ABSTRACT

The City Council, on the recommendation D.H. Jenkins, in his role as Principal Officer, decided to authorise investigation of the use of expert systems in the development of its "Land Strategy". Later, authorisation was given for the development of a prototype council house valuation system.

An explanation of the Land Strategy itself and the development of the IT strategy which prompted the project described in this dissertation provide context, as does a description of the changes in local authority property management occurring in recent years. The motives which led to the project are examined.

The remainder of the dissertation comprises a study of the knowledge employed by the council's valuation staff in the sale of houses under the Housing Act 1980 as amended; the elicitation and representaion of that knowledge in the system which is submitted for examination with this dissertation and entitled RBSOC to represent "Rule-Based Sale Of Council house system"; the development of the algorithms which give effect to the system's objectives; the design of the user interface and the method of system delivery / deployment.

General observations regarding the potential applications of the technology described in the dissertation are made and conclusions drawn regarding the impact of the technology on the valuation profession.

Appendix 2 describes and illustrates the computer programme RbSOC which is a product of the research undertaken. This programme was developed using the "Crystal" expert system shell and encapsulates the knowledge elicited as part of the research.

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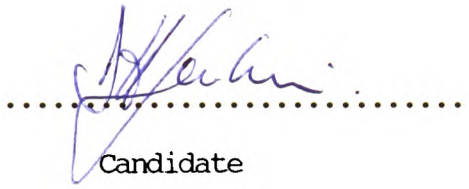
DECLARATION

This is to certify that neither this thesis, nor any part of it, has been presented or is being concurrently submitted in candidature for any other C.N.A.A. or University degree.



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Candidate

Chapter 1. Introduction.

The aims of the research stated on the registration document are as follows:

> "Evaluation of the role of expert systems in the Land Strategy of Cardiff City Council"
>
> "The development of a prototype system for the valuation of council houses".

The project which is documented in this paper commenced prior to registration for a degree by research. Before registration, the project had progressed to the stage where the **potential** role of expert systems in general had been surmised and a subjective disposition in favour of their employment in the City Council's land strategy had been reached.

a Why the project began.

The boom in the property industry in the second half of the 1980's has given way to a prolonged period of recession and consolidation. One conjunctural consequence of the boom was a considerable increase in the demand for professional services and hence professionally qualified personnel. All sectors of the industry suffered a shortage in the supply of professionals. The public sector suffered more than proportionately and vacancy rates in local government were typically in excess of 10% and in extremis in excess of 20% (Economic Development Briefing 1989).

John Edmondson, Cardiff's City Valuer, experienced vacancy rates for professional staff of 10 - 15% in this period.

Two government reports (Audit Commission, 1988 (a) and (b)) on the efficiency of property management in local government recommended inter alia an increase in establishment levels to provide more positive management of the property portfolio. Predictably, this additional demand for professional resources exacerbated the situation.
Differences between public and private sectors could be tackled in the short term by improving salaries and conditions in the sector suffering comparative disadvantage. In the face of an absolute shortage this competition between and within sectors served only to boost the general cost of staff (Chartered Surveyor Weekly 11th April 1991). Other potential solutions seemed to lie in improving the productivity of existing professionals and in substituting for professional staff.

The City Council resolved to explore both of these solutions (Edmondson J.S. 1987 and Jenkins D.H. 1988). New technology would be the means. First via the deployment of established technologies whose productivity effects were documented but which had not been adopted by the City Council. Secondly, through the development of expert systems, which were being marketed as a means of "deskilling" areas where "experts" were in short supply.
The final spur, were any needed, was the likely introduction of competitive tendering in the provision of professional services within local government (Local Authority Valuers Association (LAVA) 1989). The City Valuer was sensitive to these proposals and was, in any case,

committed to improving the efficiency of a Unit which had been the object of some criticism by elected members of the council prior to his appointment in 1987.

b The nature of the project.

The primary objective of the research was the development of a prototype tool for calculating the value of council houses for sale to sitting tenants.

It is believed that the project is unique in that no known system exists which exhibits the features of the prototype. Moreover, it is contended that the prototype is susceptible to modification which will permit the valuation of other classes of property using the techniques which have been elaborated in its development (Chapter 7).

It is also contended that valuation professionals can assimilate the technology and fashion their own systems (Chapter 7).

Further, no finished research into the development of such systems has been published, no patent registered and no copyright established, as far as it is possible to discern, other than that which attaches to the prototype and its successor systems.

As the literature review will reveal (Chapter 2), there has been little research into the subject of expert systems and property valuation. Yet published material, in particular the work of Ian Scott and Stuart Gronow, has made a substantial contribution to the success of the original project.

Scott's thesis (Scott, 1988) established that the more anthropomorphic approach which the methodologies of knowledge engineering tended to

promote, could lead to the successful development of computerised valuation systems. Scott's own prototype was limited by two distinct factors.

First, the project set out to explore valuation methodology as applied by a single building society valuer in an environment typified by lack of data. This led to a study of the knowledge that the surveyor used, its elicitation and representation within a system and an examination of the nature of uncertainty and its treatment within expert system development. Consequently, the main contribution of Scott's research was in the development of expert systems theory as applied to valuation rather than the development of a prototype as such.

Secondly, the software that was available to Scott lacked many of the features which modern expert system shells provide. In particular, an easily manipulated development environment and readily available interfaces to standard "productivity tools", especially databases and spreadsheets.

No such limitations were imposed on the development of the prototype undertaken by D.H. Jenkins. First, the project set out to improve the productivity of a group of valuers who had access to a substantial database and who were examining relationships within the data (Chapter 4 (c)). Secondly, the software was several generations removed from that available to Scott.

The key limitation on the project was that the knowledge elicitation and representation processes described by Gronow and Scott (1986) and the process of system design for the prototype were all undertaken by D. H. Jenkins. Aside from shell selection (Chapter 4), no additional resource from computing professionals was available.

Subsequent to the development of the prototype, this limitation has been removed. Chapter 7 contains a brief review of developments at Mid Glamorgan County Council, where a team of valuation and computer professionals jointly develop systems under the supervision of D.H. Jenkins.

c. Conduct of the project

Given the paucity of literature on the core subject of the project - expert systems and valuations - the need arose to attend many conferences, seminars and exhibitions on Information Technology (IT) in property as well as engage in discussions and exchange correspondence with leading practitioners in several aspects of the valuation discipline. Appendix 1 provides a list of some of these contacts and products reviewed.

Audit Commission (1988a), "Local Authority Property: A Management Handbook", HMSO.

Audit Commission (1988b), "Local Authority Property: A Management Overview", HMSO.

Economic Development Briefing (1989), "Property Manpower, Pay and Media" March.

Edmondson J.S.(1987), "The City Estate", Report to Cardiff City Council July.

Gronow S. and Scott I.P., (1986) "Knowledge Elicitation from Building Society Valuers", Journal of Valuation 4.4 394 - 405.

Jenkins D.H. (1988), "Information Technology Strategy: Interim Report", Report to Cardiff City Council, March.

Local Authoruty Valuers Association (1989), "Report of Working Party on competition", January.

Scott I.P. (1988) "A Knowledge Based Approach to the Computer-Assisted Mortgage Valuation of Residential Property", Unpublished Ph.D Thesis.

Chapter 2. The Literature.

This chapter provides a review of the literature in relation to the core subject matter of the research outlined in the introduction and highlights some of the key issues which it is considered will need to be addressed in pursuit of a rational method for valuing houses which takes advantage of the latest developments in PC (personal computer) technology.

Section "a" reviews literature dealing with expert systems and valuation; section "b" examines the recent development of valuation methodology with particular reference to housing; section "c" analyses current "expert system" development for subsequent classification of the software submitted with this dissertation (Chapter 6) and section "d" briefly discusses the nature of the "right to buy" valuation.

a Expert systems and valuation

Literature referring to expert systems and valuation remains scant.

The earliest published reference to expert systems and valuation dates from 1984 (Boyle). The paper describes a dialogue between a valuer and a computer, in which the valuer provides a description of the subject property (in this instance without visiting it) and a valuation is executed by reference to a previously programmed Multiple Regression Analysis (MRA). The paper anticipates many of the technical and valuation problems which need to be tackled in the computerisation of residential valuations and is far sighted in its recognition of the potential role of hedonic indexing techniques and value contour mapping.

The article does not describe an expert system as it would be defined today (Chapter 2(b) and Chapter6(c)), nor was a system actually built, though these facts hardly detract from the conclusions of a pioneering work.

The main body of research into expert systems and valuation has been conducted through the Polytechnic of Wales. Gronow and Scott first published material on expert systems in the valuation domain in 1985 (Gronow and Scott, 1985). Twenty six articles on the subject matter ensued during the subsequent 3 years (Scott and Gronow, 1986 to 1989) excluding Scott's Ph D thesis (Scott, 1988).

These articles serve both as a general introduction for the valuation professional in the rather arcane language and concepts of expert systems and Artificial Intelligence (AI) as well as an examination of the nature of residential property valuation and the relevance of expert systems to the valuation domain.

In this body of work are found explanations of the concepts of knowledge elicitation, capturing an expert's knowledge for the system, and knowledge representation, strategies for invoking the captured knowledge; the relationship between MRA and expert systems and the nature of uncertainty and its expressions in the valuation domain.

Scott's main conclusions are the starting point for the current research: valuation expertise can be represented by expert system technology; modern expert system shells are suitable tools for this purpose; "production rules" are sufficient to model this expertise; valuers confront incomplete knowledge rather than uncertainty and building in "redundancy" can solve this problem; heuristically assigned values may be as valid as statistically derived data; finally, that a

research programme should be co-ordinated by academic and professional institutions.

Crofts has provided an unpublished dissertation drawing heavily on Scott but contributing a useful review of expert systems literature, analysing the potential for expert systems for property managers more widely and articulating a methodology ("situation simulation") for establishing whether knowledge in a given domain was susceptible for representation in an expert system (Crofts, 1987).

Crofts carried out a "situation simulation" with a limited number of valuers in the valuation of a commercial property. He concluded that there were no elusive or phantom rules; that the valuers adopted processes that could be analysed into subsets of questions which correlated to a surprising degree; that an expert system could be devised to perform the task.

More recently, Czernkowski also concluded that valuation techniques could be modelled using expert systems (Czernkowski,1990). He uses AI principles related to a substantial rating valuation exercise in Australia to conclude that expert systems can outperform conventional Computer Assisted Valuation systems, because, by modelling the decision structure of human valuers, the constraints imposed by linear regression models can be overcome.

A further research project in Northern Ireland has examined the use of a "frame-based" approach to the valuation domain and a simple demonstrator has been built (Grant C 1991). Scott anticipated that frames would be useful in developing expert systems for the valuation

domain (Scott 1988). However, while this may be true, it would appear that frames owe more to database technology than to expert systems. Inheritance as a property of a database is highly useful, but this dissertation is concerned more with the "rule base" aspect of development (Chapter 2 (c)).

The missing element in the debate has been experience of actually building and using systems. Scott's prototypes were very much demonstrators of the possibilities rather than practical tools. More recently the experience of D.H. Jenkins at Cardiff City Council has begun to examine questions related to the use of expert systems and has stimulated research on aspects of the problem (Powell 1988). Further, the development of a practical rating valuation application has been completed by a team under the supervision of D.H. Jenkins at Mid Glamorgan County Council (Crystal User, November 1991) and further developments, referred to in Chapter 7, include an asset valuation system (Crystal User, April 1991).
The rating project has also provided the training ground for the development of a more comprehensive rating valuation system for Malaysia by Abdul Hadi bin Nawawi (1991a and 1991b).

Expert systems have been developed widely since the mid nineteen-eighties. Scott (Scott, 1988 Appendix 10) and Crofts (Crofts, 1987 Appendix 2) were able to point to the development of several applications which bordered on the valuation domain. To date, however, there would appear to be no valuation systems in use. The Alvey Project initiative sponsored by the RICS, to which Scott and Crofts refer, for

the development of an expert system to aid Quantity Surveyors was successful and "Elsie" now has over 350 users, many abroad (Melling, 1991). In fact, Chris Garbett has detected a tendency for good British software to find a ready audience on the pacific rim (Garbett 1990).

Beyond the property domain there was a veritable expert systems explosion in the late eighties. The Department of Trade and Industry produces a digest of systems and guidance and advice on development (Manufacturing Intelligence, HMSO, 1991). The largest suppliers of expert system shells also produce digests of applications developed using their products. Noticeably, Intelligent Environments, Europe's largest supplier, has no firms of Chartered Surveyors on its client list and a major rival, Expertech, produces a long list of applications containing no property systems (Expertech, 1991).
While the potential remains vast, a recent study in the Financial Times notes that expectations have been largely disappointing and that "some of the most vaunted pioneers have collapsed in the shake-out of the last couple of years" (Survey:The Computer Industry, 23 April 1991). In this climate, it is perhaps unsurprising that the property profession has failed to take expert systems seriously.

b What is an expert system...continuing debate

The mid 1980's saw a high point in academic interest in expert systems (cf Financial Times review article June 30th 1990) and a proliferation of expert system softwares. An unresolved philosophical debate about the

nature of intelligence provides the backcloth: a 1987 survey by the American Office of Technology Assessment found three categories of "artificial intelligentsia": Believers, Sceptics and Critics. The Believers think that all thought is rule based and therefore capable of reproduction by logical processors. The Sceptics stress the non-analytical way in which concepts are often handled and the lack of understanding of "insight" (Penrose 1990). While Critics are more concerned about the loss of human control implied by the delegation of decision-making to machines.

Believers and Sceptics have channelled practical AI research into two distinct areas: neural networking and expert systems. Neural networks attempt to imitate the brain by substituting processors for neurons. The research has been held back by two factors: a lack of understanding of brain chemistry and poor hardware. The development of multi-layer perceptrons in 1986 by Rumelhart, Hinton and Williams has opened up this field and led to substantial investment in speech and image recognition by businesses, though actual applications are very rare (Example: The Connex project at Univerity of East Anglia funded by British Telecom). This dissertation is not concerned with experimental work which may have been conducted in relation to property valuation and neural networking.

Expert systems are perhaps less ambitious. The basic premise was advanced by Minsky and Papert at MIT during the 1960's. If the rules which humans use to make decisions can be deduced, then computers can follow the rules and execute them consistently.

Much academic energy was spent on defining expert systems. Scott noted in his doctoral thesis the lack of a standard definition. Basing his definition on the work of the British Computer Society (BCS, 1981), Scott considered the following appropriate:

" An expert system is a computer system which contains knowledge pertaining to an area of human specialisation. The system can also implement that knowledge in such a fashion as to be able to act as a consultant expert in that field of specialisation. Such a system typically requires the user to provide answers to relevant questions in order to supply advice based on those responses. In addition the system is able to justify or explain the reasoning behind a course of action it recommends, in order to defend its deduced solution". (Scott,1988)

Crofts too was concerned with definition and identified up to 14 elements of a definition from a sample of 10 definitions (Crofts, 1987 Appendix 1). Crofts settled on the following:

"An expert system is a computer program which tries to emulate human decision-making expertise in a specified domain or field by applying the techniques of logical inference to a knowledge base, and which is capable of explaining its reasoning." (Crofts, 1987).

The original debate was fuelled by the extravagant claims made for expert systems on the one hand (Hu, 1987) and, on the other, counter claims that "expert system" was a fanciful misnomer. The resulting downturn in interest in expert systems Hu refers to as an "AI Winter".

Scott and Crofts were bound to relate to the debate because of their starting point. That is Scott and Crofts were starting with the solution, "expert system", and applying it to the problem, "valuation domain". Clear definition was a prerequisite.

By contrast, this research started with the problem, "how can certain valuation work be completed to a satisfactory quality given lack of professional resource?", and arrived at a solution by way of commercial and technical considerations. However, there was a presumption, reflected in the title, that "expert systems" as a general category could provide the solution.

As software development races ahead of problem definition (Hollnagel, 1989) this could not have been otherwise. Because of an a priori assumption that an "expert system" was necessary to solve the problem, it seems reasonable to test that assumption with the benefit of hindsight and attempt to place the prototype in a definable category (Chapter 6 (c)). This requires an adequate benchmark for testing systems which claim to be "expert systems".

No attempt is made here to provide a fresh general definition of an expert system. Nevertheless, aspects of the debate will be addressed, partly because they permit an approach to a definition of the prototype (RbSOC), partly because they bear directly on the legitimacy of the title "expert system" and because they have a practical significance: choosing software (Chapter 6).

The first step is that expert systems and conventional programs be differentiated. In order to carry out the differentiation, one might

apply the general definitions referred to above. But it is the technical component of the definition which is critical in this analysis and reference to this aspect of definition is appropriate.
According to Hu, what is common to expert systems are the following basic elements: a knowledge base, an inference engine and a user or person-machine interface. "The knowledge base contains facts and heuristics, the inference engine performs interpretation (reasoning) and control of search for solutions, and the user interface provides the user with semi- or full natural language...." (Hu, 1987).

Further, "A knowledge base is executable , but a database is not. A database can only be queried and updated" (ibid.).

What distinguishes an expert system from a conventional system can be summarised as follows:
conventional program = data + algorithm

expert system = knowledge + inference engine (Cornick, 1986).

In reviewing the problem, first data and knowledge then algorithm and inference will be compared.

Data, Information and Knowledge

Crofts pointed out that "The literature appears to assume that there is a hierarchy which has data as its lowest level and rises via information to knowledge" and notes that "whilst useful distinctions are drawn

between data and information it is hard to find a comprehensible discussion of all three concepts and their respective attributes, or any meaningful attempts at definition". (Crofts, 1987)

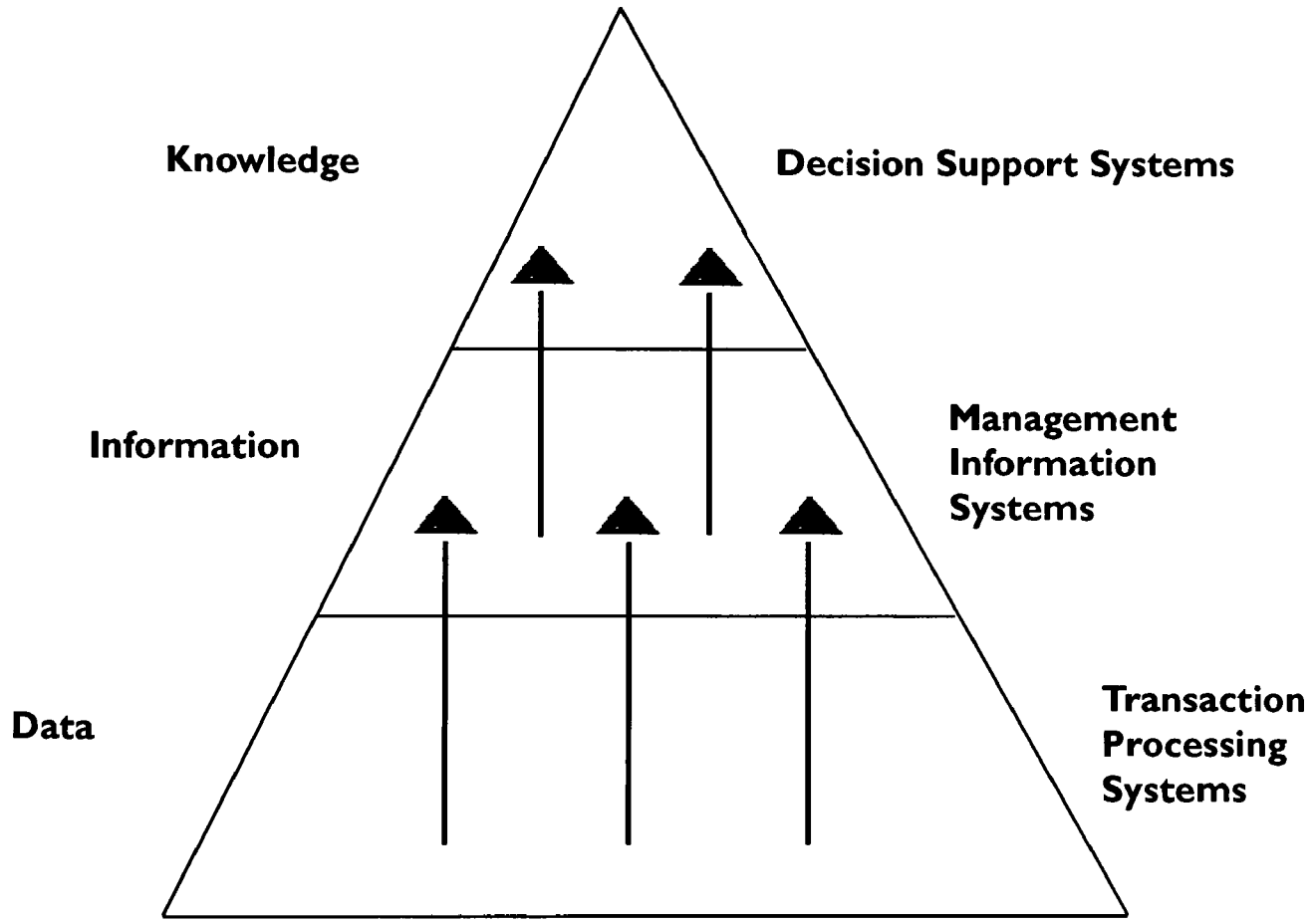
While such definitions are at the limit of human understanding and, consequently, there is plenty of room for debate, areas of consensus are emerging.

Hollnagel, building on that consensus, subsequently defined data, information and knowledge and their processing in the context of the historical development of computing (Hollnagel, op cit.).

Computers were first used as data processors; data are representations of individual or isolated facts and the computer's processing power was to the fore. The next step was the emergence of computers as information processors; information is defined as expressing the relations between data and the computer's storage and retrieval powers were to the fore. The highest step is the development of computers as knowledge processors; knowledge is defined as expressing the relations between information and the computer's reasoning (inference) power is highlighted.

Anthony's pyramid is a popular expression of this hierarchy. The version in Figure 2.1 overleaf is reproduced from Graham and Jones (1988).

Here the taxonomy of business computing is expressed in different terms. Corresponding to data, information and knowledge, they postulate "transaction systems", "management information systems" (MIS) and "decision support systems" (DSS). The first two categories are similar to Hollnagel's model. Batch processing and printed output typify the lowest category. Management information systems involve the user in direct contact with the program. This contact usually involves one of



Source: Graham and Jones, "Expert Systems: Knowledge, Uncertainty and Decision", Chapman Hall 1988

Figure 2.1 Anthony's Pyramid

the following functions: store, retrieve, calculate, translate, sort, edit, decide, monitor and control. (Frenzel 1987).

DSS are analysed in terms of their abilities in three dimensions: logic management, data management and dialogue management. (Sprague 1980).

Expert systems are defined as a subset of DSS. What characterises knowledge based DSS is the addition of a fourth dimension: uncertainty management (Graham and Jones, 1988).

At the bottom of the pyramid is data. "Items of data ....do not have to convey any meaning by themselves, whereas items of information must be meaningful. Thus, information is always made up of several items of data." (Kirkwood 1984). For example, "£75,000" is a datum as is "3 bed semi". But "£75,000 for a 3 bed semi" provides information about house values in some circumstances.

The statement, "£75,000 for a 3 bed semi is too expensive since interest rates started to rise" is knowledge about a particular market. The statement demonstrates two of the defining characteristics of knowledge. First, it can serve multiple purposes whereas information is specific. The same knowledege may be pertinent to the value of 4 bedroom detached houses. Secondly, the relations between information are "most often expressed as causal ie the **reason** for observed facts and conditions" (Hollnagel, op cit p22); £75,000 is too expensive because of market factors.

Graham and Jones (1988) go further and affirm that, **"Knowledge is concerned with action"**. In the example, negative action: "don't buy unless the price is renegotiated". But they concede that this is contentious.

If a system is processing knowledge it may be an expert system. But the

second half of the test will be whether the knowledge is executed by an algorithm or by inference.

Algorithm and Inference Engine.

This aspect of the technical definition is more difficult because of unresolved issues related to inference and inconsistency in relation to terminology in the literature reviewed.

