A Decision Support System for Local Government Regulatory Advice

Ian Watson
Dept. of Computer Science
University of Auckland
Auckland, New Zealand
ian@cs.auckland.ac.nz
www.cs.auckland.ac.nz/~ian/

Abstract

This paper describes the implementation of a decision support system that helps non-technical front-line reception staff handle complex enquiries on a wide range of local government regulations. The paper describes the knowledge engineering and the knowledge level modelling undertaken for the project. The paper describes the design, implementation and architecture of the resulting distributed system that supports local customisation of the knowledge-base in a controlled managed process. The paper concludes by showing that INFOSHOP can be considered a CBR system that uses derivational replay to solve problems rather than the more common retrieval of problem-solution pairs.

1 Introduction

The INFOSHOP project allows local government front-line staff in the United Kingdom to answer complex queries from the public or businesses on regulations. The INFOSHOP system enables the operator to offer full and consistent advice on a wide range of regulatory issues covering food safety, health and safety, building control and planning regulations.

The INFOSHOP project involves local authority departments working together with central government departments to ensure that accurate information, advice and help, is given to business and the public across a range of services in a cost effective manner. As such it is one of the first examples of the UK Labour government's "*joined up government*" initiatives in action.

INFOSHOP is an intranet application delivered to users through their web-browser. It is based around a set of decision trees provided directly by the central government organisations responsible at a policy level for the regulations about which advice is being given at the local level. The software provides a range of functionality, including fuzzy searching for information, and a suite of enquiry management functions. It is designed so that information content underlying the decision support system can be amended both by central and local government partners, and so that answers to previous enquiries increase the accuracy of future answers.

2 Background

The Modernising Government White Paper[1], published in March 1999, set out key policies and principles underpinning the UK Government's long-term programme of reform to modernise public services. The programme involves everyone working in public services and everyone who uses them (i.e., the entire nation).

As a response to the White Paper the UK Cabinet Office published an Action Plan setting out some 62 actions being taken to deliver the commitments in the White Paper. INFOSHOP is one such action. In scope, INFOSHOP is a decision support system, designed to be used by front-line staff in Local Government who deal directly with the public. It provides guidance to the user on a range of regulatory matters, based on natural language queries such as: "*Do I need planning permission for a satellite dish*".

There are certain regulatory regimes and issues on which local authorities have to deal with a high volume of enquiries of a comparatively detailed nature. Often enquirers have to be routed to one or more specialists within the regulatory departments involved. Furthermore, enquirers are often only given information relevant to the local authority department contacted and later find out about other regulatory requirements, which are often costly and time consuming because they have been addressed late in the day. This "*pass the enquiry*" process frustrates clients and leads to a number of different contacts being made. Feedback from the People's Panel (a *Service First* initiative of the Government)[2] confirmed this frustration and reports that enquirers want an answer to their query when it is first raised, not to be referred on to other staff.

In 1998 a pilot study was carried out in the London Borough of Bexley. This resulted in a case-based reasoning (CBR) system (implemented using Inference's CBR3 product[3]) [Watson, 1997], which in the area of planning legislation enabled staff to handle 60% of enquiries without referral to a subject expert. Previously the figure had been 30%. It was proposed by a group within the Cabinet Office[4] to build on the success of the Bexley pilot and see whether the same principles

[1] http://www.cabinet-office.gov.uk/moderngov/1999/whitepaper/

[2] http://www.cabinet-office.gov.uk/servicefirst/index/pphome.htm

[3] www.inference.com

[4] The Cabinet Office sits at the heart of UK Government, alongside the Prime Minister's Office and the Treasury. It's aim is to ensure that the Government delivers its priorities. It reports directly to the Prime Minister.

underpinning that project could be used in other regulatory areas.

To this end the Cabinet Office bid to the Treasury's *Invest to Save* budget for £100,000 (GBP) to support this work, with approximately matching funds being provided by the Local Authorities involved.

