

STAFF ANALYSIS
Proposed Ph.D in Computational Science
Florida State University
Classification of Instructional Program (CIP) #30.0801

Estimated Costs:

	Total	% & \$ Current	% & \$ New	% & \$ C&G	Cost per FTE	SUS 04-05 Average Cost
Year 1	\$237,461	79% \$187,461	0% \$0	21% \$50,000	\$55,462	\$27,795 for CIP 30 at Doctoral Level
Year 5	\$456,069	84% \$381,069	0% \$0	16% \$75,000	\$21,505	

NOTE: The 30 CIP Code series is a broad category for interdisciplinary programs that span science, technology, and humanities programs. For this reason the SUS average cost is not very meaningful at the two digit CIP level.

Projected FTE and Headcount are:

	Projected Headcount	Student FTE
First Year	4	3.38
Second Year	8	6.75
Third Year	12	10.12
Fourth Year	17	14.34
Fifth Year	21	17.72

On April 30, 2003, the Florida Board of Governors approved eight criteria, divided into the two categories of Readiness and Accountability, by which implementation authorization of new degree professional and doctoral programs were to be assessed. The following is an analysis of the University's proposal based on further delineations of those eight criteria.

Index to Analysis per Board of Governors' Approval Criteria

READINESS					ACCOUNTABILITY		
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READINESS

*1. **Mission and Strength** - The goals of the program are aligned with the university's mission and relate to specific institutional strengths. The program is aligned with goals identified within the State University System Strategic Plan.*

Evidence that the proposed program is responsive to the goals of the current State University System Strategic Plan and the goals of the proposed program relate to the institutional mission statement as contained in the Strategic Plan

The proposed degree has been under development for some time at FSU and was originally listed on the 1998 - 2003 SUS Strategic Plan as a program for exploration. The proposal states that the doctorate in Computational Science represents an effort to contribute to the research mission of Florida State University through an emphasis on direct and practical knowledge through development and research. As an emerging technology degree meeting statewide professional and workforce needs, the proposal argues that that Ph.D. in Computational Science supports the Board of Governors, State University System of Florida 2005-2013 Strategic Plan to increase degree production and research efforts in targeted disciplines.

Dr. John N. Shadid with the Sandia National Laboratories was retained as a consultant to review the degree proposal and commented that the proposed "program and the associated curriculum is very responsive to the current needs of major research institutions engaged in computational science research and employing computational methods in science and engineering. ... students out of this program will do very well in industrial and government research institutions."

Evidence of a relationship to specific institutional strengths

The proposal states that the interdisciplinary program combines aspects of computational mathematics, computer science, and computational statistics as well as application areas in science and engineering. For this reason the program will be able to draw upon the strengths and resources of these departments, as well as non-science related disciplines that utilize computational science (animation, dance choreography, marketing, and finance decision making). Florida State University has considerable strengths in the aspects of computational science including the School of Computational Science (SCS) Visualization Laboratory. The laboratory computing resources include a dedicated file server, providing over 200GB of space in a RAID5 configuration, An 8'x16' rear-projection Powerwall is also available in the seminar room to provide a first-class display system for teaching, presentations and visualization research. The proposal further outlines other SCS computational resources that are available to support the Computational Science degree.

*2. **Program Quality** - Planning activities have been sufficient and responses to any recommendations to program reviews or accreditation activities in the discipline pertinent to the proposed program have been addressed.*

Evidence that planning for the proposed program has been a collaborative process involving academic units and offices of planning and budgeting at the institutional level, as well as external consultants, representatives of the community, etc.

Since 1997, the university has been exploring and preparing for the Ph.D. in Computational Science degree. This has been a collaborative effort on the part of the School of Computational Sciences, Office of Graduate studies, and University administrators. In anticipation of this proposed degree program, Florida State University has allocated resources to the School of Computational Science (SCS) over a period of years. It is not anticipated that any resources will need to be shifted to accommodate the new degree program.

Evidence of an appropriate timetable of events leading to the implementation of the proposed program

A timetable of events leading up to submission of the proposal for approval indicates that this program has been fully vetted within the FSU academic community. If approved, the recruitment process will begin immediately and is intended to be completed during fall 2006. The admissions process will begin spring 2007 with the inaugural class beginning coursework fall semester, 2007. It is intended that the first degree will be conferred in the 2011-12 academic year.

