computing science discipline, AI is in its infancy - other equally theoretical computer specialities are grandfathers and grandmothers in comparison. However this is not the main reason we examine the field in this issue of the newsletter.

Rather, AI looks at representing or modelling human thought processes, and the output that results. A huge body of human thought exists which includes complex rules, reasons and rationales. This body is called Law.

Computer researchers are particularly interested in Law because it provides a large set of rules, reasons and rationales. Perhaps more importantly, Law also provides a set of techniques for using and interpreting these rules. For researchers looking into the way we handle rules, Law has a great many lessons.

It is not surprising then that an entire subset of AI and ES research has arisen in AI and Law. Recently, Oxford University hosted the third International Conference on Artificial Intelligence and Law (ICAIL). Along with luminaries from the USA, England, Italy, and the Netherlands, four Australian research groups presented papers. Two of these groups, Tyree et al. and Zeleznikow et al, have papers included in this issue. We hope to bring out another issue which includes papers from those Australian groups who were unable to prepare papers in time. At last count there are at least five groups engaged in AI and Law research in Australia. For such a small country, with a lack of funding in the science sector, these figures are remarkable. Indeed, a noted American in the field, Professor Donald Berman, who spoke at a recent seminar at LaTrobe University, said that he came to Australia not for the money (which was poor), but to discover why Australia produced so many notable projects in the field.

This issue of the Newsletter provides an introduction to the area from the perspectives of both the lawyer and the computer researcher. The lawyer's perspective is provided by articles of Richard Wright, and Graham Jefferson, while the computer researcher's view is given by Greenleaf et al. and Zeleznikow et al. We hope that you find the articles as illuminating as we have.

The Editors.

Society for Computers & the Law

ElizabethBroderick • **Editor**
Dan Hunter • **Sub-Editor**
Virginia Gore • **Layout & Design**

c/- Blake Dawson Waldron, Solicitors
Grosvenor Place
225 George Street
SYDNEY 2000

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What are Expert Systems?

As its name implies an expert system is a computer-based tool which tries to replicate the thought patterns and reasoning processes of a real live expert in a particular field. They are distinguishable from more commonplace computer applications such as decision support systems and case management systems by their use of heuristic and inferential reasoning techniques. In problem solving, the expert system attempts to replicate the analytical approach typically employed by an expert in the subject matter field under review. Some Australian-based applications include:

- ECAS, the Australian Coal Industry Research Laboratory coal mining emergency advisory system;
- Garvin Institute's thyroid problem diagnosis model;
- Lend Lease's planning assistant for building projects;
- Broken Hill Proprietary Company Operator Guidance Systems (OGS) for production activities;
- State Bank of New South Wales personal loan approval systems;
- VBARS, the Victorian Business Assistance Referral System; and
- GIO Claims Showcase System.

The expert system has two principal components from a theoretical point of view: the knowledge base and the inference engine. From the perspective of the lawyer using the system, however, the interest in the natural language interface (or "front end") might be of more than passing importance. The interface provides the link between the computer program and the user. The critical importance of the interface in the commercial acceptance and user-friendliness of a system is best illustrated by reflecting on the front end of some of the more traditional software tools presently available in the legal industry. Complex "front ends" turn potential users away.

The knowledge base in the legal application of expert systems could be described by an acronym, such as DEOL (for Distilled Essence of Lawyer). In a legal application the knowledge base would be a database of all the legal rules, precedent material and other data relevant to a particular area that a lawyer would marshall in seeking an answer to a legal problem. If we took an expert lawyer, siphoned off the contents of his or her brain, distilled the contents to separate off any etraneous matters and conceived of the resulting liquid as a set of rules and data, we would have DEOL. The lawyer would in passing have achieved immortality, at least in the sense of his or her legal mental processes living on in the system as the knowledge bases. The inference engine as its name implies is the "logic machine brain" which drives the expert system.

"...the system assists the user, rather than provides cast-iron solutions."

It takes information from the knowledge base as well as directly from the user to infer other data and conclusions to problems. The logical operator sequence mainly employed is the "if ... then" rule. An application in a fauna identification expert system would be "IF the animal has feathers, THEN it is a bird". The process of step-by-step analysis of a problem generates a logical "decision tree". The inferential process normally employed in the legal environment is known as backward chaining, through which its goal is proposed and the system employs its knowledge base and inference engine to establish whether the goal is achievable or not.

For example, Tyree uses an expert system to establish the rights of a finder of property as against a third party, not the true owner, under a number of scenarios. The "goal" is establishing "rights". The "knowledge base" is the established case law.

