

## **Criterion B.2 Program Educational Objectives**

This chapter describes the Program Educational Objectives and the processes in place to assess constituency and program needs, as well as the selection and evaluation of the Educational Objectives and their connection to Institutional Educational Objectives.

The Engineering Physics (EP) Program Educational Objectives were derived from strategic discussion among faculty members and staff of the Department of Physics, the Mechanical Engineering Department, the Electrical Engineering Department, the College of Engineering and the University. Preparation for the ABET 2006 review has had a significant impact on the development and improvement of the Educational Objectives for both the new EP program and the existing Bachelors of Science and Bachelors of Arts Physics programs.

### **B.2.1 EP Program Educational Objectives, Institutional Educational Objectives, and their relationships**

The NMSU Engineering Physics (EP) program is administered by the College of Engineering, but it is run by the Department of Physics in the College of Arts & Sciences. The EP program is administered by the Department of Physics but is a cooperative program with the Department of Mechanical Engineering (ME) and the Department of Electrical and Computer Engineering (EE). Students select a specialization in either Mechanical Engineering (ME) or Electrical Engineering (EE).

The EP program has been designed such that students acquire strong fundamental knowledge in physics and the chosen engineering field, adopt effective communication and problem-solving skills, develop the ability to tackle new problems, and achieve a level of preparation that allows continuation to advanced studies after graduation. Graduates of the EP program should be able to apply their acquired skills to solve research and development problems of interest for industry, governmental laboratories or academic institutions. The potential employment opportunities for EP graduates are extensive, and they include research and development, energy and utility, manufacturing, automotive, photonics, aerospace, defense and space, sensor technology, and many other fields. While the EP program intends to prepare the students for a wide range of professional careers in industry and governmental laboratories, it will also prepare them for graduate studies in engineering or physics.

In order to achieve the above goals of the EP program, the Department of Physics, with input from our EP External Advisory Board and representatives from the ME and EE programs, has established the Educational Objectives for the EP program that are listed in Table 2.1

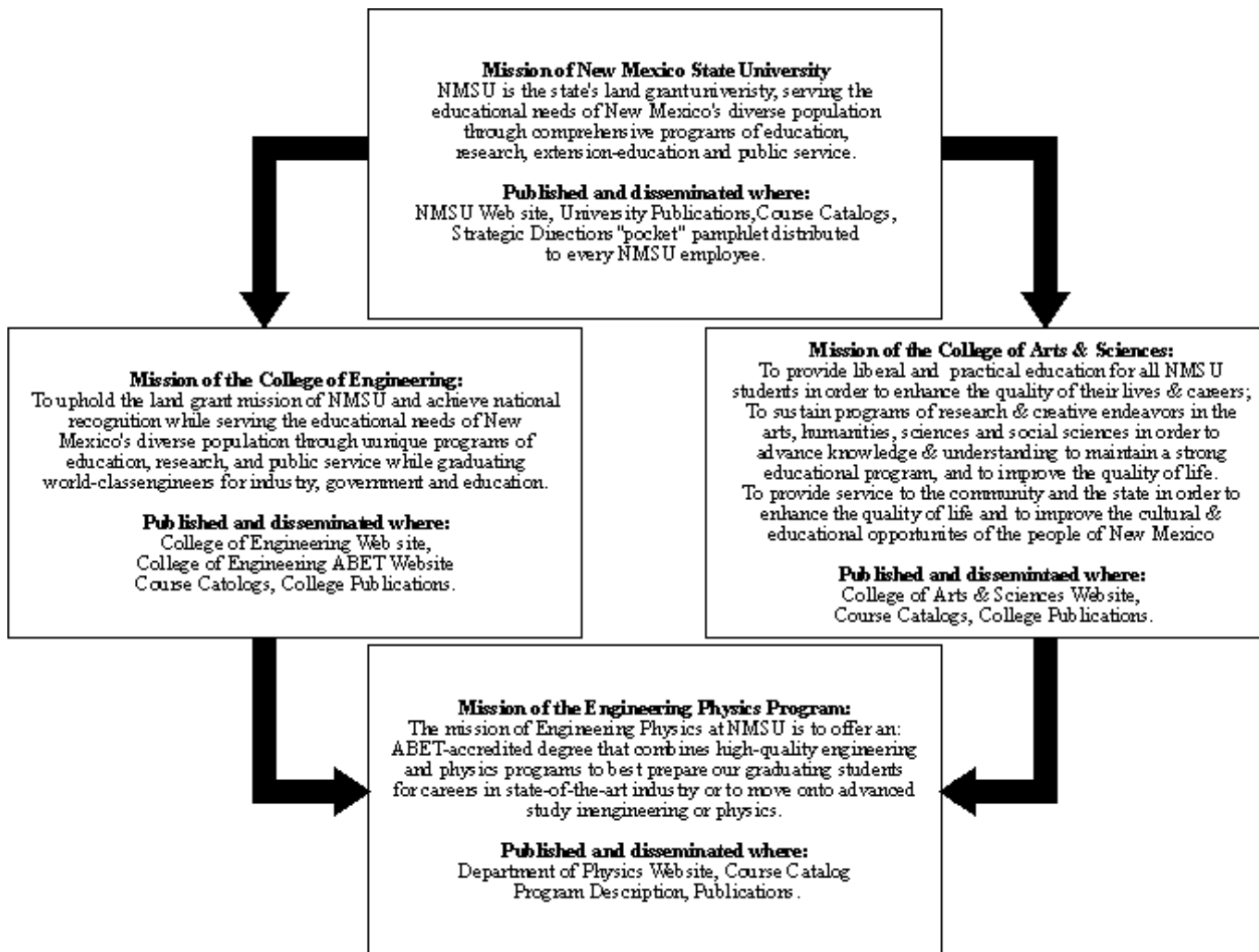
**Table 2.1:** Engineering Physics (EP) Educational Objectives.

