

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

This chapter describes the *Mission* and the *Program Educational Objectives* of the *Engineering Physics (EP)* program, the process for evaluating their relationship to constituency and/or program needs, and their connection to the *Institutional Mission* and their *Educational Objectives*.

The current *Program Educational Objectives* for EP were formulated in 2012, just prior to the previous ABET site visit. They were compiled with the help of the Engineering Physics External Advisory Board, taking into account additional considerations from administrators, faculty and staff of the *Departments of Physics, Mechanical & Aerospace Engineering, the Electrical & Computer Engineering, Chemical & Materials Engineering, the Colleges of Arts & Sciences and Engineering, and the University*.

A. Mission Statement

Provide the institutional mission statement.

The mission statement of *New Mexico State University (NMSU)* is as follows:

New Mexico State University is the state's land-grant university, serving the educational needs of New Mexico's diverse population through comprehensive programs of education, research, extension education, and public service.

The mission statement of *NMSU's College of Engineering* is as follows:

The College of Engineering will uphold the land grant mission of NMSU through nationally recognized programs in education, research, and professional & public service.

The mission statement of *NMSU's Engineering Physics Program* is as follows:

The mission of Engineering Physics at New Mexico State University is to offer an accredited degree that combines high-quality engineering and physics programs to best prepare our graduating students for careers in state-of-the-art industry or to move on to advanced study in engineering or physics.

B. Program Educational Objectives

List the program educational objectives and state where these can be found by the general public.

The *Department of Physics* at NMSU currently offers three undergraduate degrees, i.e. *Bachelors of Science in Physics (BS-Physics)*, *Bachelors of Arts in Physics (BA-Physics)* and *Bachelors of Science in Engineering Physics (BS-EP)* and two graduate degrees, i.e. *Masters of Science (MS)* and *Doctoral Degree (PhD) in Physics*. In this *Self-Study Report* only the *Program Educational Objectives* of BS-EP are evaluated, although there is often considerable overlap with the educational objectives/goals of the other degrees offered.

The *Program Educational Objectives* for EP were revised in 2012, just prior to the 2012 ABET site visit, with considerable input from the EP program constituencies (defined in part D of this section) and from our 2012 *Engineering Physics External Advisory Board (EPEAB)*; see part E of this section. The current *Program Educational Objectives* of the EP program are listed in Table 2.1. They are formulated such that they best address the needs of our constituencies and to best achieve the goals stated in the various mission statements above. The *Educational Objectives* are formulated such that they capture the spirit of *ABET's Guidelines for Educational Objectives*.

Table 2.1. *Program Educational Objectives of the Engineering Physics Program at NMSU.*

<p style="text-align: center;">EP Educational Objective 1: Competitiveness.</p> <p style="text-align: center;">Graduates are competitive in internationally-recognized academic, government and industrial environments.</p> <p style="text-align: center;">EP Educational Objective 2: Adaptability.</p> <p style="text-align: center;">Graduates exhibit success in solving complex technical problems in a broad range of disciplines subject to quality engineering processes.</p> <p style="text-align: center;">EP Educational Objective 3: Teamwork and Leadership.</p> <p style="text-align: center;">Graduates have a proven ability to function as part of and/or lead interdisciplinary teams.</p>
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Our EP *Program Educational Objectives* are widely advertised and publicly available through departmental advertising/recruitment brochures, fliers & hand-outs, program weblinks, official documents & reports (such as this *Self-Study Report*). They also posted in various places throughout the department.

C. Consistency of the Program Educational Objectives with the Mission of the Institution

Describe how the program educational objectives are consistent with the mission of the institution.

NMSU's strategic planning activities originate at the highest level of the university in the President's office. 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. 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 many 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* must 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). Over the past few years, NMSU has formulated and adopted an *Academic Strategic Plan*, called the *Vision 2020 Strategic Plan*, with goals that are listed in Table 2.2.

