The Next Generation of Legal Expert Systems-New Dawn or False Dawn?

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Abstract: Attempts to apply conventional rule-based expert systems to legal problem-solving raise seemingly insurmountable obstacles. The authors analyse the key challenges of developing a legal expert system by reference to a case study of issues arising in their prototype system, the JAES project. This paper explores the advantages of exploiting three alternative approaches- namely: case-based reasoning, blackboard architecture, and service-oriented architecture for the next generation of legal expert systems. The authors advocate the use of hybrid architecture to address the complexity and dynamic nature of the legal domain. The paper evaluates the extent to which these enhancements can meet the special complexities of the legal domain.

1. Introduction

1.1 The issues

Are reports of the demise of legal expert systems greatly exaggerated? Since the 1990's, commentators have noted that interest has diminished in legal expert systems in favour of other applications of information technology to legal practice that are less challenging and offer more immediate returns (such as automated document assembly) [1]. However, the utilisation of case based reasoning and the exploitation of blackboard and service oriented architecture offer the prospect of developing a new generation of better and more sophisticated legal expert systems. This paper will explore whether the next generation of systems will be capable of surmounting the unique challenges presented by legal problem-solving. If these techniques can be exploited successfully a resurgence of interest in the development of legal expert systems can be expected. Anyone with an interest in artificial intelligence or legal practice needs to consider these issues and join the debate.

1.2 Expert and Knowledge-based Systems

Expert and knowledge-based systems (KBS) have been defined as "an intelligent computer program that uses knowledge and inference procedures to solve problems that require significant human expertise for their solutions" (Feigenbaum, 1982). The term 'expert systems' usually refers to a system that operates in a specific and narrow domain, whereas KBSs tend to be aimed at wider domains or broader problems.. Most of these systems use a set of if/then type rules and an inference engine. Examples of expert systems are numerous including the familiar early application Mycin [2] designed to assist medical diagnosis.

1.3 Rationale for Application to Legal Practice

The motives for applying expert system techniques to legal practice are self-evident. A list of the possible benefits [3] include:

- Faster delivery of legal advice.
- Liberation of fee earning time otherwise spent in the labour-intensive and repetitive tasks of taking instructions, carrying out legal research and giving advice.
- Increased productivity.
- Reduced dependence on transitory human expertise.
- Potential savings in staff overheads.
- Increased scope for delegation of tasks to a lower grade of fee earner

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- Reduction in human error leading to improved claims record and lower insurance.
- Cost savings arising from the above.
- Increased profitability for the provider of legal services.
- From the client's perspective lower fees

Conversely, the disruption to the traditional model of providing bespoke legal services; and the reduction in the time cost element of billing will be seen by many legal service providers as potential disincentives.

However, it has been argued that the future viability of time costing as a basis for billing is likely to come under pressure as a result of increasing competitive pressure in the market for legal services[1]. It is submitted this market pressure will tip the balance in favour of efficiency savings [4]. An economic imperative for the successful synergy of the disciplines of artificial intelligence and law has arisen [5].The search for a successful synergy has been the 'Holy Grail' quest that has exercised the energies of scholars and researchers over decades. Some commentators have argued that the 2 disciplines are fundamentally incompatible [6]. Whilst there have been some successful applications in the legal domain [8], these have been in relatively narrowly-defined and selected areas of the law. It has also been observed that the extent of commercial exploitation in the English legal profession is disappointing in comparison with other professional sectors and industry [8, 9, and 4].

1.4 Questions

The relatively slow progress in developing commercially successful applications in the legal domain raises the following questions:

- What are the special challenges posed by the legal domain?
- What advances can be exploited in the next generation of legal expert systems?
- Will the next generation of systems meet the challenges?

1.5 Structure of paper

This paper will analyse each of the questions identified in 1.4 in turn. The analysis will adopt a pragmatic approach in order to place the issues in a practical context. This contextual approach will be adopted by using examples and issues arising from a particular prototype application of a legal knowledge-based system designed and developed by the authors. The prototype was given the name the Judicial Advisory Expert System project abbreviated to JAES [10]. The analysis will follow the following structure:

Section 2 will give a concise summary of the JAES project. The purpose of this summary is to enable readers to understand the context of the examples and issues from the JAES project given subsequently. Section 3 of the paper will analyse the particular challenges raised by legal expert systems with examples taken from the JAES project. Section 4 will examine the exploitation of case-based reasoning and two types of systems architecture to legal expert systems-namely blackboard and service-oriented architecture. It will then explore the possibility of hybrid integration of these architectures and methodologies. Section 5 will evaluate the extent to which the next generation of systems will be able to meet the challenges.

