Regional Integrated Management Information System*

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Abstract: Landholders, departmental agencies and other stakeholders have long been involved in knowledge building of the physical elements affecting land use. Often, however, this has been without any accompanying information on social and economic impacts, or systems for exploring catchment trade-off decisions. RIMIS is the concept of a regional management system designed for landscape managers. It has a web-compatible interface allowing multiple users to access distributed data sources (including spatial databases) and run distributed bio-physical and socio-economic models to explore catchment management problems i.e. ask *'what if?'* questions. Its models bring together science, sociology and economics, to explore interactions and show the impact of management decisions in one place on the rest of the catchment and end-of-catchment targets. RIMIS is being deployed in the New South Wales Department of Land and Water Conservation (DLWC) for their TARGET project.

Keywords: Integrated Catchment Management; Problem Support System; Interoperable Information Infrastructure; Model Flow

1 INTRODUCTION

RIMIS aims to provide landscape managers, from diverse disciplines and organisations, with both an application and a re-useable information infrastructure that together enables systematic investigation of social, economic, water quality and salinity trade-off issues for the Lachlan and Macquarie catchments in NSW, Australia. Catchment management is a complex real world problem, usefully characterised as an ill-structured [Simon, 1973] or wicked problem [Rittel and Webber, 1973] because of its broad range of stakeholders (both individuals and organisations), problem scope (covering social, economic and bio-physical processes) and evolving problem definition (such as the structure of the physical processes under investigation, constraints on feasible solutions and investigation objective). Formulation of a system to successfully support landscape managers and other stakeholders involved in the catchment management problem requires elicitation and understanding of stakeholder wants and needs. The design and subsequent structure of RIMIS recognises the requirements of the principal stakeholders in salinity and water quality management: primarily *Catchment Management Boards* (CMB), but also *Primary Producers*, *State Government Departments*, *Local Governments*, *Domain Specialists* drawn across organisations from several discipline areas, and *Interested Public*. In Sect. 2 we present major stakeholder requirements addressed by RIMIS. Sect. 3 describes the major components of RIMIS and identifies how these components meet stakeholder needs. A common theme of organisational stakeholder requirements is interoperability–in terms of data, information and knowledge re-use. Sect. 4 highlights how RIMIS uses an inter-enterprise information infrastructure to achieve interoperability. RIMIS uses a

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workflow system to co-ordinate distributed data access and process model execution. We briefly describe our workflow approach to managing cascade networks of social, economic and bio-physical models in Sect. 5. RIMIS, through its Evolutionary Problem Support System (EPSS) interface, distinguishes itself from other work by adopting a problem definition model as the underlying theme for organising and presenting information and knowledge about the problem at hand. Sect. 6 describes the RIMIS problem definition model and the EPSS interface. We identify related work in Sect. 7 and present conclusions in Sect 8.

2 STAKEHOLDERS AND REQUIREMENTS

CMBs have statutory obligations to establish interim catchment targets for salinity, water quality, soil health, vegetation management and so on. The primary requirement of CMBs with respect to RIMIS is to broadly define catchment-wide landscape management problems and set scenarios for further detailed problem exploration. *Problem Solvers*, *Decision Makers* and *Domain Specialists* assist the CMB in defining catchment management problems and subsequently exploring the effects (outcome) of various action plans under a scenario. The model of problem definitions embedded within the EPSS component of RIMIS is crucial to enabling these stakeholders to systematically explore potential landscape futures. *Domain Specialists* are people and systems that answer questions about relationships among problem variables. *Domain Specialists* wish to provide expert input (usually in the form of models and specialist data) on the causal relationships among problem variables. Interoperable access to models and data forms a major requirement for *Domain Specialists*. *Domain Specialists* typically have significant existing investments in knowledge and expertise on using and calibrating process models. This investment in legacy models is often coupled with an unwillingness to re-implement that knowledge in another modelling framework. We see *Primary Producers* and *Interested Public* as major information consumers for RIMIS, demanding easy access to CMB strategy and implementation progress documents and interaction with a more concise problem-scenario-action-outcome representation than used by CMB. *State Government Departments* and *Local Government* would like to see increased data and information sharing together with broader access to domain expertise. An important constraint on information sharing is that organisations wish to retain custodianship of data and systems.

3 RIMIS STRUCTURE

Stakeholder requirements are met through a Web-based software system that integrates data and process models in a highly interactive and problem-focussed way. This encourages unconstrained exploration of information resources and management options. Extensibility of the design enables it to be reconfigured to vary process models and data availability from time to time through reconfiguring rather than recoding. Embedded in a static Web site aimed at advancing knowledge and communication amongst stakeholders, the RIMIS offers two kinds of distinct end-user interfaces. One, intended for CMBs and their advisers, provides an evolutionary problem support interface (EPSS). This offers a problem-directed interface to integrated datasets, contextual data and process models calibrated for the problem: social, economic, water, salinity and vegetation models. A problem space is established through customisation of initial problem templates. Users explore the problem space through interaction with hypermedia maps, scenarios and action plans that describe possible futures and management options in a spatially-explicit manner, based on underlying biophysical management units. Simulated action plan outcomes are summarised through a pentagonal icon, but drill-down to underlying quantitative measures is available. The other end-user interface is offered through system tools that extract selected contextual data and management options from the problem support system and publish these to a technically simpler display-based system. RIMIS is built on an interoperability infrastructure developed by the Internet Marketplace (IMP) group [Abel et al., 1999]. Local government councils in Sydney have successfully used this infrastructure to share and access data and other information distributed across a number of organisations [Cameron et al., 2001]. The IMP infrastructure permits system extensibility, including dynamic access to custodian-sited datasets, legacy models and image processing services [Devereux and Power, 2001]. Interoperability is achieved through a declarative request language, specialised software components to interface with data and model sources, a workflow definition and management tool, and extensive internal metadata management.

3.1 Key System Components

Figure 1 sketches major components of RIMIS. The **RIMIS Web Site** is the entry portal for Public and CMB access to the Lachlan (LIMIS) and Macquarie (MIMIS) Web sites, each containing strategy docu-