6 Management and Budget

Professor Michael T. Heath, CSAR Director, and the members of the Science Steering Committee (Figure 6.1) 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

Fig. 6.1: CSAR Science Steering Committee meets weekly to provide program direction.

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 ASC/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 6.2).

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.

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

Education Program	Research Program	
Computational Science & Engineering Option	**Center for Simulation of Advanced Rockets**	**Center for Process Simulation and Design**
13 departments	DOE/NNSA funded	NSF funded
130 faculty associates	$40 million over 10 years	$6.5 million over 8 years
10 graduate fellows	20 faculty	12 faculty
80 graduate students enrolled	35 graduate students	13 students & postdocs
	10 undergrads	
	20 professional staff	

Fig. 6.2: CSAR is one of two research centers in UIUC Computational Science and Engineering Program. CSE education program is graduate student academic degree "option."

activities (Figure 6.3).

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 6.4). Recognizing the criticality of meshing to the ongoing success of CSAR, the Science Steering Committee established a "Meshing Group" in 2003.

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 UIUC on 25-26 May 2004.

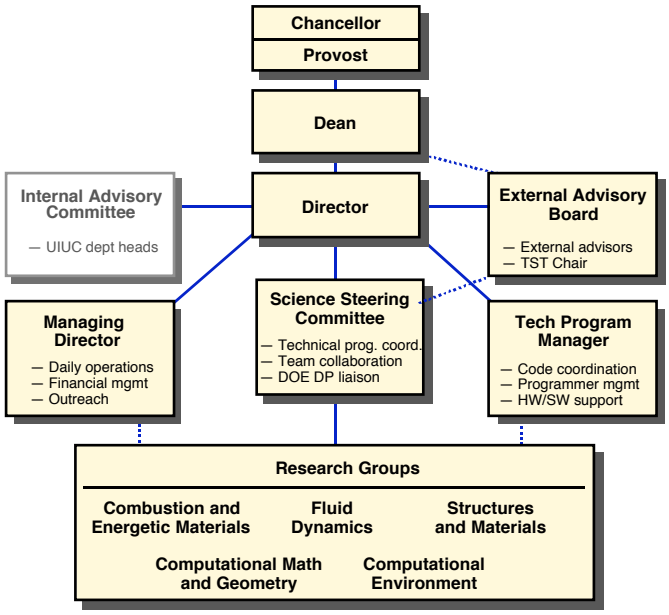

Fig. 6.3: CSAR management structure provides clear direction.

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 6.5). The External Advisory Board reviews CSAR research studies, makes research recommendations, and provides expertise for translating research findings into practice. A very 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 30 September 2003 and 13-14 October 2004.

Staffing

Administrative Staff

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 ASC computing resources) and to assure that the Center is responsive to the DOE and ASC. Robert Fiedler is the CSAR Technical Program Manager. Prior to joining CSAR, he was employed by Hewlett Packard as a consulting specialist in engineering ap-

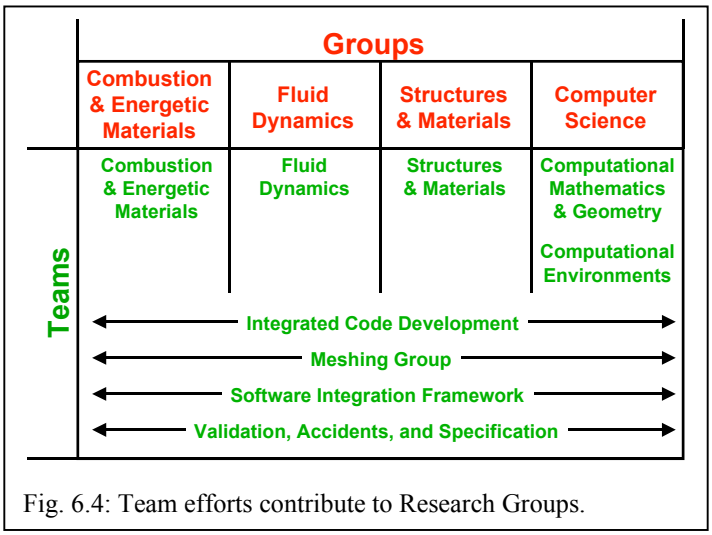

Fig. 6.4: Team efforts contribute to Research Groups.

plication 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 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.

