



5th BILETA Conference British and Irish Legal Technology Association

Creating a Civil Jurisdiction Adviser

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Keywords: Legal expert systems - civil jurisdiction - statute and common law - development methodology - expert system shells -Crystal.

Abstract: After expanding the legal background, the paper explains the methodology, specification and implementation of the two expert system knowledge bases developed in the field of Scottish and EEC civil jurisdiction. The paper discusses the feasibility of using expert system shell generally and of Crystal in particular and concludes that worthwhile and evaluateable work can be done within such constraints.

1 Introduction

This paper is in two parts. Part I concerns the Civil Jurisdiction Adviser developed by John Huntley and Alastair Mennie; Part II concerns the FAMKB system developed by Lilian Edwards as part of an MSc project at York University. Part III is a general conclusion. The two projects are closely interrelated and are a result of close collaboration between the authors. The aim of the paper is to address the development of the respective systems and the development lessons learned.

2 Part I: The Scottish Civil Jurisdiction Adviser: CJJA

There was, and still is in Scotland, a degree of unease about the complexity of the new rules on civil jurisdiction, an area which the lawyer will inevitably encounter every time that he or she envisages litigation. The complexity was introduced by the Civil Jurisdiction and Judgments Act of 1982 which came into force in January, 1987. The unease set in when new court rules in Scotland turned the drafting of initial writs inside out. The extent of the unease became clear to at least one of the authors when the seminars on the new legislation which he ran were attended by hordes of perplexed solicitors. EEC law had finally hit the Scottish practitioner, who now had to work with concepts and structures which hitherto had been of esoteric and academic interest only.

The complexity of the legislation, together with the need for relatively quick solutions without recourse to expensive expert knowledge, are what led us to think of an expert system in this area. Thus, although we were acutely aware of the practical and jurisprudential reservations about the design of expert systems and of the strong resistance of the profession, we decided that it was nevertheless a fruitful field for experimentation. With the help of a grant from the Nuffield Foundation, we established a small research team comprising Lilian Edwards and John Huntley and enrolling the help of Mastair Mennie, Advocate, a leading Scottish expert in the field.

2.1 The Legal Background

The Member States of the European Communities realised at an early stage that differing civil jurisdiction rules amongst them had a distorting effect on the establishment of a common market. In the Brussels Convention on Jurisdiction and the Enforcement of Judgments in Civil and Commercial Matters 1968 (the Brussels Convention), therefore, they agreed that, wherever possible, actions should be brought in the courts of the State where the defendant is domiciled: Article 2, paragraph 1 of the Brussels Convention (this paper and the Civil Jurisdiction Adviser are not concerned with the enforcement of judgments). This utilised the most common basis of jurisdiction throughout the Member States and would introduce a necessary and marked measure of uniformity since domicile as applied in the various Member States had a fairly uniform application. Hence, there would be no need to establish a uniform meaning of domicile within the Brussels Convention. Indeed, Article 52 expressly reserves the courts of each Contracting State the determination of domicile within that State. Furthermore, to encourage uniformity, reliance on what were considered as exorbitant bases for jurisdiction, such as nationality, would no longer be relied upon where the Brussels Convention applied.

The intention was to establish uniformity only in matters which were truly civil or commercial, so that Article 1 of the Brussels Convention excludes certain categories of subject matter for the avoidance of doubt.

Even so, it was clearly neither practical nor desirable to make domicile the exclusive basis for jurisdiction; indeed in some circumstances it would be necessary to supplant domicile with some other basis for jurisdiction. Consequently, there are two major exceptions to the domicile rule: first, in certain circumstances, certain courts are stated to have **exclusive** jurisdiction over certain categories of subject matter, regardless of domicile (Articles 16 to 18); second, certain courts would have jurisdiction in addition to the courts of the defendant's domicile, if a **special** basis for jurisdiction could be established.

The Brussels Convention also recognises that jurisdiction over **insurance matters** (Section 3, Arts 7 to 12) and **consumer contracts** (Section 4, Arts 13 to 15) required special regimes.

The result is that the Brussels convention created a self-contained, uniform regime for civil and commercial jurisdiction, applicable in disputes with an EEC dimension, the major components of which are:

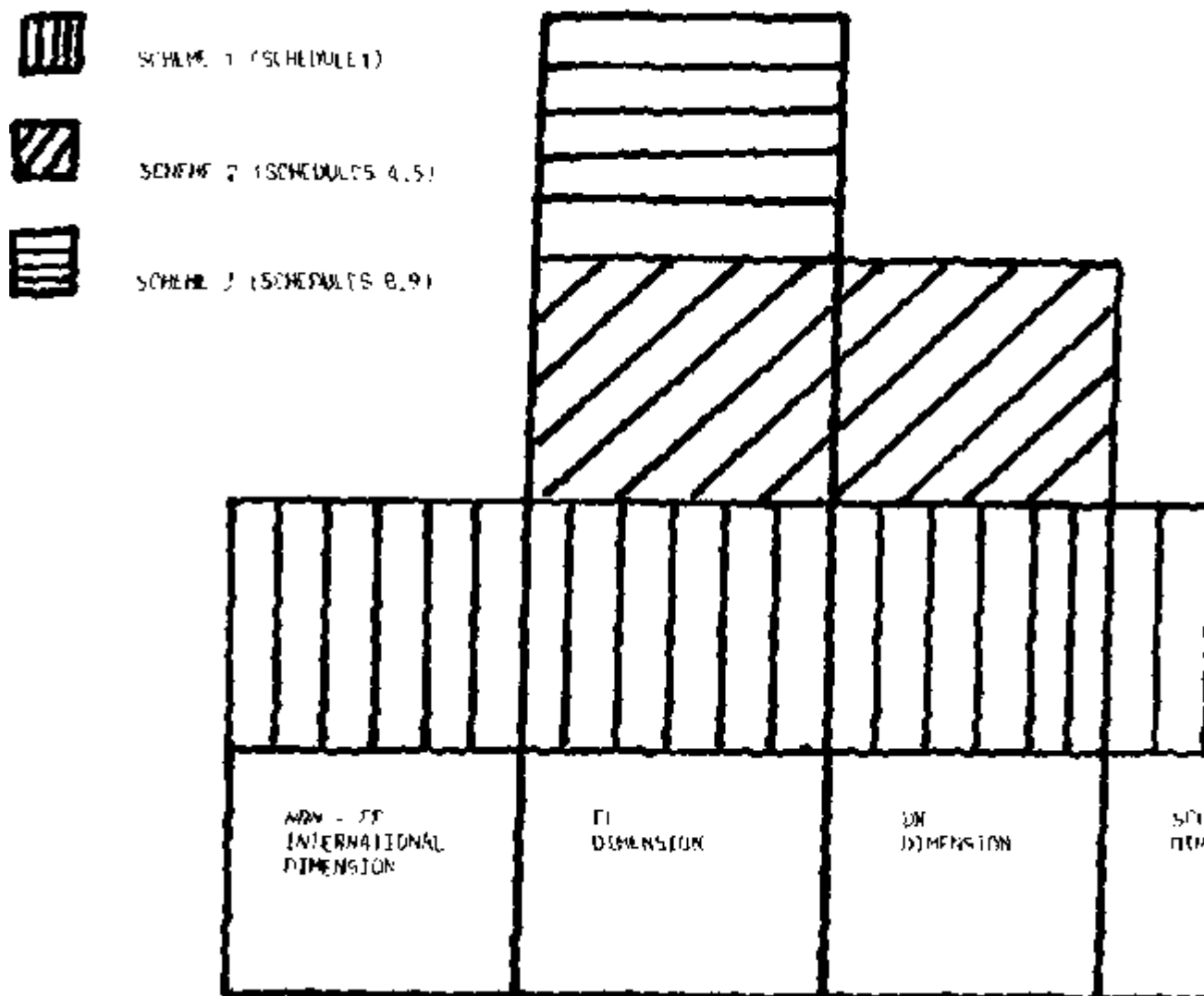
1. Matters covered by the Brussels Convention;
2. Domicile;
3. Exclusive jurisdictions;
4. Special jurisdictions;
5. Special jurisdiction regimes (insurance and consumer contracts).

Finally, to maintain uniformity across jurisdictions, it would be necessary to standardize interpretation. Hence, by means of the Protocol on the Interpretation of the 1968 Convention by the European Court, 1971, the European Court of Justice was given the power to give preliminary rulings on the new rules, much in the same way that it does under Article 177 of the Treaty of Rome. Furthermore, an authoritative report on the interpretation of the Convention prepared by Mr P Jenard (the Jenard Report) would also facilitate uniformity.

When the United Kingdom, Denmark and Eire joined the Community, an Accession Convention was signed in 1978. This Convention made minor modifications and scrapped exorbitant bases for jurisdiction in the acceding States, such as jurisdiction based on presence in England or arrestment **ad fundandam jurisdictionem** in Scotland, in matters covered by the Convention. It left two major matters unanswered: first, the definition in UK law of domicile for the purposes of the Conventions;

and second, the allocation of jurisdiction between courts amongst the various law districts of the United Kingdom (the Report prepared by Professor Schlosser on the 1978 Accession Convention is the equivalent for the Accession Convention of the Jenard Report for the Brussels Convention). Thus, when the EEC scheme established by the Conventions was eventually implemented in Part I of the Civil Jurisdiction and Judgments Act 1982 and Schedule 1 thereto, a common definition of domicile was established in Part V (Sections 41 to 46) and a second scheme for the allocation of jurisdiction amongst the law districts was created in Part II of the Act and Schedules 4 and 5 to the Act. This UK Scheme replicated the Convention to a great extent, but in key and significant areas it differed from the EEC Scheme.