- **EP Objective 1: Skills.** Develop skills pertinent to problem-solving in physics and engineering, including expertise in design, data collection, analysis and modeling, creative thinking, and effective communication and collaborative-working skills;
- **EP Objective 2: Career Preparation.** Prepare graduates to begin productive careers in industry, governmental laboratories and academic institutions, or to continue to advanced study in either a chosen engineering field or in physics;
- **EP Objective 3: Professional Adaptation.** Enable students to adapt as needs in the profession change;
- **EP Objective 4: Ethics.** Instill in our students an understanding of their professional and ethical responsibilities, grounded in the real life conflicts they will encounter after leaving school.

The EP program educational objectives are consistent with and supportive of the institutional educational objectives of the College of Engineering, the College of Arts and Sciences, and New Mexico State University. NMSU strategic planning activities originate at the highest level of the University in the President's office, and each of the Colleges, departments and supporting units are required to produce their own strategic plan that supports and is consistent with the overall plan of the University. Diagram 2.1 shows the relationship of the strategic mission statements of the University, the College and the Engineering Physics Program.

As a minority-serving land-grant institution, NMSU has established that its main overall mission is serving the people of New Mexico through education and research with special emphasis on preserving the state's multi-cultural heritage, protecting its environment, and fostering economic development in the state of New Mexico and the interdependent world. NMSU's primary mission is to provide quality education to a student body of various ages, interests, and cultural backgrounds. The university seeks to educate each student not only in how to earn a living but also in how to live a meaningful life.

NMSU has long supported and participated in a variety of strategic planning activities. Representatives of academic departments, colleges, support units and administrative units are involved in the development and assessment of a single strategic plan for the University and a number of related plans for the supporting units. An important task of strategic planning is to determine, advance, disseminate and refine the educational objectives of a program. These educational objectives have to be consistent with the overall strategic mission of the University as well as those defined by the New Mexico Commission of Higher Education (NMCHE) and the North Central Association (NCA).



**Diagram 2.1:** NMSU strategic mission statements at the university, college and program levels.

The program goals and objectives of the University are listed in the Strategic Directions pamphlet distributed to every NMSU employee. In undergraduate education, the University strives to enhance the undergraduate experience and maintain NMSU as *the university of choice* for New Mexico residents. Table 2.2 summarizes the educational objectives of the University designed to achieve this goal.

