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Review of the Sandia National Laboratories - Albuquerque, New Mexico DOE/DP Critical Skills Development Programs

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Prepared by
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Review of the Sandia National Laboratories — Albuquerque, New Mexico DOE/DP Critical Skills Development Programs

FY '02

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Abstract

Sandia National Laboratories has developed a portfolio of programs to address the critical skills needs of the DP labs, as identified by the 1999 Chiles Commission Report. The goals are to attract and retain the best and the brightest students and transition them into Sandia – and DP Complex – employees. The US Department of Energy/Defense Programs University Partnerships funded seven laboratory critical skills development programs in FY02. This report provides a qualitative and quantitative evaluation of these programs and their status.

ACKNOWLEDGEMENTS

The coordination of Sandia NM Laboratory Critical Skills Development Programs is a personal and professional accomplishment. The participating students, technical line staff, university and community college faculty, and support staff are the foundation of our programs' success and are commended for their efforts. Sincere appreciation to DOE/DP Office of University Partnerships for sponsorship of – and commitment to – these programs.

Special thanks and appreciation to the following individuals:
- Phil Gallegos – Advanced Manufacturing for Education
- Bob Hutchinson – College Cyber Defenders
- Shanalyn Kemme – Photonics Technical Support Initiative
- Ron Loehman – Materials Science Research Institute
- Regan Stinnett – MESA Institute
- Ken Struve – National Collegiate Pulsed Power Research Institute
- Pete Wilson – ASCI Program

- Essel Baca, West Mesa High School
- Tom Daly, West Mesa High School
- Carmen Di Gregorio – West Mesa High School
- Art Guenther – UNM Center for High Tech Materials
- Leno Pedrotti – Center for Occupational Research and Development
- Mike Stanton – Albuquerque High School

- Anna Chalamidas – Program support and database maintenance

- Department 3531-2 Recruiting and Student Programs – Infrastructure and support of student internship programs.

This evaluation shows a strong correlation between focused critical skills development programs and full-time employment within the Complex, as well as showcasing the importance of the pipeline programs in helping the Labs meet the recommendations of the 1999 Chiles Commission Report.

Thank you for your interest and attention.

Sincerely,

Dominique Foley Wilson
Consultant, DOE/DP Laboratory Critical Skills Development Programs

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Summary

Sandia National Laboratories[1] (Sandia) is entering its second half-century of producing science-based solutions to national defense challenges. This program mission requires a vital and cutting-edge research program capable of responding quickly and effectively to a range of potential threats from a multitude of sources. Fundamental to such a research program is a well-trained, experienced, and agile workforce. As part of a systematic approach to addressing these workforce needs, Sandia has developed a portfolio of pipeline programs using Department of Energy, Office of Defense Programs (DOE/DP) funding. These programs address the critical skills needs recommended by the 1999 Chiles Commission Report with the goal of producing the highly qualified technical staff needed by Sandia. The programs are focused at two levels—secondary and postsecondary. Integral to these programs are internships that bring promising students to Sandia—technical staff can identify potential employees, and students learn about the benefits of working at Sandia. The seven Sandia pipeline programs shown in Table 1 were funded in FY 2002, each targeting specific critical skills needs to support Sandia's defense mission.

Table 1: Summary Table of Pipeline Programs

Program	Primary Academic Level	Start Date	Student Participants	FY02 New Employee Conversions
College Cyber Defenders Institute (CCD)	Undergraduate	Summer 01	Summer 02: 20 interns	6
Microsystems and Engineering Sciences Applications Institute (MESA)	Graduate	Summer 01	Summer 02: 19 interns	3
Materials Science Research Institute (MSRI)	Undergraduate and Graduate	AY 01/02	Summer 02: 2 intern	
National Collegiate Pulsed Power Research Institute (NCPPRI)	Undergraduate	AY 01/02	Summer 02: 8 interns	
Advanced Manufacturing for Education: Advanced Technology Academy at Albuquerque High School (ATA/AHS)	High School	AY 01/02: 1st year with students	AY 01/02: 105 high school students AY 02/03: 120 students expected	
Advanced Manufacturing for Education: Advanced Technology Academy at West Mesa High School (ATA/WMHS)	High School	Pilot implemented 1996	AY 01/02: 113 high school students AY 02/03: 137 students expected	3
Photonics Academy at West Mesa High School	High School	AY 02/03	AY 02/03: 50 students expected	

AY=Academic Year

[1] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the US Department of Energy under contract DE-AC04-94AL85000.

Pipeline Programs Highlights

The attraction and retention of highly qualified people as Sandia employees in critical skills areas are the primary goals of these programs. In parallel with developing these pipeline programs; program staff developed a program matrix that identified the objectives and strategies that are used to meet these goals (see Table 3 in the body of this report). In addition, the program staff has implemented an information collection process that allows them to evaluate how the programs meet their goals, to identify the impacts of the program, and to suggest areas for improvement. The following is a summary of the highlights that were identified through this information collection for the period ending summer 2002.

College-level Pipeline Programs

At the college level, two programs have completed two full summers of interns—the CCD and MESA Institutes, and have generated sufficient data to begin to articulate findings. Two programs, the MSRI and NCPPRI, were initiated in the last year, and so only preliminary information is available. Unless otherwise noted, the following highlights are from the CCD and MESA Institutes.

- **Technical Staff are involved in all aspects of the DP Pipeline Programs.**

Technical staff members develop and implement recruiting practices and are responsible for identifying work projects and for managing interns.

- **Students who have shown promise in areas of critical skills needs are being recruited.**

Each pipeline program develops a framework for focused recruiting of students in a specific area of critical skills needs. Across the pipeline programs, the average grade point average (GPA) is 3.6 or higher, and the perception of technical staff is that the interns have made a positive contribution to Sandia's research program. Early information from both the CCD and MESA Institutes suggests that this focused recruiting is allowing technical staff to encourage colleges and universities to develop their course work in ways that more closely align with Sandia's research and workforce needs.

