Chapter 3: College of Engineering Decadal Study

As part of the 2005 strategic planning process, the College of Engineering scheduled five “Decadal Study” sessions between August 15 and October 28, 2005. Faculty and staff were invited to attend one or more of the roundtable discussions during this phase of the strategic planning process. Sixty-one members of the faculty, two research scientists, and four members of the college administrative staff participated in the discussions on the opportunities and challenges that will be facing society over the next few decades, and the role of engineering and science educators and researchers in addressing the emerging challenges and opportunities. In addition, the College of Engineering Advisory Board held their fall meeting on September 30, 2005, and for part of their meeting, board members were asked to join the college in the Decadal Study discussions. Decadal studies also were conducted during September and October 2005 during advisory board meetings for the Departments of Mechanical Engineering and Electrical and Computer Engineering.

The National Academy of Engineering publication entitled *The Engineer of 2020* was used as a basis for discussions at several meetings. This book identified deteriorating infrastructure, including IT and communications, water, transportation, energy, and environmental issues, as major challenges society will face, along with changing population demographics. The following represents a summary of comments related to teaching and learning, diversity, research and discovery, and resources and support. Additional information is provided as follows:

- Addendum 3.1: College of Engineering Decadal Study Procedure and Method (page 3-9)
- Addendum 3.2: Future Global Challenges and Opportunities (page 3-11)
- Addendum 3.3: College of Engineering External Advisory - Report of Decadal Study Discussions, Fall 2005 (page 3-12)
- Addendum 3.4: College of Engineering Participants in Fall 2005 Decadal Study (page 3-15)
- Addendum 3.5: College of Engineering External Advisory Board Participants in Fall 2005 Decadal Study (page 3-16)
- Appendix B: College of Engineering Decadal Study – Full Report of Discussions (page B-1)

**Teaching and Learning**

**Starting Points.** Assumptions about the future and projections of emerging or growing areas of science, engineering and technology are difficult to make. No one could have predicted the rapid developments that took place over the last few decades and totally changed the way the world operates. Global competition has expanded beyond manufactured products to include competition for our students and jobs.

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Objective 1. Develop an agile academic program that can adapt to the changes coming in the next decade and provide an environment in which innovation and creativity can thrive, people can reach their fullest potential, and our students leave fully prepared to meet the challenges and opportunities they will encounter and possessing the attributes of professional engineers and scientists.

Goal 1. Incorporate more problem-solving, abstract thinking, applied creative design and core analytical skills into the curriculum to enable students to take the knowledge they learned in school and apply it to any problem that they are tackling.
   × Strategy 1. Teach creativity and design to students from their freshman through senior year by expanding the number of research opportunities available in the laboratories.
   × Strategy 2. Expand ME’s senior design course into other departments in the college since it has proven to be successful in preparing undergraduates to solve real-world problems.
   × Strategy 3. Reexamine our paradigm on teaching and lecturing to provide more opportunities for graduate and undergraduate students to extrapolate knowledge and apply it to new information rather than operating by pattern recognition.
   × Strategy 4. Expand Web-based technologies in more of the standard classes so that faculty members’ time can be spent in a truly interactive bi-directional setting.
   × Strategy 5. Utilize programs such as the National Academy of Engineering Honors EPICS (Engineering Projects in Community Service) program which gives students the opportunity to learn valuable skills while working to solve real-world problems in the community.

Goal 2. Provide a state-of-the-art education and life-long learning opportunities that will keep pace with the rapid advancements in technology and knowledge.
   × Strategy 1. Adopt a plan to broaden our communications with companies and agencies along the Front Range to stay up-to-date on recruiting and industry trends, and to develop ideas for research collaborations, internships and fellowship opportunities.
   × Strategy 2. Incorporate interactions with alumni into our educational program as one means of passing current information on to our students about the U.S. and global work environment and the skills that will enable them to succeed.
   × Strategy 3. Improve distance education through new technologies that expand on our use of the Internet, including canned courses burned onto DVDs.

Goal 3. Provide our students with a strong fundamental knowledge of mathematics, physics, statistics, science and engineering, as well as a basic understanding of how to learn so they can work on increasingly complex problems that require more fundamental knowledge than ever before.
   × Strategy 1. Raise our admission standards in order to ensure we are producing graduates who will be successful in the new global marketplace and are training students who can compete with people from the top schools in the nation.
   × Strategy 2. Expand our thinking beyond the standard credit-hour course, using MIT’s Independent Activities Period, co-ops, Engineers Without Borders, or a more organized and project-focused Study Abroad program to reach our goals.

