STRATEGIC PLAN

for the

SCHOOL OF CIVIL ENGINEERING

Submitted to:

Office of the President
Georgia Institute of Technology

by:

Civil Engineering Faculty

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EXECUTIVE SUMMARY

"Therefore, when we build, let us think that we build forever. Let it not be for present delight, nor for present use alone. Let it be such work as our descendants will thank us for, and let us think, as we lay stone upon stone, that a time is to come when those stones will be held sacred because our hands have touched them, and that man will say as they look upon the labor and wrought substance of them, "See, this our fathers did for us."

—John Ruskin, 19th century author, art critic, and social reformer

INTRODUCTION

Civil Engineering was the first, civilian engineering profession established to meet the needs of a modern society. Civil Engineers have a proud tradition of providing the "stones" noted in the above quote. And certainly, Civil Engineers from Georgia Tech have traditionally played an important role in building the physical systems that have provided the foundation for the economic development and quality of life enjoyed by citizens of our nation, state, and metropolitan area.

However, the Civil Engineering profession, and the School of Civil Engineering at Georgia Tech, stand at a crossroads. A profession that has been based on the application of known methods now faces rapid technological changes. A profession that for many years provided built facilities with limited attention to environmental consequences is now immersed in better understanding the environment in which we live and how to build with minimal impact. A profession that was busy providing the basic support systems for a modern society, with little or no fanfare, now finds itself in the midst of major public policy debates (e.g., hazardous waste disposal and provision of adequate transportation facilities). A profession that focussed primarily on local infrastructure now finds itself developing the systems and facilities that are critical to survival in a world market. In short, the Civil Engineering profession has become a profession in rapid change, and those who will thrive in this environment will be those who change with it.

This report is the strategic plan for the School of Civil Engineering at the Georgia Institute of Technology. The report was prepared in response to a request from the President's Office for each academic unit at Georgia Tech to prepare a plan that could be used in developing an Institute-level plan for taking Georgia Tech into the future. The plan was to be based on a realistic assessment of the current status of the School, a visionary consideration of its mission, an evaluation of the environmental factors that will affect the School's ability in carrying out its mission, and the statement of specific strategies and action steps that will be followed to carry the School into the future.

Our strategic plan was developed in a truly participatory fashion. A faculty retreat was used to provide maximum faculty input into the identification of the issues and possible solutions. Each major group or committee in the School was asked to prepare their own written assessment of the School mission and needs. Several faculty meetings were held on specific components of the strategic plan. Graduate and undergraduate student groups also provided input into this process, by participating in several meetings and submitting a report to the Director. The Director met with members of professional societies and several Georgia Tech alumni, and the plan will be reviewed by a selected group of alumni and business leaders. A great deal of discussion and interaction occurred in the strategic planning process that has served the School well. This plan will be an
important guiding document in helping focus the decisions that will be made concerning the future of the School.

The reader should be forewarned that the strategic plan is long. Although such a lengthy document was not envisioned at the beginning of the process, it became apparent very early in our deliberations that the School of Civil Engineering was at a turning point. A new Director had just been hired. Several senior faculty members had just retired. New and exciting initiatives were being undertaken by the School faculty. In short, the faculty felt that a truly comprehensive document was needed at this point in the School's history.

This first chapter is an executive summary of the strategic plan. By reading this chapter and the material in chapter IV (Implementation), the reader will understand the most important points and recommendations that surfaced from our process. These two chapters combined are self-contained and convey the exciting challenges, opportunities, goals and strategies of the School of Civil Engineering. However, the material in between provides the logic and philosophy that underlay the strategies and action items recommended for implementation, and thus for future reference and understanding is necessary to include in the document.

WHO ARE WE?

The School of Civil Engineering currently has 36 full-time faculty members. This total of 36 full-time faculty members has fluctuated dramatically over the past 10 years. In 1981, when Civil Engineering and Engineering Science and Mechanics were separate Schools, there were a total of 61 professors (38 in Civil Engineering and 23 in ESM) on the combined faculty. In 1988, one year after Civil Engineering and ESM were combined, there were 39 professors.