- **The pipeline programs cause these students to see Sandia as an employer of choice.**

The number of interns who said that they did not consider Sandia to be an employer of choice dropped from 39% to 4% after students had been an intern in one of the pipeline programs. The primary reason given by students for not considering Sandia to be an employer of choice prior to their internship was lack of knowledge about Sandia and the career research opportunities available at Sandia. This is an important recruiting issue given that 73% of the interns came to their experience at Sandia having already had work experience in organizations that compete against Sandia for hiring technical staff.

Pipeline program interns are strongly motivated by the work environment at Sandia: challenging research, work in the national interest, the collegial environment, the range of research opportunities, and the resources at Sandia. Students who were interviewed were consistent in their appreciation of the opportunity of working with, and discussing their career development with, technical people of the caliber of those at Sandia.

- **The pipeline programs retain the interns that they bring into Sandia.**

Most, 88%, of the CCD Institute interns from the summer of 2001 returned to Sandia as interns in 2002, or remained at Sandia as technical employees. This number becomes 94% if the intern who accepted a position at another DOE National Laboratory (Los Alamos) is also included. To date, the CCD Institute has produced six new members of the technical staff at Sandia.

All of the MESA Institute interns from the summer of 2001 returned to Sandia as interns or remained at Sandia as employees. The MESA Institute has converted three new technical staff members in its two-year history.

High School-level Pipeline Programs

These programs are focused at local high schools and at Albuquerque's Technical Vocational Institute (TVI). Students are beginning to move through the pipeline to employment at Sandia. The primary efforts to date have been on curriculum development and establishing the programs in the high schools, on supporting articulation of curricula between the high schools and TVI to provide a clear pathway to an AAS, and on getting students involved in the program.

- **The high school level programs are well established and clearly motivating students to pursue the challenging academic preparation needed for a technology career at Sandia.**

Sandia technical staff members have identified critical skills needs, and have been involved in advising on curriculum development.

More than 200 students were enrolled in two high schools in the ATA programs in the 2001/2002 school year, and the number is expected to be higher for the 2002/03 school year.

Students and teachers see this program as interesting high school students in technology careers, and as important in motivating students to take on, and succeed at, challenging academic preparation.

To date, students populate all stages of the pipeline including high school students who have graduated and entered the AAS program at TVI, and high school and TVI student interns at Sandia.

Three new technologist staff members have resulted from this program to date.

Summary Recommendations

Program staff should continue to review the program matrix and to collect the information that will enable them to determine that the programs are meeting their goals.

These programs are beginning to produce employees who have evidenced academic success in critical skills areas. Students are clearly and strongly pleased with the programs. In addition to continuing to monitor the programs for meeting their goals, a few areas have been articulated by students as worthy of consideration as the programs continue to evolve. These areas are identified in the specific program write-ups in the body of this report.

College-level programs

Look for ways to increase interaction between technical staff and interns. Although not unique to these programs, it bears repeating that one of Sandia's greatest assets in attracting new technical staff is the existing technical staff when they interact with students. Resources, staff time, and interest limit the number of technical staff that can interact with the interns in supervisory roles. The pipeline programs staff should consider ways to provide more access between interns and technical staff that does not include supervisory responsibility. Students made two suggestions along these lines. Periodic and informal brown bag lunches during which staff members discuss their work and take questions from interns would provide a breadth of exposure for students to Sandia and staff. A mentor "pool" of technical staff willing to be available on an occasional basis to interns to discuss work or career development would make more individual attention possible. The creation of such a pool may mean that

effort will need to go into informing staff of the importance, and value to Sandia, of mentoring technical interns.

Consider collecting information on whether or how the programs are affecting college or university research programs in critical skills needs areas. An important element of the college level programs is focused on recruiting students in critical skills areas. Early information suggests that this recruiting is also allowing Sandia technical staff to influence the academic programs in critical skills areas at the colleges and universities from which student interns are recruited. Program staff should consider whether this is an important aspect and whether it would benefit program development, especially regarding recruiting new employees, to collect at least preliminary information about the programs' effects on college and university research programs.

High School-level programs

Broaden information collection to include students who have graduated from high school and entered the pipeline at TVI and Sandia. Because these programs involve curriculum development at high schools, significant time was needed to collaborate with and support efforts at the high schools to establish the programs. The programs are established and there are sufficient students in the pipeline to make it feasible to begin systematic collection of information on students as they move into the pipeline at TVI and Sandia.

Consider a larger array of work-based opportunities for students. The amount of interest shown by students and school administrators is significant with more than 200 students expected at the high schools in AY 2002/2003. Resource and time constraints limit the number of meaningful internships that are possible at Sandia. High school students and their teachers, however, were clear about the degree to which interaction with and at Sandia is an important motivating factor for students. Program staff should consider whether there are other feasible work-based opportunities for students that would require fewer Sandia resources, such as job shadowing for part of a day, staff-led tours, or presentations at the schools by technical staff.

Pipeline Programs

Sandia National Laboratories[2] (Sandia) is entering its second half-century of producing science-based solutions to national defense challenges. This program mission requires a vital and cutting-edge research program capable of responding quickly and effectively to a range of potential threats from a multitude of sources. Fundamental to such a research program is a well-trained, experienced, and agile workforce. As part of a systematic approach to addressing these workforce needs, Sandia has developed a portfolio of pipeline programs using Department of Energy, Office of Defense Programs (DOE/DP) funding. These programs address the critical skills needs recommended by the 1999 Chiles Commission Report with the goal of producing the highly qualified technical staff needed by Sandia. The programs are focused at two levels—secondary and postsecondary. Integral to these programs are internships that bring promising students to Sandia—technical staff can identify potential employees, and students learn about the benefits of working at Sandia. The seven Sandia pipeline programs shown in Table 2 were funded in FY 2002, each targeting specific critical skills needs to support Sandia's defense mission.

