University of North Carolina at Charlotte
Request to Establish a Doctoral Program in Infrastructure and Environmental Systems

Introduction

Following a recommendation from the Graduate Council and from the Senior Vice President for Academic Affairs, the Committee on Educational Planning, Policies, and Programs approved on May 10, 2002 the request from the University of North Carolina at Charlotte to plan a doctoral program in Infrastructure and Environmental Systems. The University of North Carolina at Charlotte now seeks approval to establish a doctoral program in Infrastructure and Environmental Systems (CIP: 30.9999) effective August 2004.

Program Description

The institution describes the new program as follows:

> Growing, urbanized regions face complex challenges related to the infrastructure needed to support the regions' economic and social development and related to the interplay between the infrastructure and the environment. Finding solutions to these challenges require an innovative approach that considers three aspects -- design, science, and management -- of solutions and that promotes an understanding of the interdependency of the three. These considerations and understandings are best obtained at the global, systems level. The proposed Ph.D. program in Infrastructure and Environmental Systems (INES) provides advanced interdisciplinary studies of the relationship between infrastructure and the environment and the relationship between design, science, and management. It is through this interdisciplinary, systems-based approach that we will arrive at optimal solutions to infrastructure and environmental challenges. Most Ph.D. programs address a single discipline or a group of disciplines with a primary focus on science, design, or management. Students could develop an interdisciplinary plan of study, but in most cases such is not the purpose of the program. The proposed INES Program will engage students in intensive interdisciplinary study and research. The interdisciplinary nature of the program, with an emphasis on infrastructure and environmental systems in the core curriculum, will inherently educate students about the complex relationships between the infrastructure and environment. As a part of the process, the program core curriculum will also bring together design, science, and management aspects of problems and solutions. Such an approach will allow students to develop superior solutions as they focus on specific areas of interest following completion of the core curriculum. Robert A. Frosch, a senior research fellow at the Center for Science and International Affairs at Harvard and former National Academy of Engineering Senior Fellow, sums up the enormity of the approaching demand for highly educated professionals:
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> *"How can we refurbish our older cities without undue disruption? How can we design and build or somehow assemble the equivalent of eight 10-million-person cities a year for the next five decades? How can we site such cities, or have them grow, without*

damaging the environmental systems that are needed to sustain them? These are challenges of great magnitude. Addressing them will require massive invention and innovation, and different and cheaper techniques, if we have any hope of paying for what we design." (The Bridge, National Academy of Engineering 29(1), Spring 1999).

Further testament to this challenge is the American Society of Civil Engineers' 2001 estimate that the United States would need $1.3 trillion invested in infrastructure development and repair over the subsequent five years. These challenges must be addressed through innovative, interdisciplinary approaches.

Program Objectives
The graduates of the INES program will have an understanding of complex, interdisciplinary infrastructure and environmental systems and make significant contributions to the advancement of knowledge of those systems. The educational objectives designed to achieve these goals are:

- to provide students with educational opportunities in science, engineering, and management, culminating in an interdisciplinary research-based Ph.D. in Infrastructure and Environmental Systems;
- to prepare students for careers as doctoral-level research scientists, engineers, and resource and systems managers who will lead in developing the next generation of infrastructure and environmental technology;
- to involve students in the support and expansion of the base of research in rapidly growing fields related to infrastructure and environmental systems in the Charlotte region, North Carolina, and across the nation and world;
- to enhance the educational experience in science and engineering for all students, graduate and undergraduate, at UNC Charlotte; and
- to expand the educational experience of students by participating in the activities of interdisciplinary institutes at UNC Charlotte such as the Global Institute for Environmental and Energy Systems (GIEES), the Center for Transportation Policy Studies, and the UNC Charlotte Urban Institute.

