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Conceptual Data Modelling for Geographical Information Systems

**A thesis presented in partial fulfilment of
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Abstract

This thesis sets out to find an answer to the question: does an appropriate conceptual data model exist for the practitioners of Geographical Information Systems database design? It aims to investigate and answer the question by:

- Finding a workable data model to solve a database design problem (Manawatu-Wanganui Regional Council, Palmerston North, Natural Resources Management, Groundwater Section database).
- Analysing the user's data requirements and producing a feasible conceptual schema.

Usage of Geographical Information Systems applications is a recognised need in a growing number of organisations in New Zealand, but many factors block the way of this relatively new technology. One of these factors is the lack of well-designed databases to support the data needs of these non-traditional applications. One school of thought adopts general data modelling techniques for every database design problem, another group of researchers suggests that specialised data models are necessary to model data in various problem domains.

This thesis summarises the "specialities" pertaining to the GIS database domain. The most important are the special data needs of GIS applications and the problem of the placement of spatial data models in the traditional taxonomy of database models. It chooses the objectives of conceptual data modelling as the evaluation criteria which the selected data model must satisfy i.e. to model reality and to form the basis for database schema design.

This thesis reviews a group of published papers, selected from proponents of the entity-relationship and the object-oriented data modelling paradigms and the applications of these data modelling techniques in a spatial context. It compares various extensions to the original entity relationship model, and a comparison of the main data modelling paradigms is included. Data modelling shortcomings encountered in the literature are also summarised. The literature reviewed concludes that not appreciating the conceptual data modelling objectives leads to unsatisfactory conceptual database design.

The selected data model, the spatially extended entity relationship (SEER) model is described and applied to the database design problem of a local authority to produce conceptual schemas. Findings are summarised and issues for future research are identified.

Conclusions reached are: further evaluative work on the applied spatially extended entity relationship (SEER) model would be useful and clear directions are essential for practitioners showing the guiding principles of conceptual data modelling in a spatial context.

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Table of Contents

1 Introduction and Objectives	1
1.1 Research Motivation and Problem Statement	1
1.2 Background to Conceptual Data Modelling	2
1.2.1 General Background for All Types of Database Design	3
1.2.2 Glossary of General Terms	5
1.2.3 Data Modelling Paradigms	6
1.3 Research Objectives	7
1.4 Research Methodology	8
1.5 Thesis Structure and Content	9
2 What is so special about GIS?	10
2.1 Introduction	10
2.2 Spatial Information Systems and GIS	10
2.3 Geographical Data, Geographical Data Structures, GIS Database Architecture and Thematic Map Layers	12
2.3.1 Geographical Data	12
2.3.2 Geographical Data Structures	13
2.3.3 GIS Database Architecture	15
2.3.4 Thematic Map Layers	16
2.4 Taxonomy of Spatial Data Models and Levels of Abstraction	17
2.5 Chapter Summary	20
3 Literature Review	21
3.1 Introduction	21
3.2 ER-based approaches	22
3.2.1 The Entity - Relationship Data Model	22
3.2.2 Wang and Newkirk's ER Model for GIS Development	27
3.2.3 Laurini's ER Model of Urban Data	29
3.2.4 The Entity-Category-Relationship Data Model	31
3.2.5 ECR for a Spatial Decision Support System	35
3.2.6 The Extended Conceptual Entity-Relationship Model	38
3.2.7 ECER for Soil Database	42
3.2.8 Bedard and Paquette's Sub-Model Substitution Method	45
3.2.9 Comparison of ER Models	50
3.3 Object-Oriented Approach to Conceptual Data Modelling	52
3.3.1 Definitions of IFO	53
3.3.2 Object-Oriented Data Modelling for Spatial Databases	56