Table 2: SNL Pipeline Programs

Program	**Primary Academic Level**	**Status**
College Cyber Defenders Institute (CCD)	Undergraduate	Initiated summer 01
Microsystems and Engineering Sciences Applications Institute (MESA)	Graduate	Initiated summer 01
Materials Science Research Institute (MSRI)	Undergraduate and Graduate	Initiated AY 01/02
National Collegiate Pulsed Power Research Institute (NCPPRI)	Undergraduate and Faculty	Initiated AY 01/02
Advanced Manufacturing for Education: Advanced Technology Academy at Albuquerque High School (ATA/AHS)	High School	AY 01/02: 1st year with students
Advanced Manufacturing for Education: Advanced Technology Academy at West Mesa High School (ATA/WMHS)	High School	ATA program pilot, implemented 1996
Photonics Academy at West Mesa High School	High School	In planning, 02/03 first year with students:

AY=Academic Year

There is significant involvement of technical staff in program development—from developing recruiting strategies, to recruiting students, to identifying appropriate student projects and supervising and mentoring students. The high school level programs involve working with local high schools to highlight pathways to careers that have been clearly identified as current and future areas of need for Sandia technicians. Sandia encouragement and support has led to active collaboration to articulate the curricula between the high schools and the Albuquerque Technical Vocational Institute (TVI). Students that obtain an AAS in the technical field are prepared with the skills needed by Sandia.

[2] Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the US Department of Energy under contract DE-AC04-94AL85000.

Goals and Objectives of Pipeline Programs

The following goals and objectives of the program have been articulated for the pipeline programs as a whole.

The attraction and retention of highly qualified people as Sandia employees in critical skills areas are the primary goals of these programs. At the same time it is generally understood that, given the increased mobility of the workforce and the ever-clearer need for research partnering, Sandia also benefits when students who have a positive personal and professional experience at Sandia move into the research community at large. The following objectives of the pipeline programs have been developed as a means of accomplishing the stated program goals.

Pipeline programs objectives that are integral to the program goal

- *Increase the pool of technical staff involved in DP pipeline programs*
- *Identify and recruit promising students in critical skills areas (CSA)*
- *Showcase Sandia as an attractive career option*
- *Retain qualified technical students in CSA both at Sandia and in the DP complex*

The objectives have been further broken into the strategies and program elements used to accomplish the goals and objectives of the pipeline programs, as well as evaluation metrics (see the Program Matrix following the next section in Table 3). The program matrix is an evolving tool and is reviewed annually by program staff to ensure its relevancy to the program goals. Revisions and their corresponding rationale are documented.

Information Collected

In parallel with developing these pipeline programs, program staff has implemented an information collection process that allows the evaluation of how the programs meet their goals, identifies the impacts of the program, and suggests areas for improvement. During 2002, the following information collection activities were undertaken:

College-level Pipeline Programs

- In 2001/2002, pipeline programs data collection processes began. That data is the basis for this report.
- A subset of CCD/MESA students and their technical supervisors were individually interviewed in February 2002. Individual interviews were held to provide an informal opportunity for participants to discuss their program and to articulate trends and identify issues.
- Information from the February interviews, from the summer 01 review, and from the programs' goals and objectives was used to develop a survey instrument that was administered to all interns, intern conversions to employees, and supervisors. Return of surveys was voluntary. The surveys, with aggregate responses, are included in Appendices 3 and 4.

High School-level Pipeline Programs

- Information collection during AY 2001/02 focused on establishing data collection processes within the high schools. (See Appendix 1 for data needed for 02/03.)
- An informal meeting of teachers, counselors, and administrators from the WMHS and AHS ATA was convened December 2001 to gain an insight into the overall effect of the program on the students and schools. The professionals in attendance had a broad experience of the larger school system as well as of the ATA programs in their specific schools. A summary of the comments from this meeting appears on Appendix 2.

- A focus group was held in April 2002 that included seniors, teachers, counselors, and administrators from WMHS. These attendees had multiple years of experience in the program; some have been involved in the program from the inception of the WMHS ATA. A complete report of this discussion is available and provides detail about the program from the schools' and the students' perspective. This data is being used to fine-tune the program.[3]
- Initially, program staff planned to survey all students at both ATA sites. APS is developing an evaluation of the Small Learning Communities, of which AHS ATA is one. Program staff collaborated with APS to develop of a pilot survey that was administered at AHS ATA in May 2002. The results of that survey are not yet available.
- Those who developed the Photonics Academy were interviewed in order to document the history of the Academy. A summary report of these interviews is available in Appendix 5.

Report Structure

The following report presents the results of information collection on the pipeline programs from the beginning of the 2001/2002 academic year up to the end of summer 2002. The report addresses the college-level programs and then the high school-level programs. Each program is presented in four sections:

- Highlights: This section describes highlights of the program through the year.
- Program Participants: This section describes data collection issues of note and provides information on the number of student participants.
- Program News: This section describes activities over the last year that has had a direct impact on the development of the program.
- Program Objectives: This section describes how the data collected about the program relates to the overall program objectives, as described in the program matrix in Table 3. When information collected suggests specific areas for consideration for program development, recommendations are presented in this section. In addition to these specific recommendations, program staff concerned with developing the pipeline programs should continue to review the program matrix as a continuing check on program evolution.

[3] Clark, Katherine. Science Policy Research. *West Mesa High School Advanced Technology Academy Focus Group Meeting*. May 2002.

Table 3: Program Matrix for Pipeline Programs

Objective	Strategy	Program Elements	Evaluation Method
Increase the Pool of Technical Staff in DP Pipeline Programs	Target & recruit uninvolved tech staff in critical skills areas Maintain pool of involved technical staff	Presentations to recruit and inform staff Staff involvement as appropriate in pipeline programs (see below) Staff involvement in career development of interns Upper mgmt support/recognition for mentoring/conversions of interns	Trend Data: # of participating staff, # of students/staff member
Identify and Recruit Promising Students in Critical Skills Areas (CSA)	Identify CSA anticipated needs	Tech staff involvement Chiles Commission Report HR Staffing Plan	TREND DATA: # of recruits, # of acceptances, # who return, # who convert to FTE. SURVEY OR INTERVIEW: Query supervisors as to promise of students.
	Identify and recruit promising candidates in CSA	Technical staff recommendations in relevant program areas Standard ranking indices for academic achievement (for example Gourman) Nationally recognized programs Technical staff contacts with universities referrals HR resumix	
	Choose students for participation that meet program criteria	Program staff review resumes for eligible candidates Involve technical staff in review of resumes and choosing students for offers Manage process of review, making offers, and hiring using existing tools	