2. The JAES Project

The JAES project in essence aimed to embody the rules on passing of property and risk that are contained in sections 16 to 20 Sale of Goods Act (SGA) in a prototype expert system. Disputes between buyers and sellers on the question of which party bears the risk of accidental damage to goods are inevitable. Insurance companies need to clearly identify the risk-borne party when settling claims. Traditionally, in such a situation, sections 16-20 of the Sale of Goods Act (SGA) are applied by lawyers who advise the parties or their respective insurers. The traditional approach is both time consuming and expensive. JAES was developed by the authors in order to speed up the process and make it more cost effective especially for low value and routine disputes. The inference engine applies the logic contained in the knowledge base to the information input by the user and outputs advice on whether the seller or the buyer bears the risk of loss or damage to goods in a particular

contract for the sale of goods. The rules comprised in sections 16 to 20 SGA were deliberately selected as the subject matter for the knowledge base, as the authors perceived them to be an attractive area for a legal expert system for the following reasons:

- The logical basis underlying sections 16 to 20 SGA is relatively clear.
- It is an area of the law of practical commercial importance.
- This area of law has been stable with relatively infrequent statutory amendments.

A modular approach to the design of the system was adopted. Owing to the number of rules required, the system's performance needed to be enhanced in a later version by utilising a Q-learning algorithm. This modular design with Q-learning algorithmic implementation is shown in the figure 1, and further explanation can be obtained from [11]. The key output of the system is to use sections 16 to 20 SGA in the knowledge base to advise a user whether the seller or the buyer is responsible for bearing the loss of damage to goods.
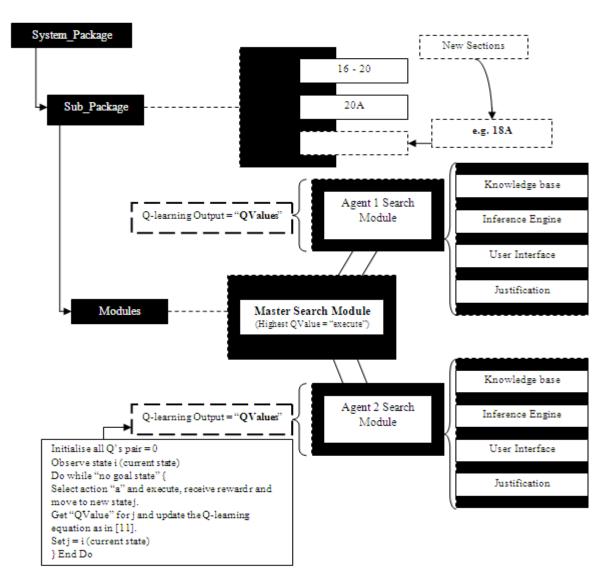

Figure 1: Q-Learning Algorithm in JAES Modular Design [11]

3. What are the particular challenges of the legal domain?

The JAES project highlighted a number of problems. Some arise from the intrinsic nature of law. Other issues are not unique to the legal domain but arise from the intrinsic problems of expert system development. Legal expert systems need to overcome both sets of obstacles if they are to be of practical utility. Some of the main challenges the authors encountered in the JAES project were as follows:

3.1   Complexity

The JAES project selected a relatively discrete, narrow and specific area of law-namely the rules comprised in sections 16 to 20 of the Sale of Goods Act and applicable case law precedents. However, the reality of legal problems is that they are seldom confined to discrete and narrow areas of law. In practice they usually raise multiple issues of law which are interconnected and therefore cannot be isolated [12].

Example 1. Consider the following factual example of a dispute where (S) a business in Leicester sells photocopiers to (B) a business in Boston USA. On arrival the photocopiers are found to have been damaged at some point in transit. Some of the preliminary legal issues that may arise in this situation:

1. Does English law or US law govern the contract of sale?

2. Has a contract been concluded that is recognised by the governing law?

3. If S's terms and B's terms are different which terms govern the contract?

How would a user without sufficient legal expertise be able to answer these questions? Would a lay person recognise the significance of the issue in the first place? Each of the above questions could themselves form the basis of a separate and complex expert system. The answer to each of these questions has to be answered correctly before a user can determine whether the JAES system is relevant to the problem or not. For example, if US law governed the contract the problem would be completely outside the scope of JAES' knowledge base. This example highlights the inconvenient reality that legal problems are complex and raise multiple issues that are interconnected. This is a major challenge for computerised problem-solving. This difficulty is acknowledged and has led to suggestions that legal expert systems cannot realistically be expected to replace entirely the activity of giving legal advice and the appropriate use should be confined to augmenting legal advice [13].