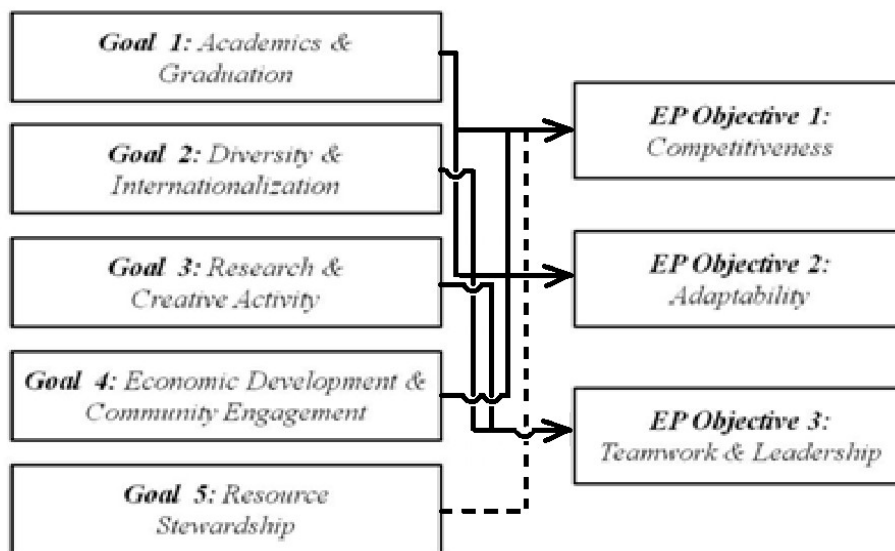
Each of NMSU’s colleges, departments, academic programs and supporting units are required to produce their own individual strategic plans that should support the overarching strategic goals of the university. In this section, we hope to establish that the *Program Educational Objectives* of the EP program are consistent with and supportive of the institutional goals of NMSU.

Table 2.2. *Current Vision 2020 Goals for NMSU*

<p>Goal 1: Academics and Graduation. Provide stellar programs, instruction, and services to achieve timely graduation.</p> <p>Goal 2: Diversity and Internationalization. Provide a diverse academic environment supportive of a global society.</p> <p>Goal 3: Research and Creative Activity. Promote discovery, encourage innovation, and inspire creative activity.</p> <p>Goal 4: Economic Development and Community Engagement. Drive economic, social, educational and community development.</p> <p>Goal 5: Resource Stewardship. Optimize resources to effectively support teaching, research and service.</p>
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Our three *Program Educational Objectives* for EP are closely linked to NMSU’s *Vision 2020* goals, as shown in diagram 2.1.

Diagram 2.1. *Relationship of NMSU’s Vision 2020 Institutional Goals with the EP Educational Objectives.*



D. Program Constituencies

List the program constituencies. Describe how the program educational objectives meet the needs of these constituencies.

The *Engineering Physics (EP)* degree is an engineering degree awarded through the *College of Engineering*, but it is housed in the *Department of Physics*, which belongs to the *College of Arts & Sciences*. The College of Engineering and the Department of Physics established an *Engineering Physics (EP) Program Committee* with members from the departments of *Physics*, *Aerospace & Mechanical Engineering*, *Electrical & Computer Engineering* and *Chemical & Materials Engineering*. EP students can select between four different concentrations: *Engineering Physics with the Aerospace Concentration (EP-AE)*, *Chemical Concentration (EP-ChE)*, *Electrical Concentration (EP-EE)*, or *Mechanical Concentration (EP-ME)*.

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

EP students

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

Potential Employers (Industry, Academia, Government)

This is probably the most important constituency group, and it is strongly represented on our *Engineering Physics External Advisory Board (EPEAB)*; for membership, see part B of this section. The *EPEAB* typically meets every other year, although more frequent annual meetings may be called, if needed. 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 *EPEAB* 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 NMSU faculty and staff members have close interactions with representatives from industry and/or national laboratories, and their comments and suggestions are considered as well.