A project group at the Cabinet Office was established along with representatives from:

- Department for the Environment, Transport & the Regions,
- Department of Health,
- Health & Safety Executive, and
- University of Salford[5],

The following Local Authorities joined the project to pilot the system:

- Barnsley Metropolitan Borough Council
- London Borough of Bexley
- London Borough of Camden
- London Borough of Ealing
- Eden District Council
- Knowsley Metropolitan Borough Council
- Lincolnshire County Council & North Kesteven District Council
- Norfolk County Council
- Reigate & Banstead Borough Council
- Teignbridge District Council
- London Borough of Tower Hamlets
- Thurrock Borough Council
- Vale Royal Borough Council
- London Borough of Waltham Forest

For all involved this was the first time that so many Local Authorities had collaborated on an IT project together, and the first time that several Central Government Departments had worked together with Local Authority partners. It was this collaboration which was the ethos of the Labour Government's "*joined-up government*" initiative.

3 Design Issues

The key design issue was to create a collaborative environment. The purpose of bringing together central government departments and Local Authorities was that a single knowledge-base could be created to cover national regulations. However, this had to be customisable at a local level in two ways.

Firstly, in many instances, and particularly in planning regulation, there are significant local variations in the application of legislation. Central government departments set out policy which local government interprets and applies within their own context. As a consequence regulations differ from one authority to the next. Thus, the centrally provided knowledge base would have to be customisable by the Local Authority in a controlled fashion without the need to employ costly consultant knowledge engineers or programmers.

Secondly, many enquiries, whilst based on the same legislation will result in different actions in different authorities. For example in one authority a request for planning consent may result in forms being posted to the client, whereas in another details may be taken over the phone, and in a third a case officer may be instructed to visit the property in question. Thus, even where the legislation was being interpreted and applied the same in several authorities the resulting actions may differ. Consequently, actions needed to be locally customisable.

The other main design consideration was one of cost. Local Authorities do not have large IT budgets and have many financial and legal constraints on how revenues can be spent. As a consequence it was essential that INFOSHOP should run on standard PCs and not require expensive user licences.

Linked to this was the budget for the project. £100,000 had been obtained from the Treasury and a contribution of approximately £6,500 was made by each of the Local Authorities giving a maximum budget of nearly £200,000. This sum had to cover all project management expenses, knowledge engineering, implementation, the cost of software licences for the pilot, user training, evaluation and dissemination activities. Given that the money was coming from public funds this budget was fixed and non-negotiable.

4 Implementation

Although the Bexley pilot had used a conversational CBR system [Aha et al., 1998] the project team thought it wrong to prejudge the technology which might eventually be used to implement the INFOSHOP system. As a consequence the development of the system was split into three distinct phases:

1. *Knowledge acquisition*, which would result in a knowledge level [Newell, 1982] model of the knowledge intended for the system.
2. *Implementation*, which would implement the knowledge in the chosen technology and develop the user interface.
3. *Evaluation*, which would evaluate the pilot system in the field.

Furthermore, in the interests of objectivity it was decided that phases 2 and 3 would not be performed by the same contractor or consultants.

An invitation to tender for phases 1 & 3 (either separately or together) was advertised in early 1999. The consultants PricewaterhouseCoopers won the bid for both phases 1 and 3.

4.1 Knowledge Acquisition

The project team decided that the INFOSHOP should deal with planning regulations (already partially covered by

[5] The author was employed by the University of Salford before moving to the University of Auckland in early 2000 and was a Central Partner of the INFOSHOP project providing advice on knowledge engineering and other technical matters.

