Proposal for funding the

The Mathematics Consultation Clinic

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Introduction. This proposal requests that the LSU Center for Applied Information Technology and Learning considers supporting the Mathematics Consultation Clinic (MCC) through new state funds being provided by the information technology (IT) initiative. The goals of the MCC and the IT initiative are harmonious, and there is a two and a half year track record of the MCC promoting economic activity in Louisiana. Moreover, previous grants have provided sufficient infrastructure to expand upon its activities, while at the same time, further resources are being sought through new grant proposals. The requested IT funds will institutionalize the MCC in ways not realizable through grants, by hiring a director, supporting two graduate students, and providing travel and support costs. The total request is for approximately $ 140,000. This short proposal describes (I) the set-up, (II) the beneficiaries, (III) the past, present, and future projects, (IV) a plan for expansion, and (V) the proposed role of the director.

(I) The set-up. A section of the capstone course Math 4020 has been offered each of the past four semesters that is devoted to the projects of the MCC. The course gives students practical experience in applying mathematics to solve real-world problems, and its members operate as a research team, with students and faculty working together to address a problem of interest to a sponsoring corporation, government agency, or university research group.

The following criteria determines the suitability of an MCC project:

- The project involves the formulation and implementation of a non-trivial mathematical model.
- The solution is of real interest to the client.
- The client agrees to provide feedback by allocating time and effort to assist in the model formulation and implementation.
- The size and complexity of the problem are appropriate for undergraduates, and fit the time constraints for a one-semester seminar course.

Typically the course runs as follows. The faculty supervisor operating the seminar assigns the projects that have been selected, which may vary widely in content and implementation. In the early stages of the semester, the faculty introduces some of the mathematical techniques that are relevant to the client's problem, and assists in forming teams consisting of several of the participating undergraduate and graduate students. Then the consultation teams begins formulating a mathematical model while studying the nature of the problem and the available data and other information. The model(s) are then presented to the client, who provides feedback. The implementation takes the rest of the semester. Every student is required to formulate a technical description of the project that describes the significant aspects of the problem that need to be addressed by the model along with a brief outline of the model itself. During the semester each consultation team submits brief status reports every other week. At the end of the semester, the class gives a formal presentation of the clinic results to the sponsor and to the Department.

The course has an indirect impact on the economy by training students in the tools of modern mathematical applications. But successful MCC projects can and have been continued after the semester is over, and thus impact the economy directly beyond the classroom setting.

(II) The beneficiaries. The Mathematics Department, university, participating students, and clients are all direct beneficiaries of its operations:

- The department (and the university) benefit from the heightened public exposure. Indeed, the department now has a vehicle for direct participation in the Louisiana economy, and the goals of the Louisiana Technology Park dovetail perfectly with the goals of the MCC. The knowledge and experience gained through the MCC is also being incorporated into courses in Applied Mathematics, and the momentum generated by this activity has helped broaden the scope of the department's educational and research activities to include more areas of applicable mathematics.

- The students benefit by experiencing first-hand how mathematical thinking is used in real-world applications, which is difficult to convey in the usual classroom structure. Relevant training and practical experience enhance their job prospects. More subtle benefits accrue from exposure to open-ended and sometimes loosely defined problems, and from experience gained working as a team member under time and resource constraints. Several past students have expressed appreciation for the Clinic experience, and one student in particular is pursuing graduate study at Rice University in algorithm development, an interest that was kindled by a Clinic project.

- The clients benefit from the availability of a technical resource that substantially strengthens their capability and productivity in a given problem area that time constraints or lack of expertise prevent them from addressing. Since initial charge fees are not solicited, the clients may obtain solutions to important problems at a fraction of the cost of hiring outside consultants. Finally, links to the university give clients an advantage in recruiting new talent.

(III) The past, present, and future.