Program Matrix continued

Objective	Strategy	Program Elements	Evaluation Method
Showcase Sandia as an attractive career option	Ensure technical managers offer "real" work	Technical staff involvement	SURVEY OR INTERVIEW: Query students
	Treat students as professionals, facing career choices. Provide broad-based overview of SNL Offer professional development at SNL	Technical SNL Speakers Mini-Institutes Tours of and talks about SNL Conference/travel Orientation Administrative support for flexibility in self -identifying future work Technical mentor Experienced students as role models (SNL Ambassador) Information on graduate programs and hiring tools Employee/staffing benefits information	
	Provide assistance with non-work related aspects of the program that support the work experience	Salary Relocation assistance Assistance in identifying housing Transportation assistance Social mentor for questions and support	
	Provide students with Albuquerque info	Existing SIP infrastructure Social mentor for questions and support	
Retain qualified technical students in critical skills areas both at Sandia and in the DP complex	Create a positive work experience at SNL Opportunities for career development through student & hiring programs Provide support in navigating the hiring process.	See Above Technical and social mentors discuss opportunities Information on graduate programs and hiring tools Accessible source of information for funding sources for school/work opportunities. Administrative support in pursuing the hiring process	BASELINE DATA for comparison. TREND DATA: Trends in those students who return. SURVEY OR INTERVIEW: Query supervisors and students about retention issues.

College Cyber Defenders (CCD) Institute

Highlights

- The CCD Institute provides a forum for focused recruiting of promising students for cyber security work. The average GPA of summer 2002 interns was 3.7.
- Technical staff is responsible for establishing recruiting practices, recruiting students, identifying research projects, and managing students.
- The CCD Institute caused students to change their academic and career focus to cyber security.
- The CCD Institute caused students to consider Sandia an employer of choice.
- Lack of knowledge about the research program was the biggest reason that students did not see Sandia as an employer of choice prior to their internship.
- The challenging work environment is clearly the biggest reason that students see Sandia as an employer of choice.
- The CCD Institute has produced six new cyber security technical employees at Sandia. One intern has been employed at Los Alamos. This represents 27% of all student participants in the program.
- Of the summer 2001 interns, 88% returned to Sandia as interns or employees, and 94% remained in the DOE national laboratory system.
- The job market for cyber security is competitive. This is exacerbated by the fact that there is not a clearly established academic training pathway. The focused recruiting effort has allowed technical staff to encourage and affect the development of academic training for cyber security.

CCD Intern Participants

There were more interns during the summer of 2002 than there were in 2001, as shown in Table 4. Interns in 2002 came from more schools than 2001 interns, both overall and including five schools that were not represented in the 2001 cohort. Most of the interns are at the undergraduate level

Table 4: CCD Intern Participants

Summer	# Enrolled	# Schools	Gender		Degree Level			Avg GPA
			M	F	HS	AS/BS	Grad	
02	20	13	14	6	2	17	1	3.7
01	16	9	11	5	1	13		3.7

CCD Program News

The College Cyber Defenders (CCD) Institute has just completed its second summer of bringing interns into an area that is a critical skills need, in which there is a national shortage of trained people, and in which there are no university programs in existence that prepare students for a career in cyber security.

Summer 2001 was the first year in which there were CCD interns. In the period leading up to

summer 2002, program technical staff has actively worked to develop recruiting policy. Recruiting began with identifying the schools that have academic expertise in areas related to cyber security, have indicated an interest in cyber security, that are interested in working with Sandia in this area, and that are working in areas of interest to Sandia. They have been assisted in this effort by a list compiled by the National Security Agency of schools and universities that have indicated an interest in cyber security. Program technical staff has focused their recruiting efforts on four schools that meet the criteria—encouraging them to develop a cyber security program and/or related course work. The schools are New Mexico Tech, University of Illinois at Urbana-Champagne, University of Colorado at Boulder, and Texas A&M.

CCD program staff recruited students for the program by contacting university chairs and professors of targeted schools, visiting the schools, meeting with students, and encouraging qualified students to submit intern applications to the CCD Institute through the Sandia student intern program (SIP). CCD program staff reviewed student applications from the entire student pool for students that have appropriate expertise and interest in cyber security and that meet minimum Sandia hiring requirements. They then conducted telephone interviews. According to the technical staff coordinator, most (about 80%) of the interview questions are designed to winnow out individuals with an interest in learning about computer hacking rather than cyber security. Because of the critical importance of this last facet, the program is considering asking a psychologist to review their interview questions as part of a continuing proactive process of security awareness.

CCD interns for the summer 2002 are the first group for which there has been sufficient time and opportunity to actively recruit nationally and to target schools.

CCD Objective

Objective: Increase the pool of technical staff in DP pipeline programs.

Technical staff is directly involved in developing recruiting practices and in recruiting of interns. Students in the program all have the same technical supervisor, although they have access to other technical staff for questions. Program technical staff is heavily involved in recruiting, choosing, and managing students. The technical supervisor considered the program to be worth his time and resources as students make a positive contribution to the research program.

In earlier interviews, several interns indicated an interest in more interaction with technical staff.

Recommendation:

1. As with the MESA program, the importance of meaningful work-related interaction between interns and staff cannot be underestimated in its importance to attracting promising employees. To this end, look for ways to increase intern and technical staff interaction. This may involve non-supervisory interaction such as periodic brown-bag lunches in which staff members discuss their work with students, or it may involve individual staff members who are willing to act as mentors. Consider developing a pool of technical mentors with whom students can initiate contact to discuss career development. Refer to discussion about this subject under the MESA program.
2. Look for ways to continue to inform technical staff about these pipeline programs and of the value of being available to student interns. Consider a Sandia News article.

Objective: Identify and recruit promising students in areas of critical skills needs.

Interns that are accepted into the CCD Institute meet selective criteria. As discussed earlier, program staff have actively developed and implemented a recruiting strategy to identify and recruit students with an appropriate background. According to the primary technical supervisor, about one-tenth of the student applications that were reviewed resulted in an offer of an internship. All 20 students accepted the offer, and have an average grade point average of 3.7.