Rocket Industry
Aerojet
ATK Thiokol
Atlantic Research
Geisler Enterprises
Lockheed-Martin Missiles & Space
United Technologies Chemical Systems Div

Universities
University of Colorado
Yale University

Government Research Agencies
Air Force Research Laboratory
Army Research Office
Lawrence Berkeley National Laboratory
NASA Headquarters
NASA Marshall Space Center
Naval Air Warfare Center, China Lake
Sandia National Laboratory

Fig. 6.5: Critical constituencies included on EAB.

Technical Staff

Thirteen research scientists, seven research programmers, and five postdocs worked to develop codes and advance the subscale simulations and physical models in FY04. In addition, roughly sixty graduate research assistants (35 funded under the DOE/CSAR subcontract) work with faculty principal investigators (Tables 6.1 and 6.2).

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.

Integrated Code Development Team (Incode): This team brings together each of the lead code authors from the four Research Groups. Responsible for developing the integrated simulation code.

Table 6.1
CSAR Staff Employment (DOE Funds Only)

	FY00	FY04	Projected FY05
Senior investigators	38	22	22
Technical staff & visitors	26	20	20
Administrative staff	4	3	3
Graduate students	39	34	35
Undergraduate students	3	7	8
Total	110	86	88

Table 6.2
FY04 CSAR Technical Staff — All Funds (by Group)

	Senior Investigators	Graduate Students	Technical Staff
Combust and Energ Mtrls	7	12	5
Computer Science	5	18	6
Fluid Dynamics	6	16	5
Structures and Materials	10	16	5
Integration and V&V		1	4
Total	28	63	25

Meshing Group: Responsible for crafting and executing a strategy for developing our approach to meshing, remeshing, and mesh adaptation. Formally established in FY03, this team of scientists and faculty have worked together for many years.

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 ATK/Thiokol in the past year to collect detailed performance data for the Space Shuttle RSRM that will be used for verification and validation (V&V) of CSAR code modules and simulations. Also responsible for assessing various failure modes, and effects of aging and damage on constituent materials.

Combustion and Energetic Materials Team (CEM): 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 contiguous, centralized office space for the program management and for the technical research staff. The Center occupies approximately 5000 square feet of office, conference room, and dry lab/computer space in the Digital Computer Laboratory, a building in the heart of the Engineering campus.

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 2003-04.)

Budget

The CSAR budget has been adequate to maintain an aggressive research program throughout the program. 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).

Table 6.3
CSAR Program Budget
(in Thousands)

	FY03 Y6 Exp	FY04 Y7 Est	FY05 Y8 Bud	FY06 Y9 Proj	FY07 Y10 Proj
Salaries					
Senior investigators	$267	236	250	250	250
Administrative staff	0	0	0	0	0
Technical staff & Visitors	1436	1060	1250	1300	1300
Graduate students	501	480	594	600	600
Undergrads	26	17	9	20	20
Benefits	425	346	462	489	500
Equipment	51	41	70	100	100
Travel	75	91	0	100	200
Materials & subcontracts	0	118	100	200	150
Indirect costs	1718	1366	1515	1666	1650
Total ($22M over 5 years)	$4500	$3755	$4250	$4725	$4770
UIUC and State Match	$396	$175	$190	$200	$100

Table 6.4
Expenditures by Research Group
(in Thousands)

	FY04 Y7 Est	FY05 Y8 Bud
Combustion & Energetic Mtrls	$700	$850
Computer Science	800	850
Fluid Dynamics	900	950
Structures & Materials	800	1000
Admin & System Integration*	555	600
Total	$3755	$4250

* Includes all equipment purchases.