6 Management and Budget

Professor Michael T. Heath, CSAR Director, and the members of the Science Steering Committee provide world-class leadership and focus for the Center for Simulation of Advanced Rockets. The Center is administratively housed within the Computational Science and Engineering Program of the UIUC College of Engineering, reporting to the Dean of Engineering, David E. Daniel.

Science Steering Committee

S. Balachandar, Fluid Dynamics
M. Brewster, Combustion and Energetic Materials
W. Dick, Managing Director
R. Fiedler, Technical Program Manager
P. Geubelle, Structures and Materials
M. Heath, Director, Computer Science
K. Hjelmstad, Structures and Materials
L. Kale, Computer Science
R. Moser, Fluid Dynamics

The Computational Science and Engineering Program is inherently interdisciplinary, requiring expertise in advanced computing technology, as well as in one or more applied disciplines. The purpose of the CSE Degree Option at the University of Illinois is a perfect complement to the academic goals of ASCI/ASAP—to foster interdisciplinary, computationally oriented research among all fields of science and engineering, and to prepare students to work effectively in such an environment (Figure 6.1).

The CSE Program does not independently admit students or confer graduate degrees—students wishing to elect the CSE Option must first be admitted to one of the participating departments before enrolling in the CSE Program. Similarly, all faculty members affiliated with CSE have regular faculty appointments in one of the participating departments. Students electing the CSE Option become proficient in computing technology, including numerical computation and the practical use of advanced computer architectures and in one or more (traditional) applied disciplines. Such proficiency is gained, in part, through courses that are specially designed to reduce the usual barriers to interdisciplinary work. Thesis research by CSE students is computationally oriented and actively advised by faculty members from multiple departments.

Education Program	Research Program	
Computational Science & Engineering Option	**Center for Simulation of Advanced Rockets**	**Center for Process Simulation and Design**
12 departments 130 faculty associates 10 graduate fellows	DOE funded $4-5 million per year 10 year program 28 faculty 36 graduate students 5 undergrads 27 professional staff	NSF (& DARPA) funded $6 million over 6 years Extended in FY02 12 faculty 13 students & postdocs

Fig. 6.1: CSAR is one of two research centers in UIUC Computational Science and Engineering Program. CSE education program is graduate student academic degree "option."

Program Management

The Director and Science Steering Committee members are responsible for nurturing the research program, administering the Center, and maintaining and expanding relationships with the DOE DP laboratories. This directorate provides the leadership necessary to ensure that the Center identifies the most important research areas, attracts the most qualified researchers, and pursues and completes the work effectively over the long term. A small administrative staff works to properly execute Center activities (Figure 6.2).

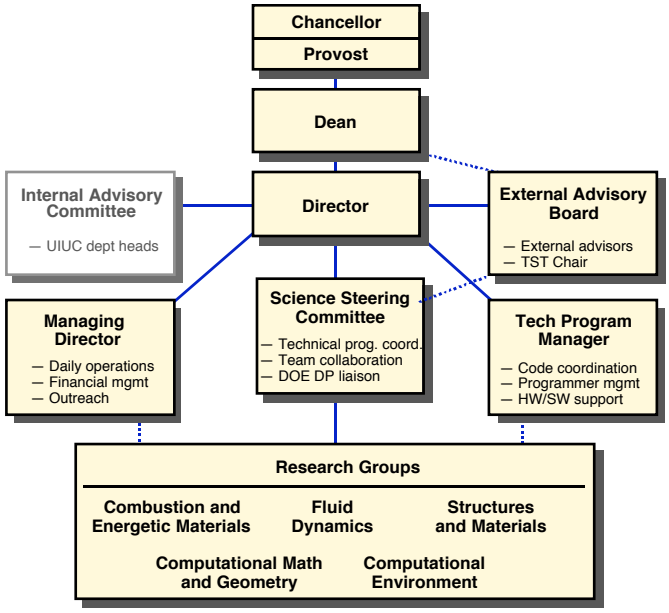

Fig. 6.2: CSAR management structure provides clear direction.

