Conceptual Data Modelling for Geographical Information Systems

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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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