3.2 Uncertainty

3.2.1 Factual Uncertainty

Rule-based expert systems rely on clear factual premises for the rules in the inference engine to work on. However, legal reasoning in practice is by its very nature adversarial. For instance if the circumstances outlined in Example 1 above came before a court factual disputes may well have to be determined by the court after hearing conflicting evidence. Possible factual disputes could include any of the following: the extent of the damage to the photocopiers; the precise time during transit when the damage occurred; whether the damage was caused by the fault of any party; the precise cause of the damage; what verbal terms were agreed. A conventional expert system relies on the user inputting clear answers to factual questions. If the facts are disputed which version of the facts should be input? Clearly if incorrect factual information is input by the user, the premises on which the reasoning is based will also be incorrect and inevitably the system will output erroneous or flawed advice. If there is no consensus on the factual premises there will be no reliable data for the system to work on. However, this limitation also applies in the traditional interaction between lawyer and client when advice is given on the basis of factual instructions given by the client that may well prove subsequently to be erroneous or are rejected by a court.

3.2.2 Legal uncertainty (open-texture)

Legal advisers learn from practical experience that the precise way in which the law is applied to particular facts and the precise outcome of a case can rarely be predicted with 100% certainty. If legal outcomes were 100% certain familiar characteristics of legal systems such as adversarial advocacy opposing arguments on points of law; differing linguistic interpretations of statutory provisions; judicial distinguishing of case precedents; dissenting judgments and appeals would be impossible[14,15]. Furthermore as law impacts on human society its interpretation is often driven not just by objective factors but also by policy based valued judgments. It is extremely difficult if not impossible for artificial intelligence to adequately reflect these discretionary subjective matters.

3.2.3 Dynamism

Law in any jurisdiction is not static. Therefore any legal expert system has to be flexible and constantly updated to take account of changes emanating from legislation, statutory instruments, case precedents, or European Union law. A possible approach to the updating of a system to take account of case law precedents is to use case-based reasoning [16]. Case based reasoning inferences by analogy. In essence it derives principles from specific cases and applies them to subsequent cases. However, in legal applications it will be challenging to isolate the important principle established by the precedent (referred to by lawyers as the ratio decidendi) and distinguish this from irrelevant factors that do not form part of the precedent. The integration of case-based reasoning with rule-based reasoning in legal knowledge-based systems is one way of addressing this problem [17]. However, in a world where legislation is constantly changing a legal expert system also needs to be able to cope with the challenge of major changes in the law. For example in the context of the JAES project consider the hypothetical example given below.

Example 2 (hypothetical). Many of the member states of the European Union have adopted the Convention on International Sale of Goods (CISG) which differs from the Sale of Goods Act in a number of respects including the legal rules that determine the passing of risk. This has led to calls for the United Kingdom to adopt the CISG in order to harmonise the law on sale of goods within the single European Union market. If this ever happened it is possible that, the Sale of Goods Act 1979 could be repealed rendering JAES obsolete. An entirely new system would need to be created. Any users who had purchased the original version and loaded it on their computers   would have a dangerous system that output erroneous and outdated advice based on the old law. Therefore the product would need to be recalled from all users who purchased the original system.. The advantage of a web services based alternative system to mitigate this problem is self evident.

3.4 Financial disincentives

The investment of time required to develop a knowledge- based system even in a narrow area of law is considerable. Firstly, there is the onerous task of deriving the domain knowledge and structuring this in a manner which is comprehensible to the knowledge engineer. Once derived the knowledge and expertise has to be translated into computer code. Testing improving and updating the system also needs to be factored into the time required. Owing to law's complexity and open-texture a legal expert system requires more time than many other domains. From the point of view of a legal practitioner time represents lost fee earning time measurable in financial terms [18]. If given the choice practitioners will prefer the alternative of charging for bespoke advice on an hourly basis rather than make their scarce expertise more widely available at a lower cost. There is a strong financial disincentive therefore to deter practising lawyers from acting as domain experts.

From the perspective of the end user it is not likely to be cost effective to invest in the purchase of an expert system to resolve a particular legal problem that may only arise infrequently. However, a web services application which is only accessed and paid for on a pay for use basis makes more economic sense.