Goal 4. Provide communication, leadership, ethics, legal, and management training, as these are increasingly important to engineering and science professionals in the new global marketplace.
Strategy 1. Work with industry to expand the number of co-ops, undergraduate internships and graduate fellowships to give students experience in applying what they learned in the classroom to a real-world project and expand their communication and teamwork skills.

Strategy 2. Invite industry representatives to serve as mentors and to participate in a variety of educational activities at CSU in order to share their advice and real-world experiences.

Strategy 3. Encourage faculty to make non-engineering courses more attractive to our students and interface more with the Colleges of Liberal Arts and Applied Human Sciences.

Strategy 4. Encourage departments to adopt ECE’s undergraduate composition course to develop the proposal and publication writing skills that our students need in the workplace.

Strategy 5. Develop a techno-ethics in engineering and science course.

Goal 5. Provide the strongest four-year undergraduate experience possible to prepare students for careers in engineering that are outsource-proof, because in today’s global economy many of the routine analytical functions and technical jobs as well as innovation, design and manufacturing are moving overseas where the work is done by lower-salaried employees.

Strategy 1. During their first year as undergraduates, actively counsel students and engage them in the process of identifying what they need to do in order to be successful.

Strategy 2. As early as the freshman or sophomore year, enable students through scholarships or non-paid positions to receive more research experiences in our laboratories.

Strategy 3. Identify opportunities to hire undergraduates for research projects across disciplines to prepare them for the interdisciplinary work in industry.

Strategy 4. Educate students through additional laboratory, project, or classroom work to be creators and innovators, to manage and lead, to sell the products, and to make presentations.

Strategy 5. Expand the cooperative education program in a more organized project fashion to provide a more broad-based and global educational experience.

Strategy 6. Set up a summer job program that would apply directly to each student’s specific educational program and give them relevant work experience.

Strategy 7. Provide more systems engineering in our curriculum and place more emphasis on creativity to help students make connections to the fundamentals.

Goal 6. Broaden our programs to provide a more interdisciplinary education that will prepare students to be successful in a multidisciplinary work environment and to interact with people who have a wide diversity of educational backgrounds, job titles and responsibilities, as well as to work effectively outside their field of expertise.

Strategy 1. Consider blending research into new graduate programs such as ecological engineering.

Strategy 2. Develop new interdisciplinary programs at the undergraduate level that include majors outside engineering, such as business students.

Strategy 3. Expand senior design by blending in students from majors outside engineering to work on new cross-disciplinary projects and provide this level of interaction.
Strategy 4. Add more science into our curriculum to educate students for careers in molecular-level engineering including biomaterials and nanostructures.

Strategy 5. Develop a program in international development that focuses on interdisciplinary projects in an engineering system that is oriented to natural systems.

Goal 7. Cross-cultural training and more foreign languages will be needed due to the globalization facing science and engineering firms; it will no longer be possible to conduct business if you just know one language.

Strategy 1. Consider adding foreign languages as a requirement for undergraduate admission to the college.

Strategy 2. Develop new programs that go beyond the typical international experience students receive through Study Abroad so that a majority of our students may gain experience outside the U.S. to prepare them to work in the global marketplace.

Goal 8. Fulfill the mission of the land-grant university to help people raise their status in life by giving students a well-rounded education in engineering and teaching them how to think, thereby preparing them to move on to successful careers in fields both within and outside the engineering profession that benefit society in different ways.

Strategy 1. Consider the feasibility of adding a minor in pre-law to the new B.S. in education/engineering degree to attract public-service minded students and produce more policy-makers, lawyers and politicians who possess an engineering and science background and can bring an understanding of engineering and science to the issues society will face.

Strategy 2. Establish an interdepartmental PhD degree in biomedical engineering to attract new students interested in the health sciences, especially diverse and out-of-state students.

Strategy 3. Create a new degree program in social engineering that would tie public policy, science technology and human values together and attract Native Americans and women.

Strategy 4. Use the Engineering Science degree as an incubator to experiment with alternatives such as law, public policy, medicine and business tracks.

Goal 9. Educate students in the legal and ethical issues related to engineering and science research and practice before they leave the university.