When the Committee established to consider the effects of the Conventions on Scottish jurisdiction reported in 1980 (the Maxwell Report 1980), its major recommendation was that, because the Scottish rules on jurisdiction so closely resembled those of the EEC Scheme, Scottish rules of jurisdiction should be amended to conformed as closely as possible with the EEC Scheme. Clearly the exorbitant bases of jurisdiction would remain where the Conventions did not apply, but domicile as defined by the 1982 Act would become the normal basis of jurisdiction. Part III of the Act (Sections 20 to 23) and Schedules 8 and 9 thereto thus create a third, Scottish Scheme of jurisdiction. The interrelationship between the three Schemes is explained in Figure 1.



This seemed a laudatory effort at harmonization and a rational simplification. The effects, however, were far more complex. Scots lawyers, unlike their English counterparts, were to be faced with three

separate but interrelated Schemes and would have to deal with the new structure and concepts of the Conventions in every case where litigation was contemplated. The major complication, however, is that it is often unclear which particular scheme covers the fact of a particular case. The complexity is compounded by the changes in the rules of Scottish courts which make it necessary, from the initial writ, to make appropriate averments or statements as to jurisdiction or risk having the writ returned. The solicitor, therefore, must either have a comprehensive knowledge of the new Act and its fourteen Schedules (somewhat unlikely), or be prepared to devote much time to poring over the primary or secondary sources on the subject (there is very little Scottish published commentary on the Scottish rules). The solution is the development of rules of thumb in the drafting of averments: precisely the kind of development to which expert systems lend themselves.

2.2 Building the System

We were, as has already been stated, aware of the reservations about the development of expert systems and of the fact that much research is currently being done on their jurisprudential justification. Nevertheless, we were and remain convinced that there are features about the domain of civil jurisdiction which make it eminently suitable as an expert system development. We were undoubtedly influenced by Richard Susskind's (Susskind 1987) sanguine analysis of the jurisprudential issues. We agree that jurisprudential rigour is necessary in the construction and evaluation of systems, but that there are no conclusive theoretical or practical objections to the development of at least rule-based expert systems in law. In particular, we feel that many of the jurisprudential objections apply to legal method generally, rather than to the mere representation of expert legal knowledge in program form. Recent literature supports the view that a systematic approach and a clear statement of expectations can lead to results which at the very least can be evaluated (Martino, Oskamp, Walker et al in Vandenberghe 1989; Koers et al 1989).

2.3 Choosing the domain

Why, then, choose the daunting area of civil jurisdiction in Scotland after 1987? Capper and Susskind's elaboration (Capper and Susskind, 1988), was particularly useful on domain selection. We should therefore suggest the following elaborations on their guiding principles.

First, we should agree with Oskamp (Vandenberghe 1989) that expert system development is more appropriate to certain levels of legal knowledge than others. However, whereas her analysis differentiates between two levels, primary level advice and secondary level advocacy, we should suggest that a third category, procedural or adjectival rules, is an eminently suitable domain. It is an area which tends to avoid probability and one where an heuristic approach is reduced to a minimum (in other words, such rules as there are, are clear). Being, therefore, primarily rule based, it has the added advantage that the practitioner is bound to have recourse to the rules in ordinary practice. If he is an expert in the field, he will not need an expert system; but if, as is often the case, he has the knowledge to deal with the standard case but not that to deal with the complexities which inevitably arise, he may be more likely to benefit from the system. This is particularly true of the new civil jurisdiction rules in Scotland.

Secondly, therefore, we took account of the fact that the domain was complex enough to demand expertise, rather than common sense, and complex enough to benefit from knowledge processing. Furthermore, we took account of the fact that the domain was inherently difficult and that, in the interrelationship of the three schemes, even the expert would take time in arriving at the answer. This was amply illustrated to us when a practitioner colleague, by no means a novice in the field, took a weekend to determine jurisdiction in an instance where the program, prototype in the extreme as it then was, took a couple of minutes.

Thirdly, the domain should be virgin territory. Expertise in the domain must be scarce. As has already been stated, in many areas of procedural law, that expertise will be common currency; but in the law of civil jurisdiction on Scotland after 1987, the number of "experts" were at the most a handful and the conditions for developing an expert system seemed favourable. It should also be added here that, in the present context, scarce means not readily available to the user, rather than merely numerically scarce.

Fourthly, taking account of the literature on jurisprudential reservations, it is preferable that the domain be rule-based. This tends to be more true of statutory as opposed to case-based domains, though it is inaccurate to think of the two as alternatives. The logic of the 1982 Act particularly lends itself to a rule-based analysis. To establish which court has jurisdiction, or whether a particular court has jurisdiction, a series of clear "yes/no" questions must be answered. This is in sharp contrast with, for example, a similar EC domain, product liability, on which we have also been working, but which generates problems which demand probabilistic evaluation. For example, whereas the typical jurisdiction question might be "Is the defender a natural person", the typical product liability question might be "Is the product defective?" The civil jurisdiction regime, however, although complex, is rigidly rule-based, with critical paths a key feature.

Of course, none of this means that the domain is not plagued by some of the difficulties to which legal expert systems are exposed, as many writers have pointed out. For example, a great advantage of civil jurisdiction is, as has been stated, the fact that it is **tabula rasa**. Yet this could, in theory at least, create a vast number of undetermined hard cases to which no solution is clearly given by the legislation. Furthermore, the authors were clearly aware that the problem with hard cases is that it is difficult to predict their existence. They are the black holes of jurisprudence. To some extent, however, many of the difficulties have been anticipated in Schlosser and the other official reports, so that the possibility of resorting beyond the normative structure of the Schemes is minimised. Furthermore, the solutions in such Reports are to some extent integrated into the normative structure since they are given official weight in the scheme of the Conventions and of the Act itself. In any case, the authors tend towards the view that solutions to hard cases of this type are readily reducible to rules in the vast majority of instances, because the solutions are part of the rule structure. To the extent that the European Court of Justice has often exercised policy discretion, even here there is a large measure of predictability, in that the discretion will be used to give interpretations in favour of the standard application of the central rule: that the defender be pursued in the place of his domicile. The internal device is that discretion will be exercised in the light of the basic rule. Additionally, there is a degree of open texture and fuzzy logic in this area of the law, as in any other. However, as a highly structured piece of legislation, backed by a systematic commentary and case law this is an area where fuzziness and open texture is minimalised (By contrast, open textured concepts were the primary area of difficulty in developing the knowledge base FAMKB).

Fifthly, following Capper and Susskind, civil jurisdiction in Scotland is eminently identifiable and self-contained and of manageable dimensions or modules. In Scotland, at least, there is little need to look beyond the domain once it has been established that the Act applies. There is a manageable amount of case law, specific to the domain, which will develop as a self-contained adjunct of the legislation. The same could be said of the commentaries, textbooks and the still manageable number of articles in legal periodicals.

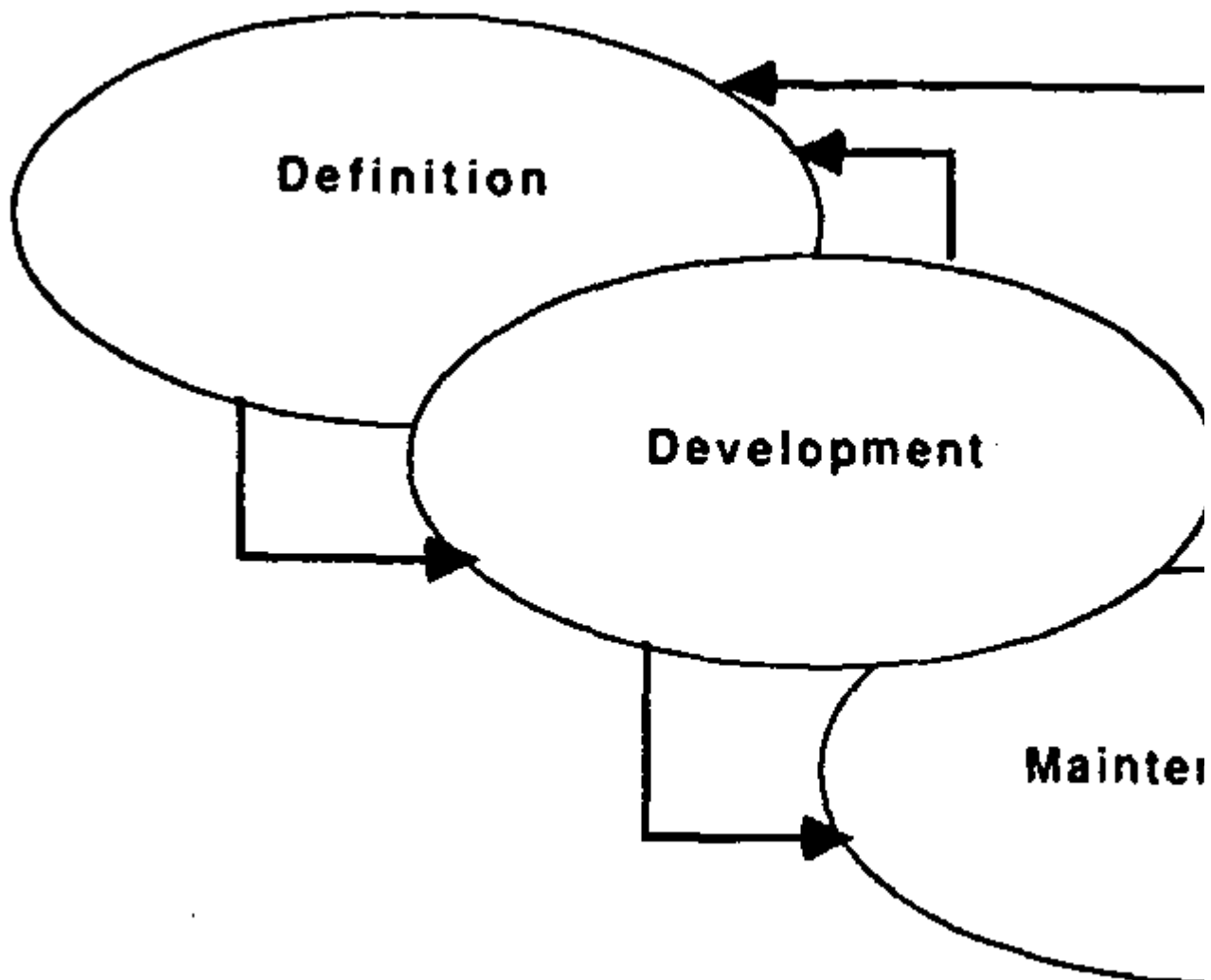
This does not mean, of course, that the domain is small. The parameters of the domain were defined as the 1982 Act, the Conventions which it implements, its Schedules, the Official Reports (ScMosses and the others), the amendments to the English Rules of the Supreme Court, the Acts of Sederunt implementing the Scottish amendments to the Court of Session and sheriff court rules, the case law of the European Court of Justice, the UK case law and the numerous books and articles on the domain. What we lost in terms of compactness, however, we gained in having a domain that was clearly identifiable and self-contained. In particular, the fact that there were clearly definable compartments to the legislation meant that it could easily be modularised to facilitate development.