3.3.2.1 Data Models.....	57
3.3.2.2 Discussion of an Object-Oriented Data Model.....	62
3.3.2.3 Is IFO Object-Oriented?.....	65
3.3.2.4 Evaluation of Worboys' et al. paper	66
3.4 Conclusions	67
3.4.1 Comparison of Data Modelling Paradigms	67
3.4.2 Data Modelling Shortcomings Encountered in the Literature.....	69
3.4.3 Summing Up.....	70
4 A Spatially Extended Entity Relationship Model.....	71
4.1 Introduction	71
4.2 Rationale for the Extension to the Generic ER Technique.....	71
4.3 Requirements for Conceptual Data Modelling Abstractions.....	72
4.3.1 Locational and Geometry Requirements	73
4.3.1.1 Location	73
4.3.1.2 Geometric Data Types.....	73
4.3.1.3 Thematic Layer as a Conceptual Model.....	74
4.3.1.4 Inter-Layer Connections	74
4.3.2 Spatial Relationships Requirements	76
4.3.2.1 Hierarchical Order of Spatial Relationships.....	76
4.3.2.2 Classification of Spatial Relationships.....	77
4.3.3 Summary of the Required Abstraction Mechanisms.....	78
4.4 A Spatially Extended Entity Relationship Model.....	79
4.4.1 Entity-Relationship Model in the SEER Model	80
4.4.2 Locational Data Modelling in the SEER Model.....	81
4.4.3 The Spatial Sub-model of the SEER Model.....	84
4.5 Data Modelling Objectives and the SEER Model.....	87
4.6 Chapter Summary	89
5 Case Study - Modelling for an Underground Water Database.....	90
5.1 Introduction	90
5.2 Thematic layers : Inter-Layer Relationships	90
5.3 Intra-Layer Entities and Relationships	92
5.3.1 Groundwater Layer - Entity Sets.....	92
5.3.1.1 Business Rules for the Groundwater Node.....	96
5.3.1.2 Spatial relationship for the Groundwater Node.....	97
5.3.2 Catchment Layer - Entity Sets.....	98
5.3.3 Soil Layer - Entity Sets.....	98
5.3.4 Road Layer - Entity Sets.....	99
5.3.5 River Layer - Entity Sets	100
5.3.6 Land_Use Layer - Entity Sets.....	101

5.4 Findings	101
5.5 Chapter Summary	102
6 Research Issues and Thesis Conclusion.....	103
6.1 Proposed Future Research	103
6.2 Thesis Conclusion.....	103
References	106
Appendices	
Appendix A Preparation for the Data Requirements Collection at Manawatu-Wanganui Regional Council (MWRC).....	113
A.1 Objectives	113
A.2 Venue.....	113
A.3 Time.....	113
A.4 Short Description of the Planned Activities	113
A.5 Background Material	114
A.6 Questionnaire.....	114
Appendix B Manawatu-Wanganui Regional Council- Extract from the Strategic Information Systems Plan for the MWRC, Report Number 94/EXT/121, March 1994. -.....	115
B.1 Introduction.....	115
B.2 The Beneficiaries	115
B.3 Representation.....	116
B.4 Purpose and Functions	116
B.4.1 Overall Direction	116
B.4.2 Operating Principles.....	117
B.4.2.1 Statutory Mandates - functions, duties, powers and activities under:	118
B.4.2.2 Corporate Conduct - indicates how the Council will carry out its duties (functions, duties, powers and activities).....	118
B.4.3 Functional Activities	118
B.5 Resource Monitoring and Investigations	118
B.5.1 Description.....	118
B.5.2 Overall Objective.....	119
B.5.3 Outputs.....	119
Appendix C.....	120
C.1 Organisation Chart.....	120
C.2 Resource Monitoring Department.....	121
Appendix D Report on the Data Requirements Collection.....	122
D.1 Introduction.....	122

D.2	Introducing - Groundwater Management	122
D.2.1	The three major components	122
D.2.1.1	Groundwater allocation	122
D.2.1.2	Groundwater monitoring	123
D.2.1.3	Groundwater modelling.....	123
D.2.2	Operational duties.....	123
D.3	The source of groundwater data	124
D.4	Previous groundwater “databases” - a short historical background	125
D.4.1	The dark ages.....	125
D.4.2	The grey ages.....	126
D.4.3	Partly computerised system	126
D.4.4	The high TECHBASE age.....	126
D.5	The existing database.....	127
D.5.1	TECHBASE.....	127
D.5.2	WELLARC tables and fields - a detailed description	127
D.6	Data Requirements of the Underground Water Database.....	132
D.6.1	Simple inquiries	132
D.6.2	Complex inquiries.....	132
D.6.3	Non-inquire based tasks.....	133
D.6.3.1	Reports to management	133
D.6.3.2	Environmental impact assessments - information given to Consent Department	133
D.6.3.3	Aquifer vulnerability studies - information given to Consent, Policy and Monitoring Department	133
D.7	Data deficiencies - from the user perspective.....	134
D.7.1	Bore locations and ownership.....	134
D.7.2	Groundwater permits and groundwater use.....	135
D.7.3	The lack of reference data.....	135
D.8	Conclusions.....	135
Appendix E Database Definitions for the Present Underground Water		
Database		137
Appendix F		173

