A Client Centred Approach to the Development of Expert Systems

Dr. Ian Watson, Senior Research Fellow on the EDESIRL Project at the University of Salford outlines an Expert System development method for smaller companies.

Several years ago the majority of expert systems in business were developed by very large companies such as ICI, Unilever, Shell and British Telecom. However, as the recent DTI Knowledge Based Systems survey shows, smaller companies are increasingly taking up this new technology. As expert systems have left the research labs more interest has been focused on methods to assist in building them — it is now usually assumed that the technology is mature and stable.

Ironically, just as many developers in the traditional information systems community are moving away from prescriptive formal development methods such as SSADM towards more flexible contingent development methods (*e.g.,* Soft Systems and Multiview) the expert systems community is moving in the opposite direction (*e.g.*, KADS-II).

The desire to have a single development method that will always be successful is a natural one. A step-by-step method provides security, particularly if one has never built or commissioned a similar system before. However, this desire is unrealistic, and dangerous. Expert systems development methods must be contingent rather than prescriptive because the skills of different knowledge engineers and the situations in which they work must always be taken into account in any project. If this is now accepted to be true for information system design it is more true when one is encoding human expertise and knowledge.

Client Centred not Technology Centred

The Client-Centred Approach (CCA) is designed to help small and medium sized enterprises (SMEs) gain access to expert system technology. Until recently, this technology was only available to large organisations. Therefore, the available development methods and tools available were designed to cater for their needs — this tends to emphasise the technology. However, unlike these approaches, the CCA places the clients at the centre of the entire development process.

The Client Centred Approach (CCA) enables practitioners to use their own techniques and tools within a guiding framework. It is designed to help managers avoid wasting time and money developing systems that are not brought into regular productive use. The CCA pays particular attention to decisions made at the early stages of the system's development. This means the benefits and limitations of the system are clearly stated at the beginning of the project rather than at its end.

The CCA provides clearly defined stages or audit points to help managers guide the development process from the system's initial conception through to its eventual use within the organisation. Project development is controlled by a simple project management technique the identifies potential threats to the project's success.

The Stakeholders

The CCA involves **all** the project stakeholders in the development process. A stakeholder refers to anyone who is or will be affected by use of the expert system. There are many of these:

- **The Client:** The person or organisation for whom the expert system is being built. The client owns the problem that motivates the expert system project and provides or authorises resources for the project.

- **Project Manager:** The person within the client's organisation responsible for the management of the project.

- **Knowledge Engineer:** An IT professional who obtains and organises the knowledge and programs the expert system. A project may employ several knowledge engineers from within their organisation or use consultants.

- **Expert:** Someone with expert knowledge in the problem area. There may be experts who

provide knowledge and experts who check the system's results. The experts may be employed in the client's organisation or brought in from outside (e.g., academics).

- **Information/Data Supplier:** someone who supplies data or information that the expert uses to solve a problem. This person will need to supply the expert system with the same information.

- **Information/Data User:** someone who uses the solution made by the expert. The person may become a direct user of the expert system or they may obtain their information indirectly through a subordinate's use of the expert system.

- **Software & Hardware Support:** someone responsible for the maintenance of the client's software and hardware.

- **Customers & Suppliers:** the customers and suppliers of the client's organisation who may be affected by the installation and use of the expert system.

- **Anyone Else Affected:** The above list is **NOT** exhaustive. A stakeholder is **ANYONE** who will be affected by use of the expert system.

A Staged Method

The CCA is designed to assist SMEs manage expert system development projects. It uses a seven-stage structure to guide the development from initial conception through to regular beneficial use of the expert system.

These stages are named after the deliverables the client receives throughout the project. Consequently, managers using the CCA (who are not expected to have backgrounds in IT) can make informed decisions throughout; that is, managers do not have to rely entirely on the advice of external consultants or in-house experts.