Strategy 1. Add ethical and legal training to existing classes to better prepare students when they meet these challenges before and after they graduate.

Goal 10. Encourage ABET to compare the U.S. educational system to that in Europe and other countries to see if alternatives to the current educational paradigm will provide the means to expand the education and training of engineers and scientists by adding courses recommended by NAE.

Strategy 1. Determine whether choosing to remain strong in the basic fundamentals of a four-year degree program and encouraging students to go to graduate or professional school for more training will provide the education and skill sets that students and industry need.

Strategy 2. Conduct studies on the advantages of replacing the Bachelor’s with a 5-year or Master’s degree as the terminal degree for engineers, the European educational model.
Goal 11. Promote more interaction between graduate and undergraduate students to expand the research experiences and provide training on real-world projects.

- **Strategy 1.** Identify College-wide programs that we know will be important in the future that encompass both undergraduate and graduate education (not just in the classroom) as well as faculty research, and create concentrations or minors as appropriate. Suggested areas for consideration include bioengineering, robotics and automation, energy, water and the environment, and advanced materials (including nanotechnology).
- **Strategy 2.** Plan to create joint graduate-level courses, hold joint seminars, and work on group proposals such as IGERT at the graduate level, or expand the REU program.
- **Strategy 3.** Determine if an advanced degree in integrative engineering/engineering management is a way to integrate graduate students at the Master’s level into the undergraduate research experience to better prepare them to manage projects.

**Diversity**

**Starting Points.** The college has invested in diversity through support of the Women and Minorities in Engineering Program and establishment of a College Diversity Committee to help guide our recruitment and retention activities. With the projected growth in underrepresented populations, the engineering and science professions must develop a plan to attract more people from diverse groups. Attracting more women is equally important to the future of the professions and to society.

**Objective 2.** Establish a culture that promotes and supports the academic, personal and professional goals of all citizens.

Goal 1. Recruit more women to the engineering and science professions to provide the diversity of viewpoints and skills, giving the U.S. an advantage over other countries and causing a shift in innovation, communication and other important areas.

- **Strategy 1.** Establish an effective recruiting and retention program for women in order to raise the number of female engineering students in the college.
- **Strategy 2.** Promote the programs that are appealing to women such as atmospheric science, chemical and biomedical engineering, as well as emerging areas such as green engineering or social engineering through new marketing activities.

Goal 2. Expand the number of female faculty in the College to provide more role models.

- **Strategy 1.** Develop a competitive edge to attract the few numbers of women faculty on the market by seeking additional resources for salaries and start-up packages.
- **Strategy 2.** Change our culture so that we begin to do things differently in order to recruit and retain women faculty.

Goal 3. Recruit a more diverse group of students to the engineering profession through targeted marketing and promoting a more positive image of the engineer.

- **Strategy 1.** Educate the public on how engineers impact their everyday lives through development of new technologies and solutions that range across almost every aspect of their lives, and thus interest more high-quality students in pursuing an engineering degree.
Strategy 2. Reconsider the former model where two years of core courses were required before students were asked to select a major.

Goal 4. In addition to better informing the public on how engineers design solutions to everyday problems, we also need to change the “Dilbert” image of the engineer, which is the one most people have today, in order to recruit students and develop their interest in science and engineering.

Strategy 1. Expand our outreach into K-12 and demonstrate what engineers and scientists do in a positive and fun way similar to CSU’s “Little Shop of Physics.”
Strategy 2. Change the stigma of engineering by bringing graduate and undergraduate students from other colleges into the laboratories or onto project teams on a rotational basis.
Strategy 3. Use the pipeline concept at the high school level to reach out to young people who want a career that allows them to make a positive impact on society. Show these students that engineering is one way to make an impact on the environment and society.

Research and Discovery

Starting Points. Innovations in science and technology that no one could predict have produced dramatic changes in the way people work and spend their pastimes. Our competitive strength will come from innovation, and significant research problems will be addressed by being creative in making the connections to the basic sciences. No one can predict what the future holds and what innovations lie in store. We need to be prepared, and to prepare our students for any number of new scenarios that will develop over the next decade.

Objective 3. Perpetuate the college values of creativity and discovery, entrepreneurship and innovation, collaboration and partnership, and collegiality through strategic planning and implementation.