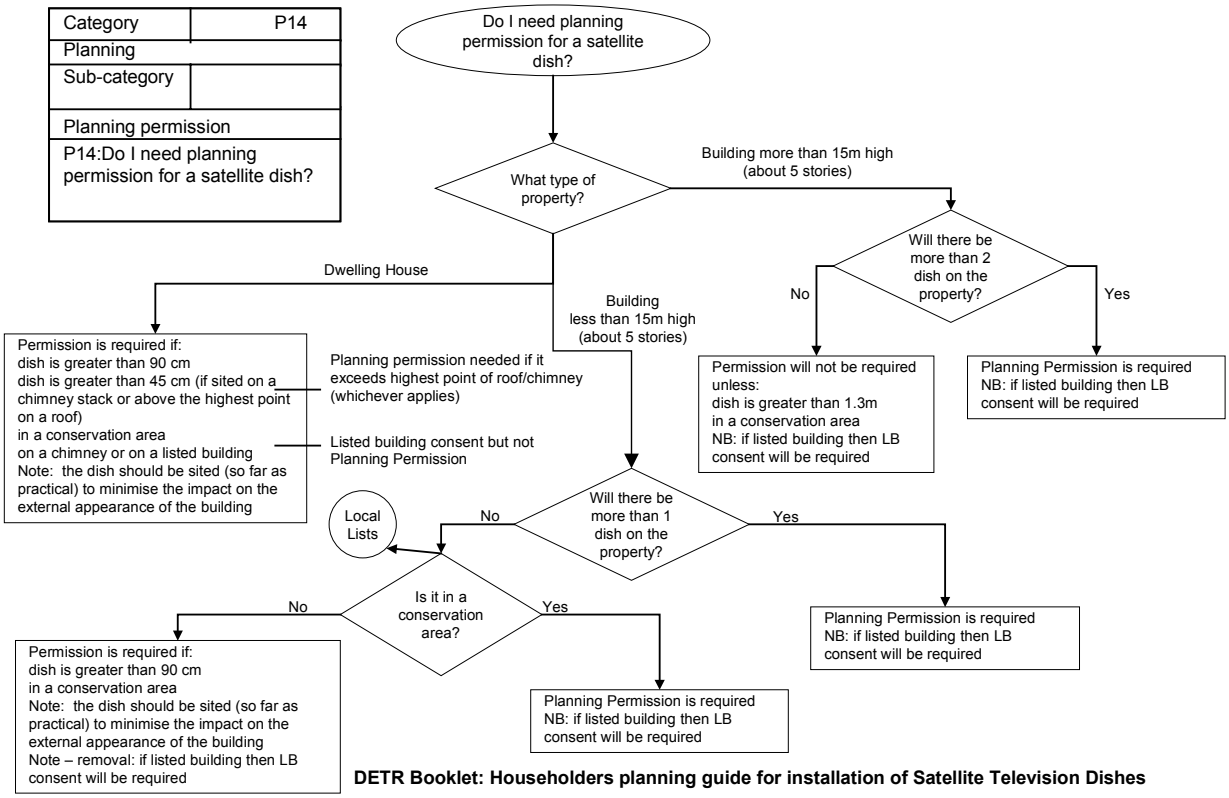

Figure 1 A decision tree from the planning domain

the Bexley pilot), building control, health and safety and food safety. It was planned that the INFOSHOP should be able to handle the most common 80% of enquiries from the public. PricewaterhouseCoopers therefore set out to interview each Local Authority to establish what were their most common questions. These were then collated from all the partners to identify the most frequently occurring 80%.

Regulatory Area	No. of trees
Planning	51
Building control	35
Food safety	79
Health and Safety	67
Total	232

Table 1. No. of Decision Trees per Regulatory Area

Knowledge engineering was then undertaken to identify what knowledge was required to answer or handle each question. A form was developed to capture this information and PricewaterhouseCoopers modelled this information as decision trees, which have been widely used as a concise and readable notation for decision making knowledge [Longbottom & Wade, 1973; Moret, 1982]. A total of 232 decision trees were created for the four regulatory areas (note that several question were often subsumed by one decision tree). The knowledge engineering phase took approximately three months.

5 Implementation

An invitation to tender for the implementation of the system was issued in May 1999 and Tagish[6], a company with a strong track record in Local Government IT work, was selected as the contractor. A decision was taken by Tagish to directly implement the decision trees using the flowcharting tool Visio[7]. Visio enables the content of the decision trees (nodes and arcs) to be stored and indexed in a database, which can be searched enabling the correct tree to be retrieved from an initial natural language query. Changes to individual trees can be made using the flowcharting tool, which does not require any programming or knowledge engineering experience. It was hoped that providing proper versioning control was implemented this would satisfy the local customisation requirement for the knowledge base.