4. Alternatives for the next generation of legal expert systems

In this section, case based reasoning (CBR) as an appropriate alternative or addition to a rule based system is proposed. Additionally, Blackboard and Service-oriented architectures are considered as having particular relevance for the overall structure of the next generation of legal expert systems. Both architectures are described prior to illustrating their hybrid integration for the legal expert system paradigm.

4.1 Case Based Reasoning (CBR)

The design of most intelligent systems is usually inspired by the desire to emulate human capabilities in some way. One example of this is the way that humans are able to recall previous similar experiences when attempting to solve problems [22]. CBR is an approach to intelligent systems development that aims to emulate this capability. A CBR system stores problems, retrieves closest matches when a new problem needs to be solved, adapts the previous approach to suit the new problem exactly and finally stores the new case. The stored knowledge is known as the case base and one way of storing these is as objects with links between classes and instances that enable effective retrieval to take place. Such an approach might be more appropriate in the legal domain. One significant reason for this is that the knowledge base is built up over time, thus getting over the "knowledge acquisition bottleneck" [18] to some extent; secondly it can evolve in much the same way that the law does, so the content need not be artificially static.

Rissland, Ashley and Branting [30] consider the historical development of CBR and law identifying a number of systems that have exhibited varying degrees of success in different areas of the law and using different mechanisms for reasoning. A notable example is the HYPO system [31] that applies case-based reasoning in the legal domain using a 6 stage process. HYPO's use of CBR has the considerable advantage for the legal domain of outputting alternative arguments as opposed to definitive answers. This provides a more realistic outcome which is more reflective of the open-textured nature of legal problem solving. HYPO's system has been utilised in a more recent system known as CATO [32, 33, 34] to teach law students how to reason with case law precedents in the law relating to trade secrets and confidential commercial information. Other systems that are developments of HYPO are described in [30].

ASHD-II [35] was developed as a hybrid legal system in the area of divorce law. It consisted of a rule base and a case base. The reason for the development of this hybrid was to take advantage of both of these methods since the nature of law means that it can be necessary to use precedents (easily represented by CBR) and other legal sources such as statutes, codes (more easily represented in a rule based format). The system illustrated that there was success in terms of creating the hybrid system but that even this did not did not fully capture the behaviour of a legal practitioner and they concluded that the system was more useful as an aid to the less experienced practitioner. Law provides an excellent testing ground for new approaches to CBR and by its nature CBR lends itself very well as a potential mechanism for automating some areas of legal decision making.

This paper proposes that CBR be used to develop one or more of the knowledge sources required for the blackboard architecture; the other knowledge sources would be rule based. The most appropriate mechanism would then be applied for each problem that the system is required to handle. The blackboard architecture is explained in the next section.

4.2 Blackboard architecture

This is a task-independent architectural design which mimics the natural process where heterogeneous team members solve a particular problem via a communication medium called a blackboard. Blackboard architecture is informal, owing to the fact that it can be applied to a variety of problems and each problem involves a slight reinterpretation of the architecture itself [19]. It has been viewed as an ideal architecture for open-textured, complex or non-deterministic problems [21]. It promises therefore more sophisticated techniques which are more appropriate for legal problems. The concept of this architecture is shown in figure 2 and it is based on the

metaphor of a meeting room, where a number of different experts surround a discussion board and use their expertise cooperatively to brainstorm a particular complex problem posted onto the board. The discussion board equates to the "blackboard" component of this architecture. The "knowledge source" component equates to each specialist who contributes their particular expertise in solving the problem. In order to control the flow of the problem solving process and schedule the contributions of each of the knowledge source onto the discussion board, the "controller" component of the blackboard architecture is needed which is equivalent to a chair in the human metaphor.
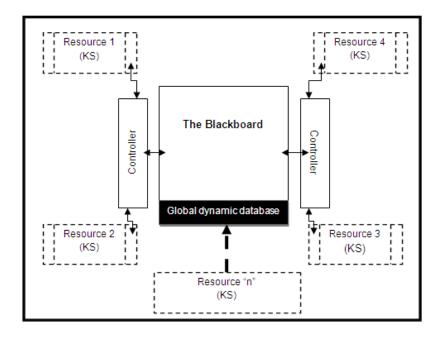

Figure 2: Blackboard Systems Architecture

The knowledge sources (KS) share a common global dynamic database (i.e. the blackboard). The access to this shared resource is managed by a control shell (i.e. controller). The knowledge sources can be either internal or external (i.e. remote). The blackboard can be a single publicly accessible region or subdivided into regions or panels. The controller can be implemented as a separate entity (centralised) or can be partly implemented in the blackboard and partly in the knowledge sources (distributed). Communication between the knowledge sources can only take place via the blackboard.