An algorithm is defined as "a process or rules for calculation" (Oxford Reference Dictionary). Inference is generally used to imply "reasoning", the examination of facts and rules to produce conclusions: an inference "engine" is a program which employs a reasoning strategy or strategies, requiring **control**, the order in which inferences are made (Harman and King, Chapter 5).

At a superficial level the non-technical reader encounters contradiction. Algorithm appears as an instance of inference. Consequently, if an "expert system" is simply rule based it must rely on algorithm: if it relies solely on algorithm, it cannot be an expert system because it lacks other aspects of inference.

Common strategies employed in the inference engine referred to in the literature depend on the level of expert system construct. Programming languages generally employ first order predicate logic and some method of predicate calculus. The literature refers to modus ponens and non - monotonic reasoning. Whether or not predicate logic is different from and augmented by fuzzy logic is beyond the scope of this dissertation (see for example the contradictory statements of Kowalski and Hayes referred to in Scott, 1988 at p135).

At the level of the "shell", most references are to backward and forward chaining and the concept of "inheritance". These have been adequately explained by Scott (1988, pps 118 - 135) and Crofts (187, pps 21 - 23).

Whatever the limitations of rule-based systems, they are capable of handling uncertainty, the criterion which Graham and Jones use to distinguish expert systems from DSS (op cit.). All of the strategies which Scott described for the handling of uncertainty, probability theory, Bayes Theorem, Fuzzy reasoning (Scott, 1988, pps 154 - 174) can be built into algorithms.

For practical purposes it is considered that an inference engine which processes "production rules" is sufficient for current development requirements. Whether or not this amounts to "expert system" development is considered in Chapter 6 (c).

"Production rules" are statements which contain antecedent and consequent clauses linked by the operators IF, AND, OR, NOT, THEN and are usually expressed in the form,

"IF X IS TRUE AND Y IS TRUE, THEN Z".

For example,

"IF THE PROPERTY IS RESIDENTIAL

"AND THE PROPERTY IS LET ON LONG LEASE

"AND THE RATEABLE VALUE IS LESS THAN A FIGURE SPECIFIED

"AND THE LESSEE'S PERIOD OF RESIDENCE QUALIFIES

"THEN THE LEASEHOLD REFORM ACT APPLIES".

Each of the antecedent components of the rule (IF and AND statements) may itself be dependant on sub-rules. In the example given, each of the

antecedents contains real sub-rules. For example, what constitutes a "residence" could be expressed, imperfectly, as follows:

"IF THE PROPERTY IS A HOUSE

"AND NOT A FLAT

"AND NOT SUBSTANTIALLY BUSINESS PREMISES

"THEN IT IS A RESIDENCE".

Each of the rules could be further qualified. Ultimately, the system will contain all the appropriate rules, including, perhaps, rules laid down by the Lands Tribunal for the proper conduct of the valuation. Thus an "expert system" relying on production rules will not act intuitively, as a human expert might. It will simply process the pre-defined rules and advise accordingly. This limitation should not blind one to the fact that much of human expertise consists precisely in the mundane application of knowledge codified as rules.

A true expert system will process knowledge and will reason. Later, having considered the practical development of the valuation model at Cardiff, the question of the nature of the prototype will be examined more closely. (Chapter 6 (c)).

c Valuation methodology

Traditionally, valuation method in general has been poorly defined by the British valuation profession . The most widely read text books regarding valuation were prone to assume that methods were correct, understood and sufficient. Consequently examination of method occupied little space (for example Millington (1988) devotes 14 pages to the

subject). This lack of precision with regard to method has been recognised for more than a decade. Byrne and Mackmin long since exposed the limitation of traditional investment valuations (1975).

In more general terms, Baum and Mackmin discovered that "A lack of basic mathematical ability often prevents valuers from understanding modern or alternative approaches to valuation..." and noted that "For many years there was only one recognised UK book covering the subject of property valuation" (Baum and Mackmin, 1979). It is a sign of changing times that "Modern Methods of Valuation" in recent editions contains a more critical component (Britton, Davies and Johnson, 1989).

The interest in method which arose in the late 1970's (as a result of some embarassing positions in the property recession earlier in the decade) was not confined solely to investment valuations, but this was the main area of concern. A decade later, after the publication of a crop of text books on the subject (Darlow (1983), Baum & Crosby (1988), Scarrett 1991 et al) it is interesting to note that "In investment valuation, there is the continuing debate on the benefits and advantages of different approaches" and, more interestingly, an identification of "matters which have received little attention and which are crucially important to the profession" (Scarrett D. 1989).

Alongside the growing list of text books, the Journal of Valuation, now the Journal of Valuation and Investment, has provided a focus for the many areas of concern to practitioners. In recent years the formation of the Society of Property Researchers has given an organisational focus for the concern, though the latter concentrates its attention more on data than methodology.

The academic perception of inadequate methodology was shared by the RICS, who recognised the need for research into method as early as 1975, with the establishment of a working party, though progress has been slow. An interim report (Trott, 1980) was followed up by seminars only in 1986 and, more recently, by a series of technical papers (Colborne 1990; Marshall 1990; Crosby 1991; Britton, Connellan and Crofts 1991).

One of these papers, an in-depth analysis of Depreciated Replacement Cost and Contractor's Test methodology, has discovered a basic inconsistency and lack of definition (Britton, Connellan, and Crofts, 1991). The Report finds that

"1 Whereas general theoretical advice abounds it is not sufficiently clear nor sufficiently specific to be of much practical guidance to valuers.

2 In practice, disparate methods are used in an attempt to address 1 above in valuation terms, confirming the lack of a recognised methodology." (P87)

Residential Valuation

A similar void exists in relation to the valuation of residential properties for owner occupation. The only UK book devoted to the subject contains a single chapter on valuation method and three and a half pages in relation to the most commonly used residential valuation method, Direct Capital Comparison or DCC (Mackmin, 1989). Further recommended reading in relation to that chapter is the earlier work cited in relation to investment valuation (Baum op. cit). Such brief treatment

would be sufficient if there were consensus about method, but as Mackmin earlier pointed out the "mainstream of residential property valuation is under-researched and poorly represented" (Mackmin D. 1985).

Residential property in the United Kingdom is 68% owner occupied, 25% public sector rented and 7% private sector rented (Brennan 1990). This dissertation is concerned solely with the valuation of property for owner occupation.

Transfer of property in the owner occupied sector is usually of the total equity in a freehold interest, though equity shares in residential property became more prevalent in the late 1980's. Valuations tend therefore to be of the entire capital and to arise on the execution of a mortgage to finance a transfer. Generally, neither vendor nor purchaser will arrange the valuation; the valuation will be the initiative of the lender. The determination of asking price by the agent on behalf of the vendor cannot be regarded as a valuation (despite the perception of the vendor) and this separation of the roles of agent and valuer is suggested by Mackmin as a partial explanation of the reluctance of the profession to "examine the art of residential valuation" (Mackmin, 1985).

This gives rise to the fact that neither the vendor nor the purchaser are specifically advised as to "value for money" in the transaction which they are undertaking. A strange fact, when it is remembered that for most people, as is often said, house purchase "is the biggest investment decision of a lifetime". The lender is concerned to ensure

that there is sufficient security in the property to justify the sum advanced.

Although in a climate where lenders fiercely compete for market share pressures build up on valuers, employed directly by the lending institutions (staff valuers) or commissioned (panel valuers), to deliver "appropriate" valuations.

The issues which this raises in relation to conflict of interest and valuation accuracy are aired by Gronow (1991) Clarke (1991) and Croydon (1989).

Nevertheless, the mortgage valuation report indicates the estimated open market value of the property. It is undertaken in the light of the transaction price agreed between the parties. Both the mortgage value and the transaction price are confidential, but they are known to the lender, the borrower, their advisers and to the Inland Revenue. None of the information is published.

This lack of accessibility to data serves to compound the problem faced by valuation professionals (Adair and McGreal 1986). Why this should be so becomes apparent when the method of valuation, DCC, is considered in more detail.

Why Direct Capital Comparison?

In a perfect market, value and price tend to equate, rather, they are different expressions for the same relationship (see Stanlake (1976) for example). In this perfect market, the equilibrium price of a property is equal to the cost of land plus the cost of buildings (including the

developer's profit) less any depreciation to reflect building obsolescence.

There are many imperfections in the UK housing market. Not least is the lack of perfect information. In arriving at a valuation method for this market, valuers are guided both by the accessibility of information and its usefulness.

The first source of information suggested by the perfect market model might be land transactions and building costs. Certainly building cost information is readily available, though land values, like house values, are unpublished. But the rate of addition of new units to the market is such a small proportion of the total stock (150000 per annum on average in a total of 23 millions) that new houses have a limited influence on values generally: "Builders traditionally have had to price their new flats and houses with a close eye on the price of neighbouring older houses" (Financial Times Property Focus September 22 1991). Consequently costs are not indicative of value and land costs, especially in the short run, may be highly volatile: economic rent is a large part of price. Valuers have to look elsewhere for their information and methodology.

Relaxing the perfect market assumption, one might expect valuers to employ an analysis of supply and demand information in the determination of house prices though in practice such a route is fraught with difficulties. The imperfections in the housing market are such that few economic models (as opposed to house price indices) seem to exist (see, for example Brennan 1990a) and none appear to be used in practical valuation in the U.K.. In fact, neither the Treasury nor the Bank of

England include house prices in their own modelling (cf Brittan, Financial Times 17th May 1990).

Two examples illustrate the difficulties. On the demand side, the policies of the lending institutions heavily influence prices (see for example "Housing Finance", Council of Mortgage Lenders August, 1990). While on the supply side restrictive planning rules maintain prices at high levels on one hand and, in the arbitrary nature of their application, ensure unpredictability in sub-markets on the other (cf Mogg 1990).

This is not to say that no attempts have been made to model housing markets with the aim of producing valuation "forecasts". As long ago as 1971 Michael Ball was able to describe 12 studies which had been conducted in the previous 5 years (Ball 1971). Half of those studies were British, the other half American.

In fact, American academics have conducted much debate about the merits of different econometric approaches and about appraisal of "family residences" more generally. Bloom and Harrison's (1978) textbook is the best known and most comprehensive contribution but the material is plentiful and much of it remains to be assimilated by a British audience.

A common refrain of UK valuers is that housing has special characteristics; that all houses are unique and that valuation is not therefore susceptible to econometric, statistical and mathematical modelling. This proposition is of doubtful validity. While properties are undeniably unique, properties share locational and physical

characteristics. Moreover, in terms of social and psychological functions, houses share a more limited range of primary objectives. Greaves (1985), in analysing the determinants of house prices, noted the following special characteristics: housing as a long term investment with attendant capital appreciation; the income and capital tax concessions in housing finance; the satisfaction of family rather than individual needs and the relationship between housing and status. These factors help to explain aspects of value in national markets (prices in the UK relative to other markets); aspects of value in relation to horizontal segments of the market (for example the effect of marginal tax rates or council tax bands on prices) or idiosyncratic tendencies in relation, for instance, to luxury homes.

Paradoxically, these factors may tend to detract from the pursuit of accuracy in relation to the physical factors. If they have an influence which cannot be quantified there is a prima facie case that detailed analysis of physical factors amounts to spurious accuracy. Valuers unlike accountants, in the old addage, have no wish to be precisely wrong rather than approximately correct. This may account for the observation that while logic suggests that the effect of physical factors can be quantified, "the number of valuers who consistently carry out such analyses remains small" (Mackmin, 1985).

At the very least, the econometric approach is one which merits further research. If the current state of knowledge fails to generate working models, there is no cause for complacency. A systematic analysis of past results and a synthesis with new methods is overdue.

Multiple Regression Analysis (MRA) has specific uses and its merits and limitations have been discussed comprehensively by Bruce & Sundell (1977), Baum (1982) and others. While newer computer driven tools undermine the traditional objection simply by being consistently accurate. For example, the Fulcrum System is able, within acceptable margins of error, to predict the value of any typical house in any area of the country by reference to a price/floor area ratio derived initially from analysis of Nationwide Building Society data (Microval Software).

Given the reluctance of the profession, the lack of research and in relation to MRA "the inabilities of the user" (Statistical Applications for the SREA Market Data, The Real Estate Appraiser, December 1973 cited in Kirkwood op.cit), the methodology available to valuers is the "default". That is, despite the lack of published evidence, valuers use a methodology which requires the deduction of value by a process of comparison.

Direct Capital Comparison

Valuers are able, through their own practice, to collect data about transactions. Analysis of these available data gives valuers an insight into the market. Past transactions are used as comparables to deduce value. There are two aspects of this direct capital comparison.
One is an assessment of market movement since the date of the available transaction data. The other is a more or less strict comparison of the

attributes of the subject property with properties in its comparable "range" to provide an opinion of open market value (OMV).

OMV is usually defined to be the price obtainable at the valuation date assuming:

"(a) a willing seller

(b) a reasonable period in which to negotiate the sale taking into account the nature of the property and the state of the market

(c) that values will remain static during the period

(d) that the property will be freely exposed to the open market

(e) that no account will be taken of any higher price that might be paid by a purchaser with a special interest."

(Asset Valuation Practice and Guidance Notes, 1990).

This definition of OMV has been challenged by several commentators (Whipple 1990, Smith 1986) and is currently the subject of a debate allied to revision of the definition in the "Red Book" (Ibid).

According to Mackmin (op. cit p38) the valuation process is broken down into 4 steps.

"1 Select comparables

2 Extract, confirm and analyse comparable sale prices

3 Adjust sale prices for noted differences

4 Formulate an opinion of OMV for the subject property"

The adjustments referred to include time differences, ("an appropriate and supportable percentage to reflect market movement" (Ibid P38));

locational differences ("a percentage or lump sum adjustment" (Ibid P39)); condition and accommodation differences ("the value of the property as if sound and then deduct the cost of making good the defect") and finally sale conditions (where aspects of the OMV conditions are relaxed).

The adjustment for time differences is referred to in mainstream economics as forecasting ie an attempt to explain the present and the future by reference to numbers derived from the immediate past. As the Financial Times put it in a recent polemic against Treasury econometricians, "This (methodology) is clearly a nonsense when the real economy is subject to huge structural upheavals, as in the 1980's".(Editorial August 31st 1991). Not only did housing markets reflect the general market changes in the last decade but they underwent some peculiar structural changes themselves, one of which was the mass sale of council houses.

The recent exposure of building societies to substantial losses on the forced sale of previously overvalued property (not to mention the human misery) is arguably a direct consequence of poor data and poorer methodology.

The exact timing and depth of the current housing recession was not predictable. Macroeconomics is hardly an exact science. But the general onset of recession was predictable and predicted by several economists: notably by Samuel Brittan and Barry Riley in the Financial Times. The general impact on property markets is understood from historic analysis. Supply and demand figures for many property sectors are becoming available as a consequence of a more focussed data research

effort in the late eighties (cf. Stapleton et al, Property Research, EG, 1989). Given this background an open and honest debate about the accuracy of valuations should be joined instead of silence. The profession needs to pay closer attention to "adjustments for time differences" and the treatment of economic trends at national, regional and sub-regional levels. The treatment of time effects on comparison can be found in Chapter 5, sections (b) and (d).

In relation to the other adjustments, according to Mackmin, "..it is better to have one good genuine comparable than half a dozen sales that require much price adjustment.." (Ibid p40) and he warns that "The more unusual the property is, the more difficult it is to find comparables" (ibid. p41). Millington issues the same warning, "In using the method it is desirable that the comparison be made with similar properties situated in the same area, and with transactions which have taken place in the recent past... the more uncommon a property is, and the more specialised the type of property, the less likely is it that the valuer will find good comparables, and it is not unusual for there to be a complete lack of evidence.." (op. cit p71).

Advice regarding method in case of this last eventuality is not offered. Interpolation is not possible without data; extrapolation also requires a starting point. Perhaps the contractor's test method becomes operative though evidence of land values is equally likely to be absent. Some form of land value mapping may help in regard to the latter, perhaps enriched by research into the value of journey time (eg Wabe 1971). Alternative approaches to the solution of the same problem may flow from analysis of

the demand side. Studies of consumer choice and behavioural modelling may throw light on the subject. A number of studies of hedonic indexing might also contribute to a more rounded theory of house prices (egs Cubbin 1970 and Ferri 1977). The necessary prerequisite would again appear to be further research.

But even where evidence is apparently plentiful and "where properties appear to be similar", Millington warns, "close inspection often reveals that they are different".

Resolving this dilemma requires a valuer's skill, though the skill is largely undefined. Millington expresses it thus:

"..the skill of the valuer will be required to make an allowance in money terms for such differences. Similarly, a skilled valuer will be able to quantify the difference in value caused by different geographical situations" (op. cit p72).

It relates in part to careful data management; in part to careful analysis (both Mackmin and Millington offer comparables analysis charts). The need for both has been highlighted in a number of studies. For example, Byrne and Mackmin's study of house prices in Oxfordshire and Adair and McGreal's database on residential transactions in Northern Ireland (Adair A, McGreal S, 1986).

Adair and McGreal were able to identify, using MRA, areas where statistical variability in house prices was low for certain types of property. Predictions of prices in these areas was facilitated by the study which concluded that similar techniques could give detailed knowledge of variability at street level given the data.

The recommendation that data be pooled flowed from both of these studies. But does the valuer's art consist only in collecting and

analysing data? Beyond data, exhortations to common sense and reliance on experience are what appear to define the valuer's skill (Scott,1988). Chapter 5 (a) examines the nature of the valuer's skill more closely.

At this stage, a preliminary conclusion suggests that lack of consistency and lack of standards result in a consensus that valuation is art. Heterogeneity in the housing stock, while real, is used as an excuse for inertia in respect of valuation method.
As Kirkwood pointed out, however, "With the arrival of the ubiquitous silicon chip the scenario has changed and valuers no longer have an excuse not to use the more advanced analytical techniques" (Op. cit P235). This begs the question "which techniques?"

d Council house sales

Prior to 1979 sales of public sector housing to sitting tenants was an option exercised by some public bodies (Richards 1984). The Housing Act 1980 (HMSO) made sale compulsory on the demand of the tenant. An incentive was given to qualifying tenants (Mollart 1985) in the form of a discount to open market value. The valuation is a modified open market valuation of the freehold interest in the entire equity in most instances. It is akin to a mortgage valuation.

The "modifications" include the application of the discount, a deduction from open market value to reflect any improvements to a property which the tenant has initiated and allowances for defects. This latter category is not a departure from a typical mortgage valuation except in

the sense that an offer letter has to make the presence of the defects explicit. Failure to note a defect in this way can give rise to a subsequent claim by the tenant against the housing authority.

A further modification applies in respect of the newly constructed council house: the discount cannot reduce the price below the cost of providing the unit.

One other difference with valuations for mortgage purposes is the lack of pressure to generate business. Valuations are conducted by local authority employed staff, either directly or under contract. There is a right of appeal by the tenant to the District Valuer of the Inland Revenue.

The heterogeneity problem referred to in Chapter 2 (c) above is relaxed in three respects. First, the nature of public sector housing provision in the UK has been such that large estates of similarly constructed buildings predominate. Secondly, the variable quality of fixtures, while still a factor, is less problematic. This is in part because of the requirement to ignore tenant's improvements, in part because of the uniformity in standards as a result of practice notes and budgetary constraints in the provision of housing. The third simplification relates to conditions of sale. In respect of the comparable evidence supplied by sales of other council houses, no adjustments are necessary to reflect lack of an arms length approach resulting from, say, a mortgage foreclosure, a cash purchase or a re-sale consequent upon an exchange of a new house.

Chapter 4 contains a detailed study of valuation practice at Cardiff City Council in relation to the Right to Buy. This practice has been

compared with traditional practice of several other local authorities and few material differences in appraisal approach have been discovered.

Abdul Hadi bin Nawawi and Gronow S. (1991a), "Valuation Strategies", IRRV Journal September 1991.

Abdul Hadi bin Nawawi and Gronow S. (1991b), "Expert systems in Rating Valuation", Surveying Technician.

Adair A., McGreal S. (1986), "The direct comparison method of valuation and statistical variability", Journal of Valuation Vol 5.1, 41 - 48.

Ball (1971), "Recent Empirical Work on the Determinants of Relative House Prices, Urban Studies 1973, 10, 213-233.

Baum A.and Crosby N. (1988), "Property Investment Appraisal", Routledge.

Baum A. and Mackmin D. (1979), "The income approach to property valuation", Routledge and Kegan Paul.

BCS (1981), "British Computer Society Specialist Group on Expert Systems, Newsletter No.4, October 1981.

Bloom G.F. and Harrison H.S. (1978), "Appraising the Single Family Residence", AIREA, 1978.

Boyle C. (1984), "An expert system for the valuation of residential properties", Journal of Valuation 2, 271 - 286.

Brennan J. (1990), "A long hard road to recovery", Financial Times, 30th December 1990.

Brennan J. (1990a), "Forecast offers cold comfort for estate agents", Financial Times, 15th December 1990. Review of Milne and Clark model from LBS Centre for Economic Forecasting.

Britton, Connellan, and Crofts (1991), "The Cost Approach to Valuation", Research Report for RICS, Kingston Polytechnic.

Britton, Davies and Johnson (1989), "Modern Methods of Valuation", Estates Gazette, Eighth Edition.

Bruce RW and Sundell DJ (1977) ,"Multiple Regression Analysis: History and Applications in the Appraisal Process, Society of Real Estate Appraisers.

Byrne P.J.and Mackmin D.H.(1975), "The Investment Method: an Objective Approach" EG 234:29, April 5th.

Byrne P.J.and Mackmin D.H., "The residential market in Oxfordshire and parts of Berkshire and Buckinghamshire : An analysis and review.

Clarke M. (1991), "Mortgage Fraud", Chapman & Hall.

Colborne A. (1990), "The Profits Method of Valuation", Bristol Polytechnic.

Cornick T. (1986), "What is an expert system?", in CICA/BSRIA.

Crofts M.K. (1987), "Expert Systems for Estate Managers", Unpublished B.Sc dissertation, Kingston Polytechnic.

Crosby N. (1991), "The Valuation of Freehold Reversionary Property Investments in U.K. Practice", Oxford Polytechnic.

Croydon R.H. (1989), "Mortgage Valuation Fraud", M.Sc. Dissertation, University College Cardiff.

Cubbin JS, (1970), "A hedonic approach to some aspects of the Coventry Housing Market".

Czernkowski (1990), "Expert Systems in real estate valuation", Journal of Valuation Vol 8.4.

Darlow C. Ed. (1983), "Valuation and Investment Appraisal", Estates Gazette.

Expertech (1991), "101 uses of Xi Plus".

Ferri M.G., (1977), "An application of Hedonic Indexing methods to monthly changes in housing prices", AREUEA Journal 1977, p445-462.

Frenzel L.E. (1987), "Understanding expert systems", Macmillan.

Garbett C. (1990), "Computers in education - the Hong Kong experience", The Valuer, November 1990.

Graham I. and Jones P.L. (1988), "Expert Systems: Knowledge, Uncertainty and Decision", Chapman and Hall.

Grant C. (1991), Unpublished M.Sc dissertation, Ulster University.

Greaves M. (1985), "The determinants of residential values: the hierarchical and statistical approaches", Journal of Valuation Vol 3.1.

Gronow S. (1991), "What next - fraud?", The Valuer, April 1991.

Gronow S. and Scott I.P. (1985), "Residential Valuation - Expert Systems", EG 276 1012 - 1014, 30th Nov. 1985.

Gronow S. and Scott I.P. (1986), "The true value of an expert", Building Societies Gazette, Vol CXVIII, No 1431 p38.

Gronow S. and Scott I.P. (1986), "Selection in Action", Expert Systems User, Vol 1.10, p13, March 1986.

Gronow S. and Scott I.P. (1986), "Expert Systems", Rating and Valuation, April 1986 p111 - 112.

Gronow S. and Scott I.P. (1986), "Expert systems: The Thinking Man's Computer", CSW, Vol 15.7, p561, 15th May 1986.

Gronow S. and Scott I.P. (1986), "Expert Systems and Multiple Regression Analysis", EG 278 694 - 695, 17th May 1986.

Gronow S. and Scott I.P. (1986), "Learning to Place a Value on Knowledge", Expert Systems User, Vol 2.5, 10 - 13, August 1986.