List of Figures

1.1 From left: General database design phases (Batini et al., 1992:7) and Overview of GIS Database Design (Chambers, 1989:2)	3
2.1 Information Systems Taxonomy (Adapted from Dale and McLaughlin, 1988:10)	11
2.2 Levels of Abstraction (Peuquet, 1984:70).....	18
3.1 An Entity-Relationship diagram (Chen, 1976:19)	24
3.2 ER Model for GIS (Wang and Newkirk, 1988:169)	28
3.3 Conceptual model for parcels and blocks (Laurini, 1991:481).....	30
3.4 ECR Basics (Armstrong and Densham, 1990:9).....	34
3.4 The ECR cartographic view (Armstrong and Densham, 1990:9)	36
3.5 The ECR spatial analytical view (Armstrong and Densham, 1990:10)	37
3.6 The integrated SDSS view (Armstrong and Densham, 1990:11)	37
3.7 A sample ECER schema diagram (Czejdo et al, 1990:28)	40
3.8 Conceptual schema for the soil database (Fernandez and Rusinkiewicz, 1993:530)	44
3.9 ER Schema - explicitly including (in bold) geometric entities and relationships (Bedard and Paquette, 1989:823).....	47
3.10 The Sub-Model Substitution(SMS) symbols with their.....	48
3.11 SMS Representation of the Model from figure 3.9 (Adopted from Firms, 1994b:64)	49
3.12 Three atomic IFO types (Abiteboul and Hull, 1987:529)	53
3.13 Constructed object types (Abiteboul and Hull, 1987:530).....	54
3.14 Two simple fragments (Abiteboul and Hull, 1987:531)	54
3.15 The Vehicle example (Abiteboul and Hull, 1987:533).....	55
3.16 Entities and Relationship (Worboys et al., 1990:371)	58
3.17 Generalisation and Specialisation in IFO (Worboys et al., 1990:372).....	58
3.18 Aggregation and Association (Worboys et al., 1990:373).....	59
3.19 Polygon modelled in IFO (Worboys et al., 1990:377).....	60
3.20 Relationship between 1981 census units in IFO (Worboys et al., 1990:379)	61
3.21 An object-oriented data model schema example.....	64
4.1 Generic Models of Two 1:n Relationships and Three Entity-sets (Firms, 1993:11)	75
4.2 A Hierarchical Order of Relationships (Firms, 1994b:105).....	76

4.3 General Taxonomy of Relationship Genuses and Entity Characteristics to be Supported by the SEER Model (Firms 1994b:112).....	79
4.4 Three Components of the SEER Model (Firms, 1994b:131).....	80
4.5 ER Diagramming Notation (Firms, 1993:10).....	81
4.6 SEER Diagramming Notation for Locational Data Modelling (Firms, 1994a:293).....	84
4.7 Topological Spatial Relationship Genuses in the SEER Model (Firms, 1994a:294).....	86
4.8 Is-part-of Relationship Genuses in the SEER Model (Firms, 1994a:294).....	87
5.1 "Context "Diagram for the Underground Water Database.....	91
5.2 Groundwater Layer	93
5.3 Catchment Layer	98
5.4 Soil Layer	98
5.5 Road Layer	99
5.6 River Layer.....	100
5.7 Land_Use Layer	101
C.1 MWRC Organisation Chart (Strategic Information Systems Plan for the MWRC, Report Number 94/EXT/121, March 1994)	120
C.2 MWRC Resource Monitoring Department (Strategic Information Systems Plan for the MWRC, Report Number 94/EXT/121, March 1994).....	121
F.1 Map: Bore Positions in the Manawatu Wanganui Region (by courtesy of Gabor Bekesi, Manawatu-Wanganui Regional Council).....	173

List of Tables

1.1 Terminology in Data Modelling (Firns, 1994b:8).....	5
1.2 Dependence of conceptual, logical, and physical design on the class of DBMS and the specific DBMS (Batini et al., 1992:8)	5
2.1 Classification of geographical data (Maguire and Dangermond, 1991:322)	13
2.3 A Taxonomy of Spatial Data Models and Levels of Abstraction (Adapted from Firns, 1994b:81).....	19
3.1 Classic Entity/Relationship Types (Adapted from Kennedy, 1993:66).....	25
3.2 Properties of Relationships (Adapted from Chen, 1976:20).....	26
3.3 New terms of ECR (Adapted from Elmasri et al., 1985:89).....	34
3.4 New terms of ECER.....	42
3.5 Comparison of terms of ER, French E/R model, ECR and ECER Models.....	51
3.6 Relational model of a polygon (Worboys et al., 1990:371)	57
3.7 Comparison of Data Modelling Paradigms (Adapted from Firns, 1994b:37).....	68
4.1 Basic Terms for Locational Data Modelling in the SEER model.....	83
5.1 Business Rules of the Groundwater Node.....	97
B.1 Mission Statement for the MWRC (Strategic Information Systems Plan for the MWRC, Report Number 94/EXT/121, March 1994)	116
B.2 Goal Statement for the MWRC (Strategic Information Systems Plan for the MWRC, Report Number 94/EXT/121, March 1994).....	117
D.1 MWRC Groundwater data description.....	128