Of the four colleges and universities that the CCD Institute is targeting, one has put in place cyber security classes, one is working to define a cyber security curriculum, and one is in the process of establishing an administrative relationship that will enable development in this area. In the coming year these relationships will be maintained and a focus will be to begin the process with the fourth university.

CCD interns are largely at the undergraduate level and early in their academic careers. Even despite this, however, 14 of the 20 students have already had intern or work experience at potential employers other than Sandia, including private companies, universities, and another national laboratory. This only reinforces the importance, especially in this extremely competitive field, of bringing students into Sandia early in their academic careers.

Recommendations:

1. Track recruiting of interns from targeted and other research programs.
2. Contact representatives of targeted colleges and universities to explore their perceptions of the program and any effects that the program has had on university research programs.

Objective: Showcase Sandia as an attractive career option.

The CCD Institute has clearly influenced interns to pursue careers that are in line with Sandia's needs in the area of cybersecurity and to see Sandia as an employer of choice.

Of the 15 interns responding to the survey, 14 said that being an intern has reinforced or focused their career plans and that they now consider Sandia as an employer of choice. About half, 6 of the 14 interns, did not see Sandia as an employer of choice prior to their internship program. By and large, these 6 students identified lack of knowledge about Sandia or the National Laboratories, and about the range of work carried out at the labs as the reason that they had not considered Sandia prior to the internship. One of the 15 students began the intern program considering Sandia an employer of choice, but indicated after the internship that Sandia was not where he would choose to work. After the surveys were returned, this student initiated contact with the technical supervisor and clarified that his negative responses were for personal reasons that were unrelated to Sandia or the CCD program. Note that even with this single negative respondent, the overall numbers were extremely positive.

Interns were clear that the work environment is the most important element in making Sandia an employer of choice. Students were enthusiastic about the challenging and interesting work, about the flexibility possible in research areas, about work in the national interest, about the collegial and encouraging atmosphere for students, and about the resources—people, equipment, and technology—available as part of the research program. Repeatedly, interns also identified the technical staff, their expertise and their accessibility, as being important inducements in wanting to work at Sandia. Two primary issues were identified as making Sandia less desirable as an employer—the location in Albuquerque, and the presence of a large and bureaucratic corporate culture.

Interns were also asked about the CCD program itself, and ranked the program and its importance to them in career development a 4.7 and 4.6 respectively, out of a possible 5. Most, 14 of the 15 respondents, felt that the program

provided them with opportunities to learn about the range of career opportunities at Sandia, primarily through introductions to people who were able to discuss their work in different research areas. In addition to the opportunity to do work that they see as meaningful and that contributes to the overall research program, students appreciated that the program provided financial support for education, provided someone to talk with about the field and career opportunities, that they were treated like responsible adults and allowed to work independently, and that they were able to work on state of the art equipment.

Interns were asked to identify both the weaknesses and the value-added of the program. Nine interns identified weaknesses, ranging from the cost of housing in Albuquerque to project related issues. No clear consensus as to weaknesses emerged from these comments, although the list suggests that these interns are strongly work oriented—wanting more focus and communication within their project experience.

Recommendation:

1. Continue having technical staff involvement in identifying challenging research opportunities for interns.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex.

The CCD program, in its two-year history, will have produced six new employees at Sandia in this critical skill needs area by December 2002. This represents 23% of all students participating to date in the program. An additional student has taken a position at Los Alamos National Laboratory. Of those interns who participated in the summer of 2001, 88% returned to Sandia as interns or employees and 94% remained within the DOE DP laboratory system.

Responses by new hires from the interns were similar to those of the interns. The identified strengths of the CCD program focused on the nature of the work and on having access to people to discuss their career opportunities. The challenging and interesting work and financial support for further education were listed as aspects making Sandia an employer of choice. Administrative policies and requirements were listed as aspects that would make Sandia less than desirable as an employer.

Microsystems & Engineering Sciences Applications (MESA) Institute

Highlights

- The MESA Institute has developed and is continuing to refine a recruiting policy focused on identifying college and university researchers considered to be leaders in microsystems technology and who have promising students.
- Sandia technical staff has primary responsibility for recruiting, for developing focused research projects, and for interns they bring to Sandia.
- Technical staff members say that interns make valuable contributions to the research programs.
- The MESA Institute has caused interns to see Sandia as an employer of choice.
- Lack of knowledge about Sandia was the primary reason that students did not consider it to be an employer of choice prior to participation as an intern.
- Almost all of the interns have had work experience at organizations that could be considered Sandia's competition for hiring employees.
- Interns are most attracted to the work environment at Sandia, especially the research opportunities, but also the people and equipment.
- The Institute provides a framework for encouraging research collaboration between Sandia and colleges or universities in this critical skills area.
- The Institute will have produced three new technical employees at Sandia by December 2002.

MESA Intern Participants

The 19 interns enrolled during the summer of 2002 came from 14 schools as shown in Table 5. About one-fourth of the summer 2002 interns were new, and all of the summer 2001 interns have returned to Sandia. Most of the interns are at the graduate level.

Table 5: MESA Intern Participants

Summer	# Enrolled	# Schools	Gender		Degree Level			Avg GPA
			M	F	HS	AS/BS	Grad	
02	19	14	16	3		4	15	3.7
01	15	13	11	4		2	13	3.6

MESA Institute Program News

The MESA Institute is in its second full year. Researchers and engineers in the field of microsystems technology are in demand nationally, and it is considered an area of critical skill needs at Sandia. The MESA Institute focuses its recruiting efforts not on students, but on professors with whom Sandia wants to collaborate because of their expertise.

The Institute recruits Sandia technical staff as a first order of business, by attending director-level meetings and by meeting with supervisors in the microsystems area to inform them about the MESA Institute. If the line organization is willing to pay 30% of an intern's salary and any equipment or conference costs, and to be responsible for the student, then the Institute will pay the remaining 70% of the intern's salary costs. Technical staff must identify a professor at a university who is doing work in which Sandia is interested and who is interested in working with Sandia. If the professor has a promising student, then the staff person and professor develop a proposal for research that is appropriate for the student, that supports the professor's work, and that benefits Sandia's research program, and submits the proposal for review for funding.