Sixthly, the domain was suitable because of the recurrence of the problem which was being addressed. Every civil case in Scotland must now contain averments on jurisdiction.

Finally, the domain was suitable because it was not volatile. It is unlikely that the EEC will fundamentally review the jurisdiction rules which it has taken almost thirty years to implement. There will, of course, be development of the law, but this is merely an aspect of the maintenance stage of the systems life cycle.

2.4 Development methodology

Much has been written on software development methodology (but see below), focusing on the identification of the software life cycle. Diagram 2 suggests a three-stage generic paradigm of Definition, Development and Maintenance. More sophisticated models, such as Royce's "waterfall" (Royce 1970) and Boehm's "spiral" (Boehm 1988) suggest that this is an oversimplification and that the development process is far more reactive and incremental. Capper and Susskind offers the most sophisticated development paradigm for expert systems in law (Capper and Susskind 1988) and the methodology suggested by Koers (Koers et al 1989) has much to commend it.



As many before us have found, the key factor in expert system knowledge base design is the relationship between the knowledge engineer and the expert. To a great extent, those roles in the CJA project are taken by Huntley and Mennie respectively. To a great extent, therefore, the development of the system evolved around the working relationship and practices evolved between them.

That being so, the development methodology comprised the following:

1. Requirements/specifications;
2. Modelling and mapping;
3. Prototype design;
4. Testing and validation;
5. Delivered system;
6. Maintenance.

There is, of course, a high degree of overlap between the various stages and there is a need for constant review of each stage as the project progresses (see diagram 3).

2.5 Choosing the development tool

A variety of choices were, in theory at least, open to us. Conventional programming languages are varied and readily available, but are generally not suitable for knowledge base representation. Artificial Intelligence languages, such as PROLOG, are undoubtedly more suited to the demands of expert system design, particularly where there is a significant heuristic element.

Why, then, did we select the Crystal shell? Given time and resource constraints, we were not particularly concerned to develop our own shell. Notwithstanding the limitations imposed by shells and particularly those imposed by Crystal, we wanted to set up a prototype in the domain as quickly as possible. Since the programming resources available to us were limited, a shell was the convenient answer. Crystal was easy to learn, cheap and sufficiently flexible. In particular, it was a rule based system which would suit the rule based structure of the domain. Furthermore, we had to design a system which could be easily modularised and readily altered. The relatively simple command structure of Crystal lends the system internal portability. In any case, once we had developed the expert system knowledge base within Crystal, that expertise could readily be reworked in an appropriate language. Crystal also provides a very user-friendly interface. The most important feature for us, therefore, was that we could develop a structured, presentable system within the shell, whereas we lacked the facilities, inclination and expertise to develop our own shell or develop a knowledge base using an AI language.

Of course, we were aware of the limitation. In particular, we could see that the fact that there was no backward screening facility meant that the system would inexorably march to a conclusion and there was limited scope for looping through Crystal's "Restart" rule. The user would be locked into the logic of the shell. Bearing in mind that the domain itself was inexorably structured to identify whether there was jurisdiction and, if so, on what basis, this seemed a small price to pay. It was also clear to us that the shell imposed overall design constraints. It would be like trying to build a kit home rather than designing one from scratch.

A major limitation which we anticipated and quickly encountered was the limited extent to which factual information could be displayed in a Crystal developed database and the relatively blunt tools within Crystal for so doing. In common with Capper and Susskind, Oskamp and Walker et al (Vandenberghe 1989), we found that at some stage the knowledge base comprising the expert knowledge would have to interact with what might be called the posited knowledge in the domain: the statute, the cases, the commentaries etc referred to above. This could best be achieved through

the creation of a separate database which interfaced with the Crystal shell. It is that which led to the design of the Helptree system at Strathclyde Law School, with the assistance of Bird Semple Fife and Ireland, a large Glasgow practice.

Finally, a design limitation in Crystal which we did not anticipate was the large demands on RAM made by Crystal building. We are already at the edges of limits of a PC640 and will undoubtedly have to redesign. Fortunately, the structure of Crystal and of the domain facilitate modularization, so that this does not pose a major difficulty.



2.6 Implementation

Creating the specification

The specification had to be a clear statement of the objectives of the system. Our initial question was: for whom was the system designed? If the expert advice was to be usable, it had to be created with a particular user in view. If we simply took the logic of the Statute and implemented it as an expert system, we should undoubtedly encapsulate legal knowledge - but would that best serve the end user?

Our search ended at the desk of the Scottish solicitor representing a potential pursuer, at a loss as to where he can most conveniently bring the action and what he should include in his writ. We decided on the solicitor hoping to bring his action in his local sheriff court as the most common and likely possibility. If we designed the system with this as the primary critical path, the system would take the most common jurisdictional problems first and exit, unless the facts disclosed more complex issues. Our first design requirement, therefore, was to provide the user with a statement whether an action could be brought in his or her local sheriff court and, if so, provide him or her with an appropriate averment.

To some extent, this meant turning the logic of the Act on its head. Whereas the solicitor's primary objective would be to establish whether or not the pursuer could bring his action against the particular defender in the pursuer's, rather than the defender's local sheriff court, the Act is designed with the objective of leading the pursuer to the defender's local court.

A major element in the specification was designing the system in such a way that the pursuer's solicitor would spend as little time as possible in using the system in order to get his answer. This inevitable meant taking an approach which did not replicate the structure of the Act. For example, the three Schemes within the Act each cover slightly but significantly different subject matter. There would be no point, however, in taking the user through the subject matter exemptions in the EC Scheme merely because the Act is designed with that as the primary Scheme. It ought first to be established that the EC Scheme applied: something which by definition must be rarer than the application of the other Schemes and which in any case cannot be established at such an early stage in the program. The solution, therefore, was to identify the commonality of exclusions in the three Schemes and take the user through those, and, where appropriate, out of CJA altogether and into common law modules such as FAMKB.

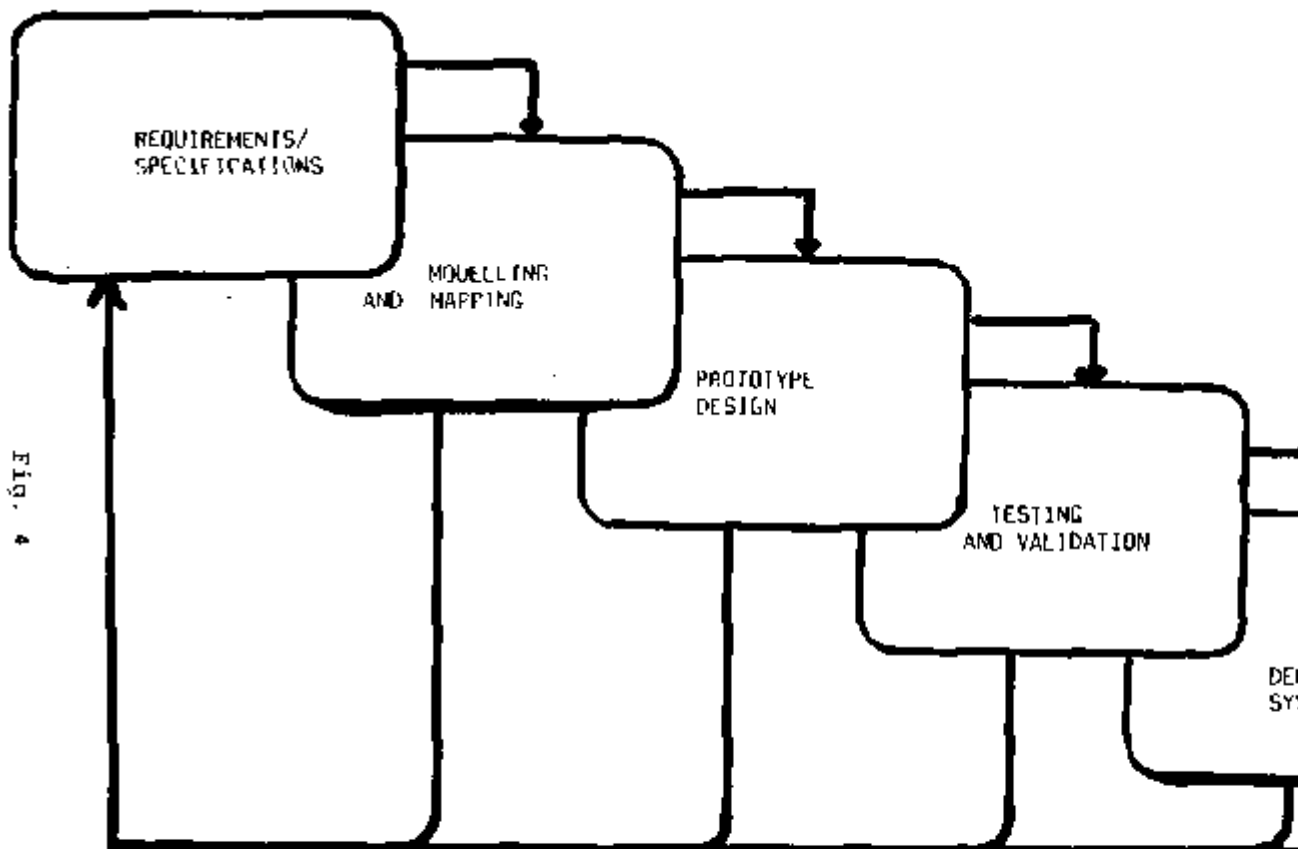
The specification would therefore contain the need for a critical path throughout the system, with the end user's needs in mind.