Physics Faculty and Staff

The *Department of Physics* holds annual retreats 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 cross-college EP program, the *Department of Physics* has created an *EP Program Committee* that includes members of the Department of Physics and the associated engineering departments. The *Physics Department Head* and the *Associate Dean of Engineering for Academics* are *ex-officio* members of this committee. Current membership of the *EP Program Committee* can be found in the first section of this Self-Study Document (*Background Information*). The *EP Program Committee* oversees the program progress, makes sure that assessment procedures are followed, continuously evaluates the health of the program, and implements necessary program changes. While the *EP Program Committee* directs the EP

program, it relies on the involvement of other faculty members from physics and the participating engineering departments for program assessment and improvement.

Faculty of Affiliated Engineering Programs

Three engineering faculty members, one each from the *Departments of Mechanical & Aerospace Engineering, Chemical & Materials Engineering* and *Electrical & Computer Engineering*, serve on the *EP Program Committee*, and they participate in the committee meetings on a regular basis. The engineering committee members also serve as spokespersons for the needs and interests of the EP program at their respective home departments in the *College of Engineering*.

Alumni

Since its inception, the *Department of Physics* has tried to keep an updated list of its alumni, their addresses and their present occupation. In many cases, the department has succeeded to keep close contact with past alumni and it performs occasional alumni surveys. Moreover, the *EPEAB* has alumni representation on the board.

Peer Institutions that offer EP or similar majors

We are in close contact with other academic institutions that also offer an *Engineering Physics Programs*, accredited by *ABET*. The *EPEAB* has a representative from such peer institutions, and we built on their experience for program progress and accreditation purposes.

Graduate Schools

Graduate schools are an important potential destination for our students. Several of our EP alumni pursue advanced graduate studies in physics or engineering following their graduation from EP. The curricula of the pre-existing physics and engineering programs are therefore tailored for the needs of students seeking graduate education. The *EPEAB* has current representation from academic institutions, which offers graduate programs to EP graduates.

Citizens of New Mexico

As the land-grant state university in New Mexico, NMSU and its programs have strong commitments to citizens of the state and in the region. Many of our EP students and their parents come from New Mexico, and the EP program is actively involved in many outreach and educational activities to the public.

Constituency needs are implemented into the *Program Educational Objectives* such that they are consistent with and supportive of the strategic mission of the university and its units. 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. Moreover, many of our constituencies serve as members of the *EPEAB*, see Tables 2.3-5. With their input, the EP program has been designed such that students acquire strong fundamental knowledge in physics and individual engineering concentrations, 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.

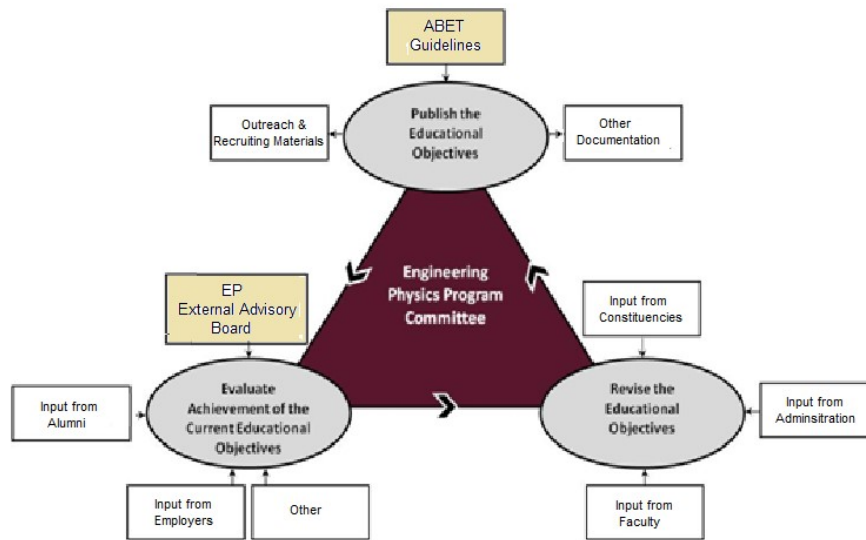
E. Process for Review of the Program Educational Objectives

Describe the process that periodically reviews the program educational objectives including how the program’s various constituencies are involved in this process. Describe how this process is systematically utilized to ensure that the program’s educational objectives remain consistent with the institutional mission, the program constituents’ needs and these Criteria.