Goal 1. Support research areas that have achieved levels of international excellence to facilitate future growth and excellence, and make use of these successes to build for the future.
Strategy 1. Identify nuclei of excellence that can be nurtured, starting with areas of strength that can be used to attract people and build up the programs.
Strategy 2. Provide a college culture that embraces chronic change and adapts readily to the evolution of technology and science, giving us the flexibility to quickly respond to emerging opportunities by utilizing existing areas of excellence to build new programs.
Strategy 3. Explore new opportunities for innovation through collaboration, blending business and industry with university science and engineering programs to develop new products to apply engineering and science to societal problems.

Goal 2. Expand the number of interdisciplinary research programs to address complex global challenges. CSU has nationally and internationally recognized programs that could be combined with other programs in the university to the benefit of all.
Strategy 1. Establish agile programs in areas such as water resources, energy, IT, climate change, materials science, and environmental quality that can adapt to changing needs.
Strategy 2. Capitalize on our unique positioning to apply specialized climate forecasting to infrastructure and food systems, to add preparation and resiliency to these systems.

Strategy 3. Develop stronger connections between disciplines within the college and university, with K-12 educators, and with industry to promote interdisciplinary and cross-cultural cooperation.

Strategy 4. Develop collaborations with other top-notch departments and programs at CSU by identifying students with a joint interest in both areas, thus giving them the incentive to collaborate and produce results across disciplines.

Strategy 5. Think creatively about ways to highlight and market our current interdisciplinary activities.

Strategy 6. Broaden our faculty base to include more interdisciplinary faculty, since one of our goals is to bring a more interdisciplinary focus into our teaching and research.

Strategy 7. Develop collaborations with agencies such as the National Renewable Energy Laboratory to help expand research into new multidisciplinary areas.

Resources and Support

Objective 4. Provide an environment conducive to conducting the highest quality teaching, research and outreach programs.

Goal 1. Strive to ensure an adequate number of faculty members in the college in order to meet the educational needs of our students and address the research opportunities and societal challenges that are facing us.

Strategy 1. Utilize the services of a political lobbyist, following University procedure, to obtain line item funding in budgets to support research and teaching programs.

Strategy 2. Continue to seek additional funding from the University to provide base support for faculty salaries so that we can retain our excellent faculty members.

Goal 2. Provide relief to faculty members of the extensive time commitments involved in managing senior design courses, which are invaluable in preparing students for real-world projects.

Strategy 1. Develop a half-credit course in teaching, using external speakers to train students in how to teach, thereby expanding the students’ communication and teaching skills while providing instructional support for senior design projects.

Strategy 2. Provide mentoring hierarchies for the student design teams, getting graduate students involved in these projects. The new Engineering Science/Engineering Education degree program could be used for this.

Goal 3. Support faculty in their efforts to expand their research into new multidisciplinary areas and be more competitive in identifying new funding sources, obtaining grants and managing projects.

Strategy 1. Identify new seed money to support the development of new interdisciplinary research proposals that align with the mission.

Strategy 2. Work with the University to develop the infrastructure necessary to support interdisciplinary proposal development and to build synergies that are supported not only by the CSU infrastructure, such as superclusters, but also by funding agencies.
Strategy 3. Return RA/RSP money to the individual faculty members so the funds can be used to travel to national funding agencies to obtain new projects, as well as to build other collaborations on new projects.

Goal 4. Establish a rewards system that provides for sharing of the rewards across the college, and quickly moving resources to people showing promise.

Goal 5. Attract and hire the top people in the field through ongoing strategic planning and marketing.

Strategy 1. Market these strengths of the College when hiring: the emphasis on applied teaching and research, the interdisciplinary nature of the research, the international orientation based on a history of internationally recognized teaching and research programs, the unique strengths that we can build upon, the excellent facilities including the Foothills and Main Campuses, as well as the outstanding laboratories located around Fort Collins.

Strategy 2. Develop stronger ties with the emeritus faculty.

Strategy 3. Expand existing or add new facilities to aid in recruiting of faculty and students and promote interdisciplinary interaction between students, faculty and staff.

Strategy 4. Capitalize on the existing natural resources in Colorado – the land, agricultural economy, growing population, mountains, forests and water.