Gronow S. and Scott I.P. (1986), "Refining the art of mortgage valuation", Vol 55.7, 230 - 231, August/September.

Gronow S. and Scott I.P. (1986), "Knowledge Elicitation from Building Society Valuers", Journal of Valuation, Vol4.4, 394 - 405.

Gronow S. and Scott I.P. (1987), "Expert System Shells for Valuation", Journal of Valuation, Vol 5.2, 200 - 212.

Gronow S. and Scott I.P. (1987), "Multiple Regression Analysis and Expert Systems", The Valuer, Vol 56.1, p27, January 1987.

Gronow S. and Scott I.P. (1987), "Expert Systems for Valuation Surveyors", The Valuer (Australia), Vol 29.5, 400 - 402, January 1987.

Gronow S. and Scott I.P. (1987), "Information Technology and Building Society Valuations", The Valuer, Vol 56.2, p57, March 1987.

Gronow S. and Scott I.P. (1987), "Getting prices right in the housing boom", Expert System User, Vol 3.2, 14 - 16, May 1987.

Gronow S. and Scott I.P. (1987), "Expert Systems for Rating Valuation", Rating and Valuation, 171 - 172, June 1987.

Gronow S. and Scott I.P. (1987), "House Valuations - Get an Expert Opinion", Building Societies Gazette, Vol CXIX, No 1450, 34 - 35, July 1987.

Gronow S. and Scott I.P. (1987), "Mortgage Valuation - An Expert System", 283 EG 951, 29th August 1987.

Gronow S. and Scott I.P. (1987), "Valuation, Shells and Take-away Knowledge", 283 EG 1370, 19th September 1987.

Gronow S. and Scott I.P. (1987), "Knowledge Representation for Building Society Mortgage Valuations", Journal of Valuation, Vol 6.1, 87 - 101.

Gronow S. and Scott I.P. (1988), "The Home Service", Expert Systems User, Vol 3.10, 7 - 9, January 1988.

Gronow S. and Scott I.P. (1988), "Expert Systems: Don't be static, think systematic!", CSW, Vol 22.13 p34, 31st March 1988.

Gronow S. and Scott I.P. (1988), "Mortgage Valuation - Expert Systems to the Rescue", CSW, Vol23.11, p54, 16th June, 1988.

Gronow S. and Scott I.P. (1988), "Examining the properties of Expert Systems", Expert Systems User, Vol 4.4, 10 - 14, June 1988.

Gronow S. and Scott I.P. (1988), "Expert Systems for Property Managers:1", Property Management, Vol 6.2, 83 - 91.

Gronow S. and Scott I.P. (1988), "Expert Systems for Property Managers:2", Property Management, Vol 6.3, 187 - 196.

Gronow S. and Scott I.P. (1991), "Valuation: Quality Assurance and the Surveyor",EG 30th March 1991.

Harman and King (1986), "Expert Systems", Wiley.

Hollnagel E. (1989), "The reliability of expert systems", Ellis Horwood.

Hu S.D. (1987), "Expert systems for software engineers and managers", Chapman Hall.

Kirkwood J.(1984), "Information Technology and Land Administration", Estates Gazette.

Mackmin D. (1989), "The Valuation and Sale of Residential Property", Routledge.

Mackmin D. (1985), "Is there a residential valuer in the house?", Journal Of Valuation Vol 3.4.

Marshall P.J.L. (1990), ""Development Valuation Techniques" , South Bank Polytechnic.

Melling P.(1991), "Achieving competitive edge through expert systems", Surveying Technician, October issue.

Millington's "Introduction to Property Valuation"

Mogg R. (1990), Independent on Sunday, 28th May.

Mollart R. (1985), "The rights of local authority tenants to buy their home", Property Management, Vol 3.3.

Penrose R. (1990), "The Emperor's New Mind".

Powell A.C., (1988) "Expert Systems and the Valuation of Council Houses:A Feasibility Study". Unpublished Final Year B Sc. Degree Dissertation, Department of Mathematics and Computing, The Polytechnic of Wales.

Richards S. (1984), "The right to buy provision reconsidered", Property Management, Vol 2.1.

RICS (1990), "Statement of Asset Valuation and Guidance Notes", 3rd Edition , RICS.

Scarrett D. (1989), "New Directions, Property Research, Estates Gazette.

Scarrett D. (1991), "Property Valuation", RICS.

Scott I.P. (1988), "A Knowledge Based Approach to the Computer-Assisted Mortgage Valuation of Residential Property", Unpublished Ph.D Thesis, Polytechnic of Wales.

Smith H.C. (1986), "Inconsistencies in Appraisal Theory and Practice", Journal of Real Estate Research, Vol 1.1, 1 - 17, cited in Whipple.

Sprague R.H. (1980), "Framework for the development of decision support systems", MIS, 4.4.

Stanlake G.F. (1976), "Introductory Economics", Third Edition, Longman.

Trott A.J. (1980), "Property Valuation Methods: Interim Report", Polytechnic of the South Bank/ RICS.

Wabe (1971), "A study of house prices as a means of establishing the value of journey time, the rate of time preference etc.", Applied Economics 1971, 3, 247-255.

Whipple R.T.M. (1990), "Valuations: A problem solving imperative", Journal of Valuation and Investment, Vol 9.

Chapter 3. Cardiff's land strategy

This Chapter will describe the situation facing local government property managers at the time of the project's inception. Changes since then and their impact on the rationale for developing rule based applications are referred to in Chapter 7.

a Managing the public estate

In March 1988, the Audit Commission published two major reports on the management of property in local authorities, (Audit Commission 1988a and 1988b).

They were the product of several years research and followed a period of prolonged consultation, not only with bodies representing property professionals, principally The Royal Institution of Chartered Surveyors (RICS) and The Royal Institute of British Architects (RIBA) but with political representatives as well as representatives of other disciplines, for example Chartered Institute of Public Finance Accountants (CIPFA); Society of Local Authority Chief Executives (SOLACE), some of whom had also published extensive treatments of the subject (See for example SOLACE 1986).

The practices of many authorities were scrutinised and the findings of the Commission were highly critical. Property owned by local authorities was described as a national asset. A spot valuation, itself probably conservative, estimated a portfolio worth £100 billion. The running costs of these assets, about £4 billion per annum, is a substantial part of all local government spending (20% in some authorities, Audit

Commission 1988a).

This enormous resource was considered to be neglected - it was "a largely hidden and undermanaged resource" according to the Commission (Ibid.). Indeed the Audit Commission was able to point to a "maintenance timebomb", a lack of basic property information (no complete terrier), space wasting, no standards for basic services, poor energy management, no portfolio valuation, lack of management information and systems and poor accounting.

There were three root causes of this situation. The first lay in the relationship between central and local government: no incentives were provided to encourage good land management and, in the penal nature of capital controls over local government expenditure, the Commission found a real disincentive to positive estate management. The second cause was the neglect by members and chief officers of policy and strategy in relation to property portfolios. Finally, property users and managers were not enabled to "operate professionally and effectively" (Ibid.).

The Commission's reports contain much that is prescriptive but it is the resource question that underpins most aspects of the "solution".

A pool of professional manpower is an obvious pre-requisite. An article carried in The Valuer (Anon., 1988) reviewing the Audit Commission Reports and a contemporary report on property management in the National Health Service (National Audit Office, 1988) concluded, "It is difficult to resist the conclusion that Government needs to allow all arms of the public sector to invest... in both professionals and its property". In its submission to the Commission, the RICS asserted that, "Staff costs

are anyway insignificant in relation to the benefits to be gained from effective management" (RICS, 1987).

The emphasis on more and more influential property advisers compounded a problem that already confronted most local authorities - the recruitment of property professionals. A brief review of the nature of the property professional's status in local government helps to explain why.

Historically, the property management/ valuation function is likely to have been subsumed in some department other than one specifically designated for the purpose (Anon 1989). At County level, the task was often added on to the architectural function or perhaps had become an Economic Development role. At District level the task could be part of legal services, a chief executive unit, the Treasurer's Department or even a Planning and Development Control Department.

Even where a separate property department existed, it was not uncommon for it to have been overwhelmed by the weight of council house sales, commercial rent reviews and mundane aspects of estate management. A very common example was that of the one or two man team doing little more than procuring valuation services, often from an increasingly busy Inland Revenue Valuation Office, and carrying out routine management functions.

As a result, the property manager had a reactive rather than proactive role and had little say in the development of policy. Combined with a relatively lower level of remuneration than the private sector enjoyed, a relentless media debate about local government inefficiency and the ever present prospect of reform/abolition, it was easy to see why

recruitment problems arose. In the words of Paul Orchard-Lisle:

"The public sector has always been, and still is, one of the best training grounds for a surveyor, but it amazes me how it continues to keep its high quality staff. Poor conditions of employment (not just salary) and the political attitude to public servants make the overall position of the professional in the public sector unenviable." (Quoted by Miller R.J., LAVA Presidential address, 4th November, 1988).

This picture of property management was not universal. Some authorities had established the true importance of the resource. The Commission was able to point to many examples of good practice. Despite the problems, men and women of high calibre with a sense of public duty have consistently been attracted to local government. Some had organised Property Departments with a clear remit for planned maintenance, asset registers, reviews of surplus accommodation and the other good practices associated with positive property management. But these were the minority. "Managing the corporate estate of Leicester City Council" provides evidence of one such exception (Roberts B 1983). For most others the tasks prescribed by the Commission were entirely new.

If in relation to its previous reactive role local government was experiencing recruitment problems, the additional duties would serve to exacerbate the situation. The newly qualified, or for that matter experienced, property professional was a diminishing resource. In the context of a continuing property boom, the supply of a new cadre of officers would be problematic.

As referred to above (Chapter 1 p1), John Edmondson, the Cardiff City Land and Valuation Officer, faced a high vacancy rate throughout 1989. The subsequent collapse in property markets has eased the situation. But unless the supply of new graduates increases (there has been a 23% fall in general practice TPC registrations in 1991 (Estates Times, 11/10/91)), demographic changes suggest a return of the problem in the last years of the current decade.

Nor is the resource problem simply a question of more manpower. Kirkwood and Padden drew attention to the cultural changes that would be required amongst existing staff if the challenge was to be met (1988). They stressed the need for skill training and computer literacy. Indeed, the need to harness information technology as a resource, the subject of the next section, was another key recommendation of the Commission. A three page Appendix to their main report outlined the core data which a proposed property database should capture (op. cit).

Estimates of progress since 1988 are difficult to make. One early correspondent to the Estates Gazette (Greenly R. 1989) complained that no progress had been made and drew fire from the Local Authority Valuers Association.

At the other end of the spectrum, Graham Mather, general director of the Institute of Economic Affairs, believed that some authorities manage better than many private sector firms (Financial Times, 20/9/89), a comparison pursued by Gibson (1991).

Indeed, subsequent research by Reading University (Avis M. Gibson V. Watts J, 1989) has demonstrated that the findings of the Audit Commission in respect of local authority portfolios are more generally

applicable. Property needs tend to be subordinated to the operational needs of companies (councils) rather than integrated with them; management systems are poor; property professionals are too thinly spread and rarely sit on boards of directors or positions of influence.
Local government has been responding to the criticisms since 1988.
In that time many reports have been produced by or with local government organisations addressing the issues (see for example "Efficiency and Initiative in Local Government", South West and Mid Wales Property Management Group) of which the most influential has been "The Economic, Effective and Efficient Management of Public Authority Landed Estates", Joint Report of Surrey Council and Kingston Polytechnic.
As well as reports, there has been considerable action. Most local authorities now have a property review function and computerisation of property management has been widespread. To date, however, only Cardiff City Council and Mid Glamorgan County Council appear to have made decisions to develop "expert systems" for property functions.

b Business plan and information strategy

At Cardiff City Council the challenge that the Audit Commission was to articulate was first addressed in a report in July 1987 (Edmondson J.S. 1987a). This report set out to define the City Estate, define responsibilities in the management of the estate and proposed a "land strategy policy". Following its adoption, a Land Strategy team was appointed within the Land and Valuation Unit of the Legal and Administrative Services Department, with the remit to develop policy, a

business plan and an Information Technology (IT) strategy. The team would be created from existing resources and be self financing.

Prior to this, the Land and Valuation Unit had undertaken a series of activities which had accrued over the years. Typically the day to day activity of the unit was decided by ad hoc pressures. Management of the estate was reactive: 100% of maintenance, for example, was in response to call-out by tenants or occupiers, and most of this was emergency rated. By far the most resource consuming work of the unit was Right to Buy valuations; this was followed closely by compensation work for highway schemes carried out on behalf of South Glamorgan County Council (an authority which, at that time, had no valuation staff at all).

There had been no review of surplus land nor of Direct Service Property (defined by the Audit Commission as premises occupied by the Council itself in the provision of services) and none was contemplated. For such positive management roles there were no explicit proposals and no resources. The lasting contribution of the unit had been its role in the development of the city centre, a role that had grown out of its valuation work under Clearance Area Orders but which had been largely completed by the late 1980's.

The new business planning process went hand in hand with the development of an inventory: a full listing of the portfolio to identify the nature of the estate and its most pressing problems; and a caseload analysis of each professional and technical officer.

This process was not seen as a once and for all operation. The inventory

is kept up to date; caseload is reviewed on a regular basis and the business plan, now known as The Service Plan, is reviewed annually.
The anchor of John Edmondson's "Land Strategy" was his mission statement:

> "The efficient, positive, co-ordinated and cost-effective (value for money) management of land and property" (op. cit).

The emphasis was placed on a minimum of additional manpower and the maximum improvement of efficiency of existing staff through the adoption of an information technology strategy. In a submission to the Audit Commission in 1989, John Edmondson stated his view that,

> "Creating new empires is no longer in vogue: neither is it valid. At Cardiff, we have responded to the stimulus by an attempt to improve efficiency in general, to release the enterprise that was latent in an existing department and through an information technology strategy to redirect resources to the kind of positive management envisaged by the Commission". (Edmondson J.S. 1989)

In September and November 1987, a second (Edmondson 1987b) and third report (Jenkins 1987) laid the basis for the business plan and information strategy. The method used to develop the business plan and the information technology strategy was produced by D.H. Jenkins and N.G. Shippobotham, Senior Systems Analyst at Cardiff City Council, assisted by P. Hall, Senior Technical Officer.
Essentially, corporate business objectives were mapped onto a functional analysis of the Unit (Jenkins and Gronow, 1989). As soon as the business

priorities were decided, the susceptibility of the functions to automation was evaluated. The business case for priority applications was costed and reported to Committee. An overview was represented in diagrammatic form (Figure 3.1).

Pivotal to the plan was the development of a database to administer the sale of council houses, record valuations and provide a comparables database (see Chapter 4); the completion of a previously commenced "terrier" database; a system to administer and value a large portfolio of residential freehold reversions and a commercial property register. The council house system would also lay the basis for the introduction of an "expert system" for actually valuing the houses, denoted by "*" against "Council House Sales" in Figure 3.1.

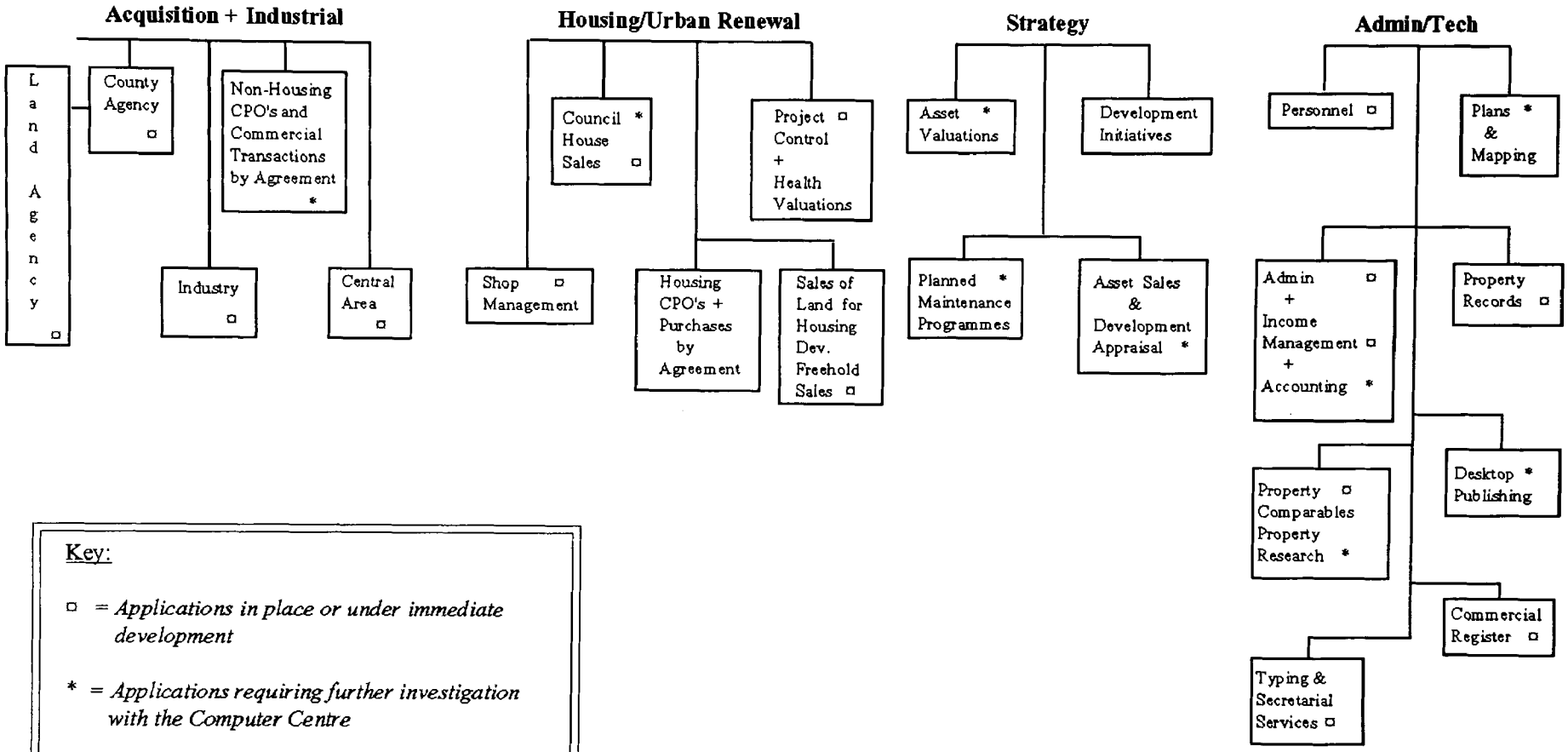
Other applications were identified but the priority applications above would bring considerable productivity improvements releasing valuers for the positive management tasks envisaged by the Commission.

Before proceeding it was necessary to review the marketplace for software and examine the merits and disadvantages, costs and benefits of acquiring versus developing sofware in-house. N.G.Shippobotham, P. Hall and D.H. Jenkins undertook an exhaustive review of IT for property management and valuation in 1987 and 1988. Every seminar, conference and exhibition in the U.K. which came to attention on the subject area was attended. A substantial product library was developed and many potential suppliers were invited to demonstrate software. Property and computer journals were reviewed for relevant aspects of the topic and catalogued. This review process was instructive, especially as regards the potential pitfalls for the uninitiated in relation to software acquisition and

APPENDIX 2C

(ii) INFORMATION TECHNOLOGY OBJECTIVES: DRAFT STRATEGY

VALUATION DEPARTMENT - PRIME FUNCTIONS



Key:

□ = *Applications in place or under immediate development*

* = *Applications requiring further investigation with the Computer Centre*

Fig. 3.1 Cardiff City Council, Valuation Department: IT Strategy

development (Prescott, Gronow and Jenkins, 1989 supplies a partial account of the review).

Two observations flowed from these researches. The first was that, despite the potential market for a database tailored for general housing valuations, none existed, nor was there a product for the more specialised area of council house valuations. Secondly, suggested by the first observation and more generally, it appeared that property valuers were by and large unaware of the capability of IT.

The next section examines IT in the profession and particularly in local government property management.

c IT in the property profession.

A recurring theme of the seminars and conferences attended in 1987 and 1988 was the slowness of the profession to espouse existing technologies (Jenkins and Gronow, 1989). The fact that the RICS could attract a large audience in 1990 to a seminar entitled "What is a database?" is indicative both of a continuing cultural deficit and of the need to address it. According to Christopher Garbett, IT Editor of The Valuer, "..I still have the feeling that our profession is reluctant to take advantage of new technology; this can only be to its detriment and, ultimately, the public which we serve" (Garbett, 1991).

Why this should be the case is difficult to say with certainty. There may be structural reasons: the differentiation of skills within the profession and the consequent lack of portability of solutions in a fragmented market. The problem may be subjective - the nature of valuation as art and the emphasis on experiential learning. Perhaps

the enthusiasts overemphasised the extent of the likely contribution of the technology. The Estates Gazette's IT editor expressed the view that, "Modern technology should not enshrine valuations in scientific respectability, it should highlight the importance of good judgement" (Kirkwood, 19, p260).

Local government has certainly reflected the generalised apathy. The early IT applications were in accounts and in many instances the Data Processing (DP) manager still works for the Treasurer. Some property applications were developed in the 1970's, for example, income collection, maintenance systems and even property record systems. These systems still commonly reside on mainframes using software designed by the DP unit or written by mainframe suppliers for a captive market as verified in a recent survey (Webster-Blaine 1991). Even before the Commission reported there were some developments. The arrival of wordprocessing and the availability of spreadsheet packages to accountants overflowed into some property departments.
Newly trained entrants from the Polytechnics contributed to the demand for valuation spreadsheets. Experiments were started with commercial and residential agency software and investment valuation software. At the organisational level, DP managers were being freed of their accountancy ties as the general applicability of micro-computers became apparent. Corporate IT strategies began to emerge and the property professional was perhaps invited to declare an interest.
One brake on development has been the generally low level of resources available for investment in IT. While the level of investment in IT in

local government is rising and exceeded £0.5 billions in 1988,(Society of Information Technology Managers(SOCITM) 1988), the DP manager besieged by the requirements of Housing Benefit, Community Charge etc may have relegated property systems to the bottom of a long list. Evidence of a substantial turnaround in investment in property systems in this sector is beginning to emerge (Webster-Blaine, 1991).

The Association of Heads of County Property Departments (COPROP) established a computer applications group which has produced several reports as well as a focus for the development of property systems in County Councils. County Council property departments are multi-disciplinary and the concerns of COPROP go beyond the bounds of valuation and property management.

The Association has developed the database model outlined by the Audit Commission (COPROP 1989a). A comprehensive list of management information has been laid out as "property data sets" and a record of progress made by participating authorities. A second document (COPROP, 1989b) surveyed all mainframe, mini and micro systems in use in COPROP authorities with a detailed breakdown of software used and function. COPROP continues to act as a spur to the further development of systems.

This sort of focus is absent in the private sector. While systems are sometimes seen to give an edge in the market and understandably commercial secrecy is to be respected, there is no good reason for the failure of the professional institutions to draw up a programme of education, to set standards and promote good practice in this sphere.

In the private sector, by contrast, during the boom years when high fee income could have sustained an investment programme in IT there does not appear to have been progress of the type associated with COPROP and what progress there has been is poorly documented (See for example Feenan 1990) Then when recession began to bite it appears that investments in technology and research departments were among the first to be trimmed (from a discussion with I.P. Scott, Assistant Director, Research, Fletcher King).

The only solution to this cultural problem appears to be the sustained exposure of property managers to new technology, starting with the integration of the latest software into professional training. Not that everyone can or should be a systems developer. The notion of hybrid managers, developed by the British Computer Society (BCS, 1989), may provide a transmission belt for IT into the profession. Essentially, the hybrid manager is one who is vocationally trained but then specialises in the development of IT. Such "hybrids" are responsible for the development of many successful systems (Ibid.). Practices of sufficient size would benefit from the employment of such a hybrid or the use of such consultancies which have emerged in the late 1980's.

If not everyone can be a system developer, all should be confident in the use of the computer. As modern tools become more accessible, knowledge of the "query language" should become commonplace. Academic and professional institutions can play a major role by ensuring that the syllabus and professional competence reflect the latest advances. Today that must involve the principles of relational database management systems and expert systems.