Thirdly, if the user's time at the terminal was to be minimised, the **sequencing** of the program's modules would be crucial. Again, this would mean even further departures from the structure of the legislation. The Act sequences the Schemes EEC Scheme, UK Scheme and Scottish Scheme. Again,

there would be little point in dealing with a Scheme other than the Scottish Scheme first, in the majority of instances.

The "explain" facility in Crystal is very basic and cannot be used to elaborate information. It is possible to build "Help" facilities within Crystal knowledge bases, as indeed we have done in FAMKB and in our Product Liability System. The device is to develop help screens for key words or concepts below any particular screen in which they arise, or to use the device for the brief exposition of cases, statute and other explanatory material. This can be very limiting for the user, demanding on memory and make significant programming demands. We therefore decided, as part of the specification, to follow a pattern similar to Capper and Susskind. We decided to develop a separate document retrieval package to be used as the end-user "Help" interface for the Knowledge base developed in Crystal.

Finally, it was decided that, for the purposes of the research project, it was not appropriate to include the special regimes for insurance and consumer contracts. Separate modules could be designed and added later once the basis specification had been implemented. The final specification is represented in Diagram 4.



2.7 Modelling

At the earliest stages of development, modelling took the form primarily in flow charts, although there is a strong temptation to use Crystal as a direct design tool. The advantage of Crystal in design is the speed with which the structure can be created. As the prototype developed, it became increasingly necessary to map the system. This can be laborious, although essential once the prototype has reached a level of complexity which makes it difficult to trace rules within the knowledge base (it should be noted that Crystal has a useful rule trace facility built in). We found that the facilities in Crystal for obtaining print-outs, even in tree form, particularly useful in mapping.

2.8 Prototype Features

The Exceptions Module

The great advantage for Scots lawyers of the 82 Act is that it applies the new scheme throughout. Thus, unlike the rest of the UK, but in common with the rest of the Community, the Scots lawyer should need to refer to a single set of rules. However, because the rest of the UK, for a variety of reasons, decided not to adopt the new structure in its entirety, there are in fact three schemes: the scheme which applies to disputes involving another EC state; the scheme which applies to disputes which involve more than one jurisdiction within the UK; and the scheme which applies to Scotland internally, or where another jurisdiction, other than another EC or another UK jurisdiction is involved. As one might expect from a parliamentary draftsman, the Act is drawn up in such a way that each different scheme states the subject-matter to which it applies.

Unfortunately, the subject-matter of the three schemes differs. We were thus faced with the problem of whether we should adopt the Act's structure of the three schemes and risk alienating the user with much material at an early stage which would in most cases be irrelevant to his action; or analyze the three schemes, find the commonality of subject-matter between them and expose the users only to those. We chose the latter course, which would also mean that we would not attempt to push the user into one particular scheme out of the three at a time when we had not yet obtained enough information to make a rational judgment on the matter. The menu we eventually devised referred the user only to those subject-matter exceptions common to all three schemes. At a later point in the consultation, when there would be adequate information, the system would refer the user to the exemptions peculiar to the scheme which had been identified as covering his case.

We recognise that there is here a trade-off. The expert view was, however, that the exceptions peculiar to the schemes are so rare, that no great inconvenience would be caused to the user if reference to them was delayed. For example, how many actions are likely to involve the application of Section 6 of the Protection of Trading Interests Act 1980? If we were to ask the question at this early stage, all we would be able to do would be to store it in memory until such time as we had enough evidence to determine the applicable scheme: a pointless exercise.

Originally, we had designed the menu to set a simple numerical variable depending on the user's selection of a particular subject-matter. The effect of any such choice was that the system would succeed and exit once the user had been informed that the subject-matter of his action was outside the scope of the Act and must be brought in accordance with common law rules. It soon became clear that this was simplistic, because part of the action might be exempted, whereas another part was not. What was needed was a matrix structure, allowing a yes/no response to each exemption possibility. Designing the array necessary is a relatively simple matter within Crystal, using a combination of standard programming commands and the Crystal "restart" command. Despite the vastly increased programming and the not insignificant use of memory, the array made the interaction with the user much more flexible and the responses from the system much more finely tuned.

Exclusive Jurisdictions Module

Having established that the subject-matter is within the convention, the writers had to envisage what the next appropriate question was. As has already been said, civil jurisdiction is more or less virgin territory and the steps would have to be determined almost in a vacuum. The structure of the Act suggests that the next matter to determine would be the domicile of the defender. This, however, would again be illogical, since the defender's domicile is irrelevant in cases of exclusive jurisdiction. We therefore decided to consider exclusive jurisdictions before consideration of domicile.

Since the exclusive jurisdictions are common throughout the three schemes under the Act, it was a relatively simple matter to devise a single variable menu to determine whether the action is within the exclusive jurisdiction of a particular court or system of courts. It was not thought necessary to establish a matrix of variables here as was necessary in the subject-matter menu, although this is a matter which the authors may yet have to revise in the light of experience. In the unlikely event that more than one category applied to the facts of the case, we allowed the user to select a menu choice to that effect and allow the system to reloop.

The Lugano Convention of 1989, which extends the EEC civil jurisdiction rules to EFTA, did, however, present us with some problems. In relation to leases, the new convention's rules are slightly different from those in the original convention, as interpreted and applied by the ECJ in **Rosier V Rottwinkel**. Designing a sub-module which took account, not only of distinctions between heritage (real property) and tenancies, between tenancies covered by the **Rosier V Rottwinkel** exception and those not, and differentiating between tenancies or heritage within the EEC and those within EFTA, was at least a bad dream, if not actually a nightmare.

A more difficult issue to resolve was whether it was appropriate to deal with the issue of prorogation clauses at such an early stage when it had not even been established that the action concerned a contract. The basic fact, however, is that the Scottish rules of court require the pursuer to deal with the matter of prorogation, regardless of the subject-matter of the action. Since a prorogation clause would also normally confer exclusive jurisdiction under two of the three schemes at least, it was appropriate to deal with the matter at this stage.

The Domicile Module

This is an area where modifications had to be made continuously as the prototype was developed. The law is fraught with uncertainty and the rules vary significantly, depending on whether it is intended to bring the action in the sheriff court or in the Court of Session. Domicile has to be established for the jurisdiction of the particular court. Not only that, but the rules of domicile differ, depending on whether the defender is a natural or a legal person. This proved to be the most difficult series of sub-modules to design, but great care was taken in so doing, because of the key role of domicile in the three Systems.

The Special Jurisdictions Module

The major problem we confronted in designing this module was that at this stage, it would be essential to know by which scheme the action is covered. The Scottish Scheme's special jurisdictions list is far more extensive than that of the other Schemes. From the information already gathered, therefore, it was relatively easy to guide the user to the appropriate Scheme's special jurisdictions list.

The Additional Exceptions Module

Having established that there is a basis for jurisdiction against the defender in the action, and having established the Scheme within which the action fell, it would at this stage be appropriate to deal with the additional exceptions from the legislation. This is done by merely referring the user to a simple menu choice.

We could be criticised for allowing the user to wend his or her way through the system, only to find at the last hurdle that the action does not in any case fall within the legislation. The problem was, however, one of trade-offs. To put the user through laborious lists of exceptions, all of which are extremely unlikely to cover the case, was a matter which we felt was best delayed. In our view, the additional exceptions menus are simply final check-lists.

Figure 5 shows as a flowchart the interrelationship between the major knowledge base modules.