**Table 2.2:** NMSU’s Educational Objectives for undergraduate education.

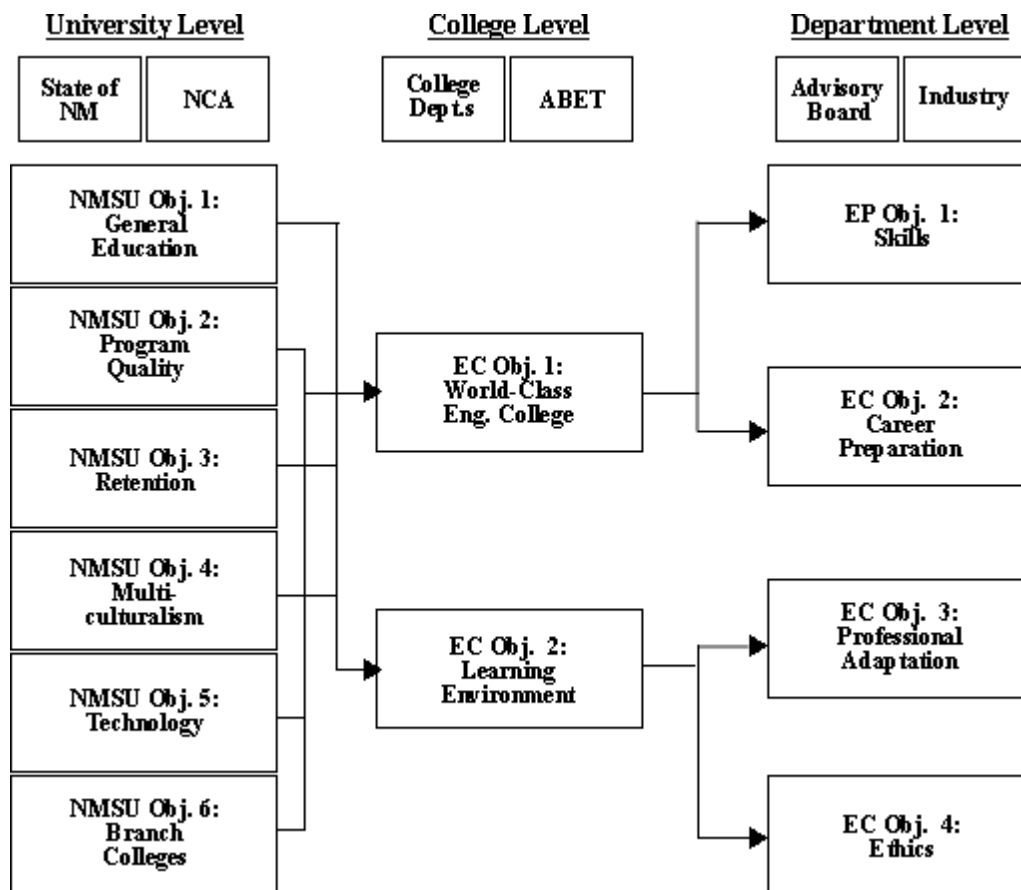
- **NMSU Objective 1: General Education.** Maintain a general education core curriculum that broadens knowledge and fosters lifelong learning.
- **NMSU Objective 2: Program Quality.** Continue to improve the quality of undergraduate programs.
- **NMSU Objective 3: Retention.** Continue strengthening retention efforts to assist students with the transition to college life, career decision-making, and progress toward degrees.
- **NMSU Objective 4: Multiculturalism.** Integrate multicultural perspectives and broaden exposure to the international community in the undergraduate experience.
- **NMSU Objective 5: Technology.** Ensure the integration of the most current information and technology into undergraduate programs to prepare students to compete in a rapidly changing world.
- **NMSU Objective 6: Branch Colleges.** Continue to provide access to higher education through the branch colleges.

Although the Department of Physics belongs to the College of Arts & Sciences, the EP degree is administered by the College of Engineering, and as such it needs to be consistent with the College of Engineering’s educational objectives. The college has established two main engineering-specific educational objectives for undergraduate education as published in the College of Engineering Strategic Plan. These objectives are listed in table 2.3

**Table 2.3:** Engineering College (EC) educational objectives for undergraduate education.

- **EC Objective 1: World-Class Engineering College.** Maintaining and further developing a world-class engineering college offering high-quality and accredited education programs that prepare students for successful engineering careers in industry and government, or for further study at the graduate level.
- **EC Objective 2: Learning Environment.** Maintaining and enhancing an environment that fosters creative and critical thinking, student involvement, professional and ethical awareness, life-long learning, societal awareness, and a continuous improvement philosophy.

As shown in Diagram 2.2, the educational objectives at the university and college levels align with the educational objectives of the EP program.