If the challenge of IT has not been met, it is not about to go away. The data handling requirements of commercial property registers, asset registers and asset valuations by DCF (Darg, 1989) and planned maintenance programmes must make it efficient to confront the data preparation task and computerise.

d Expert systems in the Land Strategy

The notions that information strategy should be included in business planning and that investment in IT should be driven by the business plan have become generally accepted within British business, though actual practice is thought to lag behind the concept (see for example Audit Commission 1990).

But the extension of the principle to the integration of knowledge in the business plan is in its infancy. While Richard Stow of Neuron Data looks forward to the day when the market might be able to put a value on knowledge bases as a corporate asset (quoted in the Financial Times, 23/4/91), there is currently an a priori assumption that if the process or service requires knowledge, it will be supplied by a human "expert". Arguably this assumption will be inverted within a shorter timescale than it took to establish that all calculations would be performed by electronic calculators from the inception of techniques for their mass production.

While it is fanciful to assume that highly trained professionals will be replaced by technicians using machine support, not all expertise requires professional training. Much of the knowledge that is required

in every organisation is shallow. Tasks often consist in the application of a limited number of rules to a manageable domain. Dr Laurence Shafe has argued that much "expert system" development will be in such areas (Expert Systems in Local Government Conference, September 1989).
Developments in recent years tend to bear this out. The Financial Times published a Management Report ("Successful Expert Systems", 1989) and concluded that expert systems do not usually replace experts. "What they do is enable less qualified people to carry out routine tasks formerly done by experts, relieving the experts to do more difficult work".

Certainly not all aspects of the work of professionally trained staff require "deep" knowledge. Informally, there is widespread acceptance within property practices, public and private, that certain types of work are more suited to the newly qualified or trainee valuer. Often such tasks are of a mundane nature. Such areas could qualify for expert system modelling. Scott used the phrase para-professional to describe this level of activity which displays "expertness" rather than "expertise" (Scott, 1988 p72.)
This is not to be confused with another observation: that valuation staff, especially junior staff, can be involved in all manner of routine support work of a technical nature. This is simply inefficiency and should be dealt with by more traditional means.

In order to answer questions like, "How can expert systems be applied in the valuation of property and in the practice of surveyors?" a brief classification of knowledge may be helpful.

Production rules are derived from "compiled knowledge", that is, "information that is organised, indexed and stored in such a way that it is easily accessed" (Harman and King 1986). There are two types of compiled knowledge (following Harman and King): domain independent (principles, axioms and laws) and domain dependent (heuristics). The former is associated with the written word and is communicated by tutors; this type of knowledge is sometimes referred to as deep knowledge. The latter is associated with experience and communicated by mentors; it is known as surface knowledge.

In practice, both types of knowledge are drawn upon by valuers. Deep knowledge forms the basis of pre-qualification education: it provides the bedrock for later development: it is refreshed through Continuous Professional Development and research. The TPC for chartered surveyors should provide assurance that the newly qualified surveyor is capable of applying that knowledge as well as providing an initiation in surface knowledge under the guidance of a mentor.

Domain independent knowledge is clearly susceptible to expression as a series of rules. But the rule structures associated with domain independent knowledge tend to be large and complex. This is no doubt why existing systems tend to be in domain dependent areas: they are concerned with heuristics, are relatively small scale and often appear to be in mundane areas.

Hu has suggested a taxonomy of expert system applications (Hu 1987). The lowest level application is an "assistant system"; such an application performs at a level much inferior to a human expert.

The next level application is a "colleague system" ; performance is regarded as only slightly inferior to a human expert. The highest level

application is an "advisor system"; such applications would be equivalent to human experts. Advisory systems are equivalent to the "consultant system" which Scott and Crofts defined as true expert systems.

From the foregoing it will be apparent that most successful systems are at the lower 2 levels. From the previous chapter it is apparent that in property management not even this type of system is being developed.

Why there should be such a dearth of applications is not clear.

The Harwell Knowledge Engineering Centre has explained the general paucity of development in terms of "escapism, hideboundness, timorousness, pessimism, tunnel vision, mammonism and fetishism" (Financial Times, 14/9/89 "The Growing Role of computerised expertise").

Perhaps a simpler explanation is the perception of expert systems as a threat to experts analagous to the robotisation threat to blue collar workers. In Japan, where these systems are widespread, they refer to them as "work assistants". To counter this perception requires education and training and the first task will be to teach people how to establish what rules exist in their working environments.

For, despite the lack of progress, it would certainly appear that a valuation office is a rule bound environment. Aside from the mundane rules associated with certain types of valuation, there are procedural, legal and professional rules. These are all susceptible to interpretation by expert system technology.

The problem confronting the City Council in any decision to develop expert systems was not "Is there a potential subject area?" but "where to start first?". The answer was supplied by the business plan. The

two most pressing areas were council house valuations and highway compensation schemes. The Interim Information Technology strategy focused on a valuation system for the former and a legal/ procedural advice system for the latter (Jenkins, 1988). The first priority would be the council house system, not only because of the substantial resources which the activity consumed but also because it operated at the level of heuristics.

Anon (1988), "Public Sector Manpower in Property", The Valuer, June issue.

Anon (1989), "The functions and organisation of estate management in local government", Mainly for Students, Estates Gazette, 24th June 1989.

Audit Commission (1988a), "Local Authority Property: A Management Handbook", HMSO.

Audit Commission (1988b), "Local Authority Property: A Management Overview", HMSO.

Audit Commission (1990), "Preparing an IT Strategy", Audit Commission Management Papers, No.7, Feb 1990, HMSO.

Avis M. Gibson V. and Watts J.(1989), "Managing Operational Property Assets", University of Reading.

BCS (1989) Report of working group on the development of "hybrid managers" reported in the Financial Times, 26th Jan 1990.

COPROP (1989a), "Property Information System Development", Oxfordshire County Council.

COPROP (1989b), "Analysis of Computers and Computer Applications in Member Authorities", COPROP Computer Applications Group.

Darg A. (1989), "Capital Accounting", Public Finance and Accountancy, 8th September 1989.

Economic Development Briefing "Property Manpower ,Pay and Media", March 1989.

Edmondson J.S.(1987a), "The City Estate", Report to Cardiff City Council July 1987.

Edmondson J.S. (1987b), "Management of the City Estate", Report to Cardiff City Council, November.

Edmondson J.S. (1989), "Land Strategy at Cardiff City Council".

Feenan R. (1990), Papers of the Conference on "IT and Expert Systems: Applications in Property" for a review of Chesterton's experience.

Garbett C. (1991), "A reluctant profession when it comes to computers", The Valuer May 1991, p12.

Gibson V (1991), "Private v Public: who manages operational property most effectively?", Property Management Vol 9.1.

Greenly R. 1989 Estates Gazette, Correspondence June 17th, July 29th, September 16th.

Harman and King (1986), "Expert Systems", Wiley.

Hu S.D. (1987), "Expert systems for software engineers and managers", Chapman Hall.

Jenkins D.H. (1987), "City Estate : Information Technology", Report to Cardiff City Council, September.

Jenkins D.H. (1988), "Information Technology Strategy: Interim Report", Report to Cardiff City Council, March.

Jenkins D.H. and Gronow S. (1989), "IT in local government property management", Estates Gazette, 28th October.

Jenkins D.H., Prescott G. and Gronow S. (1989), "Information Technology: The changing nature of Local Government Property Management", Property Management Vol 8.1 75 - 82

Kirkwood J. (1984), "Information Technology and Land Administration", Estates Gazette.

Kirkwood J. and Padden J. (1988), "What the Audit Commission did not tell us", Estates Gazette, 22nd October.

National Audit Office (1988), "Review of the NHS Estate", HMSO.

RICS (1987), "Property Management in Local Authorities".

Roberts B. (1983), "Managing the corporate estate of Leicester City Council", Property Management, Vol 2.3.

Scott I.P. (1988),"A Knowledge Based Approach to the Computer-Assisted Mortgage Valuation of Residential Property", Unpublished Ph.D Thesis, Polytechnic of Wales.

SOCITM (1988), "IT trends in Local Government", Warwickshire County Council.

Society Of Local Authority Chief Executives (1986), "Our Heritage, Property Management in a Local Authority", Joint Publication of RIBA, CIPFA, RICS and SOLACE.

Webster-Blaine Y. (1991), "The Development of A Property Information System", Unpublished Research Diploma, Polytechnic of Wales.

Chapter 4. Council House Valuations: Traditional approaches

a The right to buy valuation

As outlined in Chapter 2 (d) the right to buy valuation is a modified form of open market value. Consequently the valuation approach is similar to that conducted for mortgage valuations. Essentially the valuation is executed in two steps. The first step is inspection, the second is appraisal, which itself consists of analysis and valuation (Baum and Crosby, 1988).

Good practice in relation to the valuation mirrors the practice notes developed for mortgage valuations. The duty of care implied in the provision of a valuation to a mortgage lender (Smith v Bush) is apparently similar to the duty of care owed to the local authority and to the purchaser under the legislation (Harris v Wyre Forest). Though the local authority is under no obligation to produce a survey, nor disclose a report to the purchaser, reasonable care must be taken in the provision of a valuation and the "trail must be followed" (Roberts and Another v J. Hampson and Co. 1988). The requirement of the local authority to produce a list of known defects is probably no greater than the duty imposed by case law on the mortgagor.

One clear difference is in the statutory obligation on the lender to ensure that the valuation is performed by a suitably qualified person (s.13 Building Society Act 1986); meaning for practical purposes a member of the RICS or ISVA with local knowledge (Manual of Valuation

Guidance Notes and see Moreton P. 1990). A similar obligation is not imposed on the local authority. Often, though, the obligation is self imposed and invitations to tender for such work published in the Estates Gazette often prescribe suitable qualifications (for example Brent Council Tender, CSW, 13th June, 1991; Barnet Council Tender, CSW, 19th April, 1990). However, there is evidence of such tenders being won by Estate Agents where non-qualified personnel have conducted the inspections. Whether or not the decision in the case of Summers v Congreve Horner, 1991 and in particular the dictum of James Fox-Andrews QC on what constitutes "supervision" for the purposes of professional indemnity insurance is applicable to the valuation of council houses remains to be seen. At the time of writing the RICS is taking Counsel's opinion on the interpretation of that decision (Chartered Surveyor Monthly Vol 1.3, 1991).

Consequently the inspection of a property for sale under the legislation typically takes 30 minutes or so and will require further inspection and even specialist inspection if there are defects which could be detected by a competent inspection. This amount of inspection time corresponds with time taken in a typical mortgage inspection as mentioned in the case of Lloyd v Butler, 1990.

The subsequent appraisal will depend on a comparision of the subject property with known transactions of similar properties in the same area with a similar valuation date. The courts have also emphasised the requirement of valuers to make notes of this comparable analysis as in Corisland Investments Ltd v Druce and Company 1978. In the selection of

comparables, preference should be given to "open market sales": in this instance, resales of previously council owned or housing association owned property or sales of similar non-council housing.

A degree of artificiality existed in the early years of the scheme and as a consequence government policy had an undue impact on the level of prices. As market evidence increased, it is assumed that this policy effect on prices has waned.

Certainly Cardiff City Council was experiencing fewer appeals and fewer overruled valuations in 1988/9 than earlier years.

b Before SOC

Prior to the introduction of the SOC (Sale of Council house) database, all aspects of the valuation process were conducted manually. Survey reports were non-standard and hand written on site. These reports were stored in separate files for each property along with application forms and other papers.

Salient points from the report were kept in a manual register of all valuations: a comparables book. The salient points were : address, property type (bungalow, flat), number of bedrooms and other rooms, date of construction and construction type (traditional, BISF). This was supplemented by a code for the existence or not of a garage, central heating and plot size.

Major defects would produce a marginal note of the type "not for comparable purposes."

The conduct of the valuation involved searching the register for the closest comparables in respect of the subject property with the intention of establishing a "base" value. The notion of base value will be considered in Chapter 4 (d) below.

The files for each of the closest comparables would then be retrieved and a finer comparison made against a wider set of attributes. Properties with special characteristics or defects were usually ignored or else the valuation was adjusted to reflect their presence. In other words, the valuers adopted a traditional hedonic approach; adjustments were made up and down to reflect the valuers' perceptions of the impact of (dis)benefits.

The valuers interpolated between the comparables to arrive at a figure suggested by the evidence and then made a final adjustment to cater for perceived market movements where the comparables were "dated." This final adjustment was entirely subjective: no analysis of property sales, not even council house resales, was conducted systematically. There was simply no time. Odd shreds of evidence about particular sales had weight beyond their true relevance.

The valuations tended to lag market developments substantially. Local Councillors sometimes raised concern at this fact in a rising market. Despite this, appeal to the District Valuer (DV) tended to result in further reductions in valuations. This reflected more on the DV's perception of the market or government policy than the market itself.

The system bred inconsistency and inaccuracy which was camouflaged by the lack of data about the sub-market. It was the inefficiency of the system, however, which gave the impetus for its review in 1987. The valuers needed access to the files and to the comparables register to complete the valuation. Five or six officers, including a supervising senior valuer, would be competing for the register. Though valuers could rely on clerical help to locate files, congestion occurred. The administration of the system, from receipt of application through to completion of sale could involve 67 separate actions performed by up to 6 different clerical/technical staff in addition to the valuers.

Retrieving files was not the end of the problem: non-standard hand-written reports are difficult to read and the valuers who wrote them may have left the council's employ.

Because of delays, it was possible for two valuers to inspect neighbouring properties in the same week and be unaware of their respective conclusions. The neighbours themselves would be better informed, sometimes to the embarrassment of the valuers.

SOC was introduced both to systematise and accelerate administrative procedures and to act as a valuation tool: to make the estimate of base value and adjustments more consistent and to act as a comparables database.

SOC was built using the Clipper compiler, a database development tool based on the DBASE III PLUS file structure, to hold details of every transaction. It is a complete administrative system. Reports, using R & R Relational Report Writer, a multi file relational report generator also designed for use with DBASE data, permit the monitoring of all cases and via Mailmerge the production of all correspondence. It gives up-to-the-minute data on progress and comparables. It has had considerable impact on the valuation process.

The systems analysis in preparation for SOC was undertaken by D.H. Jenkins. All of the valuation, technical and administrative staff involved in the procedure were interviewed and a series of entity diagrams were produced mapping the 67 discrete actions which comprised the procedure.

A considerable degree of duplication and otherwise wasted effort was discovered. Four separate indices tracking cases within the system could be reduced to one. One particular item of correspondence circulated to five people beyond the Valuation Unit contained partial information of use to one of the recipients only. The system resolved to a dozen or so really necessary actions. Analysis and designs for the new system and planned new stationery to be generated by the system, prepared by Mrs. C. Harries, were sent to the Council's in-house IT team. A prototype system was built and tested and SOC became fully operational early in 1988. The following section examines the valuation aspects of the SOC system.

c Valuing Council Houses at Cardiff after SOC.

Reasons for computerising a valuation comparables database have been outlined by Dixon and were considered valid :

" *in a manual system the possibility of omitting comparable is increased.

*a computerised system will have clear advantages over a manual system in terms of time and cost saving.

*a computerised system will have clear benefits in treating data as a resource and manipulating data to produce valuation information." (Dixon, 1988).

In addition, it was felt that the new system could reduce ambiguity and establish acceptable standards in the valuation procedure.

To begin with, it was necessary to standardise valuation inspection forms. To transfer the data from still hand-written survey notes to SOC, a list of the most common attributes affecting value was coded and a help screen designed to interpret the codes, as shown in Fig 4.1 overleaf.

Some valuers objected quite strongly to both these developments. Standardising inspection notes was seen as limiting despite the

ATTRIBUTES

EXTERNAL:

A:NEW ROOF
B:ROOF REQUIRES ATTENTION
C:CHIMNEY REQUIRES ATTENTION
D:RWG REQUIRES ATTENTION
E:NEW WINDOWS
F:PARTIAL NEW WINDOWS
G:WALL TIE REPLACEMENT
H:CAVITY FILL
I:WALL TIE CORROSION
J:EXTERNAL CRACKING
K:SETTLEMENT
L:BRICKWORK REQUIRES REPOINTING

MISC:

D:DUTCH
S:STRUCTURAL SURVEY

INTERNAL:

R:REFURBISHED
W:REWIRED
C:CENTRAL HEATING
P:PART CENTRAL HEATING
F:FITTED KITCHEN
E:ELECTRICS REQUIRE ATTENTION
K:KITCHEN REQUIRES ATTENTION
B:BATHROOM REQUIRES ATTENTION
S:STAIRWAY REQUIRES ATTENTION
D:DAMP
C:CONDENSATION
I:INTERNAL CRACKING
M:WOODWORM
Y:DRY ROT

PLOT:

L:LARGE
S:SMALL
C:CORNER
G:GARAGE
H:H/S
P:POOR LOCATION
E:GOOD LOCATION

FLAT:

A:EXCLUSIVE GARDEN
B:COMMUNAL ENTRANCE
C:COMMUNAL GARDEN
D:BINSTORE
E:BALCONY
F:LIFT

Fig 4.1 Codes for value sensitive attributes

inclusion of a facility for notes; performing data entry was seen as menial. But the benefits of standardisation - consistency, ease of retrieval - were perceived as a greater good by the majority. Likewise, the additional data entry was seen as far less onerous than the paper chasing which had characterised the previous system. Initial objections melted away with experience.

The help screens rapidly became redundant as the valuers assimilated the codes for attribute descriptions. Up to 60 attributes regarded as the most value sensitive are recorded. More could be added and some small revisions have taken place. In lieu of the old manual register, a "hierarchical" report in SOC prompts the valuers to select, by street name or area, recently sold properties of similar construction, "type" and similar accommodation to the subject property. See Fig 4.2. For definition of these "critical variables" see Chapter 5 (b) page 98.

This produces a manageable list of like properties (Fig. 4.3) and a "base value" is deduced, influenced mainly by location and accommodation. The listed properties are then analysed in much greater detail in respect of those other attributes which affect value. Off screen, the valuer still interpolates between these comparables and adjusts the base value appropriately. The actual valuation result is recorded on a separate screen (Fig. 4.4).

Initially, the monetary amounts used to make the adjustments were still largely subjective. But the display of coded attribute data for the most comparable properties on one screen allows the valuer to deduce

SOC VALUATION ENQUIRY 27/09/89

THIS UTILITY WILL INTEROGATE THE DATABASE
SELECTING THOSE PROPERTIES THAT MATCH THE
PARAMETERS SPECIFIED BELOW:

WHAT RANGE OF RTB1 DATES: FROM / / TO / /

STREET(1ST 10 CHAR ONLY):

UP TO 4 OF EACH OF THE FOLLOWING CAN BE SELECTED
LEAVE BLANK IF NOT SIGNIFICANT

AREA.....				
CONSTR.....				
TYPE.....				
CODE.....				

Fig 4.2 The SOC Valuation Enquiry Screen

APP NO.	RTB1 DATE	MARKET VALUE	TYPE	CODE	YEAR BUILT	CONST	ADDRESS	ATTRIBUTES EXTER	INTER	PLOT ...
123	1/89	48000	E	1P3	1931	TRAD	1 ELY ROAD,ELY	LIJ	MI	H
186	2/89	48350	E	1P3	1934	TRAD	8 ELY ROAD,ELY	LI	MI	H
198	2/89	49950	E	1P3	1934	TRAD	19 ELY ROAD,ELY	LI	MI	G

NUMBER OF PROPERTIES SELECTED 3 AVERAGE VALUE 48425

Fig 4.3 Valuation output from the enquiry report

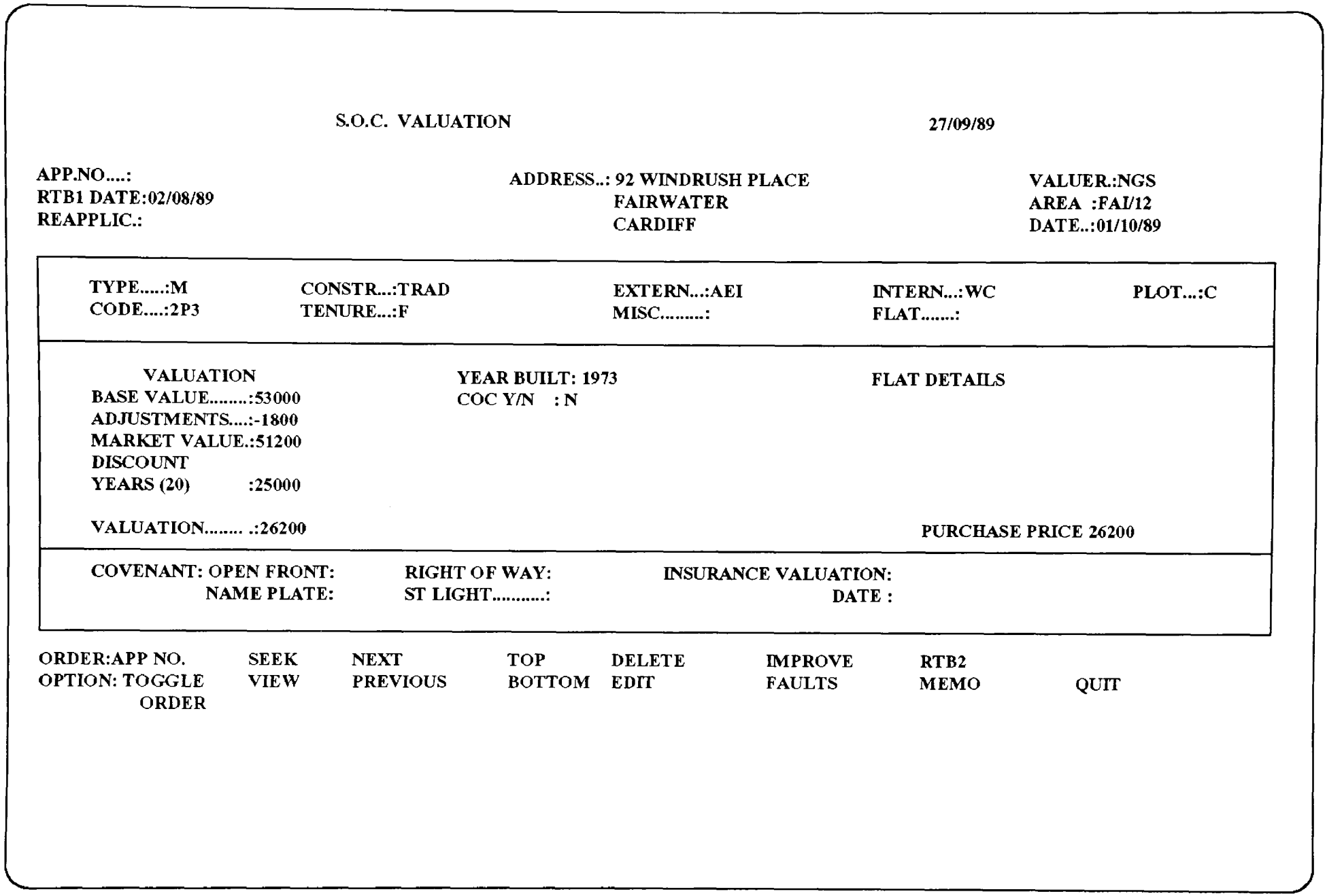


Fig 4.4 Completed Valuation Screen

quickly which properties are most similar and which attributes demand adjustments to value.

Exact matching for all value attributes, though possible, would almost always produce no comparables. Moreover, the method chosen replicated the existing manual procedure and was consequently more acceptable.

Two interesting developments followed the introduction of SOC. Firstly, a more systematic analysis of market comparables began with some valuers developing spreadsheets to analyse data. Second, regular meetings began which discussed the derivation of base value and the amount of any adjustments related to different attribute values. While the process was still subjective, the adjustments were agreed collectively by the valuers. It contained the seeds of a more rational and objective approach.

The time was found for these innovations even at the height of the housing boom in 1988/9. Efficiency was greatly improved.

SOC has been highly successful both in time saving for administrative and professional staff and in valuation accuracy and consistency.

The greatest spur to the further development of the system was the acute shortage of professional staff and the additional demands placed on valuers by the Audit Commission outlined in Chapter 3.