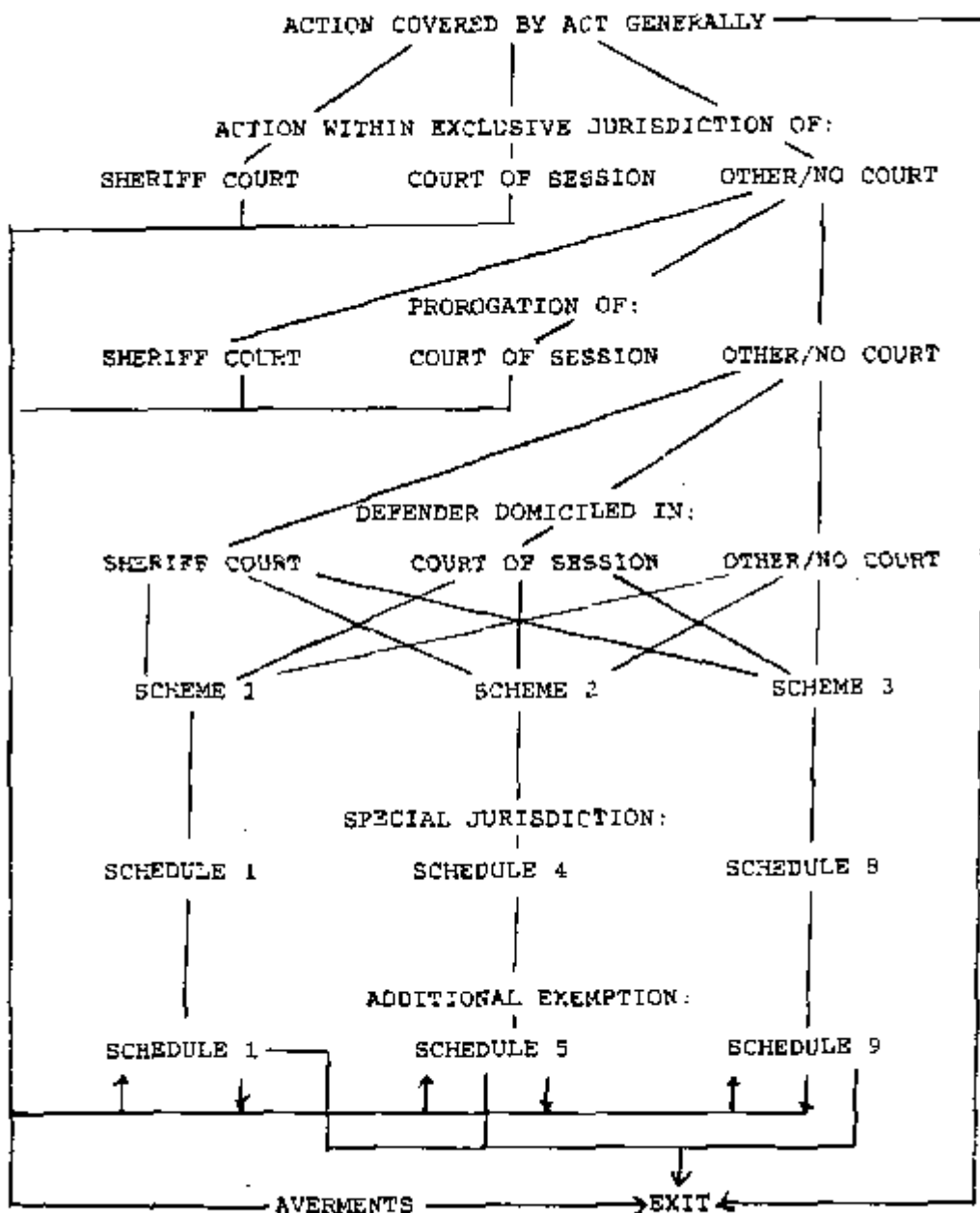


Fig. 5

3 Part II: Expert System in the Law of Jurisdiction in Family Matters -FAMKB

As noted above, work on civil jurisdiction has so far formed two parts: a knowledge base devoted to the rules of Scots law arising from the Civil Jurisdiction and Judgments Act 1982 (CJJA 1982), whose development and implementation has been discussed in the paper thus far; and a knowledge base devoted to the Scots law rules of jurisdiction arising from common law and statutory law pre-1982 which, despite the effect of the introduction of the 1982 Act, are still relevant to certain types of action, depending principally on the subject matter of the action. While the overall intention of the CJJA project was always to produce a complete expert system capable of answering the question of whether any action could be raised in the relevant Scottish court under the 1982 Act, it became clear at an early stage that work on the CJJA knowledge base could conveniently be divorced from the work on pre-1982 rules, and this was the basis on which the project subsequently proceeded.

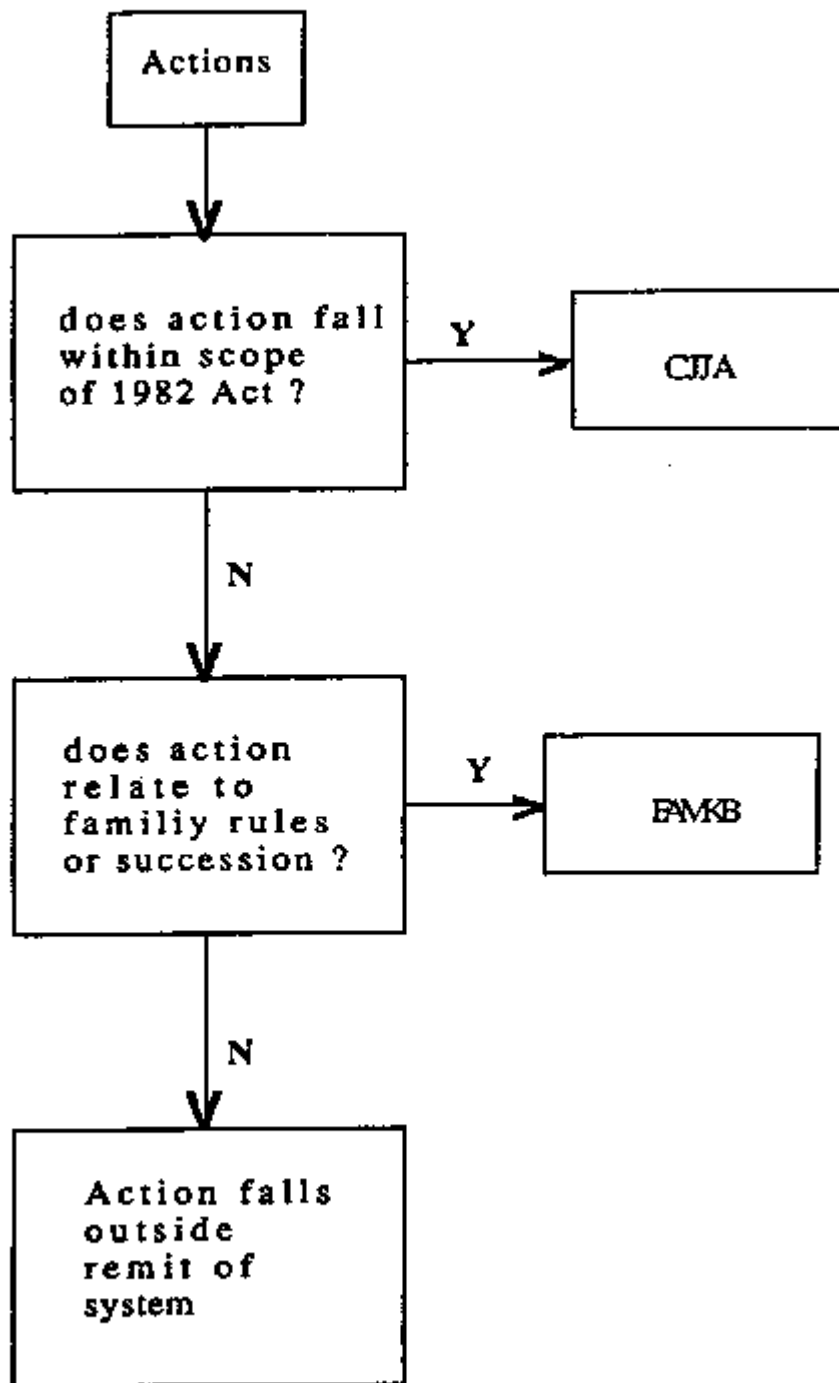
The scope of the pre-1982 module was determined by Article 1 of Schedule 1 to CJJA 1982, which specifically excludes from the regime of the 1982 Act any actions relating to (inter alia):

"the status or capacity of natural persons, rights in property arising out of a matrimonial relationship, wills and succession"

In fact within the time constraints of the project so far, only the rules relating to jurisdiction over the status and capacity of natural persons have been implemented, hence the name given to the pre-1982 rules knowledge base, FAMKB.

The effect of Article 1 is that if an action relating to any of the above matters is raised, then the rules of jurisdiction affecting it are those rules of jurisdiction that would have disposed of the case before the 1982 Act came into force. The relationship between the CJJA module and the FAMKB module is therefore as shown in Figure 6.

RELATIONSHIP BETWEEN FAMKB AND CJJA



3.1 Legal background

The rules of status and capacity demarcated by Article 1 form essentially the rules of family law. Family law was initially defined as including the areas of marriage, nullity of marriage, divorce and

separation, custody of children, legitimacy and legitimation of children, presumption of death, and a catch all area of "other rules relating to status or legal capacity".

Historically, rules of jurisdiction in the family law area have been different from those relating to commercial actions. The primary ground of jurisdiction in most family law areas has been that of domicile. So, for example, it was the rule with slight exceptions until the Domicile and Matrimonial Proceedings Act 1973 that the Court of Session only had jurisdiction to hear an action for divorce where both of the parties to the action were domiciled in Scotland.

Domicile is a typical creation of the common law, a concept which began as a sociologically simplistic and sensible idea and has become unduly complex and technical over years of development by the courts. The rules of domicile are supposed simply to signpost the country that a person regards as his permanent home. (It was the supposedly indefeasible simplicity of the whole concept which informed Lord Cranworth's famous dictum that "...by domicile, we mean home, the permanent home, and if you do not understand your permanent home, I'm afraid that no illustration drawn from foreign writers or foreign languages will very much help you to it." **Whicker v Hume** [(1858) 7 HLC 124 at 160].) It made practical sense that a person's personal status - the area that family law is concerned with - should be governed by the law of the country that he regarded as his permanent home rather than that of any state where he made a temporary residence or chose to raise an action. This concept, that personal status should be referred to the law of one's domicile (**lex domicilli**), as opposed to the law of the country where one goes to law (**lex fori**), is the expression in Scots (and indeed, UK) law of the idea known as personal law.

Following on from the idea that the law of the domicile should govern actions of personal status, it became the rule that a court should only accept jurisdiction in most family law actions if one of the parties to the action was domiciled in the country of that court. This was an acceptable restriction - the Scottish courts do not have an interest to hear the affairs of strangers - so long as the concept of domicile truly signified a person's permanent home. However, case law has progressively elaborated the concept of domicile to something increasingly artificial, technical and hard to prove. The concept has become cluttered with a superfluity of rules. For one thing, domicile is assessed according to different rules for children and adult. For another, it is often recursive, with the domicile of one person depending on the domicile of one of his parents, and so on, leading to an evaluation of historical evidence which may be scanty and difficult to assess in value. The domicile of adults is particularly problematic, since it will almost always depend in practice upon the assessment of a party's intention, positive or negative, to acquire a new domicile of choice. As is always the case, the courts, not being mindreaders, can only turn to all the facts and circumstances to ascertain such **animus** -hence most cases concerning the domicile of adults turn on inferences drawn from the qualitative assessment by the courts of the idiosyncratic facts of the case, rather than on the application of clear binary rules. Domicile thus falls at least partially into that category of "fuzzy-textured" legal concepts, such as reasonableness or foreseeability, which Reed (Reed, 1987) describes as "those concepts whose truth or falsehood is not absolutely discoverable, but instead represent a continuum of behaviour, at some point on which the classification of that behaviour changes". Such concepts have traditionally been seen as hard if not impossible to decompose adequately into production rules, which are essential to the representation of the concept in a rule based shell such as Crystal. As will be seen below, the meat of the FAMKB project was spent in evaluating and producing a partial solution to this problem.