Program Review
The review process is designed to surface strengths and weaknesses in proposed new degree programs. Proposals to establish new doctoral programs are reviewed internally and externally. The concerns from the two review processes were summarized in a letter to the Chancellor prior to the presentation to the Graduate Council. That summary follows:

The plans for this proposed program have continued to develop in a very positive way, yet there are some concerns that have arisen from the latest round of reviews. More than one reviewer raised the issue of the integration of the program, given the participation of so many departments. As one reviewer put it, "success of an interdisciplinary program depends not on mere collection of fragmented elements from a number of diverse fields, but on a careful integration, synthesis, and synergism of these elements." Another reviewer thought that more attention might be given to demonstrating how the

dissertation research project could be conceived as a way to integrate the disciplines in the programs just as the course work is supposed to. Another related issue was the comment from a reviewer that while there was excellent research by participating faculty in their specialty areas, there was very little interdisciplinary research documented by the faculty. While this will be an ongoing challenge, it would be helpful to sketch out the plans for achieving the integration of the program.

It would be helpful to have a clearer articulation of the employment opportunities of the graduates of the program. Certainly the skills appear necessary to deal with the complex tasks of industry and government. Does the program expect to draw students who may want to seek an academic career? A clearer account of the kinds of employment opportunities students will be prepared for would be helpful. Also are there plans to have a teaching requirement for doctoral students in the program? If there were to be the possibility of an academic option, that would appear to be extremely important. Even those not inclined to an academic career may find such a requirement very helpful, since presentation skills are necessary almost everywhere these days.

Courses from programs that do not have a doctoral program may present some special difficulties. One reviewer raised this issue as a potential problem basing a doctoral program on several other programs without a doctoral program. The issue is how the student is assured of getting advanced doctora- level work and not master's-level work from those departments.

One reviewer raised an issue about the mode of selection of students. Many science programs require a student to secure a major professor/dissertation director prior to being accepted into the program, so the student will be assured of someone to work with and funding. Your method is to use a general acceptance process initially then move to the assignment of a major professor. That reviewer though this could result in problems in some instances.

There were a few other issues raised. One was that recruiting into an interdisciplinary program may take added efforts, another was that it would appear the program could benefit from the addition of a systems ecologist, and finally a question was raised about the relative focus on local, regional, or international problems in infrastructure and environment.

Graduate Council

The Graduate Council had, as a basis for its consideration, the proposal to establish the program, copies of the external reviews of the program, the summary letter to the Chancellor, and a presentation to the Council by representatives of the program. No issues in addition to those summarized above were raised.

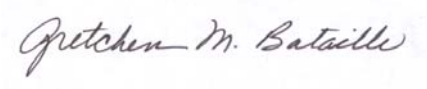
Response
UNCC recognizes the care with which interdisciplinary programs must be approached if they are to be sustained. The campus has extensive experience with interdisciplinary programs in the sciences so this would not be its first interdisciplinary endeavor. One cannot assure ahead of time that everything will work, but UNCC is putting an organizational structure in place that will be very supportive of the interdisciplinary work of this program. As they receive grants for work by interdisciplinary teams, faculty will see the direct benefit of crossing disciplinary boundaries. Both physical location of the faculty and the availability of joint appointments will contribute to integrating the efforts of the faculty in the program. The problems they seek to address are social problems and students trained to master complex interdisciplinary problems will be in greater demand as we try to solve some of these complex problems. UNCC has a growing number of doctoral programs so there are many other doctoral departments this program can draw from. The program indicates they are in the process of hiring a systems ecologist as was recommended.

Recommendation by the Graduate Council
After consideration of the issues raised by reviewers and Council members, the Graduate Council voted, without dissent, to recommend approval for University of North Carolina at Charlotte to establish this doctoral program in Infrastructure and Environmental Systems.

Resources
UNCC has been developing toward this program and has made investments in faculty in various departments and equipment to support this interdisciplinary program. The majority of the resources for the program, especially in its initial stages, will come from internal reallocations. Some resources will be derived from enrollment growth.

Recommendations
The Office of the President recommends that the Board of Governors approve the request from the University of North Carolina at Charlotte to establish a doctoral program in Infrastructure and Environmental Systems.

Approved to be Recommended to the Committee on Educational Planning, Policies, and Programs of the Board of Governors



Senior Vice President Gretchen M. Bataille **November 3, 2003**