To address the problem, D.H. Jenkins proposed a study of the methodology to discover if parts of the council house procedure could be delegated to non-professional staff. That professional expertise would still be required to ensure that quality did not suffer was not questioned. The problem was that the professional seemed indispensable to both stages of the procedure identified, inspection and appraisal, despite the often mundane nature of the work. It became necessary, therefore, to re-examine the valuation aspects of the process to discover more exactly what if anything could be "deskilled." The following section looks at the knowledge elicitation process involved in this re-examination while the analysis of the domain that emerged is outlined in Chapter 5(a).

d From SOC to RBSOC: Knowledge elicitation and shell selection.

Knowledge elicitation is a contentious area as Scott explained (Scott, 1988, pps 88 et seq). The sources of knowledge are many: personal experience, books and journals, databases. The objective is to elicit knowledge from the sources appropriate to the domain.

In the council house valuation domain, these sources include the legislative framework, agreed procedures and guidelines and the experience of the valuers.

More particularly the task was to analyse valuation expertise, as practised by valuers at Cardiff City Council and reproduce it as production rules in an expert system shell. However, not all valuers

are equal in ability, commitment, aptitude for a particular task or experience. Because of this Scott thought that "conflicting information from the different valuers can make the construction of a consistent knowledge base practically impossible" and he concluded that the elicitation task should be confined to a single building society valuer initially and exposed to critical evaluation of other valuers later.

There is an element of this methodology in the development of RBSOC in that the knowledge elicitation procedure in the development of the prototype was confined initially to a re-examination and refocusing of the knowledge gained by D.H. Jenkins in the development of the SOC system.

This lack of separation between the "knowledge engineer" and the subject may once have led to objections from AI purists, but is now a common phenomenon since the advent of more accessible shells. An example of this introspective and decentralised approach to system development is supplied by Lucas industries who have encouraged employees to develop their own systems using Crystal after short training courses. (PC Week Case study, 12/7/88).

After this initial phase, which in fact overlapped the next phase, the elicitation encompassed informal discussions with and observations of the valuers under the impact of SOC. These observations took the form of attendance by D.H. Jenkins at the regular weekly valuation meetings which started after the introduction of SOC and of closer scrutiny of the work of two of the valuers, Andrew Powell and John Jones. The

latter were also consulted occasionally about the "look and feel" of the system during prototyping.

Scott's concern about conflicting information from the valuers was mitigated by the need of the valuers' meetings at Cardiff City Council to establish a consensus.

Indeed, from the point of view of knowledge elicitation, these meetings were a very positive factor. Not only were decisions reached in relation to the derivation of base value and the weightings of adjustments, but the arguments which underlay the heuristics were exposed to group scrutiny.

These meetings could become quite animated as more experienced valuers and younger, dare it be said, more methodical valuers argued the merits of a particular approach. Greater confidence was attached to the outcome of a group discussion and the system benefited from the dialogue. The whole process was a negation of the fact observed by Mackmin (1985) that valuers do not like to discuss how they arrived at their conclusion. It is a confirmation of the views expressed by Crofts (1987 p1) and Scott (1988, Chapter 10) that the very introduction of systems would lead to an exploration of method.

At this stage of the development, the views of D.H. Jenkins were not offered unless canvassed. If the system were to be acceptable, it had to be true to the valuers; the designers's views should be secondary even if the designer is a manager.

If much of the elicitation work involved introspection, the development of the prototypes was entirely the responsibility of D.H. Jenkins. The Council's initial commitment was to the supply of the necessary software, the loan of a laptop computer and the funding of the research.

This fact has a bearing on software choice. If D.H. Jenkins was to develop the system, ease of use would be an important criterion. The choice of software was also determined by the emphasis on processing production rules referred to earlier, by the requirement to interface to the Clipper database which had been used in the development of SOC and cost.

A review of software in the field had already been conducted by N.G Shippobotham of the City Council's IT Unit. This indicated that Intelligent Environments' CRYSTAL shell provided the best "fit" with the requirements outlined. The author came to the same conclusion following "hands on" experience of Savoir, Leonardo and Crystal.

The Crystal shell is in fact a programming environment which permits the developer to articulate problems in terms of rules expressed in the English language. The system's inference engine permits forward and backward chaining in the processing of rules (Scott, 1988 p 200); it can deal with probabilistic uncertainty; it contains all the standard functions of a spreadsheet; it has a command structure and macro handling capability which facilitates the building of rule structures; it contains screen design features; it has a rule trace to assist in error detection; it contains dictionaries of the rules and variables which the user defines; it is supplied with interfaces to spreadsheet,

text and database. It cost less than £1000 and an additional £400 bought 2 days tuition from the suppliers.

Crystal has been criticised by Linderholm and others as not providing a true expert system environment (Linderholm 1987) but the following view from Dr. Phillip Humphries, Royal Insurance is instructive:

"We now have constructed a wide range of financial and underwriting systems with our customers, all using the PC shell Crystal. We also have bought and learned Prolog, Object Oriented Programming, and some second generation shells in the hope that we may one day encounter the mythical complex problem which demands the ultimate in flexibility and AI.

But it has not happened yet so we keep on using Crystal."

(Expert System User, September 1990)

Baum A. and Crosby N. (1988), "Property Investment Appraisal," Routledge, p4.

Corisland Investments Ltd. v Druce and Co (1978) 248 EG 315

Crofts M.K. (1987), "Expert Systems for Estate Managers," Unpublished B.Sc dissertation.

Dixon T.J. (1988), "Computerised Information Systems for Surveyors," RICS.

Harris v Wyre Forest D.C (1989) 17 EG 68 and 18 EG 99

Linderholm O. (1987), "Crystal and VP-Expert," Pc world, Vol 10.4 pl42 et seq..

Lloyd v Butler and Another, (1990) 47 EG 56.

Mackmin D. (1985) "Is there a residential valuer in the house?", Journal of Valuation, Vol. 3.3, 384.

Manual of Valuation Guidance Notes VGN 2A Section 4.1 (b) (a).

Moreton P. 1990, "Valuation for Mortgage Purposes," Journal of Valuation and Investment Vol 9.1.

Roberts and Another v J. Hampson and Co. (1988) 37 EG 110

Scott I.P. (1988) "A Knowledge Based Approach to the Computer-Assisted Mortgage Valuation of Residential Property," Unpublished Ph.D Thesis.

Smith v Bush (1989) 17 EG 68 and 18 EG 99

Summers v Congreve Horner referred to in Chartered Surveyor Weekly, 1st August 1991

Chapter 5. Council House Valuations: A rule based approach

In this chapter, section "a", drawing on Scott's conclusions and on observations of the council valuation staff, postulates an approach to the valuation of council houses using an "expert system shell" and identifies which aspects of the approach are modelled in the prototype. Subsequent sections illustrate how the knowledge of the valuers was represented in the system (section "b"), how the system was built and runs (section "c"), and perspectives for its implementation at Cardiff (section "d").

a The Valuer's knowledge: Inspection, Appraisal and the link between them.

Scott demonstrated how knowledge and data in the valuation domain could be separated because the expertise was transportable. The expertise comprises domain independent and domain dependent knowledge. Scott concentrated on the dependent knowledge used in the appraisal aspect of the process. This knowledge was heuristically based and could be thought of as expertness rather than expertise (Scott, 1988, p.72 et seq).
As well as heuristics valuers also use property and planning law and know about property finance and a series of other factors which can affect the value of a property. This domain independent knowledge is compiled by the practising valuer and tasks associated with it will have become automatic or "second nature" (Scott, op.cit p75). Such knowledge presents itself as procedure and would be captured for an expert system.

Any Council house valuation system, for example, would need to cope with simple algorithms for deducting discount in accordance with the residence qualification period, ensuring that no discount was deducted above the statutory maximum and that discount did not reduce the price below the cost of the unit's provision where the house had been constructed in "recent" years, as defined by statute.

Scott focused on the appraisal aspect of the domain dependent knowledge, but the complete valuation process is larger than simply appraisal. Whipple sees 5 steps in the total process: define the issue, determine the most probable use, identify the most probable buyer, select the valuation method, adjust for external factors (Whipple, 1990). Each stage is complex and the rules which valuers use can be elicited and represented.

Whipple identifies the whole process. Often though the problem confronts the valuer in a more defined form. The first three stages suggested by Whipple are all self evident in the council house valuation domain. Commonly valuers will recognise the following stages in the process: agreeing the valuation purpose (the brief), inspection, selection of valuation method, appraisal itself, and finally the report to the client. This dissertation will focus on inspection and appraisal, giving only passing attention to the end product - the valuation report.

The knowledge differs between the stages of the valuation process . The inspection is an exercise in data collection and diagnosis. The valuer investigates and notes those attributes which affect value. They may relate to the neighbourhood, accommodation and amenity, or perhaps, the structural condition. The valuer also notes other aspects of the

property which may not have a direct bearing on value but which are required by statute, by the duty of care or simply reflect local practice in the production of reports.

The second stage - appraisal - involves two steps. Analysis involves the disaggregation of data and is sometimes referred to as devaluation; procedural rules have been evinced to determine how the comparables data will be interrogated, but as Mackmin (1985) and Scott (1988) witness these rules are often poorly articulated. Valuation requires the valuer to re-assemble the data to provide "the answer".

Inspection

The first stage, inspection, offered a potential breakthrough in the quest to delegate aspects of the work to non-professional staff which arose as a result of the shortage of professionals (cf. Chapter 3 above). It had not been addressed by Scott in a comprehensive manner, while Boyle (1984) assumed and Czernkowski (1990) explicitly stated that the development of an expert system would be confined to the appraisal process. But if data collection and diagnosis could be separated, the former could be performed by non-professionals under professional "supervision" via the knowledge base. The diagnosis could be performed, remotely, by the professional. The door was opening to these possibilities because of the development in hand held computers for outdoor work (see below, in particular Chapter 7 (b)).

This appeared to be a very suitable area for the development of a rule based approach. Scott had documented how the experienced valuer

developed short cuts in property appraisal. During the knowledge elicitation process it was revealed that there are many heuristics in inspection which spring from familiarity with a locality or certain types of property. Experience leads the valuers to develop associations between location and amenity, location and development potential, house type and defect and so on. Often these associations were not portable: that is they were restricted in their applicability by geographic considerations. For example, the Morganstown area has a clay subsoil and is quite close to a working quarry: particular care is needed in the search for signs of settlement.

However, just as often the associations were capable of wider application. For example, differently constructed houses would be inspected differently. Knowing the house type identified key observations that would be required on site. For example, the valuers developed their own rules for inspecting steel framed and clad houses (BISF) on a city wide basis. This was partly the result of shared observations about the house type and partly the product of reading BRE Digests.

They learned to identify different house types early in their training. The junior officers would take a photographic and descriptive aid on site with them in case of doubt. One particular concrete framed type, "Smith's" type, was clad with concrete panels with a brick effect facing. Mortgage valuation surveyors had been known to mistake such houses for the traditionally constructed. The valuer applied a simple rule: IF it might be Smith's THEN measure the depth of the wall (the explanation facility would show the purpose: to differentiate from cavity and 9" solid brickwork).

These rules had significant outcomes for the valuation: a Smith's type would likely be valued at less than half of the value of a traditional equivalent in the same location.

The standard inspection procedures which the valuers used could be mapped as rules and a non-linear and dynamic inspection "form" could be developed on screen which would remove one of the major objections which the valuers had previously had in relation to the new standard inspection forms which had been introduced with SOC: viz. the lack of flexibility.

In informal discussions, the main objection from valuers was the large number of defects and potential defects which the trained eye can detect. These defects clearly impact on value. But while many properties have defects in need of diagnosis, many of the defects are quite common and easily recognised.

Moreover, if the "inspector", no longer a valuer, is directed to taking all relevant observations by the valuer, the latter can then analyse the results and determine whether a more rigorous inspection is necessary. As few as 5% of all cases need that additional survey in Cardiff City Council's housing stock.

Taking advantage of the most recent developments in PC technology it would be possible, in place of the hand-written standard form, to devise a menu-driven program residing on a hand-held PC operating under MSDOS. The notion that the system would be menu-driven flowed from the idea that the valuers would supply the decision structure; the inspectors, at least initially, would execute the choices. The MSDOS operating system

was necessary because of the topology of the hardware in use by the City Council ie networked PC's.

The hand held PC could be taken on site by the inspector. Each menu would prompt the inspector to gather information descriptive of the property. The rules which drive the interrogation encapsulate the "Guidance Notes to Valuers" and the procedures followed in producing a report which satisfies the standards implied by the duty of care. The sequence of the interrogation was part of the domain knowledge. The rules could be represented in the Crystal shell and information gleaned in this way could then be fed into SOC records via the database interface.

Apart from the purely descriptive aspects of this process, which are in any case often pertinent to value, such an approach offered possibilities in relation to the diagnosis of defects.

This is certainly an area where the profession in general could do better. One report by the National Consumer Council published in January 1990 discovered that a quarter of housebuyers who relied on a mortgage valuation in 1988 discovered minor defects unreported by the surveyor; 9% discovered major defects (Cited in Chartered Surveyor Weekly (January 11th 1990)). Claims in 1989 totalled 15,000 (Moreton, 1990).

Moreover, analysis of the claims directs attention to those areas of the structure which cause greatest trouble and correspondingly require greatest care. One such analysis of claims provides the information set out in Table 5.1 overleaf:

Nature of claim	%
damp/rot/timber/woodworm	18.5
walls	15.1
subsidence	13.2
roof	9
overvalued	7
floors	5.1
undervalued	4.8
services	3.5
windows	1
unidentified/other	22.7

Table 5.1. Claims handled by RICSIS (Source: Moreton, 1990).

Scott concluded that in relation to appraisal (Scott, op.cit p143) uncertain knowledge constituted a real problem and that "building in redundancy" was the preferred solution as explained in the following example.

These findings are equally applicable to the inspection and diagnostic process. Essentially, where the user is unable to answer the system's current question, a "don't know" is returned and the system attempts to derive the answer by other routes. For example,

System: "Is there wall tie corrosion?"

User: "Don't know"

System: "Is the elevation brick or rendered?"

User: "Rendered"

System: "Is there horizontal cracking at approx 0.5m intervals?"

User: "Yes".

The system concludes that there is wall tie corrosion. The supplementary questions would have been redundant had the user been able to answer the first question.

The scope to build in further safeguards is considerable. For example, a positive selection of a certain variable by the operator would indicate the presence of a defect which required further consideration and automatically produce a prompt to the inspector to refer the case to the valuer. Moreton has observed that "Often a number of defects are noted but the valuer seems blind to the overall evidence that when taken together they indicate that a more serious problem exists" (Moreton, 1990). Certainly the Crystal shell could be programmed to TEST for the existence of such relationships and caution accordingly.
More straightforwardly associations between particular defects and particular areas could be programmed into the system (exposed areas/ coastal areas/ areas of clay subsoil or more particularly areas where there is a history of settlement).
Additionally, a field for notes would permit inspectors to raise issues not explicitly catered for; in time the inpectors would themselves enhance the system by incorporating their experience.

The inspection report itself has to be comprehensive and draw attention to all pertinent facts. Because of the systematic way in which the

report is conducted and because all keystrokes are captured and held electronically, the report can be configured to supply a level of detail defined by the system manager. It could, if required, spell out not only conclusions in the form of data/ information but also recall the supplementary questions asked by the inspector and hence reveal the depth of inspection.

A feature of SOC is that it writes the offer letters and lists any defects directly from the inspection data copied from the sheets. This would be possible using the proposed system without the need to retype the data. A single keystroke entry on site is sufficient to generate a whole paragraph of report via mailmerge: the "preferred paragraphs" used for mortgage reports can be generated in the same way.

Appraisal

Much of the "expertise" of the valuer is nothing other than the data itself. After all, everybody knows or could deduce roughly the value of their own home. Every rational purchaser of property becomes a "valuer" for a short time. In one sense, the professional valuer is simply the repository of this valuation information, or a subset of it, for society.

Experienced valuers develop a "feel" for the market. Essentially, this means that they know the structure of values in the market and the relationship between data sets; they know too the dynamics of the market and the determinants of value. This market knowledge is used by valuers to deduce a base value for the subject property.

Part of the system must clearly be a replication of this market knowledge: an expression of the value "structure", owing as much to data as to rules. Moreover, no system could be programmed for posterity; regular variations to the data would be necessary both to relate to new evidence about a static market and to make the model correspond to market dynamics. The ability easily to update the value structure is an additional system requirement.

As well as value structure the postulated system would require an appraisal strategy, ie rules related to analysis and valuation. These rules are partly procedural, partly methodological.

Methodology can and does vary between valuers but there is a strong similarity of approach. In chapter 3, the lack of explicitly consistent surface knowledge was noted: the absence of mentoring in valuation heuristics. Nevertheless, the methods used by surveyors at the Principality Building Society (Scott, 1988) and at Cardiff Council have much in common (Chapter 5 (b)): perhaps they reflect common sense. Libby explains the phenomenon as a heuristic known as anchoring and adjustment which can be regarded as a general problem solving strategy (Libby, 1981).

They appear to value an abstract property which conforms to a norm, though the norm is not standardised between valuers. Then they attribute a "base value" to the norm or assume a range of values within which the property will fall; hence the experienced valuer will predict the value of the property before even seeing it. Finally, following inspection, they adjust the "base value" or range to reflect particularities of the subject property compared with other properties. If a range was adopted,

a final subjective weighting might be carried out or some form of average adopted.

The elicitation exercise at Cardiff demonstrated that specific valuation heuristics vary from valuer to valuer in this process. Differing yardsticks are used in the derivation of "base value" and differing weightings applied to the adjustments mentioned in the survey. All use their past experience or their database or both as a framework when deriving base value. Some then compare different value attributes, derived from survey, in detail; while others rely more on experience to compute a value (and on the imperfection of the market to mask inaccuracies). Perhaps this explains the notion of valuation as art.

Traditionally, the methodology has been limited by poor computing power. The human brain requires the "notional property" to provide the norm which gives effect to the comparison. There are too many bits of information to deduce a value from all the known facts directly (Libby, 1981). Even after deducing a base value, many valuers shy away from comparing lists of value attributes in detail because of the complexity. (In the opinion of one of the valuers at Cardiff, strict comparison was unnecessary because other than in exceptional circumstances the adjustments tend to cancel out approximately, creating a statistically insignificant net adjustment. This opinion was not borne out by the facts however).

The computer has no such inhibitions. It can simply emulate the human valuer or carry out the comparison to a degree of detail impossible or

uneconomic for an unassisted human. This leaves a considerable area of choice to system developers and users. The closer to existing practice, the more comfortable a human valuer is likely to be. The more detailed, the better the service to the client, provided that the model is both rational and true to the market. Certainly alternative strategies could be built in to reflect different representations of the valuation problem or simply to create greater choice.

For example, one common strategy which economises on procedure is that of "matching pairs" (Mackmin, 1985). The system could be instructed to search for an exact match in the database. The exact match might be in relation to all known characteristics in which case successful search would be rare. More successful perhaps would be the search for an exact match in relation to those attributes which make up "base value".

A variant permitted because of the processing power of the computer might be to search for all such exact matches not just a pair. This is equivalent to the hierarchical report in SOC.

If the system were to interface to data, a search strategy would be required. One possible strategy might look like this:

IF Search for exact matches for predefined attributes
AND Count number of matches in permissible date range
AND Test number of matches > predefined target number of matches
AND Interpolate

OR Test number of matches < predefined target number of matches
AND Employ Fuzzy Set of attributes 1...
AND Reveal

The fuzzy set can be defined by the system manager. For example, if one of the attributes was Street Name and no exact match was found, the system might search neighbouring Streets using a "ripple algorithm" (Powell, 1988).

Linking Inspection to Appraisal

If the base value is adjusted by reference to value-laden attributes derived from inspection and base values can be fed into the system by a valuer to provide a value structure, further possibilities exist in substituting for the professional. If the relationships between property attributes and their impact on value can be made explicit, and Cardiff's valuers had already begun to discuss this after the introduction of SOC, they can be expressed within the system or accessed across the interface. Entry on site about an attribute can automatically adjust base values by an amount predetermined by a valuer or building surveyor, and, of course, the amount can have an absolute or relative value. By this method, survey and valuation can be executed for the vast majority of cases by the inspector. The valuer retains responsiblity for the analysis which feeds values into the system. In fact, the valuer is freed to concentrate on the determinants of value.

This would suggest that the valuation and analysis aspects of the appraisal could be kept in separate systems. The analysis can be carried out in a system interfacing to the SOC database which contains not only past valuations but data on council house resales. Results can be fed into a separate inspection/ valuation system which would write its conclusions back into the database.

Such a system however would have been beyond the scope of the prototype. Writing efficient interface programmes to multi-file databases is still the province of the programmer. The objective of the research project was to demonstrate a valuation system which would release funds for the further development envisioned.

Consequently, the prototype focussed on the inspection/ valuation aspects of the process. Comparables search strategy played no further role in the development of the prototype. But because value structure and adjustments must be represented within the prototype, appraisal heuristics did require further study.

b Representing the valuer's knowledge.

A truly anthropomorphic approach will reflect the method applied by the valuers. The method used by the staff at Cardiff will now be considered in more detail and its representation in RbSOC explained.

The valuers adopt a form of hedonic index. They assume a norm whose base value varies with location, accommodation, construction type and "type": these four variables will be referred to as the critical variables.

The collectively agreed "norm" which gives effect to the comparison is a house in good structural condition and decorative order. There are no known defects and no improvements. The plot size is average. It has no garage nor central heating.

Having deduced base value they adjust it as described above to reflect variations from the notional property observed by inspection. This usually involves adding and subtracting agreed sums or percentages.

The critical variables which determine base value will now be examined briefly.

Location : Because location is a critical factor, the valuers have divided the city into 32 perceived valuation areas which are drawn on OS maps hanging on the walls in their rooms and coded into the SOC database. Below these areas, streets are recognised as useful units for comparative purposes. A pilot Geographical Information Sytem (GIS) study under the direction of D.H. Jenkins, N.G. Shippobotham and P. Hall was also interfaced to SOC to discover utility to the valuers. In the GIS pilot, conducted using ARC/INFO software, the SOC data was searched using SQL (Standard Query Language) as shown in Fig 5.1a overleaf: in this example the search is for properties valued between £40,000 and £50,000 in the first half of 1991.

Sometimes the search criteria were defined spatially, which involved mapping catchment areas, represented by polygons drawn onto the screen. Comparables for a subject property were flagged on digitised OS maps. Fig 5.1b shows the output from the enquiry in Fig 5.1a.