Because domicile has become such a complicated and vague legal concept, there has been a move in recent statutory law dealing with the jurisdictional rules over family matters to get away from the use of domicile and substitute for it, or add to it, the less annotated idea of habitual residence. So, for example, under the Domicile and Matrimonial Proceedings Act 1973, s7, the courts now have jurisdiction to hear an action for divorce if either party to the divorce is either domiciled in Scotland, or was habitually resident in Scotland throughout the period of one year preceding the date of the action. Most areas of family law are accordingly now governed by rules of jurisdiction in statutory

form similar to the divorce rule above, presenting habitual residence or domicile as alternative grounds of jurisdiction. On first beginning to acquire the knowledge to build FAMKB, then, it became apparent that much of the work of the system would be spent in defining rules to assess whether a person was domiciled or habitually resident in Scotland. This raised two problems, interrelated but at opposite ends of a spectrum.

Habitual residence is often referred to as an under-developed legal concept. While frequently used in statutes, it is not defined in any technical sense in any family law statute. Normally this lack would be supplied by case law, but there is an almost total lack of relevant authority defining what is meant by "habitually resident". Accordingly, it is hard to find rules to elaborate the concept in an expert system.

Domicile on the other hand is a concept that has been not so much defined as expounded upon by a multitude of cases. Since the law of domicile involves so many technical points, and since to some extent each domicile case turns on its own facts rather than on a point of principle, there are a vast amount of published cases relating to the area, not all of which by any means are entirely mutually consistent. Domicile has become such a complicated area that it is not unusual to spend most of a term teaching the law of domicile to undergraduates.

The implication of this was that while the original civil jurisdiction area had been highly suitable for expert systems development by all the pertinent criteria (see Capper and Susskind, 1988, p 34), the area covered by FAMKB appeared to be fairly unsuitable. The area of law was not self-contained, was not well defined, and contained fuzzy concepts not easy to break down into predictable rules. The fact that so much of the law was based on case law was particularly problematic.

3.2 Problems with Case Law Based Expert Systems

Generally speaking, developers of legal expert systems have tried to avoid legal domain areas for which case law is the major source of rules. While statutory law usually appears initially at least to consist of clear, if complex, rules, in case law, it may be a difficult task just to elicit what the rule is for which the case stands as authority. A case report is not a bland statement of the rules which determined the outcome of the case. In Anglo-American style, it is firstly, a narrative of such facts as were relevant to the decision, and secondly, a discussion of the legal rules which were, or were suggested to be applicable to the case, and more importantly, the interpretation which was to be put on the rules in the light of the facts of the case. What must be extracted from this totality, like a kernel from a shell, is the ratio decidendi of the case, an activity which is less than straightforward.

One judgement may contain several possible alternative **rationes**. Moreover, in many cases, there is more than one judgement and thus multiple plausible **rationes**. While all the judges may have come to the same decision, they may not have come to it for the same reason and may cite different rules to substantiate their position. A further problem is the existence of judicial opinions in the case which did not determine the instant issue and cannot therefore technically be said to be authoritative (**obiter dicta**) but which may be highly useful to the expert system builder for filling lacunae in the law or untangling controversies. These might legitimately be cited as persuasive in a case in court where the judge exists to arbitrate on their legal value, but is their use legitimate within an expert system where no such judicial validation exists?

The net effect of all the above is that while an attempt can arguably be made to achieve an objective formalism of legal rules derived from statute (the most famous and not uncontroversial example of this is probably the work on the British Nationality Act by the Imperial College team - see Sergot, Sadri, et al, 1986), such an approach is impossible in relation to case law. The interpretation of the raw data is inherently subjective, and indeed, such interpretation is a major component of the expertise of the system. Gardner (Gardner, 1987, p 48) points out that taken to its logical extreme

literal accuracy in the representation of case law can only be achieved by full-text incorporation in the knowledge base of all the operative facts -effectively transforming the system at hand from an expert system to a database. Any other approach is always open to a charge of misrepresentation.

Another problem with case-based law lies in the possibility of the existence contemporaneously of contradictory rules, put forward by courts of co-ordinate authority. Judges of a superior court have the right to overrule a case adjudged by an inferior court, but the builders of an expert system have no such right to disregard a case as "not the law". They can only try to reconcile the case with those that contradict it, or propose (preferably with good judicial authority) that the case is open to contrary interpretation, incomplete, not in point, or discredited.

A final problem is that case law is volatile. Rules derived from case law can be overruled or modified in the same way as statutory rules, by subsequent contrary cases of a superior court or by legislation to the contrary, but are more likely to change in a slower and less clear cut fashion. By distinguishing the facts of one case from another which is similar, judges can make increasingly fine distinctions in case based law. This is perceived as a virtue in the legal process since it keeps the law flexible and responsive to social change; but from the point of view of the builder of an expert system it means that updating the knowledge base may become a major problem. It should of course be noted that this is not just a problem for legal expert systems but a generic problem in the giving of legal advice. This is not so problematic if the expert system is implemented in a logic programming language such as Prolog where the knowledge in the system is structurally separate from the inference engine; but in a system implemented in a shell like Crystal, a change in the law which requires a change in the hierarchical tree structure of knowledge representation, might require major rebuilding of the system.

In fact one surprising aspect of the FAMKB project was how little difficulty these problems caused. Part of this can be attributed to the subject matter of the case law domain. Common law jurisdiction is not an area especially prone to controversy, nor to contradictory rulings by different courts, since it is essentially an area of "lawyer's law" with few policy issues at stake. Hence both the volatility of the domain and the expertise needed to derive rules from the raw cases are restricted. Even in the problematic area of domicile, the primary difficulties arose due to the judgmental nature of the concept: cases were not contradictory but simply derived from different points on Reed's continuum of behaviour.

3.3 Building the System

Specification

Initial surveying of the expert systems field disclosed no comprehensive methodology suitable to the building of a shell based system. (On this lack, see generally Jackson, 1986, p 46, and for the legal expert system field specifically, Susskind, 1987a.) Lacking a rigorous theoretical background, therefore, the system was partially modelled on paper using a mixture of and/or graphs, flow charts, decision trees and, where appropriate, modified data flow diagrams; and partially modelled using CRYSTAL itself as a fast and readily available specification tool . The overriding aim was to reduce the domain to a modularised rule hierarchy which would be suitable for implementation in CRYSTAL, be readable and therefore maintainable, and which would reduce the search space as much as possible in the most likely potential search of the system. So for example in each case where the user was faced with a choice between establishing jurisdiction on the basis of a party's habitual residence or domicile in Scotland, the option of habitual residence was explored first by the system since the depth of that search was considerably less.

As already mentioned, the original specification of the FAMKB project called for two interconnected knowledge bases, CJA, and FAMKB. At this stage, a third knowledge base was introduced to the

system, STARTKB. There were two reasons for the addition of STARTKB:

- For professional purposes, it was useful to have a "front end" which would request data such as the client's name (stored as variable name\$ and the fee-earner's reference ref\$). This data would also be useful to add to the "print out conclusion" option planned for the end of the run. Such a front end could easily have been added as a module to CJJA, but , because of shell limitations, it proved easier to build this data gathering module as another seperate knowledge base which would call CJJA using the Crystal "load" function.
- STARTIIB was a useful device to avoid repetitive viewing of introductory logo and advice screens when a re-run of consultation facility was introduced.

The initial specification of the complete system was derived as in Figure 7.



Implementation

Implementing the initial specification was in many parts quite straightforward. The purpose of this paper is not to provide a full analysis of the building process but to highlight those areas where problems of possible interest in relation to design were encountered.

The graphical representation in Figure 7 of the data drawn from the various jurisdiction statutes revealed some important points for implementation:

1. Four categories of action corresponded to a rule involving the domicile in Scotland of some party at some time.
2. Five categories of action corresponded to a rule involving the habitual residence in Scotland of some party at some time.
3. In the cases of legitimacy actions, and custody actions, there would be a need in some searches to "call" the rules of jurisdiction of some other category of family law action. This confirmed the decision to create a Crystal module for each type of action (marriage, divorce, etc.).

The most difficult design decision resulting from the and/or graph representation was whether to create a generic module for both domicile and habitual residence. In a conventional programming language, it would have seemed obvious to create modules for both. However, Crystal does not allow the creation of procedures which take parameters, which complicates the creation of generic modules. It does however allow variables to be introduced into yes/no questions and menus. However, this solution created great difficulties with respect to the user interface. First, it often appeared to require the asking of questions in an artificial order. Second, substituting in variables to yes/no questions gave a very unpleasant appearance to the screen, with unsightly gaps left on the screen each time a variable was instantiated.

The decision finally made was that domicile would be developed as a generic module while habitual residence would be developed in an ad hoc manner for each family action module. Primarily the reason for this was that domicile was a considerably more complex concept than habitual residence, involving far more rules that would have to be asked each time the concept of domicile was relevant in a module.

There would therefore have been considerable repetition of effort in the building process if domicile had not been developed as a generic module. The utility of building domicile as a module overcame the amount of work that would have to be done to render the user interface palatable.