Goal 6. Develop a strategy to incorporate new learning into the faculty development program to prepare them to expand or refocus their research and teaching in the next two decades when they may need to integrate areas such as biology and new information technologies.
Addendum 3.1: College of Engineering Decadal Study
Procedure and Method

Overview: As part of the 2005 strategic planning process, the College of Engineering scheduled five College-wide “Decadal Study” sessions between August 15 and October 28, 2005. The objective of the Decadal Study sessions was to help create a vision for the College of Engineering by bringing groups together to share their views about the challenges and opportunities facing society over the next few decades. The decadal study groups were divided into two segments, representing the internal and external stakeholders.

Internal Stakeholders: Faculty and staff were invited to attend one or more of the internal college roundtable discussions during this phase of the strategic planning process. Sixty-one members of the faculty representing all five departments in the college, two research scientists and four members of the college administrative staff participated in the Decadal Study during fall semester 2005. The multidisciplinary composition of the groups gave faculty and staff members the opportunity to meet each other, sometimes for the first time, and discuss in an open forum environment their views on the roles that engineers and scientists will play in a rapidly changing global society.

External Stakeholders: The College of Engineering’s Advisory Board held their fall meeting on September 30. During their meeting, board members were asked to join the college in the Decadal Study discussions and identify challenges and opportunities facing society from the perspective of their industry or federal agency. They were also asked to list the areas of science, engineering and technology that they see growing in importance to society over the next decade. A summary of these discussions is presented in the appendices. The Board members independently identified a list of Future Global Challenges and Opportunities very similar to the list identified by the college internal groups.

Method: The discussions were facilitated by the Director of Engineering Marketing and Communications, Lana Hoff, and recorded by Joanna Holliday, Assistant to the Dean. The National Academy of Engineering book entitled *The Engineer of 2020* was used as a basis for discussions during some of the meetings. This book identified the deteriorating infrastructure, including IT and communications, water, transportation, energy and environmental issues as major challenges society will face, along with changing demographics. The groups were first asked to identify future technological changes, emerging challenges and opportunities that were not included in the NAE book, and then to help develop strategies for our engineering and atmospheric science education and research programs that would carry us from 2007 to 2020. Included in these discussions was the role of engineers and scientists in the new global marketplace.

Reports: The College of Engineering Decadal Study is summarized at the front of this document, utilizing the format designated for the University Strategic Planning process. The appendices include: “Future Global Challenges and Opportunities Identified by Participants in the College of Engineering Decadal Study,” “College of Engineering Advisory Board: Report of Decadal Study Discussions, Fall 2005,” “College of Engineering (and Advisory Board) Participants in the Fall 2005 Decadal Study”, “College of Engineering Decadal Study: Fall 2005: Full Report of Faculty and Staff Discussions,” and background materials.
Feedback: Faculty and staff are encouraged to provide feedback as well as submit additional ideas relating to the Decadal Study and the College Strategic Plan. The College website will be used as a central source for materials related to strategic planning, including publications concerning the future of engineering and science, websites, and other resources. Submissions for this website are welcome and can be directed to lhoff@engr.colostate.edu.

Future Meetings: There is interest among the Decadal Study participants in continuing the discussions in smaller groups of four to five members to allow more opportunity to share their ideas. It has been recommended that the groups be separated according to current job title and function.
Addendum 3.2: Future Global Challenges and Opportunities Identified by Participants in the College of Engineering Decadal Study

- Lasers and Photonics
- Clean Energy
- Air Pollution
- Climate
- Water
- Information Technology
- Modeling, Simulation, Optimization, including Physical Modeling
- Networks and Computer Systems
- Human Health, Biological Systems, including Bioinformatics
- Data Access
- Green Engineering
- Sustainability and Efficiency
- Communication
- Microelectromechanical Systems
- Infrastructure Systems: sanitation, housing, water, and sewer systems
- Food and Agriculture
- Computation
- Materials Science
- Nanoscience and Nanotechnology
- Informatics
- Renewable Energy
- Sensor Networks and Feedback Controls
- Biotechnology
- Optics Techniques for Biological Probing and Imaging
- Robotics, Automation and Controls
- Wind Engineering, Wind Energy
- Self-healing Machines
- Disaster Prevention
- Aerospace, Nuclear Energy and Space Exploration
- Remediation and Cleanup
- International Engineering: educating outsource-proof engineers
- Social Engineering
- Transportation
- Industrial Ecology
- Self-actualization, e.g. Entertainment
- Intelligent Systems
- Security, Threats, Bioterrorism
- Disasters, Infectious Diseases
Education:

- Strong communication skills will be necessary in order to influence policy makers, solve problems, and manage projects. When working on projects, engineers often discard the options because they have decided on the right one, but sometimes you have to communicate all the options because this allows the public to decide to go with the right options. Engineers must understand the audience and be able to communicate with people who have not been on the project team. Communication also means knowing how to listen to society and hearing what is important to everyone so that you are solving the right problem.