Evaluating and improving the *Program Educational Objectives* for our EP program is an ongoing and continuous process. If needed, adjustments and improvements to the educational objectives are initiated by the *EP Program Committee*, which will suggest changes and/or modifications to the objectives, if needed. Prior to implementing such changes, we will seek the advice and input from the *EPEAB* and other constituencies, such as faculty members or institutional entities.

The *EP Program Committee* collects continuous feedback about the achievement of its *Program Educational Objectives*. The EP program is still a small program in the *College of Engineering* at NMSU with only few graduates each year, and we can therefore collect feedback from alumni or employers through surveys or similar. The process for establishing, publishing and evaluating the *Program Educational Objectives* is shown in Diagram 2.2.

Diagram 2.2. Process flow-chart for establishing and evaluating the *Program Educational Objectives* of the *Engineering Physics* program.



The main body in charge of evaluating whether the program is successful in achieving its *Educational Objectives* is the *EPEAB*. For each *EPEAB* site visit, the *EP Program Committee* will provide a collection of materials and updated data in support of whether the EP program achieves its *Educational Objectives*.

The *EPEAB* has four standing tasks:

- review current policies and procedures within the program,
- identify potential issues and areas of concern,
- evaluate whether the program achieves its stated *Educational Objectives*, and
- prepare a report for distribution to the *EP Program Committee* and the deans.

Since the *EPEAB* plays an instrumental role for the overall program evaluation and success or failure of achieving its *Educational Objectives*, their membership is of critical importance. The members for the 2012, 2014 and 2016 *EPEAB* are listed in Table 2.3.

Table 2.3. Members of the 2012, 2014 and 2016 EPEABs.

2012 EPEAB

On-Campus Visit: January 23 & 24, 2012

Dr. Steven Castillo, Sandia National Laboratory, Albuquerque, New Mexico, **Mr. Jon Haas (Chair)**, NASA Johnson Space Center, Las Cruces, New Mexico, **Prof. Mark Holtz**, Texas Tech University, Lubbock, Texas, **Dr. Alan Lovell**, Air Force Research Laboratory, Albuquerque, New Mexico, **Prof. David Probst**, Southeast Missouri State University, Cape Girardeau, Missouri, **Dr. Mark Schraad**, Los Alamos National Laboratory; Los Alamos, New Mexico, **Dr. John Schaub (EP Alumnus)**, Valparaiso University, Indiana, **Mr. Ronald Tafoya**, Intel Corporation, Rio Rancho, New Mexico

2014 EPEAB

On-Campus Visit: April 24 & 25, 2014

Dr. Steven Castillo, Sandia National Laboratory, Albuquerque, New Mexico, **Ms. Laura Dominik**, Honeywell, Minneapolis, Minnesota, **Mr. Jon Haas (Chair)**, NASA Johnson Space Center, Las Cruces, New Mexico, **Prof. Mark Holtz**, Texas Tech University, Lubbock, Texas, **Dr. Alan Lovell**, Air Force Research Laboratory, Albuquerque, New Mexico, **Prof. David Probst**, Southeast Missouri State University, Cape Girardeau, Missouri, **Dr. Mark Schraad (Chair)**, Los Alamos National Laboratory; Los Alamos, New Mexico, **Mr. Ronald Tafoya**, Intel Corporation, Rio Rancho, New Mexico, **Mr. Luke Wyatt (EP Alumnus)**, Sandia National Laboratory, Albuquerque, New Mexico

2016 EPEAB

On-Campus Visit: May 6 & 7, 2016

Dr. Steven Castillo, Sandia National Laboratory, Albuquerque, New Mexico, **Ms. Laura Dominik**, Honeywell, Minneapolis, Minnesota, **Mr. Jon Haas (Chair)**, NASA Johnson Space Center, Las Cruces, New Mexico, **Dr. Alan Lovell**, Air Force Research Laboratory, Albuquerque, New Mexico, **Mr. Nathaniel Nunley (EP Alumnus)**, University of Texas, Austin, Texas, **Prof. David Probst**, Southeast Missouri State University, Cape Girardeau, Missouri, **Dr. Kurt Schoenberg**, Los Alamos National Laboratory; Los Alamos, New Mexico, **Mr. Ronald Tafoya**, Intel Corporation, Rio Rancho, New Mexico

In the past year, the *EP Program Committee* had to replace several past *EPEAB* members, due to retirement or resignation, and it also added two additional members (one from industry and one from academia). The current members of the *EPEAB* are listed in Table 2.4.