Each of the Research Groups has co-leaders who coordinate the technical program in that area. Nine technical teams are in place to address specific areas within the research effort (Figure 6.3). In 2001 the Engineering Code Development Team changed its name to the Integrated Code Development (InCoDe) to better reflect its goals and purpose.

Two representatives from each of the three DOE DP laboratories serve on a "Tri-lab Support Team" (TST). Each lab has an "applications" and a "computer science" member on the TST; their roles are to integrate Center research into the DOE NNSA lab programs and to review periodically the technical progress. We met with the TST at Lawrence Livermore National Laboratories on 20 May 2002, and at Sandia-Livermore the following day.

The membership of the External Advisory Board (EAB) consists of individuals chosen from the DOE DP labs, industry, other governmental agencies, and other universities (Figure 6.4). The External Advisory Board reviews CSAR research studies, makes research recommendations, and provides expertise for translating research findings into practice. An active communications link has been established with the EAB. The Board annually assesses the progress of the Center in reports to the CSAR Director and the Dean of the College of Engineering. It met on 15-16 October 2001.

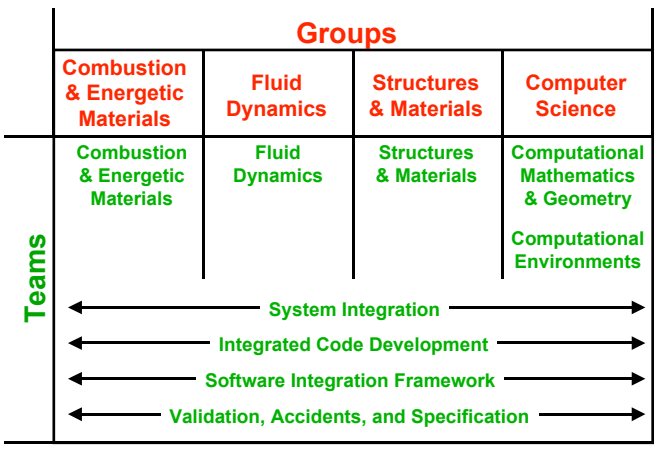

Fig. 6.3: Team efforts contribute to Research Groups.

Staffing

Administrative Staff

Rocket Industry	*Government Research Agencies*
Aerojet	Air Force Research Laboratory
Alliant Techsystems	Army Research Office
Atlantic Research	Lawrence Berkeley National Laboratory
Geisler Enterprises	NASA Headquarters
Lockheed-Martin Missiles & Space	NASA Marshall Space Center
Thiokol Propulsion	Naval Air Warfare Center, China Lake
	Sandia National Laboratory
Computer Industry	*Universities*
Hewlett Packard Company	Caltech
Intel Corporation	University of Colorado
IBM	University of Tennessee Space Institute
	Yale University

Fig. 6.4: Critical constituencies included on EAB.

The Center has appointed a very high quality professional staff that provides experienced management for the program. William Dick serves as Managing Director of the CSAR and Sheryl Hembrey is the Assistant Director. Mr. Dick was formerly Assistant Dean of Engineering for External Affairs, focusing on the unique needs of the federally funded research centers in the College of Engineering. His role in CSAR is to manage the day-to-day operations of the program, provide strategic direction, address facilities and equipment needs (including ASCI computing resources) and to assure that the Center is responsive to the DOE and ASCI. Robert Fiedler is the CSAR Technical Program Manager. Prior to joining CSAR, he was employed by Hewlett Packard as a consulting specialist in engineering application support and complex code parallelization. Dr. Fiedler manages the code development process and convenes the System Integration Team.

Dr. Mark Brandyberry joined the CSAR staff in March 2001 as a Senior Research Scientist. He is responsible for leading our verification and validation efforts. Dr. Brandyberry brought to CSAR a diverse and extensive background in engineering, computer science, and accident risk assessment drawn from a 11-year career at DOE's Westinghouse Savannah River Company and SAIC.