The problem solving scenario begins when an initial problem is posted onto the blackboard by a knowledge source. The knowledge source can be as small as a system function or as large as a complete expert system. The posted problem is globally accessible through the dedicated memory area (i.e. the blackboard) whose controller is responsible for triggering the specialist knowledge source to contribute its solution towards solving the posted problem. Once the problem is cooperatively solved by all the knowledge sources, the next problem can be generated for continuous applications. This methodology corresponds to the way human beings solve problems in a distributed team. This architecture is a highly modular way of building problem solving systems [21]. Modularising the components allow interactions between them to be regularised [23]. Furthermore, it allows clear and rigid interfaces to be defined through which the components can be accessed. Each of the components of this methodology offer modularity as well as other significant system-level benefits including performance, re-usability, security, maintainability and reliability of the overall system.

For legal problem-solving, the blackboard architecture offers scope for a number of different expert systems to work together collaboratively. To see how this can work imagine how problem solving in Example 1 contained in section 3.1 of this article could be undertaken. We saw that several complex problems need to be resolved. The first problem of which law governs the contract would be addressed by an expert system or a number of expert systems with rules to determine choice of law and a user interface that asks the user structured questions

for the inference engine to work on. Depending on the outcome further expert systems could be invoked with rules based on US law or English law as appropriate to deal with the remaining questions. If different systems give different advice, a range of possible outcomes can be presented to the user. A variety of artificial intelligence methods of reasoning can be deployed by different systems (e.g. rule-based systems, case based reasoning, etc) in a collaborative manner via the blackboard architecture. The controller component can decide as to which knowledge source is the most appropriate for a particular task based on the nature of the legal case under question. If a legal case requires hybrid reasoning (such as a CBR specialised knowledge source and rule-based specialised knowledge source), the controller component can be built with the necessary decision logic to orchestrate the access each knowledge source obtains, based on the legal case state on the blackboard, to make decisions. This offers greater potential for attempting to advise on open-textured complex and interdependent questions in the legal domain.

With reference to the challenge created by dynamic changes in the law, the modularity inherent in the blackboard architecture and its potential for remote access via deployment of external knowledge sources offers a better solution than traditional approaches. A user can dynamically access the updated system remotely at runtime without the need to load new software. If one particular expert system becomes completely obsolete due to changes in the law, the blackboard can utilise an alternative system that contains the new law.

4.3 Service-oriented architecture (SOA)

This architecture provides a model to develop systems that assemble and distribute services remotely. The key advantage of service-oriented architecture (SOA) is it enables a service provided by a third-party to be directly accessible to other systems regardless of their mechanisms (e.g. operating systems or application software) or their geographic locations. The term "service-oriented" emphasises the fact that the main priority of this architecture is centred on the service provided. Constraints and obstacles that hinder accessibility of the service in other architectures are made subservient to the service and are prevented from hindering access to the service. Businesses therefore that wish their services to be accessible and to reach a wider market understandably find this architecture commercially attractive. Consequently, SOA has been widely exploited in a number of service sectors such as financial services, and travel and tourism services, including holiday bookings. Software houses that wish to sell their software online are another example.

SOA achieves this accessibility by using web services (WS) representation. Figure 3 illustrates the basic architectural representation of web services incorporating the operations, entities and the components necessary for its functionality. These are 'Service Provider', 'Service Registry' and 'Service Requester [23, 24].
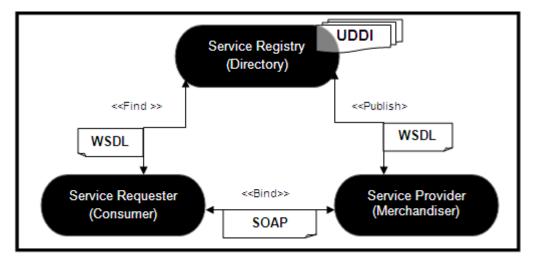

Figure 3: Web services Representation Model

The 'Service Provider' designs a particular service by defining its interface clearly and implementing its service functionality. The provider describes and publishes its details using WSDL into a 'Service Registry' [20]. WSDL provides an XML description of what messages can be exchanged and a point of contact for a successful interaction. XML messages are human and machine readable, which facilitates the debugging process and provides uniformity. The 'Service Registry' is a generally accessible registry (directory) which uses a publication standard called UDDI. The UDDI provides a directory service where all the information about a particular web service such as the service provider, type of the service, location of the service description and other business related information is kept. The UDDI contains a list of web services offered by various providers and can be searched by the 'Service Requester'. The registry can be public, private or restricted, which enables one to keep track of the currently available web services [24].