Evidence that progress has been made in implementing the recommendations from program reviews or accreditation activities in the discipline pertinent to the proposed program

The proposal stated that no program reviews, accreditation visits or internal reviews have been conducted in computational science at FSU due to the fact that it has not existed as an approved degree program. The Master's program in computational science is also scheduled for implementation in Fall, 2007. No information was provided with regard to program reviews for disciplines that will contribute to this interdisciplinary program.

3. Curriculum - The proposal describes an appropriate and sequenced course of study, admissions and graduation criteria are clearly specified and appropriate, and the appropriateness of specialized accreditation is addressed.

Evidence of an appropriate, sequenced, and fully described course of study; evidence of specific learning outcomes and industry driven competencies are discussed for any science and technology programs

The proposal provides a well-detailed course of study, complete with sample programs of studies, learning outcomes, and assessment plans. The program will have the major track of Computational Science as well as specialization areas in Atmospheric Science, Biochemistry, Biological Science, Geological Sciences, Materials Science, and Physics. The program has a total of 54 credit hours. Out of these 54 credit hours, 29 are required

coursework, 9 are specified as dissertation hours, and 16 are identified as additional courses/dissertation hours. Additional credit hours may be obtained through dissertation hours. The proposal estimates that on average it will take a student entering the program with a Bachelor's degree five years to complete the Ph.D. degree.

In his consultant's report, Dr. John N. Shadid comments that:

The degree program is well designed. I like the fact that the program contains a major track in computational science along with a selected number of specialized tracks. In my opinion the chosen specialized tracks are well selected. These specialized science fields are disciplines for which there is currently a significant application of computational methods. These scientific disciplines are also areas where computational methods have made, and will continue to make, significant contributions with high impact.... In my opinion the program has excellent course offerings that can be selected from applied math, numerical methods, computer science, computational physics, and the main line physics, engineering, biology and chemistry disciplines. I believe the program and the courses offer excellent flexibility for the students to design specialized courses of study. This will allow them to obtain grounding in the general aspects of computational science with a real and significant depth of study in a specialized field.

Evidence that, if appropriate, the bachelor's and master's degree programs associated with the program are accredited and that the institution anticipates seeking accreditation for the proposed program if available

There are no specialized accreditation agencies that address this discipline, so the university will not be seeking programmatic accreditation.

Evidence that the institution has analyzed the feasibility of providing all or a portion of the proposed program through distance learning technologies via its own technological capabilities

The instructional delivery system for this program will be using classrooms and labs on the main campus. Because this is a research focused program that requires access to substantial computing power, there is no plan to utilize distance learning technologies or self-paced instruction.

4. Faculty – A critical mass of faculty will be available to initiate the program based on estimated enrollments, and faculty in the aggregate has the necessary experience and research activity to sustain a doctoral program.

Evidence that there is a critical mass of faculty available to initiate the program based on estimated enrollments

The proposal states that nineteen faculty and one research scientist are currently available to initiate the program. In addition, there are two open lines and it is

anticipated that two additional lines will be added over the next two years. According to the proposal, five more faculty members will be hired in the first year.

In his consultant's report, Dr. John N. Shaded comments that "... the program faculty for the proposed program is very good. ... the publication records are impressive and the experience in the respective fields of study is extensive."

Evidence that the faculty in aggregate have the necessary experience and research activity to sustain the program

The proposal provides evidence that the faculty have the necessary experience and research activity to sustain the program. The School of Computational Science currently has nineteen tenure-track faculty members consisting of eleven members holding the rank of Professor, three holding the rank of Associate Professor and five tenure-track Assistant Professors. Two of the faculty members hold the prestigious Francis Eppes Professorship and another faculty member holds an Eminent Scholar Chair in High Performance Computing. Since the proposed program is an interdisciplinary degree, supporting faculty represent various departments including Biological Science, Chemical Engineering, Chemistry & Biochemistry, Computer Science, Geological Sciences, Mathematics and Physics. The proposal states that all faculty hold a Ph.D., have Doctoral Directive status, and are funded on regular lines.

It is important to note here that although SCS is the academic unit associated with the program, its entire faculty has tenure appointments in other departments. SCS exists as a consortium of faculty from affiliated departments, with a Director appointed by the Dean of Arts and Sciences. However, SCS is listed as an academic department within the organizational structure of the College of Arts and Sciences. There also exists a Guidelines and Operating Agreement that establishes a reporting structure and other administrative procedures. A set of bylaws provide for faculty governance.