Technical Staff

Ten research scientists, eight research programmers, and seven postdocs worked to develop codes and advance the subscale simulations and physical models in FY02. In addition, roughly forty graduate research assistants (30 funded under the DOE/CSAR subcontract) work with faculty principal investigators (Tables 6.1 and 6.2). Budget cuts in Year 5 caused a significant decrease in staff supported by CSAR that will continue in FY03.

Research Group Structure

The full-system simulation effort is being carried out in a collaborative manner by a number of teams, each with specific responsibilities indicated below. To facilitate communication and cooperation among teams, there are appropriate overlaps in membership.

System Integration Team (SITeam): Responsible for overall system integration, including the mathematical model selection for the system components and the specification of compatible interfaces between component models. Includes both physical compatibility of component models and software and data interfaces between corresponding component codes.

Table 6.1
CSAR Staff Employment (DOE Funds Only)

	FY00	FY02	Projected FY03
Senior investigators	38	28	26
Technical staff & visitors	26	25	20
Administrative staff	4	3	3
Graduate students	39	32	30
Undergraduate students	3	8	10
Total	110	95	89

Table 6.2
CSAR Technical Staff (by Group)

	Senior Investigators	Graduate Students	Technical Staff
Combust and Energ Mtrls	10*	10	5
Computer Science	8*	7	8
Fluid Dynamics	6	7	6
Structures and Materials	8	8	4
Integration			2
Total	32	32	25

* Includes consultants.

Integrated Code Development Team (InCoDe): New in 2000, this team brings together each of the lead code authors from the four Research Groups. Responsible for developing the integrated simulation code.

Software Integration Framework Team (SWIFT): Responsible for crafting and executing a strategy for developing a general software architecture for component integration.

Validation, Accident, and Specification Team (VAST): Responsible for specifying detailed blueprints of devices to be simulated, including physical dimensions and materials. This team is also responsible for identifying and measuring critical quantities for assessing quality of system simulation. This team has worked closely with NASA and Thiokol in the past year to collect detailed performance data for the Space Shuttle RSRM that will be used for validating CSAR simulations. Also responsible for assessing various failure modes, and effects of aging and damage on constituent materials.

Combustion and Energetic Materials Team: Responsible for combustion-injection modeling and corresponding codes for simulating burning of composite propellant. Also responsible for continuum-mechanical and molecular-level modeling and corresponding codes for simulating the thermo-mechanical behavior of energetic materials.

Fluid Dynamics Team: Responsible for fluid-mechanical modeling and corresponding codes for simulating the interior cavity flow and exhaust plume.

Structures and Materials Team: Responsible for solid-mechanical and thermal modeling and corresponding codes for simulating the case, nozzle, insulation, and propellant.

Computational Environments Team: Responsible for specifying compatible data structures and data formats for scientific data management and also for parallel I/O and visualization. Also responsible for parallelization strategies, performance evaluation, and tuning of individual component codes as well as integrated system code.

Computational Mathematics and Geometry: Responsible for parallel numerical algorithms, such as sparse linear system solvers, as well as algorithms for mesh generation, partitioning, and adaptive refinement, needed for various component codes.

Facilities and Space

CSAR has been provided centralized office space for the program management and for the technical research staff. Four contiguous offices on the second floor of the Digital Computer Laboratory (DCL) presently house the management staff, and four large offices on the third floor of DCL have been assigned for CSAR postdocs.

In addition to the space in DCL, the Center occupies approximately 5000 square feet of office and dry lab/computer space in a nearby building (Engineering Sciences Laboratory). The University of Illinois has renovated this space for use by the Center and was occupied in July 2000. This space houses CSAR senior technical staff and visitors.

CSAR Seminar Series

Known as "Rocket Science 101," the Center offers an internal seminar series designed to cross-educate the faculty, staff, and students. Further, the seminar series identifies key technology needs for research project development. (See Table 5.1 in Education and University Integration for the list of seminars offered in 2001-02.)

Budget

The CSAR budget has been adequate to maintain an aggressive research program throughout the first three years. In addition to funds provided by the DOE, the University of Illinois has provided needed support for both research expenditures and computer workstations, and facility renovation (Tables 6.3 and 6.4).