The 'Service Requester' is a consumer of the web-service who locates a specific web service by querying it from the UDDI registry. Once the description and the specification of the web service are discovered, the requester binds its application to the specific service required and communicates with it using a protocol called SOAP [25]. SOAP is an XML-based communication protocol which provides the envelope for sending web service messages using HTTP (Hypertext Transfer Protocol). The requester and the provider can be implemented in an application locally or remotely. In order to ensure compatibility and accessibility by other systems, a web service interface needs to be defined by the provider and published by the registry. This interface possesses the necessary definitions and the methods to either access any underlying data or carry out specific tasks [26].

The authors foresee a number of advantages in utilising service oriented architecture for legal expert systems in preference to conventional approaches. These are described below.

Since the web services interactions are built on existing standards like XML, HTTP, WSDL, UDDI and SOAP, it can resolve some of the limitations related to web-based expert systems. Firstly, the standardisation of message transfer can be solved using XML. Secondly, compatibility among communication protocols of various systems over the Internet can be tackled using HTTP. Furthermore, bypassing existing security infrastructures such as a firewall can be confronted using the existing HTTP business infrastructure, etc.

Enterprises relying on systems using earlier technology (referred to as legacy mechanisms) need not discard the functionality offered by these systems. Web services can easily be wrapped around legacy systems, thus requiring little or no change to the existing mechanisms. This offers the benefit of distributing knowledge to a wider range of remote audience using the existing mechanisms by plugging them in to the web services framework.

Web services enable loose-coupling of software components provided the interface has been defined and specified. This will enable the knowledge base to be amended at one end without affecting the functionality of the service delivered at the other end. As expert systems invoke web services at run-time, any upgrade to the underlying knowledge exposed as a web service, does not hinder the execution of the system as long as the interface accurately reflects its description.

Updating an existing legal expert system to reflect changes in the law is facilitated by the modular framework offered within the web services paradigm. This provides opportunities for reducing the time and expense incurred in manually updating the existing legal knowledge with the newer knowledge within an expert system. Web services-based implementation offers income generation revenue for a legal enterprise offering the necessary knowledge as a service. An end-user can be charged according to the type of legal advisory service requested. This is more cost-effective than conventional approaches, where users purchase and install license components of a system which they may never use or only access infrequently. This also provides an opportunity for legal advisory firms and consultancies of any size to invoke web services-based legal knowledge. Commoditisation of systems is enhanced and supported by web services standards. The increased

opportunities could make the next-generation of legal expert systems more commercially attractive for lawyers to develop and for users to access.

While conventional expert systems are limited in their narrow domains, web services-based systems offer the potential to access external systems remotely to deal with other specialist areas. This enables the expert system's performance to be enhanced by access to broader areas of knowledge and expertise. To revert to example 1 comprised in section 3.1 above if US law applied SOA would facilitate remote access to external expert systems in the USA containing US legal knowledge and expertise to advice on the remaining legal problems.

4.4 Hybrid integration

Limitations have been identified by Grove [27] and Duan [28] with existing web-based expert systems such as interface complexity, limited infrastructure, communication loads, inference complexities, to mention only a few. The authors foresee the next generation of legal expert systems supporting day-to-day legal advisory business requirements using a systematic and extensible framework for application-to-application interaction. This application-to-application interaction grants efficient mechanisms for large amounts of data to be transferred from one global point to another and specific tasks to be undertaken, automatically without the need for data to be processed by a web browser [29]. Globalisation demands a solution that can provide access to detailed legal expertise covering different specialist areas for effective decision making. The complexities, resource allocations (time and money) and the available technology prevent expert systems from processing vast amounts of knowledge in a stand-alone legal expert system implementation. In addition, legal expert systems need constant modification as and when the law is modified or repealed. The solution to these key issues is a hybrid integration of blackboard architecture with the flexible framework offered by web services-based SOA.
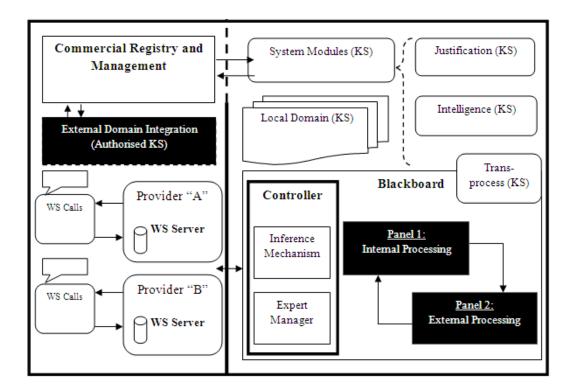