Building the Domicile Module

As explained above, domicile was early on identified as a problematic area to implement in Crystal, since it is a complicated area of law, mostly based on case law, and hard to formalise in production rules due to the fuzziness or recursiveness of many of its underlying rules. While in much of FAMKB, the rules that were implemented in Crystal were very much the rules that could be found in any legal textbook on the area, in the field of domicile it was fairly plain that a more drastic restructuring of the domain would have to be attempted.

The classical textbook division of the rules of domicile is into:

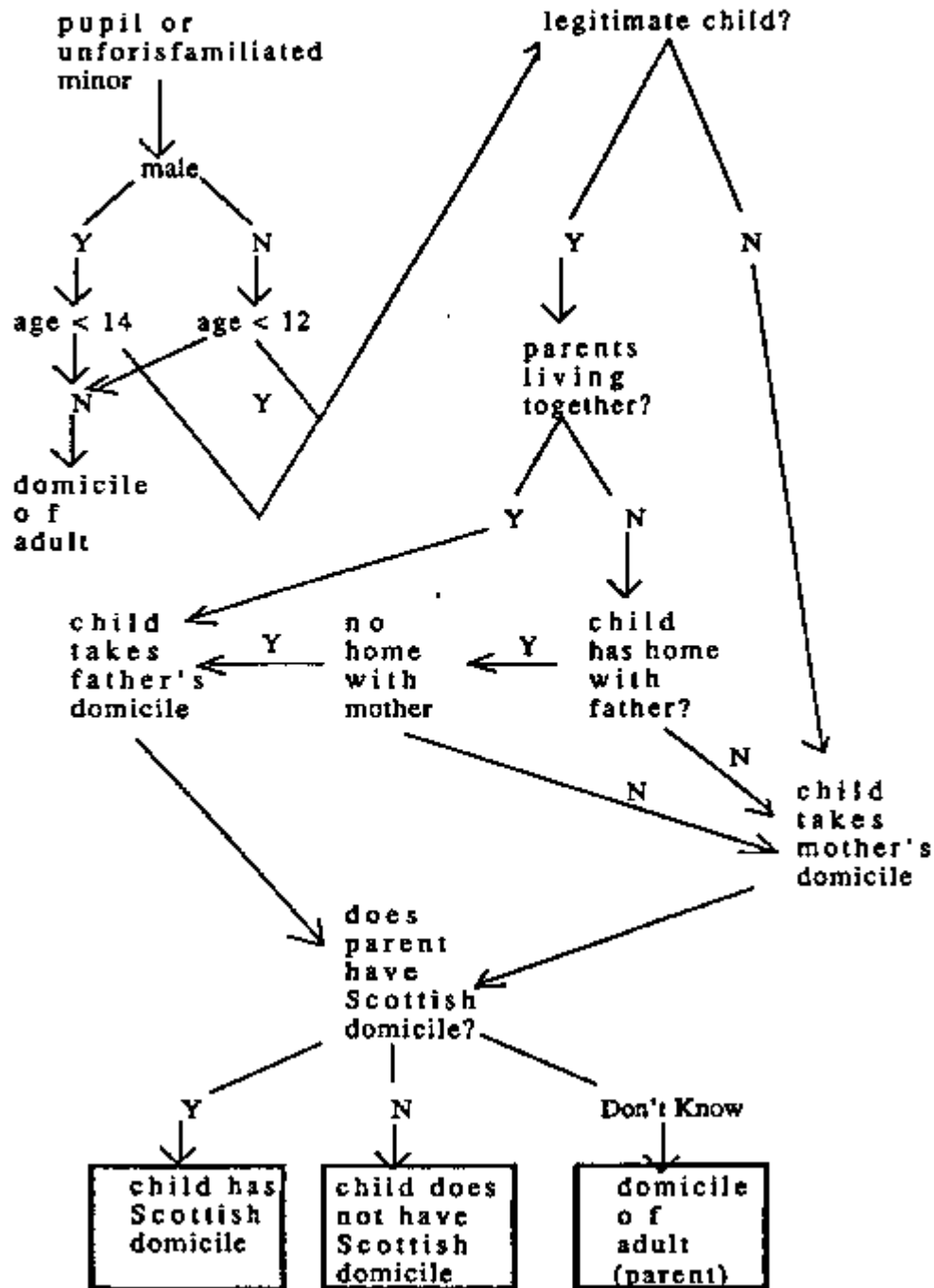
- a) Domicile of origin, which every child acquires at birth. As a rule, a legitimate child takes his father's domicile; an illegitimate child takes his mother's domicile (there are several exceptions to these rules).
- b) Domicile of dependence. If the parent from whom the child's domicile of origin is derived changes his domicile, then the child's domicile changes as well. The child's new domicile is known as a domicile of dependence. The child's domicile continues to change in this dependent fashion until he reaches the age of adulthood, at which point the last acquired domicile of dependence is retained until and unless a new domicile of choice is acquired (see below).
- c) Domicile of choice. At a certain age (that of attainment of minority in Scots law), a child is deemed to gain full capacity as an adult such as to be able to choose himself to acquire a new domicile. Such a new domicile is called a domicile of choice. The rules on acquisition of a domicile of choice are complex, but essentially there are two requirements; a permanent intention to make a new home in the new country of domicile and some period of residence in the new country of domicile.

A functional analysis of these rules reveals quickly that the real division here is between the domicile of children, which will always depend on the domicile of some adult; and the domicile of adults, which is a more complicated proposition. (For the derivation of this functional analysis, see Report on the Law of Domicile, Scot Law Com. No 107, 1987.) The search for the domicile of children can be seen as a search to find out which parent of the child should have his domicile investigated. In other words, a domicile of children module would represent a preliminary module which could then call the domicile of adults module. This division of rules into two separate modules was also jurisprudentially convenient, because the rules on children are mostly certain and derived from statute, while the rules on adults are mostly more "soft-edged" and derived entirely from case law. So while the rules about children could be implemented in a relatively straightforward way, using the usual Crystal yes/no logic, the rules about adults would probably demand a more novel approach so as in some way to represent uncertainty.

Domicile of children

The domicile of children module was modelled using a flow chart methodology (See Figure 8). Implementation in Crystal following the flow chart specification was fairly straightforward, although some augmentations were made to the flow chart specification during the building phase.

DOMICILE OF CHILDREN



Before the module proper is entered, initial data gathering menus assign values for sex and age to Crystal variables sex\$ and age (this was a numeric, rather than a string variable), which are then used in conjunction to test if the party whose domicile is being investigated falls within the remit of the domicile of children module; if not, the domicile of adults module is called instead. The initial sex and age menu questions, then, act as data gatherers for a filter which diverts a domicile query either to the domicile of adults module or the domicile of children module. The final result of the domicile of children module in all possible search paths is to call the domicile of adults module, with the variable party\$ instantiated for a particular adult (eg, "Mary Jones's father").

Domicile of adults

In contrast to the domicile of children, the domicile of adults domain presented major difficulties in formalisation and implementation in the form of clear rules.

The classic textbook approach to the law of domicile is to break it into domicile of origin, domicile of dependence and domicile of choice. Following on from this, the classic problem-solving approach to establishing the domicile of an adult is to trace the domiciles he has acquired and lost during his lifetime in a chronological fashion from birth to present day. The last domicile acquired and not lost is the adult's current domicile. The reason that the chronological search works from birth forward, rather than from the time of inquiry backwards (which would seem much quicker) lies in two technical aspects of the law of domicile. First, if no current domicile of choice of a party can be ascertained - perhaps because the party in question has abandoned his previous domicile without forming a clear intention as to where he next will settle - then the domicile of origin, assigned at birth, will revive to fill the gap (see **Udny V Udny** (1869) 7 M (HL) 89). (This accords with one of the basic tenets of domicile, the rule that at any time, everyone has a domicile somewhere.) Hence it is useful to calculate the domicile at time of birth and work forward from there. Second, there is an effective presumption in the law of domicile that the domicile of origin is highly tenacious and will not readily be displaced by the subsequent acquisition of a new residence. The most notorious examples of this in the corpus of domicile literature are the cases of **Ramsay V Liverpool Royal Infirmary** [1930] AC 588 and **Winans v AG** [1904] AC 287, where subsequent residences of 36 and 37 years respectively were held not to have displaced the domicile of choice. Thus a "snapshot" approach to domicile which does not start from the domicile at birth is more than likely to prove misleading.

The utility of this chronological approach from birth onwards has been questioned by academic writers on the law of domicile (see especially Carter, 1987) and seemed highly awkward to try to formalise in Crystal. The obvious first question to ask would be what the domicile of the client was at birth. In the presumably high incidence of cases in which the respondent would reply to this "Don't Know", the next step would have to be to try to trace the domicile of the client's father or mother (depending on whether the client was legitimate - another possible area of doubt) at his date of birth, since he would have inherited his domicile at birth from one of them. It can be seen quite easily that such an approach is infinitely recursive, and that with each generation of recursion, the chances of being able to give a definite answer get smaller not greater.

Any other approach than the chronological one, however, would have to depend on heuristics rather than rules. In other words, a better approach than the chronological method could be found, but could never be guaranteed to give the correct answer. This is because of the rule of the revival of the domicile of origin to fill a vacuum, alluded to above. If the domicile of origin is never established definitively, then, too, there will always be some cases in which the current domicile cannot be accurately established.

What other approaches than the strict chronological approach are there? The most straightforward technique would be for the system just to ask the user - who was assumed in the normal fashion to be a trained lawyer - to guess what the domicile of an adult client is. In fact, this may well be what experienced lawyers do do in practice, basing their guess on unarticulated heuristics. However, as an expert system solution it did not seem very helpful or enterprising. Furthermore, although we had assumed that our system user was a trained lawyer, we had not assumed he was an expert in the law of domicile - probably the opposite, in fact, otherwise what use would he have for an expert system in the area?

A halfway house approach might be to ask the user to make a guess about the client's domicile of origin - thus avoiding the infinite recursion problems mentioned above - but thereafter to supply him with clear rules as to how the client's domicile might have changed since birth.