**Diagram 2.2:** Relationship of Institutional and the EP Educational Objectives.

### B.2.2. Constituents and Constituency Needs

The educational objectives of the EP program are strongly determined by the input, needs, demands, expectations and requirements of our constituencies. Below, we list our constituencies and how they contribute to the development of our EP program.

- **EP students**

Students provide feedback to the program through mandatory student evaluations of each course taken, regular interviews with the EP advisor each semester and senior exit interviews with the department head.

- **Physics Faculty and Staff**

The Department of Physics holds an annual retreat and all faculty and non-administrative support staff (instructors, lab coordinators) are required to attend. The central focus of the retreat is to discuss the progress and weaknesses of all physics programs, including needed changes in the curriculum and/or the overall program educational objectives.

To manage the EP program, the Department of Physics has an ABET committee. The committee is responsible for seeing that procedures are followed, that ABET outcome data are collected, and that evaluations and program changes are disseminated to the rest of the department. This committee has been initially chaired by the Head of the Department of Physics for the purposes of preparing the ABET self-study procedures. This ABET Self-Study Guide was initially produced in sections by all members of the department to ensure broad faculty participation and support. The ABET committee served to merge these sections into a single document.

The present members of the EP ABET Committee are listed in Table 2.4

**Table 2.4:** Internal EP Committee Members - 2006

<p style="text-align: center;">           Dr. Gary Kyle, Dept. Head, Department of Physics            Dr. Thomas Hearn, Faculty, Department of Physics            Dr. Heinrich Nakotte, Faculty, Department of Physics            Dr. Steve Pate, Faculty, Department of Physics            Dr. Don Birx, Faculty, Department of Physics            Dr. Mike DeAntonio, Instructional Staff, Department of Physics            Ms. Elena Fernandez, Staff, Department of Physics            Ms. Chris Pennise, Staff, Department of Physics            Dr. Ron Pederson, Associate Dept. Head, Mechanical Engineering Department.            Dr. Paul Furth, Associate Dept. Head, Electrical Engineering Department.         </p>
---

- **Faculty of affiliated ME and EE programs**

The ME and EE departments have selected faculty members as representatives of the internal EP ABET committee, which meets every month to discuss the progress and development of the program.

- **Alumni**

Since its inception, the Department of Physics has tried to keep an updated list of its alumni, their addresses and their present occupation. Alumni receive the annual Department of Physics newsletter, which includes a pre-paid envelope for any input that alumni want to provide. The department keeps close contact with many of its alumni through additional phone interviews. Presently, alumni are represented on the External Advisory Board for the EP degree.

- **Potential Employers (Industry, Academia, Government)**

This is probably the most important constituency group, and it is strongly represented on our external advisory board. The external advisory board meets once every year, typically in the spring semester. These meetings began in 2004. Members of the board provide important feedback to all aspects of the EP program, such as required skills of graduates, educational objectives and outcomes assessment. The advisory board evaluates the overall program, identifies its strength and weaknesses and provides a written report that includes suggestions on how to improve the program. Apart from input through the advisory board, many of our faculty and staff members have close interactions with representatives from industry and national laboratories, and their comments and

suggestions are taken into account as well. The makeup of the EP External Advisory Board is listed in Table 2.5.

**Table 2.5:** Past and Present EP External Advisory Board Members

<p><b>May 2004</b> Mr. Jon Haas (Chair), Head of the Chemistry and Materials Section for Honeywell at NASA Johnson Space Center, White Sands Test Facility, Las Cruces, NM; Dr. James A. McNeil, Professor and Head of the Physics Department, Colorado School of Mines, Golden, CO; Dr. Dennis Buss, Vice President for Silicon Technology and Development, Texas Instruments, Inc., Dallas, TX; Dr. S. Thomas Picraux, Executive Director of Materials Research and Professor, Arizona State University, Tempe, AZ; Mr. John Schaub (B.S.E.P. NMSU 2004) Department of Physics, NMSU, Las Cruces, NM.</p> <p><b>March 2005</b> Mr. Jon Haas (Chair), Head of the Chemistry and Materials Section for Honeywell at NASA Johnson Space Center, White Sands Test Facility, Las Cruces, NM; Dr. James A. McNeil, Professor and Head of the Physics Department, Colorado School of Mines, Golden, CO; Dr. Robert Sanderson, Department of Entomology, Plant Pathology, and Weed Science (NMSU), and High Tech Consortium of Southern New Mexico, Las Cruces, NM; Dr. James Small, Director of Advanced Programs with Raytheon Missile Systems, Tucson, AZ, Mr. John Schaub (B.S.E.P. NMSU 2004) Department of Physics, NMSU, Las Cruces, NM.</p> <p><b>March 2006</b> Mr. Jon Haas (Chair), Deputy Program Manager, Environmental Program, NASA Johnson Space Center, White Sands Test Facility, Las Cruces, NM; Dr. James A. McNeil, Professor and Head of the Physics Department, Colorado School of Mines, Golden, CO; Dr. Frank Addressio, Fluid Dynamics Group Leader, Los Alamos National Laboratory, Los Alamos, NM; Dr. Ronald Tafoya, Senior Software Engineer, Intel Corporation, Albuquerque, NM; Mr. Vincent Salazar, Senior Manager, Sensors and Information Technologies, Sandia National Laboratories, Albuquerque, NM; Mr. John Schaub (B.S.E.P. NMSU 2004) Department of Physics, NMSU, Las Cruces, NM.</p>
---