- Engineers have to bridge the gap between theory and practice, understanding the technical aspects of a problem and developing solutions that they can apply to the real world. An engineering education that provides a systems perspective and helps people understand complex systems and solutions beyond the technical level would fill a large vacuum that exists today.

- In the U.S., we have shifted so far into the computer age that many students do not enter companies with a good grasp of the physical basics and companies have had to develop their own educational and training programs to meet their needs. An engineer is someone who has been taught how to learn; universities should not lose track of the basics.

- Teamwork is an important skill that is taught at universities through physical team experiences; how do we evolve into virtual teams that work with people around the world? This needs to be built into the curriculum and include a plan to provide actual experience with virtual teams. Seventy percent of communication is nonverbal, and in the virtual world you have a new level of communication problems.

- Multicultural and sociological training are needed by today’s engineers so they understand cultural differences to prevent conflicts. Engineers also need to understand the needs and infrastructure of other countries so that the right discussions are taking place at the right level and scope of the project for that country, rather than using U.S. standards and scope.

- Universities might consider offering engineering as a professional degree program in order to provide the basics along with the additional skills and training required in the workplace. This 5th year option would be more focused on specific areas, and the curriculum planning could be done in conjunction with industry so that students will be graduating with relevant skills for tomorrow’s workplace.

- Universities can best prepare their students for the future job market by understanding their constituents. This can be accomplished by examining the companies that hire their students, determining what the students are now doing within the companies, and finding out what the companies and industries will be focusing on over the next decade. A caution was raised, however, that universities should be careful not to limit the educational focus and make it too restrictive.
**Outsourcing:** There were several different viewpoints expressed about outsourcing, based on the framework of the industry represented.

- **Basic-level jobs outsourced** - The majority of jobs that some industries are sending overseas are very **basic and repetitive**, and these jobs are not attractive to U.S. citizens, so outsourcing of this basic work gives U.S. engineers the time to work on higher technologies.

- **Higher-level jobs outsourced** - Opportunities for innovation are infinite, and innovation is not confined to the U.S. In some industries, they are seeing more sophisticated engineering taking place offshore. An example is GE, which has a large medical research facility in China and is expanding the R&D and product development for the global marketplace. The mindset in industry is “Change your capacity, but don’t change your capability.” Through evaluations of people across proficiency levels, companies maintain a balance. However, engineering boundaries are so blurred that even if you have an expertise in one area, you have to know enough to **understand the broader concepts required to work on a team, and continue to break out of the boundaries**. This blurring is also occurring outside engineering, e.g. with business and IT; ISTeC is blending these together well at CSU.

- **Economics** – With more information sharing through technology, companies have to make economic decisions on whether to hire the $17K engineer or the $100K engineer. At the same time, industry recognizes that public institutions of higher education supply much of the innovation and basic research that drives the companies, and if public universities are not adequately funded then this role falls back on the company.

**University/Industry Connections:** Universities generate the innovation, and innovation is necessary to build economic competitiveness. Industry also places high value on universities because of the high level of technical knowledge and relatively low cost associated with research projects. Universities could be more closely tied with industry; it’s a natural connection. Industry is aware of the challenges universities face in balancing sponsored research with undergraduate education, and in keeping up or trying to stay ahead of the rapid progression of technology. **Outreach efforts between the universities and industry will provide a real-time connection to the rapidly changing trends,** and help universities stay on the edge not just in research but also in teaching methods and classroom and laboratory equipment. **They would also provide industry with employees who don’t require a lot of additional training** when they enter the workplace. Historically, the downsides of these research collaborations have been the contractual difficulties when dealing with sponsored programs offices, and the timeframe. These research projects take longer to get off the ground and produce results because of the way the universities must operate, and industry might have a vital and urgent need for the new technology. If solutions can be found to these challenges, the potential exists for more collaboration between industry and universities.