This was an attractive solution except that even when the bottleneck of the domicile of origin was avoided, it was found impossible to articulate clear yes/no rules which could be implemented in Crystal as to acquisition of domicile of choice - at least ones that were not so abstract as to be less useful than looking up a textbook. The fact is that the number of factors that can legally contribute to the acquisition or loss of a domicile of choice is enormous. It is a classic "how long is a piece of string?" question. One famous dictum proclaims that a person's "tastes, habits, conduct, actions, ambitions, health, hopes and projects" are all regarded as "keys to his intention" (**Casdagli V Casdagli** [1919] AC 145 at 178 per Lord Atkinson). The user would have to be asked an endless string of questions as to where the client lived, how long he had lived there, whether he planned to be buried there, where his family came from, etc ad nauseam. Even if all possible factors could be elicited from the case law - an unlikely accomplishment - there would be no guarantee of coming to the right answer because there is no scientific method of assessing the relative weightings of the factors. No statistics exist to say whether it is more significant in a judgment that a person has, say, lived in Scotland for 10 years than that he has always said he wanted to be buried in his home in India, and if so, how much more significant. Although Crystal has facilities for adding probability weighting to rules, by means of Bayesian probability factors, it would be spurious to use Bayes without accurate statistical evidence as to the relative probabilities.

Rather than building in clear rules then, we turned instead to considering a different type of user interface. The roots of this idea lay in a criticism by Anne von der Lieth Gardner (Gardner, 1987, p 60) of the technique of asking the respondent espoused above. Gardner dismisses asking the user as an invalid AI approach comparable to a student asking the teacher for answers during an exam. Her objection is that a program would only ask for assistance in hard cases where a legal conclusion calling for exercise of informed judgment was necessary, when it would be exactly such legal judgment that was lacking in the user. Could it not then however be valid to call on the human user for the human discriminatory factor - the ability to make discriminations as to a variable question such as reasonableness or intention - so long as the system provided such legal expertise as not to call on the user at the same time for expert legal judgment? In other words, what the system could do intelligently, perhaps, was to supply the user with sufficient information about acquisition and loss of domicile of origin that he became an expert in the area, able to draw an expert conclusion - or "guess" - himself. This would involve considerable alteration of the user interface for a temporary period. The expert system, for this short portion of its run, would not engage the user in a yes/no dialogue, but would instead act as a kind of browsing hypertext help system or intelligent assistant. There should, however be an opportunity for a user who was certain about the current domicile of his client to avoid the "help system" stage.

The plan of campaign for the domicile of adults module, then, now looked roughly like this:

- a) supply basic information about the domicile of origin;
- b) ask the user to guess whether the client had a Scottish domicile of origin
- c) identify where the user did not need to use the help system. This was identified as correlating to two occasions:
 - where the domicile of origin was guessed to be Scottish and there was no reason to think it had changed - in which case the domicile WAS Scottish; and
 - where the domicile of origin was guessed NOT to be Scottish, and there was no reason to think it had changed - in which case the domicile was NOT Scottish. (Note that in both these cases we are accepting a very heuristic solution.)
- d) supply the user who did not fit the categories in (3) with access to the help system

e) ask the user, once he was satisfied with his use of the help system, to "guess" what the client's current domicile was. This will also be a heuristic solution, but it will at least be informed by expert knowledge.

The alternative would have been to force the user to go through the help system on each occasion - but it was felt this could well be irritating, especially in some complete consultations where the domicile of several parties might be successively searched.

This left only the specification of the "help system". How could Crystal facilities best be used to supply the expertise? Desirable factors for a help system included:

- a) user control over the help. The user should be able to examine it in any order and go back to a piece of data as often as desired;
- b) successive layers of help so that the system can do everything from jog the user's memory about a particular piece of domicile of law, to supply detailed references to case law;
- c) some way of getting out of help when the user is happy with the expertise conveyed;
- d) an attractive user interface.

All four factors mitigated against the simplest solution, a sequence of Crystal Display Forms (screens of text, displayed until a key is pressed). The user would have no control over the order of display of the help, or the type of help, and would be unable to back-screen to look at a piece of help again. Furthermore, FAMKB was already full of Display Forms - the change in his role in the system would not be adequately signalled to the user.

The best solution seemed to be to build a menu of factors relating to domicile of choice which could be explored as desired. Crystal supplies a very easy and flexible facility for building menus. To enable the menu to be revisited at will, it would have to be built in a loop which terminated only when the user indicated he wished to continue past the menu and on with the consultation. Crystal also supports the building of loops by means of a command called Restart Rule.

Within the loop, it should be possible to:

- select a factor from the menu;
- go to information about the factor ("domicile factor sheet");
- explore case references on the domicile factor sheet ("domicile case sheet");
- indicate when it is desired to leave a case sheet and return to the factor menu;
- indicate when it is desired to leave a factor sheet and return to the main menu;
- indicate when it is desired to leave the loop altogether.

This full specification was derived as a flow chart, as shown in Figure 9. The help system was implemented by nesting Crystal menus for each factor sheet within the general Crystal menu that lists the different types of factors available to be examined. Each factor on the general menu was expanded in Crystal to be a menu itself. Each item on the factor menu was a case reference and was expanded in Crystal to be a Display Form. A case sheet could therefore be exited by pressing Return, while a factor sheet, and the general menu, could only be exited by selecting the option "Continue't. Finally, some work was done on making the user interface of the help system unusual and attractive (at least in comparison to the rest of the system).



Other Work

Two additional features were seen as essential to the user-friendly working of FAMKB: a conclusion generation module which would summarise the results of the consultation with a printout available if desired, and a re-run module which would enable the user to run the system again in a variety of fashions. Problems that arose in regards to the implementation of these were straightforward computing problems which were overcome by such devices as the introduction of a new "calling" knowledge base as a front end to the system and some restructuring of the initialisation of variables.

As finally implemented, a conclusion is generated at the end of each run through the system which presents in tabular format:

- a) the name of the person who founds jurisdiction (party\$)
- b) the ground of jurisdiction established (jurisground\$)
- c) the time at which the ground was established (juristime\$)
- d) the court which has jurisdiction over the action (court\$).

After offering this conclusion, the user is offered the choice of quitting the system or three types of re-run:

- a) run the consultation again for the same client with the answers he had given the first time retained. This would be useful if the user wished to examine the consequences of changing his mind about, say, just one or two decisions he was doubtful about.
- b) run the consultation again for the same client with the answers he had given the first time cleared. This would be useful if the user wished to run an entirely new consultation but for the same client; he might, for example, be considering a choice between raising an action for divorce with custody as an ancillary matter or an independent action for custody.
- c) re-start the system for a new consultation for a new client.

4 Part III: Conclusions

4.1 Evaluation of the shell

The use of Crystal as the system shell was a relative success. The great advantage was the ease and speed with which the knowledge base could be designed. In the area of the CJJA knowledge base, it was always anticipated that the complexity and newness of the law would make the project relatively long-term. The limitations of expert systems, and of Crystal in particular have undoubtedly shaped and will shape the final outcome. In the CJJA, where the system already includes well over 1,000 rules, over 1,000 commands and almost 100 variables, we are already encountering the RAM limits of Crystal.

The shell also imposes logical as well as practical restrictions in that it supplies only propositional logic as opposed to predicate logic. In FAMKB especially, this led to time consuming duplication of programming work. As has already been said, the practical interface problems led us to design a separate Help facility outside Crystal for CJJA. Although Crystal allows extensive cosmetic treatment of the user interface, the mode of interface is largely restricted to user-computer question and answer dialogue. To evade these constraints, we have to turn to writing our own Help system.

More theoretically, one might consider how far we have restricted creativity by using the shell. The knowledge engineer tends to style the knowledge to fit the shell and this might not be the optimal formalisation of that knowledge. We cannot tell; but perhaps there is a need for a controlled experiment formalising the same expertise using two comparable shells or, even more appropriately, a shell and an AI language or a fundamentally different structure, such as hypertext.

4.2 Evaluation of the domain

The choice of the CJA domain appears even more appropriate at the prototype stage than it did in the original proposal. The rule-based statutory structure has facilitated design. The problems anticipated over the hard cases and the foreseeability of interpretation (filling in the gaps in the legislation) could also be minimised by sticking as closely as possible to a rule based design structure and taking advantage of the closed system of commentaries and case law in the domain. The limitations we encountered overall tended to be those which are predicates of law as such, rather than of the domain. In particular, since the objective was to create an adviser rather than a "judge", we avoided many of the pitfalls which Leith addresses. By way of contrast, the major problem in FAMKB was not one technically associated with a case law based domain. Neither volatility, nor inconsistency proved problematic. Even finding the ratio was facilitated by the extensive commentary on the subject. There was almost a tradition of the rules to be extracted from the classic cases of common law domicile. Such a mythos makes rule formulation very easy. The issue, as detailed above, was the open-textured nature of domicile itself - a problem which could equally arise in a statutory domain. The real problem (and this is substantiated by both knowledge bases) is not case law; it is open texture. Reed (1990) proposes three solutions to the problem; Bayesian statistics, reasoning by analogy and implementation by a neural network. We do not see much that could be gained by any of these in a domain like CJA; but in one such as FAMKB the neural network seems a very helpful approach.

4.3 Evaluation of the system

One of the advantages of using Crystal is that our system is readily transferable and integratable with other legal expert systems developed using this tool. In the long term, we anticipate that this will be one of the major advantages of our choice of shell. For example, we anticipate that at some point it will be possible to transfer between the procedural and substantive aspects of a query.

It goes almost without saying that the expertise of the experts has been honed by the process of building the systems.

As a final comment, much of the work in the legal expert system field has been informed by a jurisprudential approach. Jurisprudence is pervasive in the field. Our experience in building these systems was that the legal domain must be drastically restructured for successful implementation in a rule based knowledge base. Perhaps the new challenge for the jurists is to construct a methodology for proving or disproving the formal validity of what we have already constructed.

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