Lotus Notes was selected to store the database and decision trees because it provides many features to support collaborative working, versioning, security and through Lotus' Domino Server content is accessible via the Internet or an Intranet. It was recognised that the decision to use Lotus Notes did have a modest licence fee implication for the Local Authorities. However, this was mitigated by the fact that only one Notes licence was needed for the designated tree "author" within each

[6] www.tagish.co.uk
[7] www.microsoft.com/office/visio/

authority plus one Notes Server and Domino Server licence per authority

For the pilot Tagish would hold the master copy of the knowledge base (the Master Trees). Each Local Authority would hold a replicated copy on their own server. Local changes to the knowledge-base would be held locally but would also be replicated back to Tagish and stored separately. When national legislation changed the Master Trees would be changed and this change replicated to each Local Authority.

A management structure was also put in place for the Local Authorities to periodically meet and review the changes they had independently made to their trees so best practice could be captured and propagated between partners.

5.1 A Consultation

INFOSHOP takes a natural language query and after processing uses it to search the Notes database containing the tree descriptions. Processing the query involves:

- removing noise words (common terms of speech such as prepositions),
- removing plural word forms,
- spell checking to automatically suggest alternatives for unrecognised words
- applying a user defined and locally customisable lexicon to deal with common synonyms and local dialect words specific to one region.

Because the text matching algorithm cannot be 100% accurate a set of candidate trees is retrieved with the best match being presented to the user and alternative "relevant inquiry routes" being displayed should the best match prove incorrect

Figure 2 shows INFOSHOP's response to the well formed query "*Do I need planning permission for a satellite dish*". INFOSHOP identifies the keywords planning, permission and satellite in the query (these are highlighted in the centre left of the screen). This query causes the retrieval of tree P14. Trees P83, P84, P82 and P80 have also been identified as relevant to this enquiry (these are listed in the bottom right panel of the screen). The retrieval of tree P14 results in the question "*Is it a listed building…*"[8] (shown in the top left panel of the screen – i.e., the region of the screen the user first looks at). If the answer to this question is yes, then Listed Buildings Consent is required regardless of the location of the building the size, position or number of satellite dishes.

Also of interest in Figure 3 is the "Make an annotation" button. At any time the user can click this and make an annotation. These might be used by to record notes for tree authors to suggest changes or to comment the legislation to improve the ease of future use.

[8] Listed buildings in the UK are of historical or architectural significance and are covered by strict regulations.

Answering "No" to the question in Figure 2 causes a series of further questions to be asked. Arriving at a conclusion (a leaf node in the tree) causes a pop-up window to launch stating the result that no planning permission is required providing the satellite dish is sited in such a way as to minimise its impact on the external appearance of the building.

Depending on the result required at each node, it can cause documents, forms and standard letters to be retrieved from a document repository system, client data to be entered into booking, logging or tracking systems or faxes and emails to be sent to appropriate people. If a successful solution cannot be obtained the consultation can be logged, appropriate notes can be added to it and it can be referred to an appropriate person to deal with.

6 Conclusion

Local Authorities are able to author the decision trees as intended, and the usability of the system has been praised by several Local Authorities.

> "*Our reception service is the front line for all services provided by the Environment Department. I am impressed with how user friendly INFOSHOP is. Also, our pilot has made a sound start in beginning to reduce those high frequency standard regulatory calls normally dealt with by Technical Officers. Reception colleagues can now deal with some of these*".
> [Rudy Bright, Records & Information Manager, London Borough of Camden]
>
> "*INFOSHOP, fully utilised will be a very powerful tool. Camden decided to go for it, warts and all! I am pleased with the start we have made although we all agree more development work is needed. Camden's INFOSHOP has been adapted to prompt reception colleagues about leaflets and other documents that could also be sent out to the enquirer. Further work will make this into a comprehensive information service.*"
> [Paschal O'Neil, Decision Tree Author, London Borough of Camden]

From an AI perspective INFOSHOP demonstrates that it is not always necessary or appropriate to use an AI tool to develop and deliver AI solutions. The design requirement that Local Authority staff be able to easily customise the knowledge base meant that many more "*sophisticated*" tools were not suitable. However, decision trees as a knowledge level representation [Newell, 1982] were ideal, enabling the authors to worry about documenting legislation and not programming code. Moreover the use of Lotus Note's sophisticated version control, replication and security features made the distributed yet controlled roll out and maintenance of the INFOSHOP feasible.