In this last year the MESA Institute initiated a Strategic University Partners Program that includes three universities with which Sandia wants to work, that want to work with Sandia, and that have research programs complementing Sandia's microsystems research program: University of Michigan, University of Colorado, and Georgia Tech. Line organizations at Sandia identified these universities and will be responsible for developing strategic relationships with them. There are three fundamental components to creating a strategic university partnership. A line organization must set up a manager-level contact to work with a university, the university must set up a formal agreement with Sandia regarding the handling of intellectual property, and some MESA slots are guaranteed for students from the universities. In the future, between one-half and two-thirds of the program's recruiting efforts are expected to be focused on professors at strategic universities, with the remaining effort being open to any university or professor that meets program objectives.

Originally the internship was seen as being for a full year. Experience has prompted concern by some professors that a full year away may result in the student becoming disconnected from the university. It also means that the student is not available to the professor for research or teaching undergraduates. Therefore, in the future the time period will more likely be for a semester or summer.

The issue was raised at the end of summer 2001 as to whether the program should focus on undergraduates as well as graduate students. Important elements to the program's recruiting strategy are to have technical staff choose the professors doing cutting edge research that complements Sandia's research and to be ultimately responsible for the interns. As a matter of practice, according to the technical program coordinator, staff and professors choose students who can make the greatest contribution to their research programs and who can derive the greatest benefit from this opportunity. Such students tend to be graduate students because of their knowledge and experience. It was noted that these students are early enough in their careers to be still in the process of identifying employers of choice. The MESA supervisors see this program as a valuable tool to develop research relationships with universities and to influence university curricula in such a way as to have more focus on critical skills areas of interest to Sandia. Further, as the relationship continues, it is hoped that professors will continue to see Sandia as an attractive place to send their promising students.

Because the MESA Institute focuses its recruiting efforts on professors—both for research collaboration and to identify promising students—brief telephone conversations were held with several professors of interns to ask about their perspectives on this program. All of the professors were extremely positive, noting that the program allowed them to leverage their budgets, resources, people, and time. Working with Sandia staff expanded both their own, and their student's, access to Sandia technical staff as well as to researchers visiting Sandia from private industry. One professor pointed out that the program encouraged him to take the time out of a busy schedule to focus on how to integrate his research in the most productive ways with that at Sandia in order to benefit his research program and student. In response to specific

questions the following concerns related to the program were identified:

- Need to remember that students often do not have funds available for traveling to Sandia, and that some advance funding for such travel would help students.
- Need to be sensitive, on a case-by-case basis, as to how much time a student needs to be at Sandia and away from their college or university.
- Some minimal funding for supplies (for example silicon wafers) used at the college for work with Sandia would be helpful.

MESA Objectives

Objective: Increase the pool of technical staff in DP pipeline programs.
As noted above, technical staff has primary responsibility for identifying student interns through contacts with university professors. There were 16 technical supervisors and an additional 8 managers involved with the MESA interns during the summer 02 intern period. Budget cuts were a direct constraint on the number of interns, and therefore staff members, that could be involved in the program. Students who were interviewed were consistent in their appreciation of the opportunity of working and discussing career development with technical people of the caliber of those at Sandia.

Resources, time, and interest in being responsible for a student intern are impediments to involving more technical staff in the program. Interns suggested two ways to increase intern access to technical staff. The professor of one of the MESA students set up an advisory group for that student composed of five Sandia technical staff and managers—a group similar to a thesis advisory group at a university. Individual members of the advisory group sought the student out every month or two to talk about her work and career plans for the future. She noted that having a group of people looking out for her professional development and providing an introduction to different parts of the laboratory had been a great benefit, and because it is a group from different organizations, took the pressure off any one individual. The student strongly recommended such an advisory group, especially for graduate students. Another student suggested having monthly brown bag lunches in which technical staff members from across Sandia discuss their work.

Recommendations:

1. Look for ways that do not involve supervisory responsibility to involve technical staff as mentors to interns. Consider forming a mentoring pool of technical staff members that are willing to be available to students wanting to initiate contact. Consider also the formation of advisory groups, as discussed above. While forming advisory groups for all interns may not be feasible, consider whether there is some subset of student interns that are particularly desirable as employees and for whom it would benefit both Sandia and the intern to form such groups, perhaps on an ad-hoc basis. Informal regular brown bag lunches with featured speakers from different parts of Sandia's research program would be an efficient way to expose interns to the range of career opportunities at Sandia.
2. Look for ways to continue to inform technical staff about these pipeline programs and of the value of being available to student interns. Consider a Sandia News article.

Objective: Identify and recruit promising students in areas of critical skills needs.
MESA Institute interns have established academic success in areas of Microsystems-related research that is of interest to Sandia. Because of recruiting practices these interns have been chosen from research programs that are of interest to Sandia, and they have an average GPA of 3.6. Almost all, 14 of the 19, of

these interns have had experience in organizations that could be considered competition to Sandia as an employer of choice. Technical staff members who have been involved with these interns consider them to have made positive contributions to the research program at Sandia.

Very preliminary information from several interviews suggest that these programs, in addition, may be influencing researchers at colleges and universities to explicitly look at how their research programs could integrate better with that at Sandia for the purpose of leveraging resources and strengthening the overall research program.

Recommendations:

1. Track recruiting of interns from targeted and other research programs.
2. Consider contacting professors of interns to explore their perceptions of the program and any effects that the program has had on their own research or the research program at the college or university.

Objective: Showcase Sandia as an attractive career option.

All of the MESA interns that responded to the survey said that they consider Sandia to be an employer of choice. Almost half of those responding said that they would not have considered Sandia prior to the intern program. Further, almost all of the interns had already had experience in organizations that are Sandia's competition for hiring employees. An implication of this information is that focused recruiting of desirable students is an important tool.

The work environment was most often cited as being important to making Sandia an attractive employer, including: challenging and interesting research, flexible research opportunities, work in the national interest, Sandia staff, a collegial and encouraging atmosphere, and resources including state of the art equipment. Students who did not originally consider Sandia as an employer of choice cited ignorance of the Labs and the physical location of Albuquerque as deterrents. Given their experience at Sandia, when asked what could makes Sandia less than desirable as an employer, the two most frequent responses were related to its large bureaucratic corporate culture and its location in Albuquerque.