Members of the School's faculty are recognized nationally and internationally in their respective fields. A large number of faculty members are often asked to chair national conferences and edit scholarly journals. School faculty members have been awarded numerous honors and citations that reflect their contribution to the profession and to society. In addition, members of the faculty have been active in important public policy issues of national, state and local concern. Examples of such participation include testifying before Congress, membership on policy advisory boards, chairpersons of government task forces, and membership on expert review panels overseeing the decision-making process for large-scale projects. In sum, we feel that the School's faculty provides a strong basis to build a better School in the years to come.

Currently (Fall 1991), there are 633 undergraduate students and 283 graduate students (210 masters students and 73 Ph.D. students) in the different programs of the School. In the past three years, the total student enrollment has increased by 18 percent, with the graduate student enrollment increasing by 31 percent.

The quality of laboratory equipment is an important determinant of the quality of education that is offered students and the substance and scope of research that can be undertaken. With this in mind, it is important to note that the undergraduate soils and concrete laboratories and the graduate geotechnical laboratory are in need of extensive upgrading of equipment. The Geotechnical/Materials building is in need of substantial physical improvements. The lack of an adequate Structures Laboratory is a serious hindrance to our education and research program in that area. Perhaps the most critical laboratory situation in the School (and likely at Georgia Tech)
is the deplorable condition of the Daniel Laboratory. The recent ABET statement which seriously challenged Georgia Tech to address the Daniel Laboratory situation best illustrates how critical the problem is.

The level of funding allocated to research in FY 1991 was about $2.50 million. This funding came from a wide variety of sources including the National Science Foundation, the State of Georgia, federal agencies like U.S. Corps of Engineers, EPA, and U.S. DOT and from a wide range of foundations and industry (a total list of current research funding is found in appendix ). This research funding is currently supporting 68 graduate students, and on average has been covering 16 percent of faculty time.

One of the important indications of how well the School is doing comes in a comparison with other engineering departments, both at Georgia Tech and at other universities. Major benchmarks in this comparison are faculty size, students advised and taught, and research dollars generated. With regard to graduate student enrollment, the School of Civil Engineering has a higher per faculty ratio of masters students and a lower per faculty ratio of Ph.D. students than the College of Engineering as a whole. The combined graduate student enrollment per faculty is about the average ratio for the College. As is implied by these comparisons, the percentage of Ph.D. students in our graduate program is below the College average (26 percent for Civil Engineering and 43 percent for the College).

A comparison was made of student/faculty ratios between the School of Civil Engineering at Georgia Tech and Civil Engineering Departments at the top Civil Engineering universities in the U.S. The top universities were selected in a poll of engineering deans and of civil engineering practitioners. This combined poll identified seven major universities as having the top civil engineering departments in the country: Berkeley, Georgia Tech, Illinois, MIT, Purdue, Stanford, and Texas. Georgia Tech's School of Civil Engineering has the largest bachelors and masters students per faculty ratio of all these schools (1990-91 data), but only beats Purdue in the number of Ph.D. students per faculty (although we are close to the University of Texas and have been rising significantly in recent months with a current ratio above 2.0 ).

In terms of faculty size, the Georgia Tech's School of Civil Engineering has by far the smallest faculty of the other major state institutions included in the comparison. The ratios of research dollars per faculty at these leading civil engineering programs were also compared. The other major universities (except Purdue) showed higher research dollars per faculty than that found in our School.

WHAT ARE THE ENVIRONMENTAL FACTORS LIKELY TO AFFECT THE WAY WE DO BUSINESS?

The following environmental factors are considered by the School of Civil Engineering faculty to critical in understanding the pressures and opportunities that we will face over the next decade.