This technology is capable of producing in an easily comprehensible form, the "value structures" which valuers seem to carry around in their heads. At the time of the GIS pilot study, the costs of such systems were prohibitive for the average valuation business. Today, such systems can be built at a fraction of the price.

```
RECORD 14

00000                =
00001 ID             =     24
00002 APPNO          =
00003 YEAR       =
00004 VALDATE    =   >01/01/91 AND <01/07/91
00005 STATUS         =
00006 TYPE       =   F
00007 CODE       =   D
00008 CONSTRN    =   TRAD
00009 VALN       =   >£40,000 AND <£50,000
00010 ADDRESS    =
00011 POSTCODE =
```

Fig 5.1a

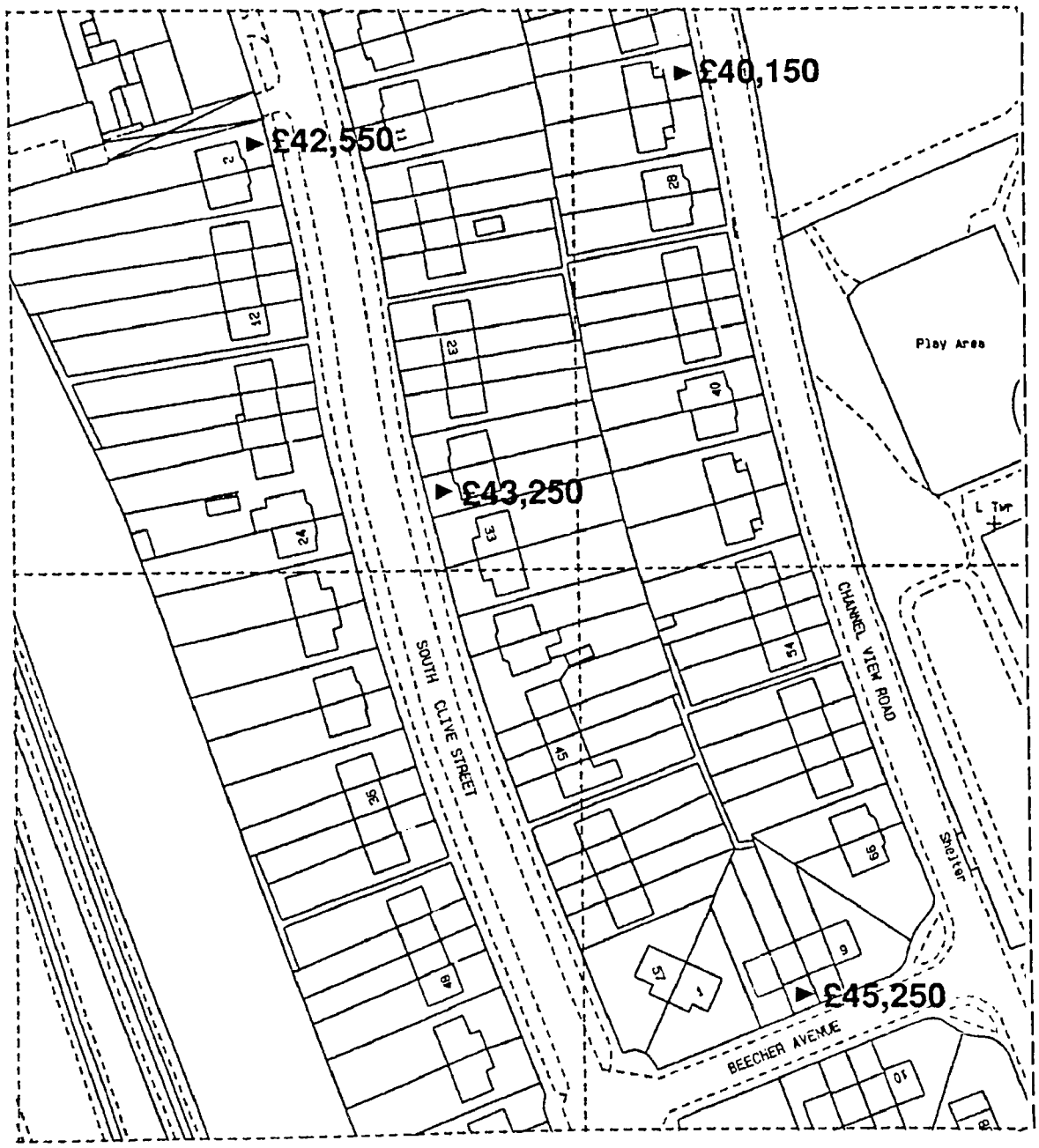


Fig 5.1b

Interfaced to an expert system this technology promises unparalleled support for valuers in the future: but software products are immature (the first UK demonstration occurred at the Association of Geographic Information Conference in November 1991) and there is as yet little literature on the subject (Roth, 1991).

Accommodation : The City Council's valuers traditionally used a 3 digit code to describe a property. The first and last digits of the code are numeric, the middle digit is a letter, example "3P3". The first digit is a reference to an age band, the second describes the accomodation on the ground floor (P means "parlour type" which means having 2 reception rooms), the third element is the number of bedrooms. The same code is used at Swansea City Council in their comparables system. Essentially the code describes accommodation as a variable and implies size as a range of floor areas.

There are five possible values for each of the elements of the code, giving a maximum of 125 alternative codes. The code is used as a unit of comparison: thus a 2N3 (1 reception room, 3 bedrooms) will be compared with other 2N3's in the same area, and preferably street.

Construction type : There are ten recognised construction types including the catch all "Traditional". This latter was defined as the negation of the other 9: ie non-system built, non timber, non steel framed etc..

"TYPE" : this unhelpfully titled category simply means, in relation to houses, either a mid-terraced house, an end terraced house, a semi-detached or a detached house. It can also refer to flats, bungalows and maisonettes which were not included in the prototyping.

The base value of any "norm" is found in SOC by searching the database on the critical variables. For example a traditionally constructed mid terrace 2N3 in area Y could be found by entering these criteria in the search report. The database lists all properties between the high and low dates including those with defects which depart from the norm. The latter are then disgarded and the remainder averaged to discover a base value. The exercise can be repeated for other accommodation types in area Y. Each such search takes less than a minute to perform and SOC itself generates high, low and average values.

In this way, a value structure can be built up for an area or a series of areas. Even so, the number of possible base values is limited only by the maximum number of possible states of each of the critical variables. In RbSOC, ignoring "Streets" as a locational variable, that amounts to 160,000 possible base values assuming that each variable is independent. Mapping these iteratively is a heavy duty (more than one man year) assuming that there were sufficient comparables within the system even for the critical variables. Scott cites Kimball who pointed out that to adjust all available comparables correctly would require a minimum total of comparables equal to the number of adjustments made plus one (Kimball 1977).

Of course it would be possible to generate such a structure using regression techniques, multiple or stepwise. But as Scott concluded, if part of the knowledge of the valuer was an innate understanding of this structure the solution could as easily be heuristically assigned as statistically derived. For Czernkowski (1990), the former solution was regarded as superior because regression assumed the structure and

discovered only the parameters. He submitted that "structure cannot be assumed but, like the parameters, must also be discovered".

To be consistent with the rule based approach, the value structure was generated for a part of the City using data from SOC in the manner described above, then submitting it to examination by the valuers and finally building a more complete structure from heuristics used by individual valuer's and those agreed at valuers' meetings. Thus much of the analysis was undertaken subjectively: the way valuers would normally perform.

A further method of generating the structure - rule induction - was briefly examined. Rule induction software was acquired from Intelligent Environments. Early indications suggest that this method may yield positive results, but the valuation model was too complex a starting point for the absorption of the necessary technique. This is one of several areas where future research may be fruitful.

In order to encode the valuation structure in the system it was necessary to build each of the critical variables into an array. Each of the critical variables has one or more distributions of base values associated with it, depending on its relationship with other variables. For example, the question

"What is the additional value of a fourth bedroom?"

might provoke a variety of replies, as follows:

a "Given, the heterogeneity of the stock, an extra £5000" or

b "10% of the base value" or

c "Dependent on "type", between £3000 and £12,000".

Any of these statements can be mapped into the system, but the first two statements denote that accommodation is an independent variable. In this instance a simple distribution of values for the critical variable could be deduced as follows:

a	b
2N3 = w	2N3 = w
3N3 = x	3N3 = x
2P3 = y	2P3 = y
3P3 = z	3P3 = z
2N4 = w+5000	2N4 = w+(BV*0.1)
3N4 = x+5000	3N4 = x+(BV*0.1)
2P4 = y+5000	2P4 = y+(BV*0.1)
3P4 = z+5000	3P4 = z+(BV*0.1)

Where the variable is dependent on one or more other variables, conditional statements need to be built into the solution. For example, in relation to statement "c":

IF Type =1, THEN	OR	Type =2, THEN
2N3 = w		2N3 = w
3N3 = x		3N3 = x
2P3 = y		2P3 = y
3P3 = z		3P3 = z
2N4 = w+3000		2N4 = w+12000
3N4 = x+3000		3N4 = x+12000
2P4 = y+3000		2P4 = y+12000
3P4 = z+3000		3P4 = z+12000

In order to build up any distribution a starting point is required. In the development of the protoype, a traditionally built mid terrace 2N3 in Whitchurch was taken which also conformed to the "norm". There was no special reason for choosing Whitchurch as opposed to another district; a mid terrace 2N3 was chosen because they were most numerous. In fact, because of the high number of mid-terrace 2N3's in the housing stock and already in the system, these critical variables came to be regarded as aspects of the norm. Its base value was deduced using SOC data.

In selecting the value "Whitchurch" for the locational variable from a menu of possible locations in the system, the user selects this base value. In relation to the variable "accommodation", 2N3 was assigned a value of zero within the distribution, as was mid-terrace in the distribution for "type".

In other words, in an additive model, selecting 2N3, mid-terrace added zero to the base value. Selecting 2P4 would vary the base value by £5000 in example "a" or 10% in example "b" or either £3000 or £12,000 in example "c" dependent on whether "type" was "1" or "2".

To generate the intervals in the distributions for each of the critical variables it was necessary either to search SOC or ask a valuer or listen to the decisions being made at valuers meetings. A combination of methods was used. For the sake of consistency, the first base value in any area was a carbon copy of the starting point in Whitchurch.

Having deduced the base value, the next step is to adjust it. Mackmin, as earlier noted, referred to adjustments to four factors; time, location, physical attributes (condition / accommodation) and sales conditions. The latter can be ignored for reasons oulined above (Chapter

4 (a)). Adjustments for location have been examined in the value structure.

Time is handled in SOC at the search stage. The hierarchical report requires a date range. The valuation staff agree over which periods it is sensible to backtrack in the search for comparables having regard to the pace of change in the market. If no or too few comparables are found in the agreed time frame, evidence from earlier periods can be used provided that they are indexed to changes in comparable-rich areas.

The valuers meetings regularly discuss updating the underlying value structure.

Time can be handled in RbSOC by regularly updating the value structure, either by reference to indicators representative of the whole market (nodal indicators) or where the effects of time are selective (tastes changing for example) by reference to the relevant base values. In this manner, absolute or relative changes in the market place can be mapped into the system in moments.

Adjustments for condition and accommodation involve 60 or so separate attributes in SOC. It should be borne in mind that valuing council houses under the legislation is easier than a mortgage valuation in that all improvements to the property paid for by the tenant are to be disregarded. This removes the obligation to estimate their potential worth to the purchaser; the stream of net utility implied by their presence.

Essentially, then, adjustments in respect of condition relate to defects. The valuers use an estimate of costs associated with rectifying the defect plus a sum for inconvenience. Ideally there would be evidence

about the impact on value of such factors. More usually, however, the valuers resort to cost estimates. Nor do the valuers carry out a comprehensive discounting on the basis of a planned maintenance program. This aspect of the adjustment was highly subjective.

In respect of size, the method used at Cardiff in relation to accommodation (2N3 for example) is perhaps inferior to the kind of capital value per unit floor area ratio commonly used for mortgage valuation. While it would be a relatively straightforward matter to rewrite the system's base value structure to represent such units, the valuers dispreferred this option. RbSOC is true to this decision though the system calculates value per unit area as a bi-product in the hope that such a yardstick would replace the existing method at some time.

In respect of plot size SOC contains a fuzzy set which could be mapped into RbSOC but which was ignored in the prototype.

Generally speaking, the knowledge base can assimilate the adjustment factors in the same way as it assimilated the value structure: subjectively.

For example, the valuers meeting might discuss the question "How much do you add if the property has central heating supplied by the council?"

The answer might be an absolute or relative magnitude: it might be dependent on other factors. Either way the decision can be mapped into the system.

If the valuers did not know the answer to a question, the system could announce its ignorance. The valuer interpreting the results would be left with the familiar problem.

In the more common case where a question had not been posed, the system would offer no help. The necessary choice would be unavailable on the menu. On site this would force the user to refer to the notes facility. The system manager would be prompted to enlarge the system. This aspect of system development - organic growth - is one of the positive benefits of the approach outlined here. Like the human valuer, the system can develop over time.

The number of possible adjustments for value is the product of the number of variants for each adjustment factor. SOC uses 60 such factors, some with many values. As a consequence the number of potential valuation figures approaches infinity. This is what should be expected - though the rule base is simple the environment it wishes to interpret is complex.

c The system: Building and Running

Building

Building any system within Crystal requires a knowledge of the BUILD function within the shell. Essentially the developer provides a definition of a Master Rule, proving which becomes the objective of the system. Subordinate rules define intermediate objectives. The system chains backwards and forwards opportunistically depending on whether a particular objective is data or goal driven. Ultimately it acquires all the data it needs to satisfy the Master Rule conclusion or else it fails along the way.

It acquires the data by interrogation. The latter can be by way of simple yes/no questions, or by menu choices, or by data input forms. In mechanical systems the interrogation can be performed by other sensory devices: camera and image recognition perhaps or calibration devices with digital read-outs.

All elements of data required are represented within the system as variables. All variables can be assigned values by the system or from interrogation; data input can be tested to ensure that variable values are within expected ranges or are otherwise sensible.

The Master Rule in RbSOC is "Valuation". This rule requires that subordinate rules, "Base Value" and "Adjustment", are satisfied. "Base Value" requires an input from each of a series of rules representing the critical variables referred to above. Thus "Base Value", in order to succeed, must acquire data about location, accommodation, construction and "type". It also demands address and size data.

Having gathered the data, the final rule element of "Base Value", "Calculation", derives the actual base value. The arrays which represent the critical variables are built into menus, which themselves are given variable names to identify them. Using these variable names in formulae makes it possible to select many different values for every key stroke. For example, using the cursor and "Enter" key at the Districts Menu selects the text string representing the distict name (Distname$[#]), and a value for the location of the cursor in the particular menu (DM). A corresponding base value for the district (d[#]) can be associated with the original keystroke using the expression: d[DM-1] which simply means the value of "d" associated with the menu position:

the anticipated expression d[DM] is false only because the first value in an array variable is zero, the first value in a menu variable is 1. Thus the "Calculation" rule in "Base Value" contains the following formula, which simply adds or multiplies together the values assigned to the variables by the selection of keystrokes:

{[d[DM-1]+s[STR-1]+t[TM-1]+Co[CM-1]}*c[CME-1]

where "d" represents the element of base value associated with district, "s" with street, "t" with type, "co" with code and "c" with construction.

Running

The prototype, running on a standard PC, uses a series of menus which prompt the user to select an area of the City, a street in the selected area, accommodation and construction types to identify the subject property and compute a base value from the programmed value structure. It then asks for inputs from site inspection; property measurements, component descriptions etc. to carry out the adjustments. Appendix 2 provides a series of sample screens.

The first prototype contained 44 rules, 309 commands and only 30 variables, 13 of which are one dimensional arrays containing up to 33 elements: it used 52K of normal memory. There were several prototypes; the current one RbSOC contains 96 rules, 428 commands and 58 variables using 77k of normal memory.

None of the SOC prototypes was ever tested properly on site. Nevertheless, the evaluation of the system, detailed in Chapter 6 (a), gave rise to the following perspective (Chapter 5 (d)) summarised in the 1989 "Service Plan", as the business plan became known on its first annual review. This plan was to take effect for the financial year commencing in April 1990.

d. Perspectives for implementation.

At the time of the Service Plan, the equivalent of four valuers were employed on SOC. A senior valuer supervised the work. With the new system, valuers as such were to be phased out except for the senior valuer, whose task would be that of system manager and valuer. Instead of valuers, two, three or four inspectors would be employed depending on demand. Phasing of the changes was left open-ended because the system would grow steadily rather than be introduced all at once and because the training of inspectors was an unknown quantity.

The inspectors were to be equipped with hand-held computers; an evaluation of products was to be undertaken by N.G.Shippobotham. The Psion MC600, to be available in June 1990, appeared to be the most suitable product; sufficiently robust and portable for outdoor work it featured sufficient battery life for a day's work, supported MSDOS operating environment (and therefore Crystal) and also had a screen width of up to 80 characters, permitting total portability of the prototype and its successors. Other hardware options becoming available at that time, like the Poqet and the Active Book required compromise in terms of system design or a complete rewrite of the concept.

The cost saving derived from employing inspectors as opposed to valuers was estimated as a minimum of £37,500 in a full year net of development costs. This assumed that at least as many inspectors would be required as valuers then in place: a most cautious estimate given likely productivity improvements arising from the speed of the computer and the removal of the requirement for subsequent data entry and report writing. The opportunity cost saving was calculated at a minimum of £69,000 per annum in a full year because the professional staff were to be redeployed to carry out the first asset valuation of the City's extensive portfolio.

Moreover, the remaining senior valuer would be devoted to the real job of analysis, training, and supervision rather than a combination of fire fighting and policing, which characterised the role previously.

As regards analysis, a separate database for comparables derived from the resale of council houses was proposed in order to obtain a better picture of the sub market. A further database of asking prices and property particulars was also planned. Indeed, data capture exercises were begun in 1989.

Trends in the market place were to be measured using a surrogate model of the market. This surrogate model would rely on estate agents' property particulars and asking prices for data. Asking prices are a good barometer of the market. At one stage in the market cycle all asking prices are being achieved or over-achieved; at another the discount of selling price to asking price is substantial. Provided the stage of the market cycle is known, a picture of selling prices from asking prices can be derived. Regular sampling will provide a picture of

movement which can inform decisions about current value structure in the knowledge base.

Cardiff's valuers had decidedly mixed opinions about the prospects of introducing the system. The work was regarded as the most mundane carried out by valuation professionals and in that sense would not be missed. Further, the prospect of carrying out the first portfolio valuation of an estate which covered almost a third of Cardiff's land area was decidedly preferable. Even so, there was some disquiet at the thought that professional work would be delegated in this way.
Despite this, the Service Plan included the proposals for the implementation of the system: given the shortage of professionals in that skills market and given also the demand side pressures which resulted from the Audit Commission reports, John Edmundson successfully argued for funding of system development and for its implementation.

Shortly before the Service Plan was to be implemented, D.H. Jenkins left the employment of the City Council. Negotiations between Mr. Jenkins and the council for the implementation of the system were at first approved then postponed by new employers (Mid Glamorgan County Council).
Two other factors frustrated the further development of the project envisaged by the City Council.
First, the long housing bull market collapsed in South Wales early in 1990. Though the impact was slightly delayed in the council house sub-market, applications to purchase under the Right-to-Buy provisions slowed dramatically.

Secondly, the requirement on the City Valuer to pursue an asset valuation was postponed because of a failure of the RICS and CIPFA to agree on a basis of valuation. In fact, these discussions are still underway and the requirement of local authorities to conduct the valuation has been targeted for April 1994 (Chapter 7b).

Nevertheless, the concepts outlined above have found expression in a variety of new systems currently in use at Mid Glamorgan County Council. These include inspection modules which have been used for data capture on site using the Psion MC600. Moreover, a valuation system capable of adaptation for council houses has been developed during 1991.

Boyle C. (1984), "An expert system for the valuation of residential properties", Journal of Valuation Vol 2, 271 - 286.

Czernkowski R.M.J. (1990), "Expert systems in Real Estate Valuation", Journal of Valuation, Vol 8.4.

Kimball J.R. (1977) "How to Document, Justify and Support", The Real Estate Appraiser, November/December 1977.

Libby (1981) "Accounting and Human information Processing", Prentiss Hall, cited by Czernkowski.

Mackmin D. (1985) "Is there a residential valuer in the house?", Journal of Valuation, Vol. 3.3, 384.

Moreton P. (1990) "Valuation for Mortgage Purposes", Journal of Valuation Vol. 9.1.

Powell A.C., (1988) "Expert Systems and the Valuation of Council Houses: A Feasibility Study". Unpublished Final Year B Sc. Degree Dissertation, Department of Mathematics and Computing, The Polytechnic of Wales.

Roth A., (1991) "Artficial Intelligence and GIS", Mapping Awareness, Vol 5.9, 42 - 45.

Scott I.P. (1988) "A Knowledge Based Approach to the Computer-Assisted Mortgage Valuation of Residential Property", Unpublished Ph.D Thesis.

Whipple R.T.M. (1991) "Valuations: A problem Solving Imperative", Journal of Valuation and Investment, Vol 9.4 325 - 343.

Chapter 6. Evaluation

a Testing.

The accuracy of the valuations produced is only one aspect of evaluation. It should be clear that if the methodology of the valuers was followed honestly, and the same data used to estimate value as that available to the valuers, the system would perform "accurately." Moreover the system was simply valuing on the basis of the valuers previous analysis. In fact, the system was able to produce accurate valuations consistently if, by accuracy, is meant a high degree of correlation with the output of the valuers.

The most extensive testing was done in relation to valuations in the Whitchurch area, which was by no means the most homogeneous in terms of housing type nor the highest volume area in terms of sales and therefore comparables. Testing was only possible against estimates of **base value** by the valuers: the prototypes do not contain sufficient data about adjustments to execute the "adjustment rules" for most components.

The system predicted base value rarely deviated more than 5% from the valuers own estimate in Whitchurch: "rarely" was not quantified in a scientific way because the deviation was almost always the inconsistency of the valuer. In fact, the system could be used as a check against the performance of particular valuers, though this is not likely to be welcomed.

In several areas of the city, the amount of data with which to compute a value structure was limited. The system could be programmed to behave in

two ways. It might still execute the valuation or it might take all of the inspectors inputs and yet not provide a valuation. In either case it could issue a warning about the dearth of evidence.
If the former, the danger is to stretch data and use imagination. Subsequent comparison with actual valuations measures not accuracy in the system but the skill of the expert whose opinions generated the structure. This is acceptable only if the end-user is made aware of the facts.

Because of low turnover in these areas, sample size was very small. The volatility introduced into the equation by time was therefore high. Nevertheless, over the longer run, the structure of values could be approximated and indexed. The prototype could not deal with such problems because of time constraints but this type of problem affected less than 10% of all valuations and because it has a spatial characteristic could be identified to the system as a problem to be addressed by the valuer.
The objective of the exercise had been to reduce the professional input: the exercise did this in part by offering a means of substitution for the expert, in part by identifying more precisely where expertise would continue to be required.

Proper evaluation would not be limited to a test of the accuracy of the valuations but requires consideration

1 of the ability of the sofware to reproduce the method of the valuer and represent it and
2 of the confidence that could be placed in the system more generally.

As regards point 1, the system is concerned not with some ideal valuer but with the City Council's valuation staff. The software is capable of modelling their decision structure. It is certainly able to reproduce the procedures that they were capable of articulating and that were witnessed. Objective verification is problematic: certainly, when asked, the valuers were able to see that the system emulated their approach.

As a result, it should permit anyone trained in its use to reproduce their decisions consistently. Moreover, if any other valuer or group of valuers organises data in a fashion similar to them, the system could be transported and operate with similar consistency (see Chapter 7 (b)).

In relation to point 2, confidence in the system again requires much more than accurate valuations. The system is as much concerned with inspection as valuation. It should be able to perform in this regard to a standard at least as good as the professional staff. Programming the system to reach this standard would take much effort. The prototype only demonstrates this ability: it has not been tested. However, it should be clear that attainment of a specified standard is only a matter of time and effort; there is no theoretical obstacle. Moreover, the time taken for the system to assimilate the most advanced method and deepest experience would be less than the time required to train one new valuer to recognise the various property types, the locational factors and relevant associations. This is partly because of the learning curve that any valuer must climb when moving to a new area, partly because there is very little formal teaching about property inspection as a methodology and property construction at the necessary level of detail.

Confidence also requires recognition of system limitations. In relation to RbSOC these have been identified as areas where data is scarce and problems where fault diagnosis suggests further expert inspection and opinion. In this respect, the system is in part simply acknowledging deficiencies in the expertness of the existing experts. To improve on these areas would require an extension of valuation knowledge and diagnostic ability, at least in respect of Cardiff's valuers but probably as well in relation to all practising valuers.
System limitations in relation to RbSOC were also recognised in the expectation that the system would need to be integrated gradually, that professional supervision of the system would be permanent and continous and in the requirement to train inspectors adequately.
If confidence in such systems were to be more widespread, cultural changes would be required additionally (See Chapter 7(c)).

Evaluation here does not include economic justification though, according to Hollnagel, this too relates more to quality and consistency of performance than to an ability to replicate or outdo the expert in the rare and spectacular case (Hollnagel, 1989).

b Refining the system

Refinements to the system can be made in terms other than those which improve confidence as referred to above.
The user interface in RbSOC, for example, is idiosyncratic. A series of refinements is possible in respect of this interface. First, it should conform to acceptable PC standards eg the Common User Access (CUA)

interface; secondly it would benefit from a facility to sketch layout plans and dimensions on site: thirdly in certain respects it may be enhanced by the use of icons; fourthly, it may be more acceptable if notations were hand written (dictated) on site and recognised by the system.