MESA interns were pleased with the MESA Institute, ranking it a 4.8 out of a possible 5. One MESA intern did not feel that he had not been given a sufficient opportunity to learn about the career opportunities at Sandia. Students learned more about Sandia via meeting staff from throughout the Labs.

Recommendation:

1. Continue focus on having technical staff involvement in identifying challenging research opportunities for interns.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex.

By the end of 2002, three interns from the program will convert to Sandia employees.

Materials Science Research Institute (MSRI)

Highlights

- MSRI was implemented in 2002.
- Responses to the survey by the interns in this program are consistent with those of all interns in the program.

MSRI Participants

Two MSRI student interns were enrolled during the summer of 2002, as shown in Table 6.

Table 6: MSRI Intern Participants

Summer	# Enrolled	# Schools	Gender		Degree Level			Avg GPA
			M	F	HS	AS/BS	Grad	
02	2	2		2			2	3.8

MSRI Program News

Implemented in this last year with two interns, the Materials Science Research Institute (MSRI) provides access to Sandia staff and resources, and research funding to undergraduate and graduate students in materials sciences. The Institute emphasizes continuing education programs as a critical recruiting tool, and as such identifies promising undergraduate students and introduces them to materials science careers at Sandia through internship and co-op opportunities. Program coordinators also match graduate thesis research and co-op programs with Sandia projects relevant to DOE/DP component development. Through these mechanisms, the program intention is to maintain close ties with the broader materials science community and to develop a pipeline of qualified materials science candidates in critical skills areas.

MSRI Objectives

The program is still new and small, and so it is not possible to begin to identify trends.

Objective: Increase the pool of technical staff in DP pipeline programs.
Not Applicable this year.

Objective: Identify and recruit promising students in areas of critical skills needs.
Not Applicable this year.

Objective: Showcase Sandia as an attractive career option.
The MSRI interns' responses are consistent with those of all of the other interns. The interns are positive about the MSRI program. A second intern joined the first in seeing Sandia as an employer of choice.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex.
Not Applicable this year.

National Collegiate Pulsed Power Research Institute (NCPPRI)

Highlights

- The NCPPRI was implemented in 2002.
- Responses by NCPPRI interns are consistent with those of interns from the other programs.

NCPPRI Intern Participants

The NCPPRI program was initiated in 2002 with 8 interns, all at the BS level, as Table 7 shows.

Table 7: NCPPRI Intern Participants

Summer	# Enrolled	# Schools	Gender		Degree Level			Avg GPA
			M	F	HS	AS/BS	Grad	
02	8	4	7	1		8		3.6

NCPPRI Program News

NCPPRI emphasizes collaboration between Sandia and targeted academic institutions to encourage students to pursue careers in pulsed power sciences.

NCPPRI Objectives

Objective: Increase the pool of technical staff in DP pipeline programs.
Not Applicable this year.

Objective: Identify and recruit promising students in areas of critical skills needs.
The interns in this program have an average GPA of 3.6, ranging from 3.3 to 4.0.

Objective: Showcase Sandia as an attractive career option.
Five of the eight interns have had prior experience at a national laboratory or in the private sector, organizations that are competition to Sandia in hiring promising students. All eight interns see Sandia as an employer of choice after participating in the program. One of those eight changed from no to yes on this issue after being in the program. As with interns in the other programs, these students are clearly most motivated by the work environment at Sandia, specifically having interesting work that is flexible and challenging, and being able to work on state of the art equipment. NCPPRI interns ranked their overall experience of the program as a 4.1 out of a possible 5 (excellent) and the importance of the program in their career development as a 5 out of a possible 5. In addition to the work, interns also cited as important the ability to have someone to talk with about career opportunities in the field and at Sandia, support for further education, and being able to work with the people at Sandia.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex.
Not Applicable this year.

Advanced Technology Academy (ATA)—AHS and WMHS

Highlights

- The ATA curriculum is established at two local high schools and Albuquerque's Technical Vocational Institute.
- More than 200 students were enrolled during the 2001/2002 school year, with increases expected next school year.
- Students are moving through the pipeline.
- The ATA is creating a group of motivated students interested in careers in critical skills areas.
- The ATA is making a career at Sandia feasible to students who would not otherwise have considered it.
- The ATA has produced 3 new employees to date.

ATA Participants

In academic year (AY) 2001/2002 both WMHS and AHS have begun to systematically collect data on the ATA programs. WMHS, as the site of the pilot program, experienced several growing pains in the first years, including the loss of the program's coordinator who was offered another job outside of the school system as a result of the exposure that the program provided. Despite early issues related to growing the program, it has proven to be cohesive and robust enough to evolve and respond to challenges. However, one result has been that there is insufficient data from the early years to establish trends. In addition, data collection for the ATA programs differs from the data collection efforts by the public schools outside of these programs. The data collection effort is still evolving to find the most efficient way to collect appropriate data. Information on enrolled participants is provided below in Tables 8 and 9 for the end of the AY 2000-2001, AY 2001-2002 and on expected participants for AY 2002-2003. It should be noted that the two programs have some differences, are at different schools, and are at different stages of development. Therefore, the numbers can help identify trends over time within each school, rather than to compare the programs with each other. Appendix 1 identifies the information to be requested from both ATA programs.

Table 8: WMHS ATA Student Participants as of summer 02

Academic Year	Freshman	Sophomore	Junior	Senior	Classes at TVI	To TVI as students	Sandia Interns	Total SNL Employees
00-01	0	15	20	16				
01-02	41	27	30	15	34	8 to date	2	3 to date
02-03 expected	51	20	37	29				

Table 9: AHS ATA Student Participants as of summer 02

Academic Year	Freshman	Sophomore	Junior	Senior	Classes at TVI	To TVI as students	Summer Interns	Total SNL Employees
00-01	No Program							
01-02 (1st yr)	83	22	0	0			1**	
02-03 expected	0	83	22+15*					

*Insufficient data to determine which class level at this time, but non-freshman

**An upper-class student who has asked to participate in the program.

ATA Program News

The Advanced Manufacturing for Education (AME) program, also known as the Advanced Technology Academy (ATA) encompasses pipeline programs at two Albuquerque, NM, high schools. These programs encourage high school students to pursue careers in advanced manufacturing. AME was piloted at West Mesa High School (WMHS) in 1996 where student participants early on renamed it the ATA—the name that it has continued to carry. Much of the early work was on curriculum development and articulation of that curriculum with the AAS program at Albuquerque Technical Vocational Institute (TVI).