Evidence that, if appropriate, there is a commitment to hire additional faculty in later years, based on estimated enrollments

The proposal states that no additional faculty members are needed to implement the program, but there are plans to fill vacant lines and hire additional faculty as the program grows.

5. Resources – The necessary library volumes and serials; classroom, teaching laboratory, research laboratory, office space, equipment, clinical and internship sites, fellowships, scholarships, and graduate assistantships will be sufficient to initiate the program.

Evidence that library volumes and serials are sufficient to initiate the program

The proposal states that the holdings of the Dirac Science Library are more than sufficient to meet the interdisciplinary research and instructional needs of the proposed program. The Library contains 408,508 volumes including materials in remote storage. It also contains 1393 journal titles, 49 of which are directly related to computational

science. In addition there are several periodicals available online via the State University System of Florida database. The proposal provides a list of Computational Science specific resources available to the doctoral students.

Evidence that classroom, teaching laboratory, research laboratory, office, and any other type of space that is necessary for the proposed program is sufficient to initiate the program

The SCS classroom and laboratory are located in the Dirac Science Library. The classrooms for the Ph.D. program will be those currently available to the School of Computational Science. The SCS Visualization Laboratory is available for use by all SCS faculty upon formal request. In his consultant's review, Dr. Shaded comments that "the current resources and facilities of the SCS are well suited to the task of fielding the degree program."

Evidence that necessary and sufficient equipment to initiate the program is available

According to the proposal, the SCS classroom houses the following hardware: 18 Intel-based workstations and one Instructor machine, a projector, a visual presenter, and a laser jet printer. The Laboratory operates the following resources: One Silicon Graphics Onyx system, Four Dell Precision Workstations with dual monitors, Dell Precision Workstation, and Several Silicon Graphics workstation. The Visualization effort at the SCS has a dedicated file server, providing over 200GB of space in a RAID5 configuration, in addition to central SCS file storage. Specific information on hardware and software is included in the proposal.

Dr. Shadid commented in his review that:

If I have one area of concern it would be that there is sufficient computing resources to enable the graduate students and faculty to engage in leading edge largescale computational simulations. While the current resources are impressive for a university institute I believe a long-range plan in this area should also be undertaken to ensure that sufficient computing power is available as the program matures.

Evidence that, if appropriate, fellowships, scholarships, and graduate assistantships are sufficient to initiate the program

The proposal states that a significant portion of the SCS OPS budget will be used for student support in the form of Teaching Assistants (TA's). In addition, the SCS faculty has been awarded many research grants from Federal agencies. The proposal lists several other opportunities for obtaining external support for student assistantships and fellowships, such as the Graduate Assistance in Areas of National Need (GAANN) program of the US Department of Education. In addition, the strong biologically-related yet interdisciplinary groups within the SCS are well suited for some of the many National Institutes of Health-funded training programs.

Evidence that, if appropriate, clinical and internship sites have been arranged
Internships are not a requirement of the proposed program. However, FSU will strongly encourage students to take advantage of any internship opportunities that become available. The SCS faculty members have numerous contacts within government and industrial research laboratories. Possible government laboratory internship sites include Sandia, Oak Ridge, Los Alamos, and Lawrence Livermore National Laboratories of the US department of Energy and the NASA Langley Research Center.

ACCOUNTABILITY

6. Need - *There is a need for more people to be educated in this program at this level and if the program duplicates other professional and doctorate degrees in Florida, a convincing rationale for doing so is provided.*

Evidence that the proposed program does not duplicate other SUS or independent college offerings or, otherwise, provides an adequate rationale for doing so

The proposal provides sufficient evidence to show that there are no similar degree programs within Florida. Although two SUS institutions offer some programs with computational components, none of them train computational scientists. The University of Florida provides interdisciplinary graduate certificates and concentrations in Ph.D. programs associated with the Center for Chemical Physics and the Institute for Theory and Computation in Molecular and Materials Science. The University of Central Florida offers two interdisciplinary Ph.D. programs: a Ph.D. program in Modeling and Simulation and the Biomolecular Science Ph.D. program.