Not all of the systems knowledge requires to be accessed at any one time. The concept of redundancy has been explained above. It is possible to improve system efficiency by removing whole sub-rules to separate files which can be accessed only when required. For example, inspection routines which relate to BISF houses may only be called when the system has tested that they are appropriate. Less substantial, but no less efficient, is the removal of help screens, text files and other extraneous data beyond the system.

This approach rapidly leads to the development of whole suites of files, where "knowledge bases" (see below) can be linked and interfaces can be built to one or many remote data files.

In this way, not only can a system grow "organically" as referred to above, it can be integrated with other systems which border on the system's domain.

c Expert System?

If a sliding scale of processing, from data to knowledge, is postulated, the legitimacy of the title "expert system" could be measured.

At the lower end of the scale, in a discipline where knowledge is shallow and data or information is critical, the development of conventional tools, albeit sophisticated, can give the appearance to the uninitiated of exhibiting expertise.

Payroll systems were among the early applications of transaction systems, but "There is a profound sense in which a payroll system, for example, is a knowledge-based or even expert system. However, its knowledge is represented in the form of procedures - because that is how payroll clerks express their knowledge", (Graham and Jones, 1988).

To call such systems "expert systems" given the taxonomy outlined in Chapter 2, would clearly be a distortion. The fact that this happened in the mid 80's is one explanation of the ferocity of debate over definition.

Further, one cannot accord the status "expert system" simply because an application was built using a so called expert system shell or high level programming language (PROLOG). All applications calling themselves "expert system" could have been programmed using third generation languages (some have been programmed using LISP) or for that matter machine code. Rule processing is fundamental to programming; clearly, it does not confer "expert" status to a system.

Moreover, many of the shells sold as expert systems provide "end-user" development (programming) environments. That is to say, their ease of use permits end users to develop their own applications. In this role, such systems are referred to as "application generators". Data and information processing is made available to a new milieu because

production rules are simplified. Much of this development is not of expert systems.

At the other end of the scale, a system might exhibit all the features of an expert system. There can be no doubt that some systems are properly called "expert", but perhaps not many. Hollnagel stresses that in many cases expert systems are simply sophisticated information processing systems "because they remain at the level of rules" (Hollnagel op. cit p23).

In this context it is interesting to note that Scott concluded that production rule processing was a sufficient condition for the development of valuation expert systems (Scott, 1988).

It is not unreasonable to suppose a grey scale between these limits. That is, systems which "try to emulate human decision making" (Crofts 1987), can act as human consultant (Scott 1988), are executable (Hu 1987) but which are simply processing information, predominantly, and remain at the level of rules (Hollnagel ibid.). Such systems can be referred to as rule based or knowledge based systems. These terms are used to convey the same meaning in this dissertation. The differences between rule-bases and knowledge bases in terms of inference capability are considered to be of degree rather than substance. The prototype falls within this hybrid category. It is not an expert system as defined. Hence its title,"Rule based Sale Of Council house system" (RbSOC).

The fact that the prototype is not an expert system, it is contended,

does not invalidate its practical value. Clearly, if it is technically capable of producing valuation output to a sufficient standard and if it can improve productivity, it will have met, at least, with Cardiff City Council's original objectives (defined in Chapter 1). In the words of Dr.Phillip Humphries, Royal Insurance,

" The pragmatic approach we have developed often means that in refined AI company we have to put a bag over our heads - but our customers, both internal and external, are happy and we like to think that this is what matters." (Expert System User September 1990).

There are areas where valuation "expertise" consists of repetitive calculations with minor adjustments requiring a subjective interpretation. So shallow in fact, that database technology is quite capable of providing a solution effectively.

But does the valuer's art consist only in collecting and analysing data? Scott's initial argument in support of research into expert systems was based on the observation that despite lack of data, valuers repeatedly make valuation decisions. Tackling the valuation problem in the presence of uncertainty leant itself to an "expert systems" approach. Scott concluded however that probabalistic uncertainty was not the key problem, that "incomplete knowledge" created the valuer's dilemma (op.cit p179).

The term suggests that mere data/ information is not the end of the problem. In one respect, at least, this is true: valuation methodology is underdeveloped in several respects.

But the incompleteness at the root of most valuation problems relates to

data or information. This explains Scott's conclusion that frame based representations would be valuable (op. cit p135). Frames are constructs which represent data/ information relationships ie a data problem.
This conclusion coupled with the conclusion that production rules are sufficient to encapsulate a valuer's knowledge base amount to a denial of the need for expert systems, as properly defined, in the use of the comparative method.
Yet as a consequence of the research Scott proved that it was possible to segregate the problem solving procedure from the data. The conclusion could only be that some intermediate or hybrid form of system was being approached. As explained above, this system is a form of DSS known as a rule based system.

In addressing the problem outlined in Chapters 1 and 3, the author set out to establish a consultant system as defined by Scott: a system which Cardiff City Council could use in substitution for valuers. This would certainly have involved a challenge to existing practice : precedents would be set which at some stage may be the subject of litigation.
It certainly appears possible that a report created by the system would satisfy the duty of care provided that inspectors were properly trained and that the system was built to an exacting specification.
If at the outset a consultant system were the objective, the exercise certainly did create the sort of "expert" assistant system described by Hu (ibid.). The knowledge elicitation and representation experience leaves little doubt that if the profession were to espouse such technology, in time the assistant could grow into a consultant.

Finally, some practical considerations. There is clearly a danger in specifying a requirement for an expert system. Particularly if, as is increasingly the case, the requirement is not for a finished system but for a shell or tool to do the job. Systems are required to perform particular functions. Historically, this may have presented no problems because computing professionals would decide which development environment suited a particular task. But increasingly, end users are able to take advantage of higher level languages and the software salesperson is targetting the end user as much as the programmer.

At the same time as these developments have occurred in rule processing environments, modern relational database management systems have also become end user tools. They too are described as "application generators". A general exposition of this trend is outlined by Hsia and Byrne (Hsia and Byrne 1989). Clearly the choice of environment will depend on the end product, but what aspects of the finished system determine choice? To say that choice depends on whether the system is to be executable or not, whether the system requires inference or algorithm does not contribute much to the solution for the end user.

The choice of environment is important too because much greater productivity is achieved using the appropriate tool. While an expert system can be developed using a second generation language, it has been estimated that a switch from Fortran or Cobol to LISP increased programing productivity threefold (Elias, 1982). Similar and greater increases in productivity have been attributed to expert system shells and modern RDBMS like Dataflex 3 (Butler Bloor 1990).

Which programing tool should the end user choose? Some facilitate rule processing, some are designed for the development of databases. Perhaps the sensible answer for a profession lacking an IT culture, which surely describes the valuation profession, is to continue to seek recourse to computing expertise for all but the simplest of systems.

For those with an IT culture, this dissertation can offer a simple heuristic: the more alternative solutions/ problem solving strategies that can be applied to the domain, the more likely a rule base/shell will be suitable.

The problem outlined here, choice of environment, while important, may prove to be temporary. Object oriented programing (OOPS) has the potential to create environments which encompass all the techniques required in the development of systems. Even before OOPS begins this process, it is possible to integrate a rule based shell with a database to provide a hybrid software. Such developments will change the nature of the problem confronting the end user and focus on culture and skills training.

Elias A.L. (1982), "An ad hoc method for estimating the unit cost of Aerospace software", FTL Memorandum M823 cited in Hu.

Butler Bloor (1991), "PC Databases: An evaluation and comparison".

Graham I. and Jones P.L. (1988), "Expert Systems: Knowledge, Uncertainty and Decision", Chapman and Hall.

Hollnagel E. (1989), "The reliability of expert systems", Ellis Horwood.

Hsia and Byrne (1989), "Computer Assisted Valuation: The Development of an Automated Prototype", Journal Of Valuation, 7.4.

Hu S. D. (1987), "Expert systems for software engineers and managers", Chapman and Hall.

Scott I.P. (1988), "A knowledge based approach to the computer assisted mortgage valuation of residential properties", unpublished Ph.D thesis.

Chapter 7. Horizons for rule based approach.

a General

Up to 30% of the housing stock in the UK is within the immediate domain of RbSOC. The homogeneity of the council housing stock and the nature of the valuation certainly contributed to the viability of Cardiff's prototype. Clearly, if RbSOC represents a contribution to the development of computer assisted valuations, other homogeneous property types would be equally susceptible to the development of such models: Eastern Europe's housing stock for example.

Less clear, but no less viable, is the modelling of more complex valuation problems. Scott established that a building society mortgage valuation could be modelled using an "expert system" approach. Scott did not have the benefit of large amounts of data and ready made interfaces to them so he concluded that the starting point would be a small scale, geographically restricted project.

As a guiding principle, the selection of manageable segments of the market is sensible: not because of machine limitations, but to ensure that projects are well defined and that expectations can be met.

The segmentation of the market can take many forms. The traditional local agent was and sometimes still is closely in touch with localised market conditions; the agent's knowledge extends beyond data on housing condition, environmental quality and more, to a profile of value structure. This experience can be captured in a rule base.

Other agencies may be more concerned with regional, national or international profiles of market segments; country houses, executive

homes etc.. These sub-markets may behave very differently to the market as a whole (see for example Savills, 1990): different rules will apply to the valuation of different residential property types.

If, however, small beginnings are sensible, aggregation of knowledge is both possible and desirable. This can take a co-operative or competitive form: the professional bodies may wish to elaborate standards for the development of systems. They may prefer to take a non-interventionist role, as they did with the development of databases, and allow the risks and benefits to accrue to individual member firms or sponsor research as with the development of ELSIE at Salford University.

Furthermore, to confine the application of rule based systems to residential property and to valuations by direct capital comparison would be an error for the following reasons.

First, the underlying method of direct capital comparison is also used by valuers in relation to other than residential property. Similar methods are used in relation to rental and yield comparisons. Admittedly, in relation to investment property the disaggregation or devaluation of data is a more complicated process, but this is an argument in favour of the rule based approach outlined here.

Secondly, many valuations are performed other than on an open market value basis or else involve statutory or professional rules which impact on the valuation process. Valuations for the council tax, rating valuations, asset valuations in accordance with the "Red Book", compensation valuations of different types are all readily susceptible to representation in rule bases as section (b) below indicates.

Many of these valuation types are used in combination with direct capital comparison or valuation methods like the contractor's test and can be modelled.

Finally, models should not be limited to those based on existing techniques. House prices are determined ultimately by supply and demand. A predictive model requires that the constituents of supply and demand be analysed; that a postulated market equilibrium be tested against changes in these constituent parts. This is an area of research which would be facilitated by the use of rule based systems. It will never be possible to value any single property by reference to aggregate data but the trend of price movements is a critical aspect of valuation: "trend" has been little understood giving rise to inaccuracy and even threatening market collapse. Knowledge of the interaction of supply and demand aggregates at national, regional and city level combined with data on the subject is a clear focus of research.

Not only is there considerable potential for such valuation systems, but there is much to suggest that the potential can be realised. An analogy with the development of the electronic spreadsheet may be instructive. The accountancy profession was the seedbed for the development of the spreadsheet. The valuation profession assimilated spreadsheets in the mid 1980's soon after the popularisation of the PC. In a very short space of time, academic institutions had included spreadsheet development as a part of the syllabus in training surveyors. Today, many valuation offices use standardised spreadsheets for residual valuations, discounted cash flow valuations or simply to condense valuation tables into one or two lines.

There are always dangers associated with such developments and a recent study of spreadsheet use in 23 "blue chip" companies discovered that "21 produced errors that were wrong by more than 5%" (Batson and Brown, 1991). Quality control in the use of spreadsheets is an important issue as is quality in their design. Guidance in modelling techniques (cf. Dixon, Bevan and Hargitay 1991) will minimise the risk of error.

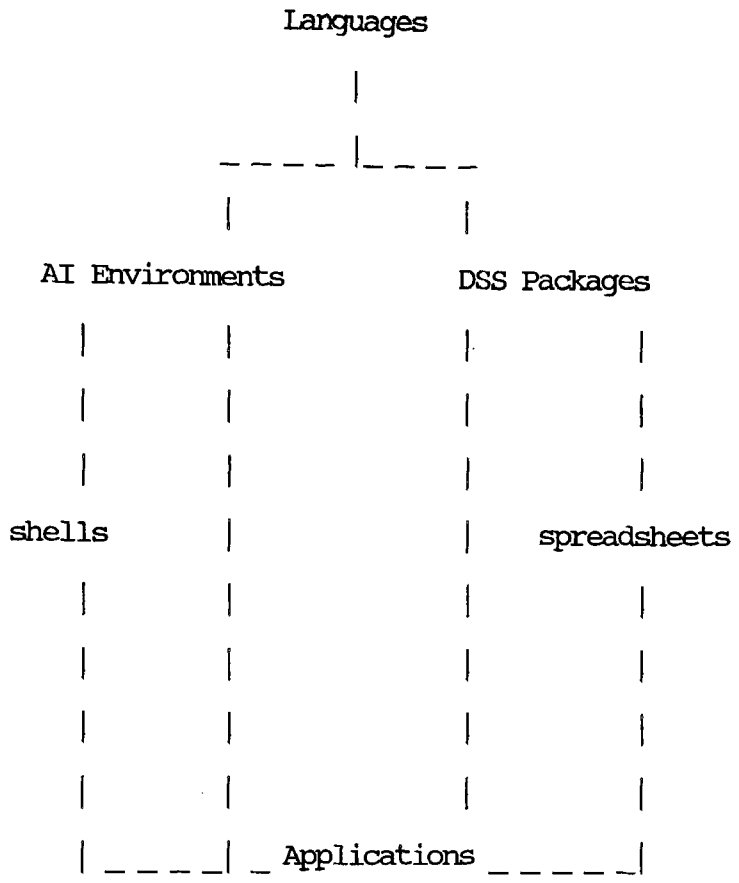
Rule based technology is equally accessible. In the last few years, many hundreds of rule based systems have appeared within the accountancy profession. The fundamental difference between spreadsheets and rule based systems is in their ability to model non-mathematical aspects of any problem. The rules which provide the context in which a mathematical operation is carried out are not easily interpreted by a spreadsheet. A rule based shell, however, is designed to put this aspect of the problem within the range of the person who could model his or her own spreadsheet, while also providing the environment to model the mathematical aspects of the problem, either internally within the shell or else via an easily assimilated interface to a spreadsheet.

This analogy between spreadsheets and rule-based shells is tacitly recognised in Figure 7.1 which depicts the relationship between AI environments and Decision Support System packages more broadly.

Given this facility of use, it will be perfectly possible for valuers to develop their own simple applications and, jointly with programmers, to model more complex applications.

Given that it is possible, what makes the development of systems likely are a series of advantages usually associated with such technology.

Fig. 7.1



Source: Graham and Jones, 1988

Whether acting as a consultant, colleague or assistant such systems are generally recognised to be tireless, attentive, unbiased and reliable (deterministic), immortal, consistent, honest and not prone to forgetfulness, confusion, ill-health and leaving to take another more lucratively paid job (in respect of the advantages of expert systems see, for example, Beerel 1987).

Nor will costs of development inhibit the introduction of this technology. A typical shell costs less than £1000 to buy (Gronow and Scott 1987). With appropriate software training, a system which encapsulated the expertness of a valuer specialising, say, in investment valuations under the Leasehold Reform Act could be developed as a prototype in days rather than weeks.

Gronow and Scott long since suggested a list of potential applications (Gronow and Scott 1987). Given the ease with which systems can be prototyped and the potential value of the systems identified by Scott (1988), Cernkowski (1990) and Cardiff City Council the paucity of development is surprising. In the following section, several systems which have been developed or are under development are described.

b Developing other rule based valuation systems.

At Mid Glamorgan County Council a small knowledge base has been developed to carry out rating valuations on school properties. With the revaluation of commercial properties in 1990, the local authority took a decision to appeal against all valuations. The most substantial block of properties were schools in the management of the local education authority, numbering over 500 sites.

D.H. Jenkins interviewed officers at each of two district Valuation Offices and analysed the valuation procedures issued. A prototype valuation system, known as GCSE, was devised which rapidly, accurately and consistently estimated the rateable value of the hereditaments on a PC. The system was demonstrated to an experienced rating valuer employed by the County Council and refinements made.

First, Mid-Glamorgan have recently sold the system to another local authority and have received expressions of interest from several others. A version of the prototype has also been sent to the Inland Revenue.

Second, Abdul Hadi Haji Bin Nawawi spent 6 months under supervision at Mid-Glamorgan and has both registered a research degree at the Polytechnic of Wales and commenced knowledge elicitation for the development of a rating valuation system for the government of the city of Kuala Lumpur in Malaysia.

Third, the techniques assimilated during the development of GCSE and RbSOC have been focussed on the development of several other applications.

1. The county council is currently reviewing social services residential homes for the elderly. The inspections related to these properties have been conducted in part using a prototype rule based system which is loaded on the Psion MC 600 (Mobile Computer). Extensive details of the site and buildings are captured as well as data on locality, environment and the valuer's opinion about possible alternative uses.
The system has been designed to ensure that other buildings held for public purposes can be similarly inspected. This is an example of a system with limited initial use which can grow "organically" as described in Chapter 5 (page 105).

2. The Chartered Institute of Public Finance Accountants (CIPFA) and the Local Authority Valuer's Association (LAVA) have been preparing the

ground (CIPFA, 1991) for the introduction of a new system of accounting and valuation of local government assets as a response to the Audit Commission reports (Audit Commission, 1988).

At the same time a study of the existing methodology of asset valuation with particular regard to no-market property, typical of much of the County Council portfolio, was undertaken on behalf of the Asset Valuation Standards Committee of the RICS (Britton, Connellan and Crofts 1991).

The study proposed a revision to existing practice and offered a new and more detailed method in respect of such properties. However, the Discounted Asset Rental method of valuation, as it is known, requires a complex calculation involving iteration. The authors modelled their calculation on a spreadsheet but were conscious that a spreadsheet based system would be complicated to use: as many spreadsheets would be required as years in the life of an asset; the iteration was time consuming; data input into a spreadsheet is not particularly user friendly; storage of the output is not straightforward and is separate from storage of the data which determined the inputs.

The obstacles have been overcome in a rule based system designed and written by the same team under the supervision of D.H. Jenkins at Mid-Glamorgan. The site data is designed to be collected by a module which is portable; inputs for the valuation decision module are obtained by interrogation; much of the process can be delegated to technical staff; the calculation has been substantially accelerated; valuation output resides in the same data file as inspection data and similar "what if" facilities exist as for "GCSE".

This system is at an advanced stage of development and will be ready for

use in the first quarter of 1992.

3. The most ambitious project is still at the development stage. The objective of the development is not a system but a "toolbox", referred to as the "Generic Valuer". Essentially, it is a development of RbSOC which builds on the underlying methods used by valuers in inspection and appraisal phases revealed during the research.

As regards inspection, a module is under development which recognises several strategies and allows valuers to shape the strategy which best reflects their current or preferred practice. On site valuers usually describe the locality, the immediate terrain, the layout of the buiding(s), the construction type, the outer skin, the internal accommodation and finishes, the services etc.. The toolbox aims to give the end-user flexibilty in respect of procedure, thoroughness and efficiency in respect of data capture and control in relation to the depth of inspection regarded as appropriate.

In relation to appraisal, the toolbox recognises that the determinants of value are related to location, "description", functional suitability, physical condition and "quality". It predefines variables in these categories at an abstract level and allows the end-user to attach particular values to variables by defining their own. For example, RbSOC uses locational variables called District and Street. The toolbox simply provides an unlimited number of locational variables called Loc${#}; the user can define Loc${1} as a country, region, city, district, sub-district, industrial estate/ street, plot number/ part street etc. and Loc${2} as the next sub-division of the locational variable for valuation purposes and so on.

Similarly, the description variables - accommodation, construction, "type" in RbSOC - can be user defined and can thus as easily relate to types of commercial as to residential property.
Another dimension of the toolbox is its ability to interface to existing data. While RbSOC held descriptive parameters and value structure internally, the first version of the toolbox contained no internal data. Descriptions of locational and other variables were all held in data files. At a more developed stage this will permit access to existing databases across interfaces and reduce the development time for new applications.

4. Safeguards were built into RbSOC to ensure quality of output. This emphasis on quality during the inspection and valuation was noticeably absent in other aspects of the Valuation Services Division's work.
As a consequence Stuart Bates ARICS, the divisional head, made a commitment to apply for 3rd party accreditation under BS 5750.
Conventionally, this involves the development of a Quality Manual which is paper-based. This implies the usual limitations to search strategies in respect of guidance from the system: chapter headings and sub-headings and an index or indices.
Because procedures are essentially rules, it was decided to follow Gronow's suggestion that the quality manual be built using an expert system shell (Gronow and Scott, 1990). Not only does this allow non-linear search strategies but it permits the manual to be distributed over the local area network and real time editing. Several procedures were prototyped in 1991 and a research project is underway which will establish a specification for a fully operational system.

c Impact on profession

Potentially, a fully fledged system operated by trained inspectors under the guidance of a qualified valuer can match the competence of the existing establishment at Cardiff City Council. If this happens the problem which prompted the research, lack of professional staff, will have been solved in a novel way.

A common fear of this technology relies on an analogy with robotisation of manufacturing industry. If in the future the valuation profession embraces rule and knowledge based systems, it is feared, the impact of their adoption may be an easing of demand for professionally qualified staff. Despite current oversupply, demographic trends still predict future shortage of professionals so that the most acute expression of this fear, large scale redundancies, is unlikely on account of the technology alone. A variant of this perspective is not excluded, but other factors are at work.

The potential displayed by RbSOC but not yet realised is the division and delegation of some of the skills of the valuer; the computer program is substituting for some of these skills, the inspector for others while the valuer focuses more precisely on the value structure and therefore on valuation issues. The research suggests that there is a distinct valuation role and that to an extent it has not yet been properly tackled because of poor method, restricted, historically, by limited computing power.

The research also suggests that the first impact of the technology will relate more to quality than quantity: it has the potential to raise the

quality of the least able proponent of the profession to the quality of the best; it has the ability to improve quality in areas where work is mundane. Certainly, the end product is valuable if the same quality advice can be obtained at less cost or if better quality can be given at the same cost.

There are several contentious issues in the cost/ quality trade off. Perhaps the most difficult area is the quality of inspection carried out by the inspector and the discharge of the duty of care owed by the local authority to the potential purchasers referred to above.

The criteria which define system quality are important.At the very least the knowledge base must ensure that the inspector is prompted to note all those issues laid down in the RICS/ISVA inspection guidelines. The report must show that a reasonably careful visual inspection took place and that it was conducted by someone "who, by training and experience and exercising reasonable skill and care, will recognise defects and be able to assess value" (from the judgement in Roberts v. J. Hampson and Co., 1988 37 EG 110). The system being developed for Cardiff could meet these requirements and in some respects it could improve on existing practice.

Firstly, the era of the "low gear" valuation would end. In order to file a report, the inspector has to complete the programme for every property inspected. This is quite rigorous. Of course, it would be possible to falsify a report. But the falsification of reports removes us from the consideration of the duty of care into consideration of fraud. In recent years it has become apparent that an unscrupulous minority may act fraudulently but this tiny minority will be unaffected by the method of

appraisal. For the vast majority, knowledge based systems would remove the temptation to take short cuts, under pressure, which violate the standards laid down by the courts and the professional bodies.

The report itself is a valuable defence against claims of negligence. It should provide a record of the inspection in a form which is accessible and which demonstrates that reasonable care has been taken in its preparation. A poorly kept record will be frowned on by the courts (cf. Singer and Friedlander v. John D. Wood).

Second, inspectors would have received training focused on the object of their studies. The difficulty facing managers charged with the task of council house valuations is that they can rarely recruit other than the recently qualified graduate. Most of these graduates have received little in the way of formal training in building construction. There is little appreciation of the different types of system building common in the council stock. They learn on the job, often with patchy or no mentoring. By the time they are gaining familiarity with the stock, they are on the brink of transfer to more interesting areas of work.

The introduction of a rule base is not the only means of addressing these problems but in conjunction with a mentoring programme for inspectors it could represent a valuable contribution.