The clinic provides the structure for the department's industrial and interdisciplinary outreach activity, and is under the purview of the Applied Mathematics Committee. The MCC has involved the active participation of the following faculty with the corresponding semester and client. Details of the actual achievements of these projects will be provided upon request, but we mention that the CII Carbon and Louisiana Lottery projects have been utilized in real application.

A. Wolenski, fall 1999 (CII Carbon) and spring 2001 (Castrol Oil),

B. Neubrander, fall 1999 (Innovative Emergency Management, Inc.) and spring 2000 (Louisiana Lottery),

C. Ferreyra, spring 2000 (Hibernia Bank),

D. Chari, spring 2001 (Castrol Oil),

E. van Wamelen, spring 2001 (Castrol Oil).

The fall 2001 is being organized by Chari assisted by van Wamelen. The main project is to develop a model and usable software that would assist the LSU Math Department to devise the teaching schedule and instructor assignments for its course offerings. A secondary project involves the

Capital Regional Planning Commission of Baton Rouge, in which some challenging mathematical problems involving traffic flow are being considered.

Wolenski is developing projects for the spring 2002 semester with BASF and CII Carbon. There has also been contact with the Louisiana Technology Park, and it is hoped that a project can be formulated in time with an emerging company based there.

(IV) A plan for expansion. The faculty members organizing the past MCC projects have thus far operated without any support resources. But it is difficult to maintain a strong research program (which is their main interest and professional responsibility) while at the same time setting up and running a clinic project. The latter involves making initial contact with potential clients, evaluating the suitability of projects, maintaining the client relationship, advertising the course, learning new computer skills, seeking further funding opportunities, etc. Furthermore, a successful project requires further consultation, maintenance, and administration. For these reasons and more, we are asking for funds to hire a director that will oversee, teach, and manage the MCC. The director would be expected to have a Ph.D. in mathematics and have qualifications or be able to demonstrate the potential for industrial outreach. This will be a full-time faculty appointment, but evaluation for promotion of this person will be based mainly on their teaching and success in the MCC and not on research. We expect that a director of high quality can be hired in the range of $65,00-80,000. Other faculty that are still interested could participate at various levels, and in this way, the past organizers can maintain participation in the capacity they most enjoy, the mathematical modeling itself. In particular, they will not be dragged down by the many other time-consuming responsibilities, and will not need to become entangled in the legalities of contractual negotiation and copyright issues.

Further funds to support the MCC include (1) two graduate student appointments devoted to participation in clinic projects rather than teaching (at $16,000 each), (2) four summer stipends for industrial internships (in the range of $3,500-4,000 each), and finally, (3) support costs for travel, purchases of software and supplies, and other miscellaneous costs ($15,000).

(V) The proposed role of the director. The full potential of the the MCC can only be realized if better management is procured. The present organizers of the MCC are trained as mathematicians, not business managers, and they need overall assistance in running the course and managing the aftermath. It is clear from past projects that there is significant economic potential for MCC activity both in the short and long term. Greater resources devoted to it will impact the local economy, but success will also be accompanied by many issues for which the organizers are not trained to deal with, such as patent and copyright issues, contract negotiations, licensing of software, etc. The sought-for director will not be a cure-all for all the problems that await us, but will nonetheless be the next step required for expansion and be invaluable to faculty, students, and clients alike. One final assignment of the director is to coordinate the MCC activity with the Applied Mathematics Program that is being newly established by Robert Lipton in Materials Science.

The profile of the proposed director will be based on the following criteria. It is a person who (1) understands and values higher mathematics and its potential to attack and solve real-world problems, (2) has knowledge of the latest trends in computing and mathematical software, (3) has good communication skills that can bridge the gaps between the professors, students, and businessmen, (4) has a background or can demonstrate potential for administrative and management duties, and (5) is a good writer that can assist in formulating new grant proposals. The director need not actually carry out the modeling projects (although it is hoped that occasionally this will happen), but will facilitate setting them up and managing their outcomes.