The CCA guides managers through the entire life-cycle of the expert system from initial conception to implementation and then to its eventual maintenance and updating.
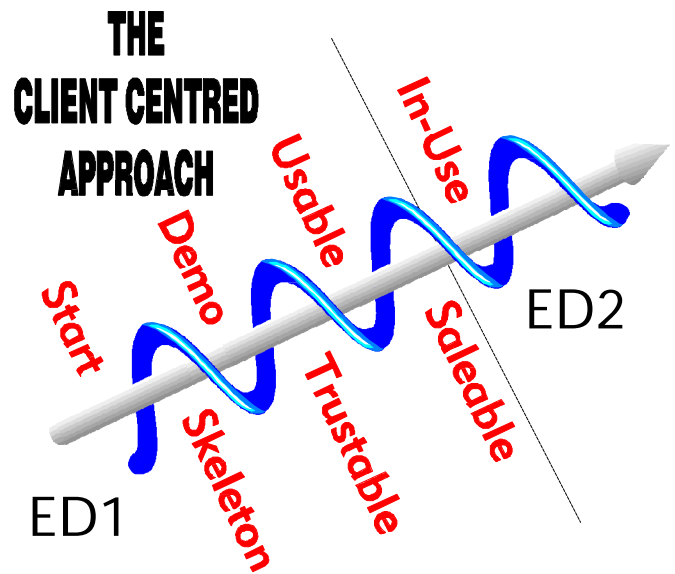

Figure 1. Seven Stages of the CCA

This is called **evolutionary development**. A central premise of this is the recognition that an expert system is never finished and that knowledge continues to evolve after the system has come into use.

Life Cycle Method

The life-cycle method is based on several guiding principles:

- Spend time and effort at the early stages of an expert system project in defining roles, benefits, objectives and so forth;
- Keep a holistic approach throughout the project, include considerations of usability and saleability from the start;
- Functioning software is useful both as a discussion point, and for deriving a specification;
- The staged approach helps the clients plan resource provision;
- The iterative approach to knowledge acquisition and representation is necessary because of the well known problems of devising a specification in ill-structured areas;
- Involve the client and other stakeholders throughout the process;
- Speak the client's language — avoid IT and consultancy jargon.

Staged development

The project proceeds in stages so clients can plan resource provision. Because of the inherent uncertainty of expert system development detailed project plans can only be made from one development stage to the next.

The CCA is divided into two broad activities:

- **Evolutionary development part one (ED1).** This considers the development of the expert system until it is in regular beneficial use within your organisation.

- **Evolutionary development part two (ED2).** This considers how the system can be kept in regular beneficial use, and considers such factors as training of users and maintenance of the system.

ED1 consists of the following stages:

Feasibility Study

The project feasibility study produces a total view of the project called a "Holistic Picture." This is used to guide the project.

The purposes of the first stage are as follows:

- to perform a feasibility study that includes business benefit, limitations and risk,
- to scope the expert system domain,
- to identify all stakeholders,
- to obtain a holistic picture of the problem by involving them all,
- to obtain their commitment to the project,
- to help the client plan resource provision,
- and to provide retrospective documentation of top-level decisions.

We recommend that developers should considering the following five questions (or hurdles) to focus their initial discussions:

1. Is the problem suitable for computerisation?
2. Is the problem suitable for expert systems?
3. Is the knowledge available to solve the problem?
4. Is the system worth developing?
5. Will the system be used?

An expert system is considered appropriate only if **ALL** the questions (or hurdles) are satisfied.

Skeleton System

The Skeleton System shows a sequence of screens that give a look and feel of the overall functionality of the expert system. The Skeleton System contains little knowledge, but illustrates the overall functionality of the intended system. This ensures the clients and stakeholders understand what is intended. The Skeleton System also helps the knowledge engineers obtain an understanding of the domain and of the types of information handled.

Demonstration Systems

Each problem has certain types of knowledge associated with it, and Demonstration Systems are designed to develop an explicit understanding of the types of knowledge and how they are interrelated. At this stage a significant amount of knowledge is acquired and encapsulated in an expert system that can be demonstrated, possibly is several different modules.