Evidence that there is a need for more people to be educated in this program at this level

The proposal cites multiple references supporting the national need for computational scientists. The 2003 President's Information Technology Advisory Committee (PITAC) chose computational science, along with health care information technology and cyber security, as the three areas of greatest national importance related to information technology. The June 2005 PITAC report Computational Science: Ensuring America's Competitiveness stated that "the most scientifically important and economically promising research frontiers in the 21st century will be conquered by those most skilled with advanced computing technologies and computational science applications." (See the full report at <http://www.nitrd.gov/pitac/reports/index.htm>)

In addition to PITAC, several other organizations have expressed the importance and priority of computational science. The proposal chronicles the discussion as far back as 1982 with the Panel on Large Scale Computing in Science and Engineering (also called the Lax Panel, after its chair Medal of Science winner Peter Lax). The Panel recommendation to the National Science Foundation was to establish five national computing centers, which spurred the creation of the High Performance Computing and Communications Initiative.

The Outlook of Employment Handbook from the U.S. Department of Labor projects significant growth from 1998 to 2008 in occupations related to engineering, scientific, and computer related jobs. Although the Handbook gives broad descriptions of occupations, it serves to demonstrate the general trend of the monumental increases in the number of jobs related to computer technology. As supporting evidence, the proposal includes a table of current job opportunities in computational science, representative job advertisements, and a list of graduates along with job positions from the interdisciplinary Ph.D. in Computational Mathematics at the Institute for Computational Engineering and Sciences at the University of Texas, Austin.

Dr. Shadid comments that “the proposed degree program is in excellent alignment with the current needs in the field of computational science... the proposed program provides a path forward for Fl St. to be a leading institution in preparing new Ph. D. level researchers for government research lab, industrial and academic positions in computational science related fields.”

Evidence of reasonable estimates of student headcount and FTE who will major in the proposed program, and commitment to a diverse student body

The proposal states that the estimates of headcount and FTE were computed assuming the student will actually take 27 credit hours per year where 32 credit hours equal one FTE for one year. The proposal states that the projected student headcount for the first year will be 4 students with a projected student FTE of 3.38. The figures for the fifth year are projected student headcount of 21 and FTE of 17.72.

The section on Attaining a Diverse Student Body is signed as the EEO statement. The proposal lays out a plan to ensure diversity and inclusion within the Ph.D. program. Florida A&M University is mentioned as a primary partner in the SCS mission to diversify their student population. No information was provided regarding the current demographics of the student body within the SCS.

7. Budget - A complete and realistic budget for the program is provided, and any redirection of funding will not have an unjustified negative impact on other needed programs.

Evidence of a budget for the program that is complete and reasonable, and comparable to the budgets of similar programs at other SUS institutions, and reflective of the proposal’s text

In anticipation of this proposed degree program, Florida State University has allocated resources to the School of Computational Science (SCS) over a period of years. It is not anticipated that resources will need to be shifted to accommodate the new degree program. Costs for Proposed Program as outlined in the budget table adequately reflect the budget narrative. The total cost of in the first year is \$237,461, increasing to \$456,069 in the fifth year.

The amount projected for contracts and grants appears low for this type of program,

and this is explained somewhat in the faculty productivity section. The faculty associated with the program have obtained approximately \$7 million in grant dollars over a five year period, but most of these dollars have been associated with their home departments. Since the faculty will continue to have dual appointments, it is difficult to determine what percentage of their contract and grant dollars might eventually be associated with this one degree program.

Evidence that, in the event that resources within the institution are redirected to support the new program, such a redirection will not have a negative impact on undergraduate education

The proposal argues that Computational Science doctorate will not have a negative impact on undergraduate education. The SCS will devote a portion of its budget to funding undergraduate student research.

8. Productivity - The academic unit(s) associated with this new degree have been productive in teaching, research, and service.

Evidence that the academic unit(s) associated with this new degree have been productive in teaching, research, and service

The faculty associated with SCS is interdisciplinary, consisting of physicists, biologists, geophysicist, biochemists, engineers, mathematicians, and computer scientists. The proposal provides evidence of individual faculty research productivity and notes that several have national reputations within the field of computational science. However, the proposal did not provide information regarding faculty teaching course loads or other related university community service, noting that, so far, courses associated with SCS have been offered through affiliated departments and therefore were not directly attributable.