Putting all this together, we have a user querying the machine, through the natural language interface. The interface will normally be a computer screen and keyboard, which allows the user to communicate with the machine in a language the user can understand. The computer will assist the user to formulate a request for the machine to process by asking questions refining technical terms of relevance to the problem and establishing the "domain" (or area of expertise) in which the user wishes to work. The interface converts the user's English into "computer speak".

In response to the user's inquiry, the machine will prompt for further information, usually of a factual nature. The machine responds to the information supplied by the user with further questions. Questions generated by the machine come from the inference engine. The engine is drawing on the rules and information in the knowledge base to form its questions. The rate of communication between the knowledge base and the inference engine is measured in many millions of instructions per second. The engine is searching through the logic of the knowledge base attempting to nar-

row down choices available which satisfy the data supplied by the user.

At any point the user can ask the machine "Why do you want to know that?" The machine will provide an answer. For example, in the response to a query by the user, it may refer to a decided case or seemingly relevant statute which its knowledge base has identified as applicable to the problem under investigation. At all times the user can be confident that he or she knows where the machine is leading.

By the series of questions from the machine and the responses by the user, the machine works towards its answer. Once it has proposed its answer the user can interrogate the machine to satisfy him or herself of the logical and factual corrections of the outcome. For instance the machine can easily display the logical rules of the "tree diagram" used in narrowing down the problem and reaching its solution for the user's inspection and explanation.

The user can, of course, reject the solution offered by the machine. But that rejection is based on a thorough analysis of the options canvassed by the machine. This factor emphasises the point that the system assists the user, rather than provides cast-iron solutions. The solution offered by the expert system is logically consistent day in day out. It does not have "off days". The system is constantly updated by new information as it becomes available. The user's decision to accept or reject a solution is an enhanced one, because he or she knows that the system has been thorough and complete in its processes.

The Role of the "Knowledge Engineer"

The knowledge engineer is the agent which extracts the DEOL from the source of expertise. The term "which" is chosen because the engineer can be a human or a machine. An interpreter working with people who cannot communicate directly because of a language barrier is a close analogy to the role played by the knowledge engineer.

The engineer interrogates an expert's "know-how" and converts it into machine "know-how". The knowledge engineer fills the position of "Human SAY-HOW" and the expert providing the DEOL, is in the position of "Human KNOW-HOW." The legal expert will instruct the engineer in "how"a problem is solved. The expert in turn has to be sure that the engineer has understood the problem. This check on understanding is achieved by asking the engineer to tell the expert what he or she understands the problem and solution to be. Once the expert is sure that the engineer is understanding the problem, and articulating it correctly, then the engineer can "encode" the rules and knowledge for the system. The knowledge engineer in the process is a real life person (but increasing research is being directed to the developments of machine-assisted knowledge engineering techniques). He or she must have the skills necessary to ask the "right" question of the lawyer. In addition, the engineer must be sufficiently skilled to turn the ideas and information provided by the expert into the machine-readable data and rules needed for the inference engine to do its work.

"Diagnostic systems in the law have direct parallels in the medical profession."

Thus, if we are building a system to advise users on questions of priorities over securities, the engineer would sit down with the expert lawyer and commence a process to identify what types of legal rules apply to particular types of property. Thus security interests and priority rules differ depending on whether or not the property in question is "real" or "personal". Questions must be asked about the legal rules which apply, whether they are statutory, equitable or common law rules.

We must also know that rules have been derived from the decided case law, in which jurisdiction and by whom, and what fact stipulations apply in what circumstances. By an iterative process, the knowledge engineer develops a logical construct of data and rules to cover the legal world of the area under review. The system is "encoded" and provided with a "front-end" to appeal to users. If the front-end does not encourage users to use the system, its acceptance as a tool to assist in the work situation is significantly diminished.

Legal Applications of Expert Systems

To explore the application of this technology at the present time and its future opportunities, we can look at the variants of expert systems as identified by Susskind[3]:

- diagnostic systems;
- procedural guides;
- intelligent checklists; and
- document modelling systems.

Diagnostic Systems

Diagnostic systems in the law have direct parallels in the medical pro-

fession. The medical systems, such a MYCIN, allow doctors to diagnose complaints and ailments from the a computer-assisted interrogation of a patient's symptoms. Mallesons Stephen Jaques, in Sydney, have a system which diagnoses trade practices problems. The system answers two questions: does the client actually have a trade practices problem, and is there a straightforward solution? The partner who developed the system requires anyone with a problem to run it through the system before he or she attempts to erode the partner's valuable time. The savings provided by this type of system are significant. The opportunities to develop similar systems for other areas of practice are considerable.

Another application of the diagnostic approach involves the combination of an expert system with a database - searching facility such as Scale or DiskROM. A diagnostic expert system could be positioned "on top of" these databases to lead a user through a structured narrowing of the search domain. The end result would be that the user would be led to the appropriate result, rather than be left with a whole lot of search results which require further work to identify the answer which is particularly relevant.