The Demonstration Systems keep the client informed and involved. It provides the knowledge engineers with an understanding of the types of knowledge in the domain, and of the technical problems that will be encountered.

Working System

The final Demonstration System should give reasonable results in unexceptional conditions. However, the Working System gives correct results in all situations in which the expert system is expected to be used.

Usable System

The Working System gives correct results but will be difficult to use — probably only the people who built it can operate it. Therefore, it can not be used to bring real business benefit. This stage ensures that the expert system is usable, by considering features such as "what-iffing," explanation facilities, and easy methods of data entry and export.

Note that giving too much effort prematurely to usability features is a common mistake, since developments can render them redundant. However, usability and such things as documentation should be kept in mind throughout the project, and we intend that user documentation should follow the expert system in parallel stages from Skeleton to Saleable.

Saleable System

This stage prepares the expert system for wider distribution. It involves improving the user interface, the wording of screens, a Help system, User Documentation, installation procedures, and preparing for the launch and subsequent activity. The deliverable is the final expert system.

ED2 Embedded in Use

The seventh stage brings the expert system into regular beneficial use, and represents the activities of ED2. This involves training users, providing help-lines and so forth, but it also means earlier planning of organisational changes required for effective use of the expert system. The timing of changes will have been determined during the first stage. The ongoing maintenance of the knowledge base will also have to be planned for.

The deliverables at the seventh stage are the business benefits that accrue from using the expert system.

Advantages of the CCA

Though it is a staged structure, the CCA overcomes the problems normally associated with linear structures because it allows for evolutionary development. Moreover, it also overcomes several problems normally associated with rapid prototyping; namely:

- Systems may satisfy the expectations of the knowledge engineers and domain experts but not necessarily those of the users.
- Prototyping can lead to uncontrolled growth of the system causing difficulties in maintenance.
- Over reliance on the iterative refinement of expert systems can result in their inability to solve problems occurring only rarely in the domain.
- The final "delivery" system is often a tidied up version of the prototype that was being worked upon when either the project's time or money ran out.
- Because of its cyclical nature prototyping is very difficult to audit.

However, although others recognise that "people" should be at the centre of methods, they do not identify the cause of the above problems, namely that they are derived from being technology centred. Both linear and rapid prototyping methodologies are described in terms dictated by the technology (e.g., elicit, represent, validate, debug), and many omit to establish an initial holistic view. Thus, the client is not fully involved and the above problems result.

The criticism of being technology centred also may be levelled at KADS. It is full of jargon and describes activities in terms of layers of knowledge and models. Such an approach will inevitably exclude the clients.

Conclusions

The CCA is exploring our understanding of the development of expert systems within SMEs. We believe that there are two underlying problems with current expert system development methods:

- they are "technology centred,"
- and they are attempting to be prescriptive.

The CCA has been shown to work on several development projects, including the ELSIE system. This expert system was developed within the Alvey project; it provides strategic budget estimates for commercial office developers. The ELSIE system has now sold over 300 copies and is regular use in surveying and architecture companies.

The CCA is currently being tested and further developed by Salford University in collaboration with the Royal Institution of Chartered Surveyors, Imaginor Systems (a commercial company that markets the ELSIE system), Inference Europe Ltd (a company that manufactures expert system shells

and provides consultancy), and Davis Langdon and Everest (the UK's largest surveying company). This collaboration is producing several expert systems:

- a system that predicts the maintenance requirements of residential housing (developed within Salford University primarily by computer scientists),

- a system that provides strategic estimates of building project's cash flows (developed within Salford University by an architect)

- a system that provides strategic budget estimates for residential housing projects (developed in Imaginor Systems by a surveyor),

- and a system that advises of project procurement methods (developed in Davis Langdon & Everest by a surveyor).

The objective of these studies is to gain a better understanding of the needs of SME's and to produce a Use Manual for the CCA that combines the strengths of the software engineering linear approach and the iterative approach of AI while overcoming many of their weaknesses.

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