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# THE ACQUISITION OF KNOWLEDGE FROM MULTIPLE EXPERTS IN THE DOMAIN OF SENSORY EVALUATION PANEL TRAINING

A Thesis Presented in Partial Fulfilment

of the Requirements for the

Degree of Master of Philosophy in Social Science

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**SIMON ANTONY EWING-JARVIE**

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Simon Ewing-Jarvie
September 1994

Abstract

Knowledge acquisition is the elicitation and representation of human expertise and is one of the first steps taken in constructing an expert system. It has often been cited as the 'bottleneck' in expert systems development due to the labour intensive processes needed to deal with the expert human. Various researchers have proposed methodologies for improving both the accuracy and the productivity of the process. This has ranged from manual to automated methods as well as examining what the expert might be thinking during a study of the conscious activity.

This research has focused on the issues involved in the manual elicitation of knowledge using multiple experts in the same domain. It utilises the transcripts of semi-structured interviews and discourse analysis techniques to construct the domain layer of a knowledge base, employing the KADS methodology.

The findings highlight the importance of the relationship between the knowledge engineer, organisation and the human experts. Issues such as motivation, organisational commitment and communication skills feature as key indicators of the likely success of an expert system development project. While automated acquisition assists with productivity, it works against the development of relationships within the project team and the trade-off must be carefully considered by the project manager.

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# Chapter 1
# Introduction

1 Introduction

1.1 An overview

The field of artificial intelligence and its offspring, expert systems has been the subject of considerable interest in recent years. Various international initiatives have added to this impetus including Japan's Fifth Generation Strategy, the European Community's KADS Programme and the British Alvey Programme for Advanced Information technology. Expert systems utilise human expertise and there has been much research (Clancey, 1985; Boose & Gaines, 1989; Wielinga, Schreiber & Breuker, 1991) into knowledge engineering techniques. Despite the proliferation of research projects in the area, there is general agreement (Clancey, 1985; Marcus, 1988; Musen, 1989; Wielinga, Schreiber & Breuker, 1991) that the major bottleneck in the construction of an expert system remains the acquisition of knowledge. This problem is further confounded when multiple experts in the same domain are involved in the knowledge acquisition process. There is a limited amount of research on the acquisition of knowledge from multiple experts in the same domain.

1.2 Nature of the research

This research was exploratory and its objective was to identify issues that will affect knowledge acquisition from multiple experts in the same domain. While there are now second and third generation software applications which facilitate the development of a knowledge base (Marcus, 1988; Musen, 1989; Gaines & Linster, 1990), it was felt that too little was understood about some basic relationships between knowledge engineer, expert and domain and that automation would blur the issues. For this reason, first generation techniques such as interviewing and discourse analysis were employed. This proved to be a valuable feature of the research as it enabled the effect of the relationship between knowledge engineer and expert to be fully explored within the context of organizational dynamics.

## 1.3 Structure of the thesis

In the second chapter the literature on knowledge acquisition is reviewed and definitions are offered for the main terms and ideas implicit in the research. It is pertinent to note that most of the published research relates to knowledge acquisition involving a single expert, rather than multiple experts.

Expert systems are symbolic, heuristic, and can cope with uncertain information. The field of sensory evaluation is of a similar nature, being involved with the use of the human senses to evaluate flavour, aroma, texture, mouth feel and colour in a quantifiable, scientific manner. Members of a panel are trained and led by sensory evaluation experts in order to enable them to carry out these experiments. The Sensory Evaluation Unit of the New Zealand Dairy Research Institute, based in Palmerston North is one of the main providers of trained panels in the country and as such, was in the position of having three expert panel leaders on its staff. This is contrary to the normal situation where expertise is scarce or unavailable and so offered a unique opportunity for the study of knowledge acquisition using multiple experts. The third chapter provides an overview of the field of sensory evaluation as well as discussing its suitability as a domain.

Chapter four details the methodological processes employed in the research. As is the nature of exploratory research, a research goal was deemed more appropriate than hypotheses. This chapter describes how the verbal data was gathered and transcribed. It explains how original interview transcripts were reduced via discourse analysis techniques to eventually become concepts and relations. Despite the best efforts of researchers, this process will remain relative to the skill of the knowledge engineer and so consistency is only maintained, for the purposes of research by using one knowledge engineer, as is the case here. However, it was noted that the use of one knowledge engineer does result in a bottleneck of administrative tasks.

The concepts and relations derived from discourse analysis form the basis of the domain layer, in the KADS methodology. KADS is explained more fully in

chapter 2, while the concepts and relations are shown in chapter 5. The KADS methodology was selected from among several alternatives as it was clear that many of the tasks involved in training a sensory evaluation panel were generic, for instance selection, discrimination and administration. KADS offered the most clearly documented framework upon which to model these activities. As the DRI had requested that the outcome be a single model of knowledge, it was then necessary to achieve consensus and derive one set of concepts and relations from the three experts' individual sets. Chapter 5 also addresses the processes which led to the successful development of a single domain layer.

The significant issues identified in this research are examined in chapter 6. These findings relate particularly to social science concepts such as organizational and individual commitment, communication, motivation and workload. This chapter serves to highlight the inseparability of computer science from the disciplines which seek to explain what energises and sustains human behaviour.

Conclusions regarding the findings are highlighted in the final chapter, chapter seven. The verbal data transcripts and output from supporting analysis is shown in full in the appendices. Despite the volume of the data, it was felt that its inclusion not only provided completeness to this thesis, but also offered the opportunity for secondary analysis in the future.