Although it was decided not to use a CBR tool for the solution, even though it had proved successful in the Bexley pilot, this does not mean that CBR as a problem solving methodology was rejected, quite the contrary. INFOSHOP retrieves the best matching decision tree from

its database (i.e., the most similar case) and then uses the retrieved tree to solve the problem.

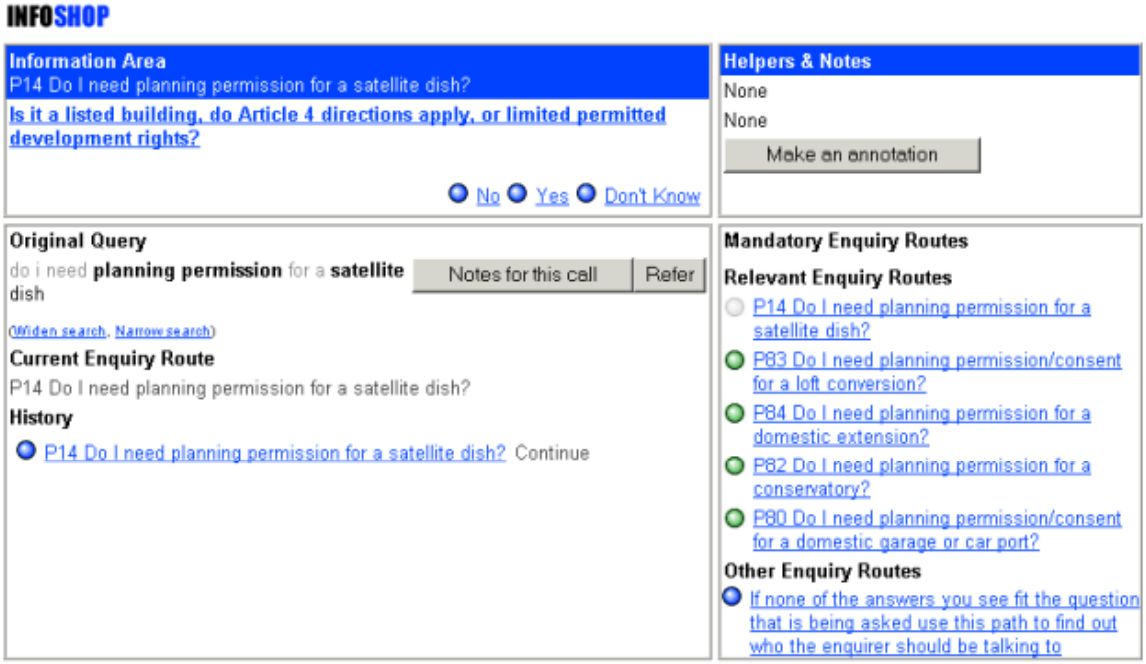

Figure 2 A screen dump from INFOSHOP

In CBR terminology this is *derivational replay* [Mostow & Fisher, 1989]. Where cases store problem descriptions and a problem solving method, which can be reused (i.e., replayed) to solve the problem. This is distinct from most CBR systems which store pairs of problem descriptions and their solution. The main advantage of derivational replay is that fewer cases need to be stored since each problem solving method can usually cover a wide range of input criteria.The disadvantage is that you need to understand the domain theory, in order to be able to create problem solving methods.

INFOSHOP also has facilities to acquire new problem solving cases through the customisation and addition of trees (i.e., the revise and retain stages of the CBR-cycle [Aamodt & Plaza, 1994]). Thus, INFOSHOP further demonstrates the omnipresence of CBR in problem solving [Aha, 1998] and is a practical demonstration that CBR is a methodology for problem solving not a technology [Watson, 1999], since INFOSHOP doesn't use any of the technologies, such as k-nearest neighbour, so frequently associated with CBR.

The management of INFOSHOP has now passed from the incubator of the Cabinet Office to the Small Business Service[9], an agency of the Department of Trade an Industry that aims to improve the regulatory environment for small businesses, and to ensure that all small businesses have access to world class business support services.

On the 19th April 2000 INFOSHOP won the UK Government Innovation Award 2000.

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