Scientific integration in the Bioregional Assessment Programme

Becky Schmidt 1

1CSIRO, Canberra, Australia, Becky.Schmidt@csiro.au

ABSTRACT

Scientific information for decision makers typically requires input from a number of different scientific disciplines. Effective scientific integration of these multiple disciplines is required for the information to be useful. This paper discusses some of the challenges associated with scientific integration within bioregional assessments (BAs), which provide information on the ecology, hydrology, geology and hydrogeology of a bioregion with explicit assessment of the potential direct, indirect and cumulative impacts of coal seam gas and coal mining development on water resources. This scientific information will be available for all interested parties – including Australian federal and state decision makers, industry and the community – when considering coal seam gas and coal mining developments.

Three techniques to ensure scientific integration are presented:

- specifying an information model that structures and governs the scientific activities, inputs and products
- collaborating to achieve consensus on the outline for all products, and implementing via simple software tools accessible to researchers in multiple agencies
- specifying and enforcing standards for language and data visualisation, and developing a vocabulary service for glossary terms.

Technological tools that support these techniques are emphasised.

THE BIOREGIONAL ASSESSMENT PROGRAMME

A bioregional assessment is a scientific analysis of the ecology, hydrology, geology and hydrogeology of a particular geographic area, with explicit assessment of the potential direct, indirect and cumulative impacts of coal seam gas and large coal mining development on water resources [1]. The Bioregional Assessment Programme undertakes these assessments for its primary audience, the Independent Expert Scientific Committee on Coal Seam Gas and Large Coal Mining Development (IESC), but also for a range of stakeholders including state government regulators, coal seam gas and large coal mine proponents, and interested community members. The outputs are a suite of 13 distinct scientific products for each of the 13 geographic areas currently being studied. All unencumbered datasets will also be published.

The programme team spans both scientific disciplines and research agencies with four main collaborators: the Commonwealth Scientific and Industrial Research Organisation (CSIRO); Geoscience Australia; the Bureau of Meteorology; and the federal Australian Government Department of the Environment. Nearly 200 people are working together to deliver over 150 products over the course of three years. In addition to scientists who specialise in the relevant disciplines, the programme also includes a products team that undertakes the quality assurance and quality control procedures with respect to content, format and delivery. These editors, mapmakers and technologists specialise in integration in interdisciplinary projects and have broad domain knowledge which they use to design products to suit their purpose and audience.

TECHNIQUES FOR SCIENTIFIC INTEGRATION

Broadly, the team uses three techniques to ensure scientific integration.

Firstly, an **information model was specified that structures and governs the scientific activities, inputs and products**. Diagrams were created of this information model, both at a simplified level (Figure 1), and at a more complex detailed level [2]. The information model has played a central role in project planning for the BAs, with activities forming the basis of project plans; the subcomponents and codes dictating the design and outline of products; and the large diagram itself framing discussions at meetings – thus improving integration of products and science. The model also plays a fundamental role in structuring the information for not only the primary content, but also the associated uncertainty and provenance. The model translates easily into a provenance ontology. Coupled with a system for recording provenance using an agreed provenance standard, the model enables on-demand provenance reporting, thus allowing stakeholders to judge the credibility of the information, ensuring transparency.

Secondly, a **collaborative process is undertaken to further specify the content for each product** (a report or module of information, corresponding to a rectangle in Figure 1). Consensus must be achieved across many team members: project leaders, discipline leaders, authors, editors and integrators. The resulting outlines must be specific enough to guide authors to write consistent products across all the bioregions, yet generic enough to accommodate the differing availability of models and data in the 13 bioregions. Once the outlines of products are agreed, work practices are specified and deployed across the entire team using desktop tools easily accessible by multiple agencies. Microsoft SharePoint is used for collaborative authoring; scripts are used to generate suites of Microsoft Word documents; and Excel workbooks are used for data management. These simple tools then link to more sophisticated data management and provenance tools that technologists design and implement.

