

The CSIRO Complex System Science Emerging Science Area

1. Aims, Vision and Performance Measures

Within three years:

- a) We will have made significant contributions to the field of Complex System Science.
- b) An active network of CSS researchers will exist in CSIRO so that advances in the science in one context are rapidly transmitted and applied to other fields
- c) Divisions will see Complex Systems Science as a key area that is essential to their operations
- d) We will be able to point to a set of projects across the spectrum from basic to applied science where CSS has been critical to success.

2. Key elements of the Program

The Program rests upon three legs, each of which is essential to achieving the aims listed above:

- a) Leading edge Complex Systems Science: we are funding innovative projects at the edge of the discipline staffed by scientists with the necessary skills
- b) Capacity building: we are funding projects where CSS techniques are applied to a range of problem areas. These projects do not aim to advance CSS per se but to build capacity within CSIRO to use CSS techniques. At the same time we are running or funding attendance at CSS training courses for CSIRO staff.
- c) External Interaction: we are fostering interaction with other Australian and international researchers in CSS primarily through defining and co-funding joint projects so that CSIRO and external researchers actually work together.

3. Structure of the Program

We have structured the program in a way that is somewhat novel within CSIRO and is intended to avoid problems encountered in previous multi-divisional programs. We have set up the CSIRO Centre for Complex System Science (CCCCSS), which has the following features:

- a) A small core group (4.5 staff plus visitors) located at CSE Gungahlin, which conducts research in complex system science, administers and facilitates the program and provides a central resource.
- b) A set of Projects in Divisions where CSS is pursued in particular disciplinary or sectoral contexts
- c) An active linkage program to ensure that activity in all Projects, both Divisional and Core is strongly coupled. The primary vehicle for this is the 'Interaction Tasks'.
- d) A CSS network throughout CSIRO that provides a vehicle for education and dissemination of information about CSS
- e) Outreach and interaction with Universities and other research organisations using Interaction Tasks as the vehicle.

The structure of the CCCCCSS is shown in Figure 1. The CCCCCSS is a Virtual Centre that relies on Divisional infrastructure to deliver all its administration and support services. Divisionally based projects are conducted according to the protocols of the host Divisions who own any IP developed.

4. Operational Processes

- a) The initial set of projects was established through an open process where projects were solicited and chosen primarily on their science quality and potential to contribute to the aims of the Program (1).
- b) With this starting set in place, it has been possible to identify gaps in areas of application and CSS core science and to start to develop projects to fill these gaps. For, example, we ran a 2 day Project-Development workshop on ‘CSS and Agronomy’ in Perth in June 2003.
- c) An active process to build joint projects with universities and other research agencies commenced in 2002.
- d) A second open call and funding round has been advertised for August 2003. Projects developed through the processes above will be expected to compete on science quality with any other submitted projects in this round.
- e) The Interaction Tasks (IT’s) are seen as the key vehicle that will link all the Projects into a coherent CSIRO initiative. The IT’s are a set of higher-level scientific questions that span a subset of the Projects. Project researchers will collaborate on these tasks and this is intended to ensure that ideas and information are exchanged between Projects as soon as they are developed. We see this linkage mechanism as so critical that we have built it into the funding model; see point 5(e) below. The IT system also provides a mechanism whereby other institutions can interact with the CSIRO program by setting up their own projects and then taking part in the Interaction tasks.
- f) The Interaction Tasks are also a means by which CSIRO and university researchers who are not members of funded CSS projects can partake in CSS research as the ITs will be run as open ‘Ideas Warehouses’ following the successful CTIP ‘GREMLab’ model.
- g) A set of skills workshops has been set up and funded and staffed jointly with universities to educate CSIRO and other Australian Researchers in CSS techniques. These workshops are one aspect of the CSIRO CSS Network.

5. Funding Model

- a) The Core Group in the Virtual Centre has an administrative structure of a Science Director (1/2 time), a Coordination and Communication Manager and a PA (0.5 EFT).
- b) The Science in the Core Group is done by the Science Director (1/2 time), a Research Assistant (level 4-5), a RS (level 4-5) and a PDF (level 4).
- c) Divisional Projects are funded at up to \$100k pa for up to 3 years.
- d) A critical part of the financial model for the CCCSS is the funding allocated to linkage between the Divisional Projects, between those Projects and the Core, between CSIRO researchers wishing to be involved in CSS and between the CSIRO effort, the wider Australian effort, particularly in the universities, and with CSS research overseas.
- e) *The Science Investment Focus Group, which included senior staff with great experience of past problems with interdivisional Programs in CSIRO, were unanimous in endorsing a funding model, where support for collaboration was separated from Project support because collaboration is always the first casualty of financial strictures.*
- f) This Linkage Funding is divided into 3 categories:
 - Collaboration: funding the involvement in the interaction tasks by researchers in Projects, collaboration with universities via several mechanisms, overseas visitors etc.

- Workshops and secondments: Funding the annual CSS workshop, and other workshop activities
- Education: supporting the CSIRO CSS Network by funding courses, educational activities, the web site and allied activities.

6. Governance

- a) The Complex Systems ESA is a theme in the ESA Program. Elements of the Governance structure are:
- Executive Director Science Planning (ESA Program Leader)
 - Emerging Sciences Oversight Committee (ESOC),
 - Theme Leaders (Science Director)
 - Science Board.
 - CSS Research Director and CSS Executive
- b) Roles of the ESOC include: advising the Executive Director Science Planning with regard to the identification of emerging science themes and deliverables; the approval of Emerging Science plans and budgets; the oversight of theme performance; and the facilitation of linkages with other Divisional activities.
- c) The CSS Science Board gives: strategic advice to the Research Director; approves appointments to the Core Group; ensures significant external input into the development and selection of the streams and/or projects that deliver the theme goals; oversees regular assessments of theme activities and quality of outputs; and facilitates engagement with relevant agencies and research groups in Australia and internationally.
- The members of the Board are Dr Jim Peacock FAIAS, FTS, FAA, FRS, (Chief CPI), Prof. Neil Phillips (Chief CEM), Dr Graeme Pearman AM, FAA, (Ex Chief CAR), Prof. Bob Dewar FAA, (Director ANU Centre for Complex Systems Science) and Prof. Michael Barber FAA.
- d) The CSS Executive is an operational reference group that actively supports the Science Director and the Coordination and Communication Manager in the day-to-day operation and decisions of the CCCSS. A key role of its members is to act as regional facilitators of CSS activities. Its members are: Dr Brian Walker (CSE); Dr David McDonald (CMAR); Dr Fabio Boschetti (CEM); Dr Ian Enting (CAR); Mr Glynn Rogers (CTIP); Dr Roger Bradbury (ANU).

7. Performance Evaluation and Management

At Project level:

- Each project has written a contract with the CSS Research Director as Internal Client specifying deliverables and 6 monthly milestones. These will be reviewed in an appropriate cycle. In the case of non-delivery, the Research Director will ask the Science Board to consider and if appropriate to recommend to the Director Science Planning the withdrawal of funding.

At theme level:

- Items 1a-d will be reviewed on an appropriate timeframe by the Science Board in the first instance and by the ESOC.

Figure 1.