At Cardiff, a Building Surveyor, familiar with the housing stock, was appointed in 1989. Though his remit is broader, he has been committed to the preparation of an information pack about the types of defects that are typically found in the stock. This work does of course identify a

series of rules which can be recorded in the rule base and, potentially, improve quality beyond existing capability.

The future of the type of computer assisted valuation system outlined here, whether consultant systems used by non-professional staff or assistant systems used by professional staff, depends in part on the attitude of the courts and on the professional bodies.

In the author's view, the RICS and ISVA should champion these new methods to ensure the highest standards. This does not mean the development of a blueprint for valuation methods but the publication of guidance notes of best practice in the use of systems.

Moreover, the fact that the valuer is part and parcel of the development of rule based systems telescopes the knowledge elicitation phase of application building and leads to the danger of bad method being represented in the system or, as Scott warned, that valuers may be tempted to invent method, which could be good or bad (op. cit p90 et seq.) While this merely reflects an existing situation, it reinforces the view that system standards need to be articulated and criteria developed for the measurement of system veracity. The obligation is one which the profession faces in any case, it is simply appearing in a new guise which must be recognised.

For the future of this technology is also in part dependent on the client: whether an institution or an investor, a housebuyer or a vendor the requirement is always for good quality, low cost and preferably both. Ultimately the failure of the profession to change in a competitive environment will rebound to the detriment of the professionals.

There are implications too for the way in which people are trained and not simply trained in new technology. If the inspection / appraisal "split" developed here is pursued, closer focus is suggested on buildings and defects on the one hand and valuation and analysis on the other. This type of split is occuring de facto in relation to portfolio valuation of investment property.

At the heart of the question of how the property professional is trained is the way the profession should be organised. In the debate which surrounds the publication of the Lay Committe Report (Market Requirements of the Profession, RICS, November 1991) the impact of technology should be a consideration.

The valuation profession as a whole has been slow to respond to the new information age. A cultural change is necessary if valuers are to assimilate information and now knowledge based systems. Such a cultural change requires careful consideration. Thought must be given to the whole operating environment. Training, retraining, supervision, quality control and operating procedures are vital issues.

Audit Commission (1988), "Local Authority Property: A management Handbook", HMSO.

Batson J. and Brown A. (1991), "Spreadsheet Modelling Best Practice", Institute of Chartered Accountants in England and Wales.

Beerel A.C. (1987), "Expert systems: strategic implications and applications", Ellis Horwood.

Britton W., Connellan O.P. and Crofts M.K. (1991), "The Cost Approach to Valuation", Kingston Polytechnic/RICS.

CIPFA (1991), "Asset Registers: A practical Guide".

Czernkowski R.M.J. (1990), "Expert systems in Real Estate Valuation", Journal of Valuation, Vol 8.4.

Dixon T.J., Bevan O. and Hargitay S. (1991), "Microcomputers in Property", Spon.

Graham I. and Jones P.L. (1988), "Expert Systems: Knowledge, Uncertainty and Decision", Chapman and Hall.

Gronow S. and Scott I.P. (1987), "Expert system shells for valuation", Journal of Valuation, Vol 5.2 200 - 212.

Savills (1990), "Prime London Resisential Property Index".

Chapter 8. Summary and Conclusions

Cardiff City Council suffered a temporary deficiency of professional staff in the late 1980's. As a consequence they examined the possibility of using expert systems in their land strategy. The business plan suggested that the most valuable area of research would be in the valuation of council houses.

A prototype system was designed by D.H. Jenkins to address the problem. The prototype demonstrated sufficient potential to be identified as a priority in the business plan. Subsequently, the research was refocussed on the requirements of Mid-Glamorgan County Council. Several systems have been developed as a consequence.

The research raises several questions about the future of such systems which are not capable of resolution in this dissertation. Should systems substitute for the skills of the valuer or merely assist in producing a quality service? Is current DCC valuation technique sufficiently robust for a more sophisticated consumer? Can supply and demand aggregates and relationships be applied to the valuation domain? Can the professional valuer also act as building surveyor? The attitude of professional bodies, the courts and the profession's clients will be germane in addressing these questions. Further research will play its part.

The research also touches on a fundamental aspect of modern valuation philosophy: the nature of valuation as art or science. The perennial debate is sterile; the greatest artists were and are men and women who have developed great technique.

Valuation is an inexact science, like economics of which it forms a part. The inexactitude of the science is no ground for complacency; rational models of the markets valuers are trying to interpret can be built and refined. Intuitive approaches to these problems should be scrutinised, understood and interpreted. The argument that valuation is art cannot be allowed to condone the negation of enquiry and the deliberate obfuscation of method.

Many valuers find difficulty in explaining their conclusions when conducting a residential mortgage valuation or a valuation of a council house for sale to the sitting tenant. Valuers certainly adopt different strategies in the valuation of residential property. In this domain, dependent knowledge is not consistent; valuation heuristics are not widely shared, at least, not explicitly. In practice there appears to be too little mentoring. Residential valuation is also underdeveloped theoretically; domain independent knowledge is also scant, there is too little tutoring.

Because of the nature of the housing market, where sale prices are fixed following a response to speculative asking prices; where policy can affect valuations performed for mortgage purposes; where valuations are carried out by companies involved in marketing property so that valuers can influence price; where information about prices may be poor; where valuers are rarely asked to verify if money's worth is reflected in price; there may be little incentive to improve valuation practice.

Nevertheless appraisal practice should be improved. The emergence of rule based technology will provide an impetus for such advances. If the development of the technology creates subsequent improvements in the environment described in the last paragraph, so much the better.

In eliciting and representing knowledge it is necessary to be true to the expert; in the development of the system described in this dissertation the methods of the valuers concerned have been faithfully reproduced. Yet it is clear that the method is incomplete and capable of refinement.

Deficiencies in appraisal methodology do not mean that prices in the market place are "wrong" (Baum A. and Crosby N. 1988). Nor, however, should accurate price estimation, assuming accuracy can be measured, debar improvements to methodology. A model which better replicates behaviour in the market place; one which is thought to be more rational by valuers or one that in fact simply predicts price better is a model which may supplement or displace what exists.

It has been argued in the past that valuation is an art because valuers have to deal with intangibles in the market place, that it is not possible to quantify quality.

Nevertheless the market consistently resolves such problems: bargains are continually being struck. Price reflects quality. Data on prices can be analysed to provide a value structure. Valuation follows analysis.

A rule based approach leads to closer scrutiny of the whole process.

The research to date has revealed primarily that rule based valuation tools are feasible. It has also identified the need for much more research. The number of property researchers is growing but a brief review of the market for expert system shells shows that no firms of surveyors have made substantial or even any investment in them. The valuation profession should address this problem urgently.

The place of a knowledge based approach in the development of a rational residential valuation model can perhaps be examined by extended analogy with Baum and Crosby's argument (Ibid) for DCF rather than conventional techniques in investment appraisal.

A DCF approach reveals more than the traditional method of decapitalising an income flow using the all risks yield. Assumptions camouflaged by the single yield figure can be made explicit; acknowledging constraints on information, the veracity of the assumptions can be tested over time: "did rental growth projections match up to the realities in a given sector?" and so on.

One traditional obstacle to the introduction of DCF techniques was the complexity of the calculation in many instances. But this obstacle was overcome by the development of the spreadsheet/database in the 1970's and the accessibility of such software after the development of IBM's PC in the 1980's.

Various packages can now be purchased with built in DCF techniques "off the shelf". Alternatively, it is possible to build one's own from first principles using today's advanced technology.

The comparative method of valuation in its "traditional" ie existing form, allows the "artful" valuer to leap from comparables to valuation with the minimum of explanation.

Indeed, even for the most conscientious of valuers, the lack of precision in this process and the sheer complexity of comparison makes explanation difficult.

The knowledge-based approach requires the valuer to state all rules explicitly. Similar to the DCF approach, the assumptions thus stated can be tested over time. Every valuation performed has a standard

explanation. The rules can be "packaged" to produce an "off the shelf" valuation tool. Alternatively the valuer, after some training, could build his/her own knowledge base to an idiosyncratic specification (and in so doing preserve certain elements of the art).

"Expert system" software of the 1980's combined with the hand held data collection tools of the 1990's will circumvent the obstacles to a rational valuation model. Hopefully, the transition will be less tardy and painful than the move to DCF appraisal. Certainly the financial advantages of a transition to knowledge bases, which may soon become apparent, will provide an incentive.

Arguably, the analogy breaks down at this point. The DCF approach to investment appraisal still requires professional judgements of the user. That is, it is a tool designed for professionals by professionals. This is not necessarily the case for a rule base; it may be designed by professionals for use by non-professionals.

The operating environment in which such a transition occurs is clearly a matter of concern. If professional bodies fail to tackle the issues which technological change engenders they are likely to become as irrelevant as the guild organisations which protected craftsmen (Clarke 1991). Sooner or later the customers are always proved right.

Baum A. and Crosby N. (1988), "Property Investment Appraisal", Routledge, for a full discussion of value, worth and price.

Clarke M. (1991), "Mortgage Fraud", Chapman & Hall.

Appendix 1

The following products have been examined, either at Exhibitions or Conferences (*), or otherwise evaluated in greater detail either in the work environment or at the supplier's offices (#):

Expert systems:

Crystal (#)

Leonardo (#)

Savoir (#)

Xi Plus (*)

Geographic Information Systems:

Arc/Info (#)

Datamap (#)

GFIS (*)

Hoskyns GGP (#)

Intergraph (#)

PAFEC (#)

PLANES (#)

WINGS (#)

CAD Systems:

Autocad	(*)
McDonnel Douglas	(#)
Generic CAD	(#)

Property Management Systems:

Byline	(*)
Craft Computers	(#)
Estate Computer Systems	(*)
Estateman	(*)
Fraser Williams	(*)
Greenly's	(*)
IPS	(*)
Logotech	(*)
Mentor	(*)
MKA	(*)
PCL Systems	(*)
Property Power	(#)
Trace	(*)

Valuation Systems

Fulcrum	(#)
Sykes	(*)
Valuecraft	(*)

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Christopher Garbett	The Valuer
David Gibson	Inland Revenue
Stuart Gronow	Polytechnic of Wales
Philip Hall	Cardiff City Council
John Jones	Cardiff City Council
John Kirkwood	Estates Gazette
Bal Mattu	Intelligent Environments
Nigel Mehdi	City University
Andrew Powell	Brinsons
Gwyn Prescott	Polytechnic of Wales
Ian Scott	Fletcher King
Nick Shippobotham	Dinas Powys

Appendix 2

The runtime version of RbSOC confronts the user with a series of screens which reflect the decision structure of the valuers at the City Council. The screens are either menu based or are forms which require data input. The following is an example of what the user might expect to be asked, together with the conclusions drawn by the system.

At runtime the user is first asked to select the district in which the property is found. Fig. A2.1 is the "District Menu". On selecting a district, the user is then confronted with a "Streets Menu" which offers a choice of all the streets where the City Council owns property in the chosen district (Fig. A2.2). Apart from the textual outputs which are saved for reporting when these choices are made, the value structure is simultaneously interrogated. Thus a district base value is chosen and then varied for the particular street. Variations also occur in relation to other valuation sensitive inputs.

In Figs. A2.3 and A2.4 the user is asked to input data for the report before being asked to select "Type" as explained on p98 (Fig. A2.5). Context sensitive help is provided throughout the system and striking the "F1" key at "Type" pulls up the screen shown as Fig. A2.6.

The next two menus (Fig A2.7 and A2.8) ask for choices about construction. When the choices have been supplied, mid terrace traditionally constructed property in this example, the system is ready to suggest a base value and summarise the data input (Fig A2.9).

The page header on Fig. A2.9 is in fact a menu. Having derived a base value the user is now enabled to make a full description of the property. By selecting "Description" from the menu, the user selects a further menu suggesting a choice of components (Fig. A2.10). A series of sub-menus exists for each choice. For example, selecting "walls" pulls up a menu of wall descriptions for a traditionally constructed property (Fig. A2.11).

After selection the user is returned to the "Components" menu (Fig. A2.10) and carries on until the description is completed. Every key stroke is captured and all selections are saved for the report.

If a defect is discovered in any component, the user can quit the "Components" menu and is returned to the next highest menu (Fig. A2.9). From this point the user can select "Defects" and a "Components" menu similar to A2.10. Selecting "Walls" will now load a menu of defect descriptions relevant to traditionally constructed walls (Fig. A2.12).

As with simply descriptive paramaters, all selections are saved for the report. In addition however, the value impact of the defect is derived and the base value is adjusted (Fig. A2.13). In this example, wall tie corrosion is noted and the system calculates the cost of making good.

When all descriptions and defects are recorded, the system can ouput a report. Fig. A2.14 provides the report in this example.

*****BASE VALUE FINDER***** PUT THE CURSOR OVER THE DISTRICT AND ENTER

TONGWYNLAIS	RADYR	ST.FAGANS	RHIWBINA	LECKWITH	GABALFA
MORGANSTOWN	FAIRWATER	ELY NORTH	ELY SOUTH	CANTON	LLANDAFF
WHITCHURCH	MYNACHDY	CYNCOED	LLANISHEN	LISVANE	HEATH
BIRCHGROVE	CATHAYS	CENTRAL	ROATH	BUTETOWN	ADAMSDOWN
GRANGETOWN	LLANEDYRN	PENTWYN	SPLOTT	RUMNEY	TREMORFA
LLANRUMNEY	TROWRIDGE	ST.MELLON			

Figure A2.1

GWAUN CLOSE	HEOL RHAYADER	HEOL MERLIN
ST DAVIDS ROAD	HEOL CHAPPEL	HEOL BOOKER
VELINDRE ROAD	TYNANT	WESTBOURNE ROAD
ERWLAS	PLASNEWYDD	HEOL BLAKEMORE
HEOL PENLAN	TYNEWYDD	FELIN FACH
MAES GLAS	VELINDRE PLACE	

Figure A2.2

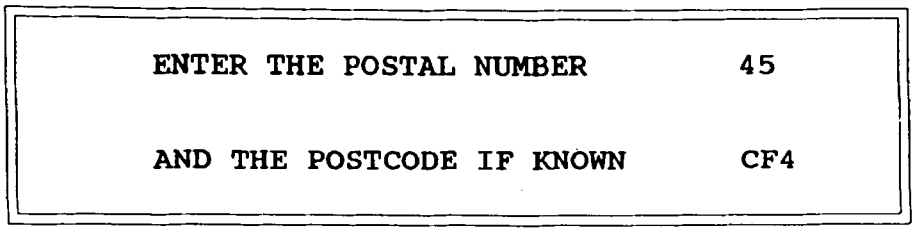

Figure A2.3

NO OF STOREYS	2
FRONTAGE	34 FT
DEPTH	67 FT

Figure A2.4

SELECT THE TYPE FROM THE LIST BELOW

1n2	2n2	3n2	4n2	5n2	1n3
2n3	3n3	4n3	5n3	1p2	2p2
3p2	4p2	5p2	1p3	2p3	3p3
4p5	5p3				

Figure A2.5

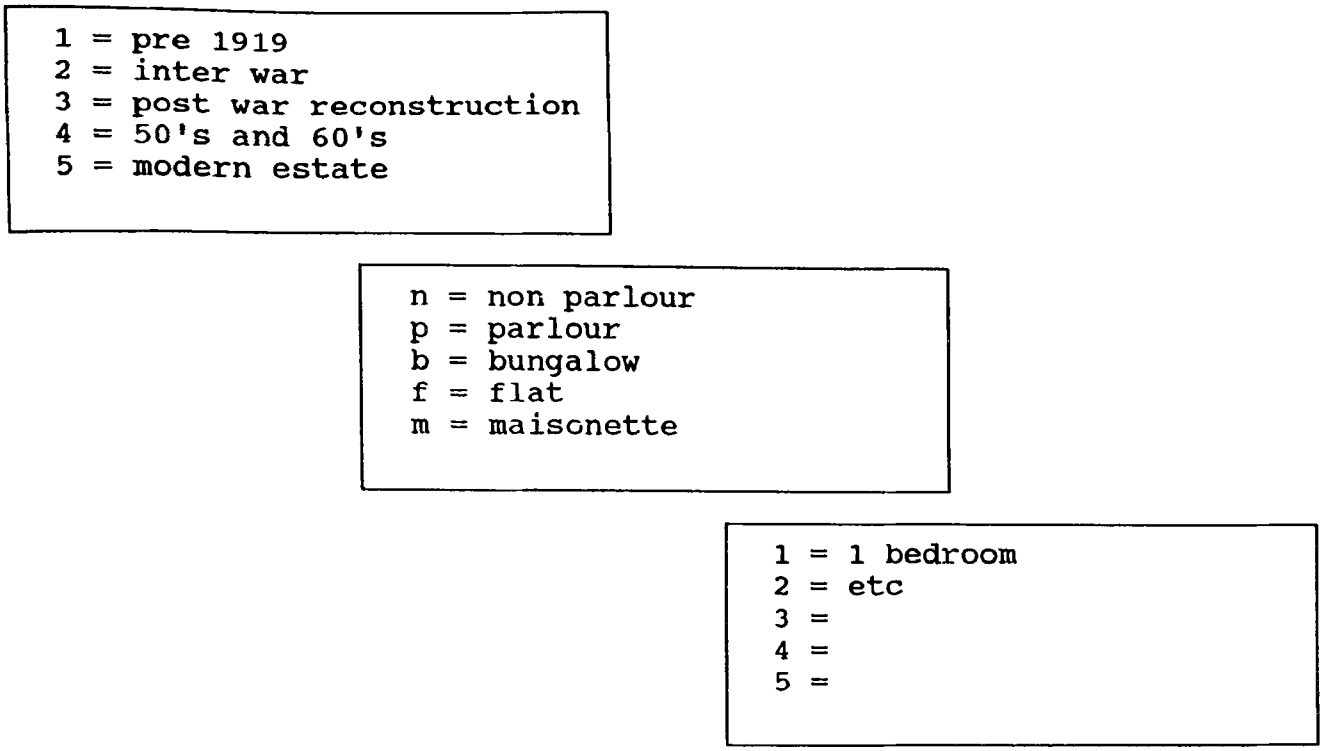
1 = pre 1919
2 = inter war
3 = post war reconstruction
4 = 50's and 60's
5 = modern estate
n = non parlour
p = parlour
b = bungalow
f = flat
m = maisonette
1 = 1 bedroom
2 = etc
3 =
4 =
5 =

Figure A2.6

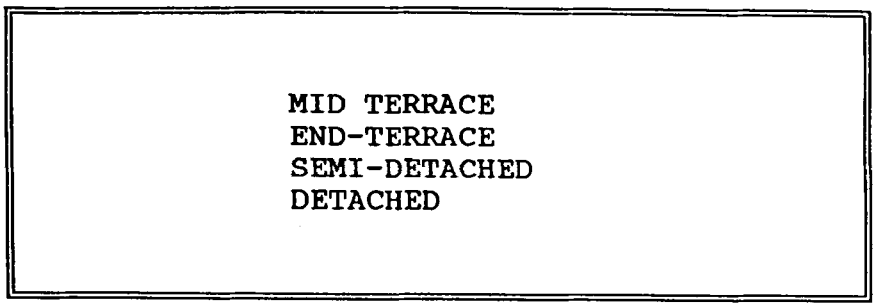

Figure A2.7

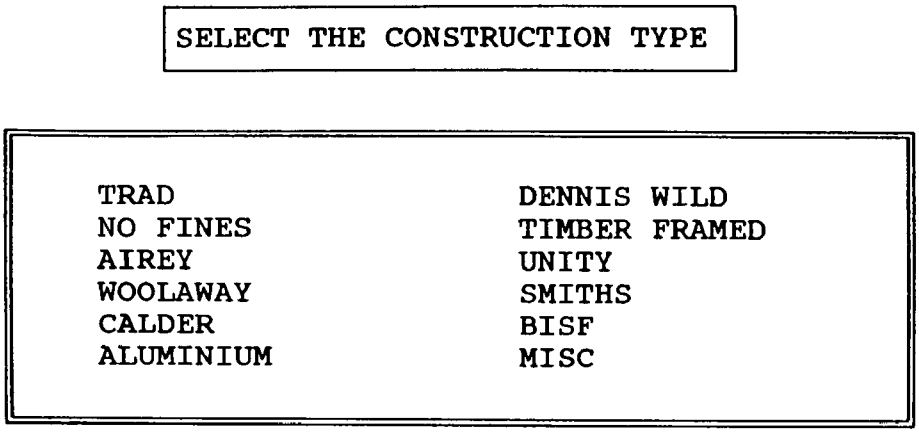
SELECT THE CONSTRUCTION TYPE
TRAD
NO FINES
AIREY
WOOLAWAY
CALDER
ALUMINIUM
DENNIS WILD
TIMBER FRAMED
UNITY
SMITHS
BISF
MISC

Figure A2.8

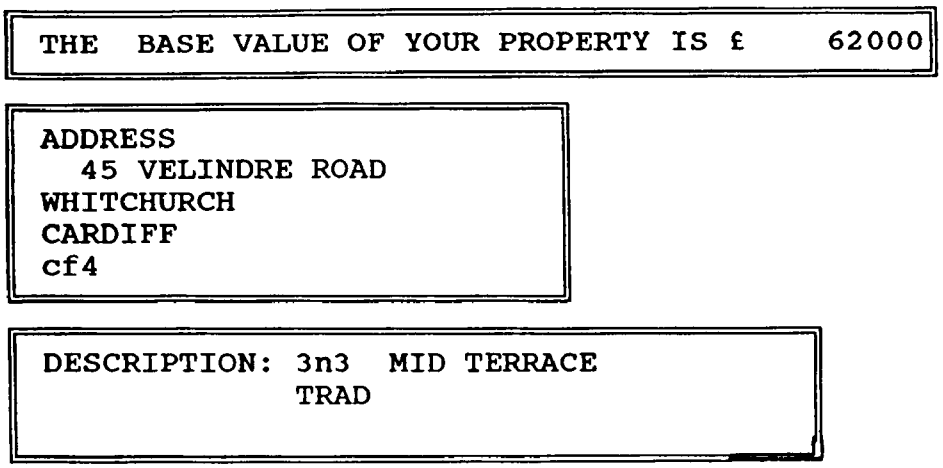
THE BASE VALUE OF YOUR PROPERTY IS £ 62000
ADDRESS
45 VELINDRE ROAD
WHITCHURCH
CARDIFF
cf4
DESCRIPTION: 3n3 MID TERRACE
TRAD

Figure A2.9

SELECT THE APPROPRIATE COMPONENT

WALLS	ROOF	WINDOWS	DOORS	CHIMNEY	GUTTERING
DOWNPIPES	BOUNDARY	HEATING	SERVICES	FLOORING	DPC
VENTILATION	QUIT				
	EX				

Figure A2.10

PUT THE CURSOR OVER THE DESCRIPTION AND PRESS ENTER

RENDERED ELEVATIONS

PART BRICK PART RENDERED ELEVATIONS

BRICK FACED PART PVC CLAD

BRICK FACED PART TIMBER CLAD

BRICK FACED ELEVATIONS

BRICK FACINGS

Figure A2.11

PUT THE CURSOR OVER THE DESCRIPTION AND PRESS ENTER

HORIZONTAL CRACKING AT 0.5 METRE INTERVAL

EFFLORESCENCE

SPALLING BRICKWORK

NEEDS REPOINTING

BULGING

VERTICAL CRACKING THROUGH BRICKWORK

Figure A2.12

PROPERTY DESCRIPTION
VELINDRE ROAD
WHITCHURCH
MID TERRACE
TRAD

	£
BASE VALUE	62000
CUMULATIVE ADJUSTMENT ..	-2448
VALUATION	59552

Figure A2.13

VALUATION REPORT: 45, VELINDRE ROAD
WHITCHURCH
CARDIFF
CF4

BRIEF DESCRIPTION
MID TERRACE 3N3 TRAD

VALUATION	
BASE VALUE	£ 62000
CUMULATIVE ADJUSTMENT	£- 2448
VALUATION	£ 59552

DESCRIPTION DETAILS
WALLS HORIZONTAL CRACKING AT 0.5 METRE INTERVALS ROOF PITCHED AND SLATE WINDOWS TIMBER CASEMENTS

Figure A2.14