**Global Marketplace:** Due to the rapid development of the global marketplace, industries find they must develop methods of deciphering information from other countries and translating U.S. processes into numerous languages, and the information must be assimilated quickly to meet project goals. Universities have to pick up the ball and encourage **foreign language education**, including an understanding of technical language, as well as the ability to learn how to adapt their methods and communication styles to other cultures.
Marketing Engineering as a Profession: Many people don’t know what engineers do and think they just solve technical problems. The percentage of people entering the engineering profession is declining and we need to work on a positive marketing campaign for the profession.

Strategic Planning: The College of Engineering at Colorado State University was expanded in the ‘60s through thoughtful and careful strategic planning. The university administrators at that time looked at the top institutions in the nation, eliminated those programs that had advanced beyond any level that CSU could normally be expected to achieve given funding limitations, and identified niche areas that complemented existing research taking place at CSU. These areas were narrowed down to one area that fit the land-grant mission of the university and capitalized on the proximity of major national laboratories in the region. The college leaders then sought out and hired the preeminent expert in this area, who was also a strong salesperson and thus would be able to expand the facilities and hire other great researchers to build the program. This was how the Department of Atmospheric Science was built, and today it is ranked among the top programs in the nation. Similar analysis of the top institutions in the U.S. aligned with strategic planning may be useful for the college.
Addendum 3.4: College of Engineering
Participants in Fall 2005 Decadal Study

Atmospheric Science
Cotton, Bill
Johnson, Dick
Kreidenweis-Dandy, Sonia
Kummerow, Christian
Randall, David
Stephens, Graeme

Chemical & Biological Engineering
Bailey, Travis
Belfiore, Larry
Dandy, David
Murphy, Vince
Reardon, Ken
Reisfeld, Brad
Wang, David
Wickramasinghe, Ranil

Civil Engineering
Bienkiewicz, Bogusz
Bledsoe, Brian
Carraro, Antonio
Criswell, Marvin
Fontane, Darrell
Gates, Tim
Grigg, Neil
Julien, Pierre
Labadie, John
Meroney, Robert
Niemann, Jeff
Oad, Ramchand
Pruden-Bagchi, Amy
Roesner, Larry
Salas, Jose
Sale, Tom
Sanders, Tom
Shackelford, Chuck
Siller, Tom
Thompson, Erik
Thornton, Chris
Van de Lindt, John
Vlachos, Evan
Ward, Robert
Watson, Chester

Electrical & Computer Engineering
Bartels, Randy
Bringi, V.N.
Chen, Tom
Chong, Edwin
Jayasumana, Anura
Lear, Kevin
Marconi, Mario
Menoni, Carmen
Reising, Steven
Rocca, Jorge
Siegel, H.J.
Young, Peter

Mechanical Engineering
Duff, Bill
Hittle, Doug
James, Susan
Puttlitz, Christian
Sakurai, Hiroshi
Sampath, Walajabad
Stanglmaier, Rudy
Troxell, Wade
Wilbur, Paul
Williams, John
Willson, Bryan
Yalin, Azer

Dean’s Office
Herrick, Rupert
Hoff, Lana
Holliday, Joanna
Seligmann, Kathleen
Addendum 3.5: College of Engineering External
Advisory Board Participants in Fall 2005 Decadal Study

Advisory Board Members:
Adams, Janet – California Department of Transportation
Anderson, Brett
Chamberlain, Ray – Former President of Colorado State University
Cousins, Bill – Pratt & Whitney
DeGryse, Donald – Lockheed Martin Astronautics
Law, Donald – Prima Exploration, Inc.
Marcus, Joseph – Formerly with Lockheed Martin Astronautics
Mattucci, Robert – Kiewit Construction Company
McMillan, Jim – National Renewable Energy Laboratory
Scott, Rocky – McWhinney Enterprises
Winkler, Mark

Special Guest:
Atteberry, Darin – Fort Collins City Manager

College of Engineering Participants:
Rutledge, Steve – Atmospheric Science Department Head
Watson, Ted – Chemical & Biological Engineering Department Head
Kirkpatrick, Allan – Mechanical Engineering Department Head
Maciejewski, Tony – Electrical & Computer Engineering Department Head
Garcia, Luis – Civil Engineering Interim Department Head
Woods, Sandra – Interim Dean
Troxell, Wade – Associate Dean
Herrick, Jupe – Assistant Dean
Siller, Tom – Associate Dean
Seligman, Kathleen – Development & Advancement
Hoff, Lana – Engineering Marketing & Communications
Holliday, Joanna – Assistant to the Dean