Table 2.4. *Current Members Engineering Physics External Advisory Board.*

<p style="text-align: center;">2017 EPEAB <i>On-Campus Visit: April 28 & 29, 2017</i></p> <p style="text-align: center;">Dr. Steven Castillo Manager; Intelligence, Surveillance and Reconnaissance Systems Engineering & Decision Sandia National Laboratory, Albuquerque, New Mexico</p> <p style="text-align: center;">Dr. Candi Cook Senior Process Engineer; Technology Development Group Intel, Hillsboro, Oregon</p> <p style="text-align: center;">Ms. Laura Dominik Systems Engineer; Systems; Certified Project Management Professional (PMP) at Honeywell Honeywell, Minneapolis, Minnesota</p> <p style="text-align: center;">Mr. Jon P. Haas Associate Principal Engineer; NASA Engineering & Safety Center NASA Langley Research Center - White Sands Test Facility, Las Cruces, New Mexico</p> <p style="text-align: center;">Dr. T. Alan Lovell (Chair) Research Aerospace Engineer; Space Vehicles Directorate Air Force Research Laboratory, Albuquerque, New Mexico</p> <p style="text-align: center;">Mr. T. Nathaniel Nunley (EP Alumnus) PhD Student; Department of Physics University of Texas, Austin, Texas</p> <p style="text-align: center;">Prof. David Probst Department Chair; Department of Physics & Engineering Physics Southeast Missouri State University, Cape Girardeau, Missouri</p> <p style="text-align: center;">Dr. Kurt Schoenberg Partner; Applied Science Enterprises; and former LANSCE User Facility Director LANSCE, Los Alamos National Laboratory, Los Alamos, New Mexico</p> <p style="text-align: center;">Dr. Katyayani Seal Technical Consultant; Quantum Design International Quantum Design, San Diego, California</p> <p style="text-align: center;">Prof. Michael Strosio Professor; Department of Electrical & Computer Engineering University of Illinois, Chicago, Illinois</p> <p style="text-align: center;">Mr. Travis Willett-Gies (EP Alumnus) Systems Integration & Test Engineer; Space Services Division ATA Aerospace, Albuquerque, New Mexico</p>
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Aside from those permanent tasks, the *EPEAB* may be asked to provide their input to imminent changes to the curriculum, university administration, or similar. For example, the 2016 *EPEAB* reviewed the proposed changes to the *General Education* and *Viewing the Wider World* requirements as well as the possibility the EP degree could be administered in 120 credits without adversely affecting the program quality and accreditation.

To assist the board with the assessment of *Program Educational Objectives*, the *EP Program Committee* will provide any data that may be available about our alumni, such as employers and job placements. Diagrams 2.3 and 2.4 provide examples of data presented to the 2017 *EPEAB*.