1. A very important societal trend relates to the growing policy and general public perspective that infrastructure and environment are critical elements of a successful society and economy. Civil engineering, of course, is a central discipline to providing and maintaining the infrastructure in an environmentally acceptable way. The School, and indeed the
profession as a whole, needs to do a better job at illustrating the important benefits that accrue to society with a strong, well-maintained and environmentally sensitive infrastructure.

2. As noted in #1, a basic relationship of creating and maintaining infrastructure in ways that minimize impact on the natural and man-made environment will remain a major basis for engineering well into the 21st century. In addition to Infrastructure and Environment, however, we also believe that this decade will be the decade of Technology. In almost every facet of engineering, the most exciting developments will in the area of high technology applications to solve existing problems and to prevent future ones. Infrastructure, Environment, and Technology are thus the three legs that form the foundation for the future of Georgia Tech's School of Civil Engineering.

3. Many of the major problems facing society require multi-disciplinary teams for successful solution. Such multi-disciplinary problem-solving will likely increase in the future. To be successful in this environment, the Civil Engineering program of the future, and for that matter, any academic program that desires to provide relevant contributions to society, must be able to bridge disciplinary gaps. This requires not only better working relationships among sub-disciplines that currently characterize Civil Engineering, but also better understanding of, and relationships with, other professions and disciplines at Georgia Tech that contribute to solving societal problems. Providing students with an understanding of this interdisciplinary problem-solving approach will be a major challenge of all Civil Engineering academic programs in the country.

4. The market place for civil engineers is extensive and growing rapidly. For example, in the area of environmental consulting and engineering alone, the projected expenditures in 1991 were on the order of $14.0 billion. Including expenditures for pollution control, resource recovery, and waste and water resources management increases this market to $135 billion. In addition, there is a wide disparity between the current yearly output in graduate level engineers and the projected needs. Furthermore, in several civil engineering disciplines, such as environmental, geotechnical, and transportation, the MS degree is becoming the de facto professional degree.

5. Our major competitors are allocating substantial levels of funds in upgrading their laboratory facilities and in developing their overall program. Even in the southeast, where Georgia Tech is considered the leading institution, other universities have become strong competitors. In some areas, Virginia, North Carolina, North Carolina State, Tennessee, Duke, Auburn, Florida, and Vanderbilt are becoming competitive with Tech because of the investment made by these institutions.

6. The 1996 Olympics will provide some unique research and marketing opportunities to the School. Discussions and debates have already begun on topics that are of concern to several areas of civil engineering (e.g., transportation, construction). Significant research opportunities could potentially result from interest in the 1996 Olympics. Georgia Tech, being the site of the Olympic Village, will also receive increased attention. The School will examine possible ways of taking advantage of this attention for attracting quality students.

7. Because of its unique location in Atlanta, and the Southeast, Georgia Tech has the
opportunity, and has made the commitment, to lead the Nation in the recruitment and retention of minority students at all levels of education. As part of this goal, and based upon our present population and prospects, the School is positioned to make significant improvements in the recruitment and graduation of minority students.

GIVEN THE ABOVE, WHAT SHOULD OUR VISION AND MISSION BE?

The vision of the School of Civil Engineering is to create a quality-driven education and research program which is recognized by peers as being one of the nation's five best Civil Engineering Schools, and which serves as a role model to other institutions seeking strategies for becoming more successful in meeting the needs of the Civil Engineering profession and society. The mission of the School can thus be described as achieving five major goals:

- Provide national leadership to a Civil Engineering profession that is supporting the nation's environmentally sensitive infrastructure and to a profession that is increasingly being driven by advances in technology.
- Play a leadership role in fostering interdisciplinary education and research programs that are fundamental to solving the problems facing a complex society.
- Be an incubator of new ideas.
- Produce a new "breed" of Civil Engineers.
- Promote a sense of leadership and service among our graduates.