Thirdly, **consensus on standards for language and data visualisation was reached**. These standards were documented and enforced, ensuring integration at a small scale, a necessary prerequisite for integration at a larger scale – if different words with different meanings are used in different section of a product, what hope is there to emerge with an integrated scientific message overall? A custom style sheet for editing software PerfectIt was built, to efficiently enforce these standards, and a vocabulary service for glossary terms was built and delivered via the website.

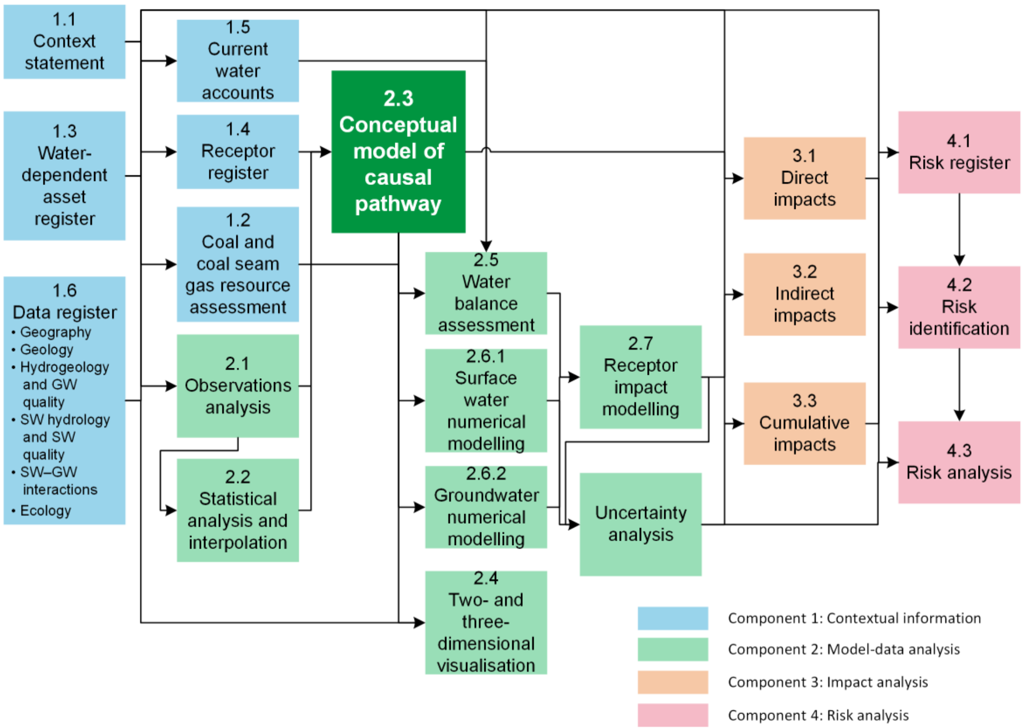

Figure 1: The flow of information through a bioregional assessment, which comprises four components of work as indicated by the colour code. A more complex diagram [2] provides further detail, including how uncertainty flows in parallel with the information through a bioregional assessment. Each rectangle corresponds to a product that is initially delivered as a report, but will eventually be delivered as a module via the web in an information platform

REFERENCES

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ABOUT THE AUTHOR

Dr Becky Schmidt is a scientific integrator in CSIRO Land and Water's Environmental Information Systems Research Program, in Canberra, Australia. She leads a team that provides editorial and scientific quality assurance of publications from interdisciplinary projects in land and water science.

Dr Schmidt has a research background in computational chemistry, and joined CSIRO in 2007. She was part of the team that was awarded the CSIRO Chairman's Medal in 2008 for the Murray-Darling Basin Sustainable Yields Project.

Dr Schmidt uses her editorial, research and technological skills to:

- develop standards and workflows for quality assurance
- integrate knowledge from multiple disciplines
- help research teams collaborate more effectively
- deliver scientific evidence in a form suitable for policy makers.

For more information see <http://www.csiro.au/Organisation-Structure/Divisions/Land-and-Water/BeckySchmidt.aspx>.