- **Peer Institutions that offer EP or similar programs**

We are in contact with other academic institutions (for example, the Colorado School of Mines) that offer similar programs, and are accredited by ABET. We built on their experience for our self-study document, and this constituency group is also represented on our advisory board.

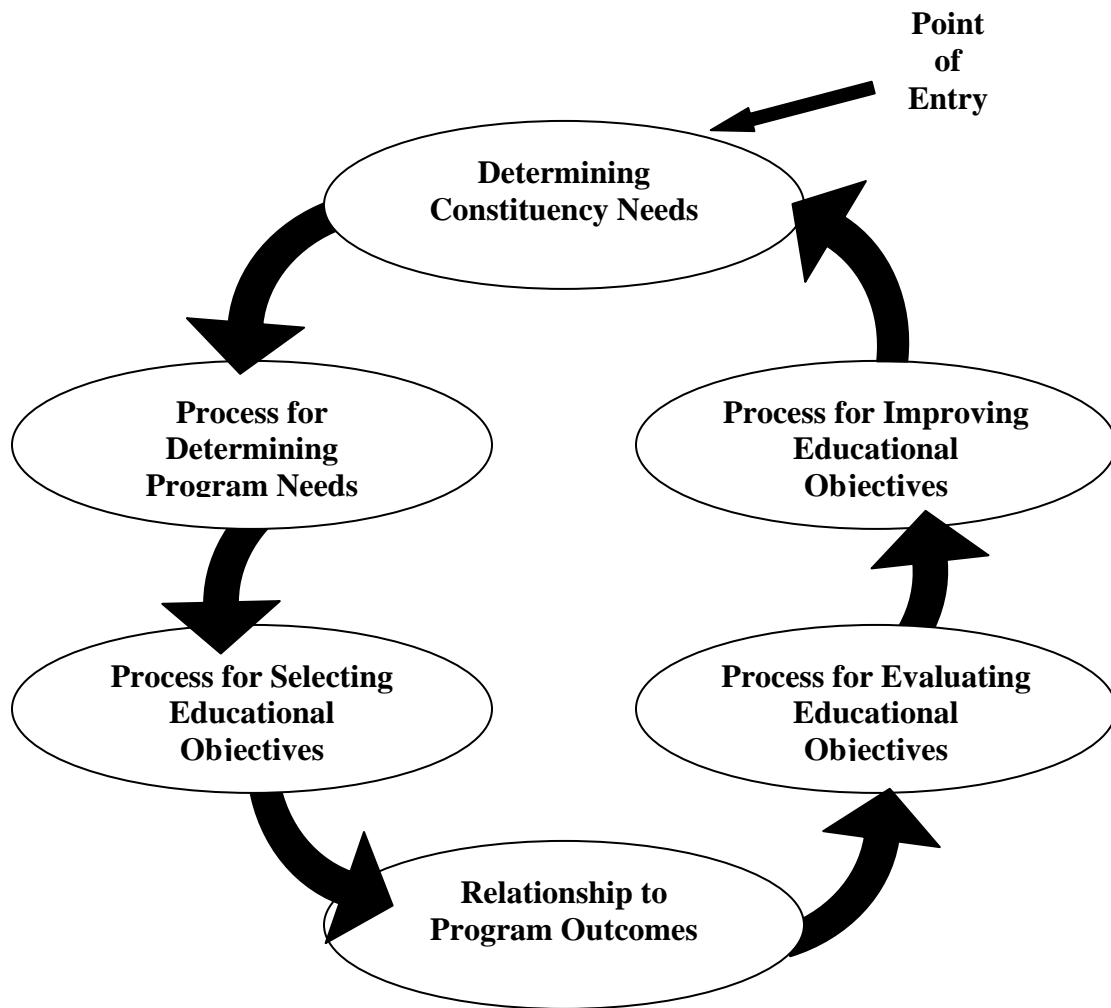
- **Graduate Schools**

Graduate schools are an important potential destination for our students; many of our graduates have already made the choice to attend graduate school in physics or engineering. The curricula of the pre-existing physics and engineering programs were already tailored for the needs of students seeking graduate education, so the needs of this constituency were built-in from the beginning. This group is now represented by advisory board members from our own and other universities, but the advisory board still needs more direct representation from regional graduate engineering programs.

Each of the constituency groups plays an important, and often complementary, role in both the evaluation and the improvement of our EP program. Input from our constituencies is included in the assessment of the program and we aggressively solicit their assistance in further development of our program.

### **B.2.3 Process of Evaluating and Improving Educational Objectives**

The process of defining and revising the Program Educational Objectives for our EP program is ongoing. The Department of Physics is committed to continually measure, analyze and improve the Educational Objectives. The Program Educational Objectives need to be embedded into the educational goals and objectives of the institution, as stated in its mission plan. The process for establishing the Program Educational Objectives is shown in Diagram 2.3.



**Diagram 2.3:** Process flow-chart for establishing and evaluating the Educational Objectives of the EP program.

## **Descriptions of the Processes:**

- **Process for Determining Constituency Needs**

This has been the initial point of entry, and this process involves a broad survey of various constituencies to identify their needs and collect their opinions. Surveys are done on a regular basis, and the Engineering Physics External Advisory Board plays an integral role in assisting the department in determining the constituency needs.

- **Process for Determining Program Needs**

There is a need to implement the constituency needs into the program such that it is consistent with and supportive of the strategic mission of the university and its units. In addition, a curriculum with suitable course content has to be in place to secure the success of the program. Program needs are addressed by the internal ABET committee, involving faculty of the Physics and participating engineering departments and with the advice of the EP External Advisory Board.