The School cannot accomplish its mission alone. Success is only possible through a partnership of faculty, students, staff, industry and government leaders, and alumni. The School and faculty will work with these partners to create and sustain a quality culture, and develop a sense of ownership of its educational and research programs among the partners. Students, alumni, and government and industry partners are also our customers, and the School and the faculty will take the lead in creating an environment of Total Quality Education. Over the years, we have come to operate in a culture that is bounded. We have become comfortable with solving problems within these boundaries. What is now needed is a change in culture - a shift of boundaries. We need to rethink the fundamental approaches to dealing with students, research, administration, and the industries we serve. Our approach to Total Quality Education will be based on a triad of customer responsiveness, continual improvement, and a supportive environment that encourages everyone to be the best they can.

WHAT STEPS NEED TO BE TAKEN TO POSITION THE SCHOOL OF CIVIL ENGINEERING FOR THE FUTURE?

In order to achieve its objectives, the faculty identified six major areas where significant steps need to be taken, these being the undergraduate program, graduate and research program, laboratory and instructional facilities, computer technology, external linkages, and School's Modus Operandum. In each category, specific strategies were identified that would address the problems found in each. Chapter IV of the strategic plan provides the specific steps (and responsibilities) that are recommended to implement the following strategies.
Undergraduate Program

- Develop a 21st Century technology driven curriculum under the leadership of the Undergraduate Curriculum Committee. Address issues of flexible vs. rigid curricula, level of specialization, and credit hours. The curriculum development must be driven by an identification of the content and quality of the education a Civil Engineer must receive at Georgia Tech to prepare him or her for the professional challenges that he or she will face in the next century.

- Address and resolve all ABET concerns. Conduct an objective evaluation of undergraduate degrees.

- Develop a recruitment and retention program to improve overall student quality.

- Collaborate with the College of Engineering to control enrollments and improve graduation rates. The target undergraduate enrollment will be in the range of 600 to 700 students.

- Increase the student population of under-represented groups. Double the number of minority students, and increase the number of women students by 50 percent.

- Create an efficient advising system. Develop a strong mentoring program.

- Develop a faculty/student interaction program that is customer-oriented and quality-driven.

Graduate and Research Programs

- Focus and promote the research and educational graduate programs along selected research thrusts. These thrust areas are: environmental quality engineering, transportation, infrastructure development and rehabilitation, engineered construction materials, computer-aided engineering and education, and hazard mitigation and safety.

- Play leading or major roles in several of the Institute’s technology thrust areas (e.g., environment, transportation).

- Recruit and develop 15 to 20 faculty members from the current base of 36 faculty.

- Increase research expenditures to $7.0+ millions per year by 1997.

- Create faculty/student/School partnerships to promote sponsored research.

- Sustain a graduate student population in the range of 300-350 students.

- Increase the number of Ph.D. students by 100% (120 to 140 students).

- Develop an aggressive recruitment and retention program for graduate students. Streamline the recruitment process, and develop fellowships and other forms of
assistantships.

- Increase recruitment and retention of under-represented groups: Increase number of minority graduate students by 100%, and number of women graduate students by 50%.

Laboratory and Instructional Facilities

- Renovate and upgrade outdated facilities, including the immediate and urgent measures identified for the Daniel Laboratory.

- Implement the laboratory and instructional facility plan (appendix to this plan) developed as part of the strategic planning process. The total cost is approximately $3.1 million over a five year period.

- Develop occupation and financing plans for a new facility for Earth and Atmospheric Sciences and Civil Engineering, and possibly other disciplines. The proposed facilities would be centered around the theme of the environment, and bring closely together the several schools in the Institute having strong interests in this field.

Computer Technology

- Develop computer laboratories and classrooms sufficient for the student population. Estimated investments over a five-year period will be approximately $1.1 million.

- Develop a multi-media computer laboratory.

- Complete the networking of the different facilities of the School.

- Integrate computer technology in instruction.

- Create a Computer Development and Policy Committee.

External Linkages

- Increase promotion of the faculty's accomplishments.

- Publish a newsletter (beginning Winter 1992) and a School annual report.