"Expert systems will not be designed to provide the legal profession with the raw data (the formal sources of law) of the legal reasoning and the legal problem-solving processes, based upon search requests formulated in terms of keywords in combination, as existing database systems in law do; but, rather, they will serve as the embodiment of a corpus of knowledge - the result of interpretation of the raw data - to which users may gain access."[6]

Procedural Guides

A procedural guide takes a user through the many complex steps involved in a particular legal process, so that critical steps in the process are not overlooked. A number of areas of legal practice could be attacked with these guides. Bankruptcy and debt collection are prime candidates for modelling. Both present the practitioner with complex procedural and administrative rule systems which are amenable to the expert system approach. The system can identify timing requirements on the lodging of papers, court appearances, and other administrative trivia which bedevil the practitioner's life and erode his or her profitability. The system is "expert" in the sense, that it will interact with the user, suggesting warnings in the use of particular approaches to the problem under review. It will tell you what to do, when and how. It will interact with other systems to produce all the relevant documents.

"The users see quality control as a major benefit of the use of expert systems."

Intelligent Checklists

Intelligent checklists provide a similar function to the procedural guide. In a complex legal environment there is always scope for a user of legislation to overlook a step in an Act, or act in ignorance of a relevant piece of subordinate legislation, such as a regulation or a code of practice. The checklist would prevent this type of inadvertence.

The use of these checklists is already emerging in the legal profession. As the cost of "partner time" becomes more and more expensive, the time spent by a partner of a law firm in laboriously proof-reading documents before they are sent to clients becomes more difficult to justify. If a document has been created through the use of an intelligent checklists, the partner needs only to check the drafter's responses to the checklist to ensure the accuracy of the document.

The users see quality control as a major benefit of the use of expert systems. The exposure of firms to professional negligence claims can be expected to grow with the size of firms and the complexity of the areas of practice. The cost of avoiding or minimising negligence claims is considerable. The ultimate responsibility for quality of advice lies with the owners of the firm. The system can work to ensure that quality is maintained.

Document Modelling Systems

Document modelling systems are of major importance to the drafter of legal documents. Their utility has been widely recognised in some areas of the major law firms around Australia. They allow speedy and accurate development of quite complex documents, at minimal cost. One user of expert systems in the private profession, drafting financial agreements of amazing complexity, notes that the use of the expert systems results in a "seventh draft" document emerging as the "first draft". The potential productivity gains flowing from the use of the technology in this type of application are immense.

In essence, the system provides a "template" for prospective drafting work. Large amounts of drafting material are prepared for storage in the "knowledge base" of the expert

system, together with the relevant rules which will allow the calling-up of this material as required. When a contract or agreement on a particular topic is being drafted, the drafter can call on model provisions automatically. Thus, if a financing agreement is being established, all the choice of law, guarantee, liquidated damages, contribution, underwriting, etc provisions are instantly available in polished prose. A major agreement can be constructed, with the assurance that the regulatory niceties which frustrate the enforcement and general functionality of this type of documentation are accounted for automatically. The template provides for speedier drafting. In addition, the expert system brings to the drafting process a high level of quality control.[7]

Why Not Use a Word Processor?

A lot of the functionality of a document modelling expert system can be obtained from the new generation of word processors now on the market. The name Computer Aided Drafting is often applied to this approach. The *Alis* word processing product, for example, allows the construction of templates, which make the development of complex documents relatively straightforward. You can call up appropriate templates: use a graphical interface to cut and paste with remarkable ease: call in parts of disparate documents, etc. But *Alis* is not "expert" in the sense that it will not keep a running check on the "sense" of the document. Thus, it will not warn you against the inappropriate use of a paragraph from another document. Or, if you choose the "wrong" template for a particular task, an expert system document modeller will be able to recognise the error and give, the drafter warning. The advanced word processor of the type we are talking about will not. To distinguish the two approaches, it is probably worth calling the word processor approach more of a data-based or document processing system, which lacks the rules which run the document modelling expert system.

Expert Systems and the Law office of the 1990s

The internal organisational structures of Australian law offices has been relatively stable over the last twenty years. Almost universally, a firm has a partner-associate-employee, solicitor structure. At the most simple, we have the sole practitioner and at the most complex, we have the mega-firms. Expert systems will make major contributions at all levels of the profession, in both the public and private sectors.

"Access to the law will be increased."

The small practices and the community legal centres will have access to systems which will assist them to identify and categorise legal problems for their clients. A range of matters will be resolved on the spot in areas that were previously beyond the scope of these types of organisation. Access to the law will be increased.