Figure 4: Hybrid Architectural Design

This hybrid architectural design is shown in figure 4 above. The common data structure, (i.e. the blackboard) stores initial data, any intermediate decisions and the final solution. In order to minimise complexity in processing the knowledge bases, and to improve the performance of the overall system, the blackboard is divided into two distinct areas called panel 1 and panel 2. Panel 1 deals with internal processing associated with any local legal domain knowledge of the expert system; whereas, panel 2 deals with all the external processing

associated with any web service invocations. Any information transfer between panel 1 and panel 2 is carried out using a dedicated knowledge source (KS) called trans-process. The controller is divided into two logical sections namely an inference mechanism and an expert manager. The inference mechanism implements a reasoning technique of the expert system whereas the expert manager controls and manages all the access and contributions made by every knowledge source at runtime.

The knowledge sources can be domain specific or system specific. Domain specific knowledge sources are further divided into local legal domain knowledge sources, pre-existing in the expert system, and external authorised legal domain knowledge sources, dynamically acquired using web services invocation. System specific knowledge sources are modules which contribute to the overall workability of the system and provide add-on services like justification, online / offline support and assistance, system intelligence, etc. The architecture stresses the importance of a commercial registry and management legislation system to be in place to link the internal expert system knowledge processing mechanism with the SOA based legal knowledge bases, in order to support necessary web service registration, authorisation, validation and pricing control procedures. The authors advocate a hybrid architectural design style shown in the figure 4 to achieve the maximum sophistication and flexibility needed in a legal expert system.
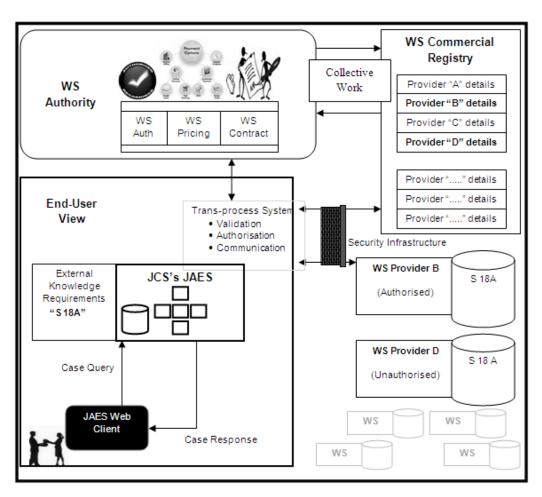

Figure 5: Operational Layout of the JAES using Hybrid Architecture

Example 3. This is a hypothetical problem solving scenario using hybrid architectural design as illustrated in figure 5 above. In order to demonstrate how this hybrid design could work the following scenario is given and this is illustrated in figure 5 above. "JCS" (Judicial Consultancy Services) is a hypothetical legal consultancy firm. JCS specialises in providing web-based legal consultancy services to end users who prefer to resolve legal disputes without recourse to litigation by paying a small access fee. The target users are those who would like to save time and money by alternative dispute resolution. In order to provide such services, JCS uses an expert

system called "JAES" (Judicial Advisory Expert System). JAES has a number of local knowledge base modules covering a wider array of legal expertise. One of its local modules deals with sections 16 to 20 Sale of Goods Act 1979 (SGA).

