DESIGN AND CONSTRUCTION OF MAINTAINABLE KNOWLEDGE BASES THROUGH EFFECTIVE USE OF ENTITY-RELATIONSHIP MODELING TECHNIQUES

by

WILLIAM YANCEY PIKE
B.S., University of West Florida, 1987

THESIS

Submitted in partial fulfillment of the requirements
for the degree of
Master of Science
College of Engineering
University of Central Florida
Orlando, Florida

Summer Term
1993

ABSTRACT

The use of an accepted logical database design tool, Entity-Relationship Diagrams (E-RD), is explored as a method by which conceptual and pseudo-conceptual knowledge bases may be designed. Extensions to Peter Chen's classic E-RD method which can model knowledge structures used by knowledge-based applications are explored.

The use of E-RDs to design knowledge bases is proposed as a two-stage process. In the first stage, an E-RD, termed the Essential E-RD, is developed of the realm of the problem or enterprise being modeled. The Essential E-RD is completely independent of any knowledge representation model (KRM) and is intended for the understanding of the underlying conceptual entities and relationships in the domain of interest. The second stage of the proposed design process consists of expanding the Essential E-RD. The resulting E-RD, termed the Implementation E-RD, is a network of E-RD-modeled KRM constructs and will provide a method by which the proper KRM may be chosen and the knowledge base may be maintained. In some cases, the constructs of the Implementation E-RD may be mapped directly to a physical knowledge base.

Using the proposed design tool will aid in both the development of the knowledge base and its maintenance. The need for building maintainable knowledge bases and problems often encountered during knowledge base construction will be explored.

A case study is presented in which this tool is used to design a knowledge base. Problems avoided by the use of this method are highlighted, as are advantages the method presents to the maintenance of the knowledge base. Finally, a critique of the ramifications of this research is presented, as well as needs for future research.

ACKNOWLEDGEMENTS

The author would like to thank his wife, Tracey, for inspiring, motivating, and occassionally forcing him to continue his education. The author offers no small amount of gratitude to Dr. Soheil Khajenoori for displaying tremendous amounts of patience; to Drs. Tom Peeples and Allan Lang for their assistance and support; and to his parents, Billy and Eola Pike, for their love and guidance through the years. Finally, but most importantly, the author would like to thank the Lord, without whose supreme assistance this work would be impossible.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Although the topic of knowledge base and database integration has recently been an area of considerable research from both from academia and industry, for the most part this research has failed to integrate conceptual database design principles into the design of knowledge bases.

The need for such a design methodology in the knowledge base system world is inarguably a real one. The design of knowledge-based systems (KBS) and their underlying knowledge base management systems (KBMS) suffers from a lack of a de facto standard methodology (**Gonzalez and Dankel 1993**). This lack of a methodology can lead to a *paradigm shift*, in which, during the development of the KBS, the developer must shift to a new technology. (**Gonzalez and Dankel 1993**) This paradigm shift is caused when the initial selection of knowledge representation model (KRM) can not adequately perform its intended function. This represents perhaps the most serious problem in KBS development. However, there are other inherent problems, as described in (**Gonzalez and Dankel 1993**). One problem lies in the difference between solving traditional information-system problems and heuristic-oriented problems. The data needed for algorithmic problems can be determined fairly easily, while in the case of knowledge-based systems, sometimes the "nature and quantity" of the knowledge isn't known even by the experts. The process of knowledge acquisition can thus prove to be fairly frustrating. One of the underlying reasons for this, claims Earl Cox, a columnist for *AI Expert*, is a common perception that AI is commonly defined in "terms of ever more advanced knowledge representation schemes devoid and divorced from fundamental architectural and design