Diagram 2.3. *Career Choices of NMSU EP Alumni (data from Spring 2017).*

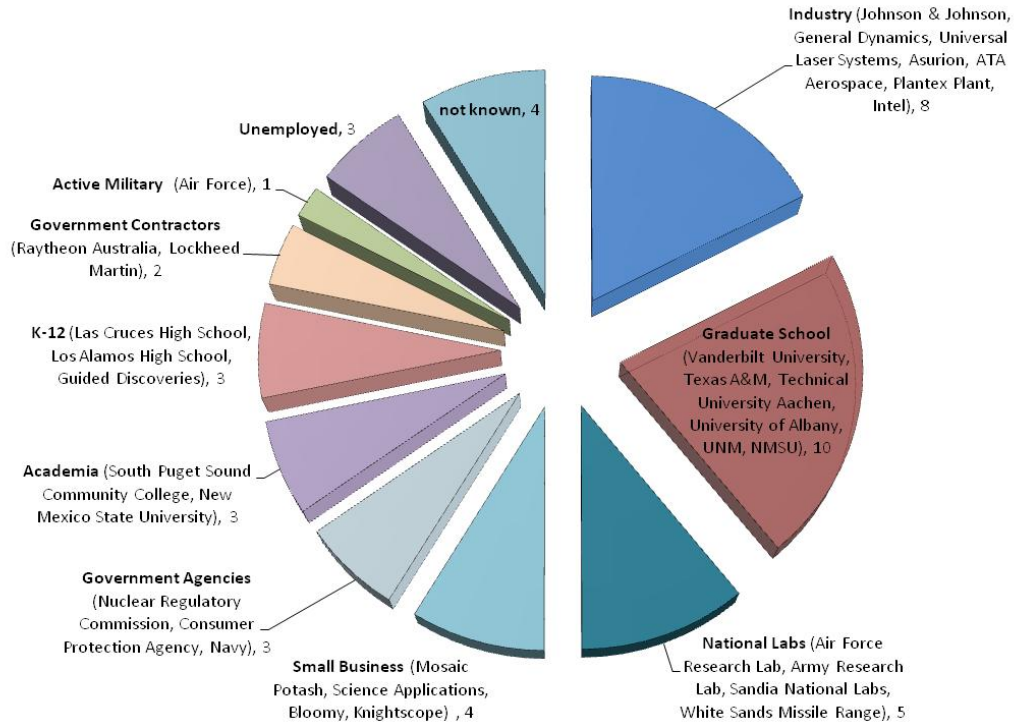
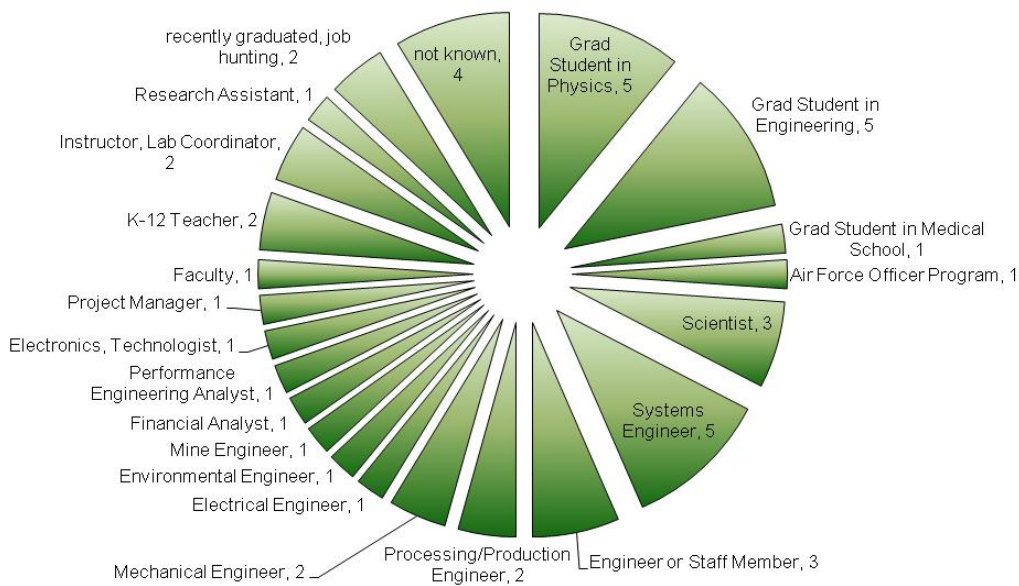


Diagram 2.4. *Job Titles of NMSU EP Alumni (data from Spring 2017).*



In general, the *Department of Physics* hosts a 1-2 day on-campus meeting with the *EPEAB*. The meeting consists of formal presentations to all aspects of the program, including graduation rates, retention, curriculum, staffing and budgets. The *EPEAB* meets with all faculty members from physics and faculty representatives from the associated engineering programs. The board also meets separately with the EP students of all concentrations and sometimes alumni.