An end user remotely accesses JCS's JAES via the Internet in order to resolve a particular SGA dispute. However, JAES' knowledge base has not been amended to take account of a hypothetical amendment to the SGA. Imagine hypothetically that an amendment has been passed by statutory instrument and there is a new s18A which is not reflected in JAES' knowledge base. Therefore external legal knowledge needs to be accessed. Other web service systems are available which include the hypothetical s18A. The trans-process system of JAES therefore interacts with the WS authority and the WS commercial registry to validate, authorise and communicate with the target web services. Only those web services are invoked where the provider is authorised (WS Provider B, in this case). The WS authority details any authorisation descriptions, pricing details per consumption and any formal contracts between the JCS and the provider for every available web service. Once these necessary steps have been established, JAES can incorporate the s18A knowledge into its inference process for decision making by passing a set of XML parameters to the remote web service through the security infrastructure adopted by JCS. This hybrid design allows external knowledge bases from distributed JCS authorised partners to dynamically interact with JCS's existing infrastructure, and resolve a legal problem via remote web services invocation. Furthermore, any amendments to English law can be incorporated without redesigning JAES. The only process required is to amend the internal tasks of web services, which is a task carried out by the service providers. A system operating over a distributed enterprise model may require quick and efficient access to any new knowledge when it is not built into its existing framework of expertise. This access can seamlessly be integrated to any business infrastructure by using SOA web services technology. With conventional approaches, any modifications or addition to the knowledge base may either require extensive changes to various existing components of the expert system such as its data structures, functional routines and existing control processes, or forces a complete re-write of an entire expert system. The proposed architectural description has various system components described in a modular way, thus changes to any of its components can be made relatively independently, making the system flexible and reconfigurable to future changes.

Similarly the advantage of being able to access external sources of expertise without issues of compatibility using the SOA element of the hybrid architecture have been seen in example 1 in section 3.1 above where external US legal knowledge may be required and in example 2 in section 3.3 above where new law requires a totally different knowledge base.

5. Will the next generation of systems overcome the challenges?

Hitherto the problems posed by expert systems in the domain of legal practice have been formidable. The complexity, uncertainty, and dynamic nature of legal advice have acted as significant barriers to the development of effective and useful commercial applications. Financial disincentives have also impeded the development of commercial legal applications of expert systems on the supply side. Cost effectiveness of traditional expert system software loaded on to a stand-alone computer or local area network has been questionable therefore restricting the demand for such systems.

Case based reasoning offers the prospect of reflecting more accurately the complexity and dynamic nature of legal reasoning than purely rule based approaches. In common law jurisdictions the change emanating from case law precedents can be accommodated more efficiently than in a purely rule based approach.

Blackboard architecture and the scope it gives for using different reasoning techniques including both rule based and case based and multiple expert systems in a collaborative manner is a better way of attempting to use artificial intelligence to deal with the multi-faceted, interconnected, and open-textured nature of legal problems than traditional methods that rely exclusively on single systems confined to a highly selective discrete area of law. Blackboard architecture also offers a better solution to legal updating through its inherent modularity and the flexibility deriving from its lack of dependence on one system.

Service oriented architecture for its part offers the next generation of systems the full unrestricted potential of the web both to access external sources of knowledge and expertise and to make the expertise available to a global market. The advanced techniques of service oriented architecture for overcoming the technical obstacles of compatibility open up new dimensions for exponential development of a new generation of legal expert systems. The prospect of accessing multi-jurisdictional legal expertise in a globalised economy will be demand led. Updating web based systems is considerably less cumbersome than traditional methods. Legal service providers that do not have the time or resources to update systems have the option available to outsource this function to external sources of expertise.

Hybrid integration of blackboard architecture with SOA combines the advantages of both designs to considerably improve functionality in the next generation of legal expert systems. Internal multiple expert systems using blackboard architecture can also access as and when required unlimited external sources paid for on a software use basis. The prospect of delivering legal expert advice digitally by remote means to an unlimited number of users free of technical barriers makes the whole process of expert system development more economically attractive and the financial disincentives less of a barrier. Enhanced cost effectiveness in paying for expertise only when it is required will lead to increasing demand for cheaper and faster commoditised solutions in the next generation of expert systems. In a highly competitive and challenging legal market place this client driven demand may prove irresistible.

To address the question implicitly raised in the title the advances in web technology and hybrid applications of blackboard architecture and SOA are likely to result in the dawn of a new era of development and growth in the next generation of enhanced legal expert systems. The next generation will see significant improvements on current systems by utilising the techniques analysed in this article. Untapped potential for their application in selected areas of legal practice will be realised by competitive market pressures and technical progress. However, the next generation of legal expert systems will not be able to surmount all of the problems raised by the challenging, open-textured, and dynamic domain of law. In particular the problem of uncertainty of facts and the uncertain application of the law to particular problems cannot be totally eliminated. The appropriate role for the next generation of legal expert systems will be to supplement and augment traditional legal advice. Although the total replacement of the lawyer with a digital machine may be the desired objective of many, the unique challenges of the legal domain will continue to prevent the practical realisation of this aspiration even in the next generation of legal expert systems.

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