- Enhance interaction with alumni. Distribute newsletter and annual report to alumni. Organize an annual alumni-faculty-students gathering.

- Increase individual contacts with academic, industrial, and governmental agencies.
• Focus continuing education programs.

• Organize technical conferences and workshops.

• Encourage international programs and activities. Develop formal ties with selected organizations.

• Organize and conduct a Civil Engineering Centennial/Olympics fund raising campaign with a target of $5.0 million. Conduct fund raising on an annual basis with a target of $0.30 million per year.

School Modus Operandum

• Formalize a School organization that encourages cross-disciplinary activities and problem-solving.

• Provide an administrative and support structure that facilitates scholarly activities.

• Enhance faculty input to the school direction and administration.

• Create a recruitment advisory committee.

• Form an advisory board and an alumni advisory committee.

• Improve the formation and operation of the promotion and tenure committees.

• Create a mentoring program for untenured faculty. Establish a formal evaluation/feedback process. Promote scholarly achievements.

• Develop a teaching load policy providing a fair balance between the different missions of the School, as well as supporting the goals of individual faculty members. Emphasize quality teaching.

• Implement minimum teaching requirements for PhD students. Support the professional development of teaching assistants. Increase the number of teaching assistants to 30 by 1996.

• Encourage the development of a formal sabbatical system within the College of Engineering and the Institute.

SELF ASSESSMENT

The School will develop and implement a self-assessment program. We will create a formal process to evaluate the impact our educational and research programs have on our students and their employers. Initial steps will be surveys of alumni and employers (through our Newsletters and personal contacts) and interviews with present students. In addition, we will survey selected practicing engineers and industry leaders. Many of these activities have already been undertaken. Self-assessment will also benefit from the input provided by the School's Advisory Board.
The School Director will hold quarterly meetings with undergraduate and graduate students. Our improved student advising and mentoring system will also be used to provide significant input to the self-assessment program. The goal is to develop a team-based relationship between faculty and students.

The progress made will be evaluated every year, usually at a faculty retreat, and our goals, directions taken, and strategic plan will be improved and revised. The driving goal of the self-assessment study is to continuously search for improvement in our educational environment and in the quality of our product and internal interactions (faculty/staff/students interactions).

With respect to the concept of a continuous search for improvement, the self-assessment program will be part of and benefit from the efforts undertaken by the Institute in the area of total quality management. In addition, we will take advantage of the expertise of our construction group in this field, including actual experience within the Japanese industry.

CONTINGENCY PLANNING

Achieving the goals of this strategic plan is dependent upon the School and faculty commitment to being a premier School in the country. We believe that this commitment does exist. However, it can not be over-stressed that the faculty is the key to success.

The plan can be jeopardized by the potential inability of the School to increase non-State funding (research and fund raising) and/or the inability of the Institute to increase State funding. This is especially critical for the hiring of additional faculty, and upgrading of instructional and research facilities.

If these inabilities develop, the plan will have to be modified accordingly. An important feature of our quantitative goals is that they are clearly related to the student/faculty ratio; hence goals can be scaled proportionately to these ratios and contingency actions taken accordingly. However it would involve some hard choices. For instance, if the faculty can not reach its optimum size, and one adheres to the goal of increasing the number of PhD students, undergraduate enrollments would need to be reduced.

The vision of this plan and many of its goals place emphasis on multi-disciplinary activities. Hence, success requires that such undertaking be encouraged and rewarded by the Institute.

Commitment of the Institute to improving its infrastructure and its support structures will also be an important factor affecting our program.

There are also external factors, e.g. economy, changes in research emphasis from the federal government, which can jeopardize the plan. As part of our self-assessment program, these potential jeopardies must be evaluated and factored in. As already stressed, the quantitative aspects of the plan are relative and can be scaled up or down as a function of faculty size and number of students. Hence, although undesirable, goals can be adjusted for changes resulting from lesser performance, underestimated costs, and jeopardies from within or outside the Institute.