In the last six years, each *EPEAB's* assessment of achievement of our *Program Educational Objectives* has been extremely positive, as evidenced by their written reports and the meeting minutes. For example, the 2017 *EPEAB* report stated:

The data and metrics reviewed point to a very successful EP program. The NMSU EP Program Committee continues to demonstrate good stewardship of the Program through its efforts. Of particular importance is the Program's proactive assessment of student feedback and attention to the details of changing curricula in connected departments, making course content adjustments as necessary. The EPEAB was presented with many good examples of student academic successes and students' ability to find employment in scientific or technical organizations. Recent graduates are engaged in advanced degree programs at very respectable scientific or engineering schools, or employed in industry, academic, or research lab positions.

The EP Program has three educational Objectives:

EP Objective 1: Competitiveness. Graduates are competitive in internationally recognized academic, government, and industrial environments.

The EP Program continues to attract top students into its challenging curriculum, with approximately one-quarter each of EP Program graduates engaged in graduate-level academic programs, government-related careers, and industrial or business environments (others are teaching or unknown). Unemployment in science and engineering fields is generally low. EP Program graduation rates have been trending with enrollment, indicating good retention, with career choices for graduating EP students more diverse than for either physics or engineering graduates.

EP Objective 2: Adaptability. Graduates exhibit success in solving complex technical problems in a broad range of disciplines subject to quality engineering processes.

EP Program graduates are entering advanced courses of study, and being hired into a diverse selection of high-tech jobs in industry and government laboratories, with some engaged in entrepreneurship. The employment rates and diversity of opportunities not only demonstrate that the goals of the program are being met, but this also addresses the goals of NMSU. Engineering Physics graduates demonstrate ongoing contributions to New Mexico and the nation with greater economic impact. More than 10% of the employed (i.e., not continuing in a program of study) EP graduates report Systems Engineer as their current job title, indicating an interdisciplinary career; the remainder report 16 additional job titles, highlighting the diversity of professional opportunity open to EP graduates.

EP Objective 3: Teamwork and Leadership. Graduates have a proven ability to function as part of and/or lead interdisciplinary teams.

In this area, students with EP preparation excel. Preparation for leadership of interdisciplinary teams is a generally neglected element of university preparation for engineering and science careers. Simultaneously, the ability to lead interdisciplinary teams and perform complex system integration functions are among the most necessary skills for the success of large engineering and science development projects. EP Program graduates are well-prepared to address this gap.

Recent Program statistics record that more than 20% of program graduates list supervisory duties and greater than 90% report working in team environments.

Aside from feedback from the EPEAB, the EP Program Committee performed (voluntary) alumni surveys in 2014 and 2017, which included questions to the alumni whether the EP Program achieves its three *Educational Objectives*. The two surveys were sent to students who graduated between 3 and 10 years prior to the survey. The results of these two surveys are provided in Table 2.5. The results of those two surveys provide further evidence that the EP Program generally achieves its *Educational Objectives*.

All materials connected to the *Educational Objectives* of the EP program are compiled in the ‘Black’ Educational Objectives Notebook, the contents of which are listed below.

‘Black’ *Educational Objectives Notebook* (filled in as needed)

- *Engineering Physics (EP) Program Committee* meeting minutes
- *Engineering Physics External Advisory Board (EPEAB) Reports* and meeting minutes
- summaries of *Alumni Surveys*
- other relevant information

Table 2.5. Results of Alumni-Survey Questions: Did NMSU EP achieve its Educational Objectives?

Survey	Educational Objectives	Number of Responses	Strongly Agree	Agree	No Opinion	Disagree	Strongly Disagree
2014	<i>Objective 1: Competitiveness</i>	10	2	5	2	1	
	<i>Objective 2: Adaptability</i>	10	5	5			
	<i>Objective 3: Teamwork & Leadership</i>	10	5	5			
	<i>Overall Satisfaction with Learning Experience</i>	10	3	7			
2017	<i>Objective 1: Competitiveness</i>	11	2	8	1		
	<i>Objective 2: Adaptability</i>	11	5	6			
	<i>Objective 3: Teamwork & Leadership</i>	11	3	6	1	1	
	<i>Overall Satisfaction with Learning Experience</i>	11	7	4			