- **Process for Selecting Educational Objectives**

The Educational Objectives have been designed to best satisfy the needs of our constituencies, the educational missions of the university and the college. The Educational Objectives have been widely distributed and discussed with our constituencies and the university administration.

- **Relationship to Program Outcomes**

With input from the advisory board, the internal EP ABET committee verifies that our Educational Objectives reflect the desired Program Outcomes, required by ABET.

- **Process for Evaluating Educational Objectives**

Alumni and employer surveys, as well as the performance of our students and graduates, are used to periodically determine the effectiveness of our Program Educational Objectives. A detailed discussion of assessment tools and strategies is given in the following sections.

- **Process for Improving Educational Objectives**

If needed, adjustments and improvements to the Educational Objectives are discussed by the EP ABET committee, which will suggest changes and/or modifications to the objectives. Prior to implementing such changes, we will seek the advice and input of our External Advisory Board. In addition, the development of the Program Educational Objectives is closely tied to the departmental and institutional strategic plans.

### **B.2.4 Improving Educational Objectives – Corrective Action**

We have already been able to document a change in our Educational Objectives using the process described above.

#### **Educational Objectives – Corrective Action 1**

- **Initial Condition:** Initially, we had formulated five Educational Objectives for the Engineering Physics program. Of those five objectives, one of them dealt with

preparation for various types of careers and another dealt with preparation for graduate study.

- **Observations and Feedback:** Our external advisory board felt that there was an artificial distinction being made between preparation for careers and for graduate study. A student might pursue a graduate degree with the intent to go on to any number of different careers. Furthermore, students preferred to have both options open to them at graduation. It was suggested that we combine these two objectives into a single one.
- **Corrective Action:** The previously separated two Educational Objectives were combined into one objective. The 'new' objective reads: "EP Objective 2: Career Preparation -- prepare graduates to begin productive careers in industry, governmental laboratories and academic institutions, or to continue to advanced study in either a chosen engineering field or in physics."