The major impact of the systems will be in the operations of the larger firms. The technology has the potential to lower operational costs significantly, and enhance quality control comprehensively. The expert systems will have a major effect on cost structures because they will allow a large number of relatively complex, but none the less routine, transactions to be handled by more junior and less costly staff. The combination of intelligent checklists and document modellers will ensure that the right documents are prepared and the required administrative processes are observed.

The move to expert systems will also go a long way to protecting the intellectual property of authoring firms. A document prepared by an expert system will be "unique" to a particular matter. The precedent collector will know that he or she is in possession of a "dynamic document," the unauthorised use of which raises significant dangers. The days of the hardcopy precedent bank, vulnerable to the depredations of employees and the in-house solicitor to major clients on a precedent hunt, would be severely curtailed.

Conclusions

Much of this is speculative. A lot more of it is real, and happening now. As Susskind says in the preface to the paperback edition of his work:

"Since late 1986, when the manuscript of this book was originally delivered, the field of expert systems in law has changed radically. No longer is this subject the fascination of just a handful of enthusiastic lawyers and computer scientists. It has now become the province of many investigators."[8]

In the context of the "globalisation" of legal services and Australia's role as an exporter of legal services on the Pacific Rim, the advantages offered by expert systems to the cost-efficient legal firm are considerable. Development costs are high, but these must be set off against the immense productivity gains on offer. The Cybernetic Age is with us. We can hope that the cybernauts are available to lead the way. ●

Footnotes

[1] A vendor of the top-selling expert system shell, the base upon which these tools are built, informed the Commission that a large quantity of its product had been sold but information on what applications it had been applied to was difficult to obtain.

[2] The Rand model described by Waterman, Paul and Peterson in Quinian (ed), Application of Expert Systems, Addison-Wesley, 1987, extends the rules to a number of variants such as "if...let..", "if..conclude.." and "if..assert..". The authors maintain that the complexity of legal reasoning demands an extended rule set.

[3] Tyree, A., Expert Systems in Law An Introduction to Expert Systems with Legal Examples, Prentice Hall, Australia 1989, Chapter 6

[4] Traditionally a language interface has been used, but the expansion of Graphical User Interfaces (GUI) and Computer Aided Manufacturing Systems have led to new types of interfaces such as a mouse-driven link through icons.

[5] Susskind, R.E. The Next Generation of Computers for Lawyers: Artificial Intelligence, Expert Systems and the Law, Masons, Solicitors, London, April 1990.

[6] Susskind, R., *Expert Systems in Law*, Clarendon Paperbacks, Oxford, 1989.

[7] Phillip Argy of Mallesons Stephen Jaques, Sydney, believes that it is in the area of quality control that the commercial application of these types of document modellers will pay their own way many times over.

[8]. Susskind, *op.cit.*

A Brief History of Artificial Intelligence

• *Graham Jefferson*

Attorney-General's Department, Northern Territory. *This is an extract of an article accepted for publication in the Tasmanian Law School Journal.*

Introduction

The topic of Artificial Intelligence arouses more emotion than any other in the field of computer science. The idea that machines could be made to think upsets people. This has been exacerbated by the grand claims of early AI developers and science fiction portrayals of robots. No-one has produced an undeniably intelligent machine and no-one has proved that such a task is impossible, so the debate remains speculative as well as heated. Talk of applying Artificial Intelligence to the law necessarily raises the temperature of the debate, if only because many see the law as more closely tied to notions of humanity and morality than hard sciences like chemistry and biology. However, the Commonwealth Departments of Tax, Customs, Immigration, Social Security and Veteran's Affairs are developing machines which use Artificial Intelligence to help in their administration. These machines are designed to give the same answers to questions as human experts. The departments propose that these machines will assist departmental staff in a variety of tasks, some of them involving legal decisions. The aim of this short paper is to avoid the emotion surrounding the Artificial Intelligence debate and present a history of this technology in the law.

The Emergence of Expert Systems

The development of Expert Systems (ES)[1] needs to be seen in the context of computer science generally. The emergence of modern computers occurred in the late 1940s so the field is relatively young. However, in the time since the first digital computer[2] we have made a great deal of progress. Computers in the 1990s are smaller and faster than their ancestors. Software has evolved from hard-wiring circuits into sophisticated programming languages. The influence of this new science in society is manifold. Few people in the developed world could claim to be unaffected by advances made in computer science.

At the forefront of academic research within computer science is the pursuit of Artificial Intelligence (AI).[3] In crude terms, AI researchers are "making computers smart".[4] A very large number of experiments fall under the umbrella of AI but, for the purposes of this discussion it is only important to know that AI scientists are trying to develop programs that exhibit intelligent behaviour.

Expert System (ES) technology is a limb of AI research that seeks to implement human reasoning processes within problem solving programs. Unlike other experiments in AI, ES

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