Albuquerque High School (AHS) inaugurated the second ATA during the 01/02 school year based on the WMHS ATA model. A third program, the WMHS Photonics Academy, also based on the ATA model and integrated with WMHS ATA classes, is discussed later. The ATA programs have evolved to fit each school's objectives, leading to some differences between the programs. For example, students in the WMHS ATA are expected to maintain a 3.0 GPA. The AHS ATA was inaugurated as one of a set of small learning communities. The small learning communities program does not have a GPA qualification.

In both ATA programs the high school curricula have been articulated with that at TVI so that high school students are prepared to continue the ATA pathway into a 2-year degree program for an AAS in advanced manufacturing. Students who have successfully taken appropriate preparatory classes at the high school level are also able to take concurrent classes at TVI while still enrolled in high school, transferring up to 9 credits towards the AAS. The TVI program is open to students from other high schools that are interested in this area of study.

Sandia's Advanced Manufacturing Trades Program offers internships to ATA and TVI students, giving Sandia staff an opportunity to identify potential employees and giving students an opportunity to learn about Sandia as an employer. As with TVI, Sandia's intern program is open to students from other schools.

The ATA programs have evolved to better fit each school's objectives in preparing students. During the 01/02 academic year (AY), the WMHS freshman class was "boxed" for the first time. In practice, the ATA classes are integrated into class offerings at the school. Boxing the freshmen class means that for one class each day ATA students will be in a class of just ATA students. The expectation of the WMHS program coordinator is that boxing will allow students to develop a stronger identity as ATA students and will be a convenient organizational group to keep parents better informed and involved in their student's activities in the ATA. There will be two freshman level boxed classes of about 25 students each. This total number, 50, is expected to become the average number of students at each level (freshman, etc.).

In a focus group that included WMHS seniors in the ATA program, students were clear about the need to go back to the middle schools and make sure that students at that level understand what they can accomplish with hard work and academic success. The WMHS program coordinator notes that a focus for the coming year will be to more proactively market the program in order to encourage middle school students to take on the necessary academic preparation for the program.

A significant change in the AHS program has been the decision to begin the program in the sophomore rather than the freshman year starting in AY 2002/2003. All freshmen at AHS will be included in a Freshman Academy that will allow them more opportunity to look at their options and to choose which direction that they want to go in the sophomore year.

ATA Objectives

Objective: Increase the Pool of Technical Staff in DP Pipeline Programs

A technical staff person has been involved from the beginning in development of the ATA and in supporting curricula development efforts.

The ATA programs are focused on recruiting high school students to take on the challenging academic training necessary to prepare for a career in a technology field. The focus in AY 01/02 was on curriculum development and data collection at the high school level. As the programs are growing and moving through the pipeline, information collection for AY 02/03 should evolve to include more information on students in the post-high school period.

Recommendation:

1. Interview Sandia technical supervisors of about their experience of ATA interns.

Objective: Identify and Recruit Promising Students in Critical Skills Areas

The ATA is creating a group of motivated students explicitly interested in Sandia careers in this area of critical skills needs. Both ATA had slightly more than 100 students each enrolled in AY 01/02, and expect an increased enrollment next school year. The WMHS ATA, which has been up and running for several years, has students who have been involved throughout the pipeline—from high school, to TVI students, to Sandia interns and employees.

There were 16 interns in Sandia's Advanced Manufacturing Trades Program from TVI in the summer of 2002. These interns were part of a larger cohort of interns from several schools. These internships are competitive, with interns having an average GPA of 3.6. Two WMHS and one AHS seniors are included in the 16, a significant accomplishment since high school students compete directly with more experienced TVI students for the available internships. The AHS student, although not formally part of the program is an upper-class student who, having heard about the program was interested and asked to be included in the opportunities that it offered. An additional WMHS senior who was in the ATA is also at Sandia as an intern, but in the engineering department rather than in the advanced manufacturing program as his interests have evolved.

Both ATAs are still in formative stages, but appear to be strongly established in both high schools. Teachers, counselors, and administrators in both programs are clearly pleased with the ability of the ATA to motivate students to take on academic challenges. Further, information to date suggests that the students involved in the WMHS program, the ATA with multiple years of experience, have been strongly motivated to pursue technology careers because of involvement in this program.

Data collection at the high school level is critical to tracking the success of the program. The process of this data collection is still under development, and continuing effort is important to maintaining and updating this database.

Recommendations:

1. Sandia should continue to work with the high schools to further refine data collection. Appendix 1 contains a form showing data to be collected.
2. Consideration should be given to asking all AY 02/03 ATA students, via a survey, about their perception of the program.
3. Interview TVI ATA coordinator about the program.
4. Collect information from TVI about ATA students from AHS and WMHS that are in the AAS program.
5. The notes from the December meeting of teachers, counselors, and administrators as well as the WMHS focus group provide specific suggestions for consideration in the

evolving programs. The high schools have the authority and final decision-making responsibility in deciding on and making changes in the day-to-day activities of the programs, but Sandia staff could continue to look for ways to offer support to these activities.

Objective: Showcase Sandia as an attractive career option

There is no doubt, on the basis of information from WMHS students, that this program has made a career at Sandia an option to students that would not have considered it before involvement in the ATA.

An important aspect to developing the career pathway aspect of the ATA, and to encouraging students, is increased work-based experiences for students. Internships were given to 16 students in the ATA program, three of those at the high school level. WMHS students in the focus group were enthusiastic about the possibility of internships and they understood that their chances of an internship increased once they were at TVI and had more experience. However, they and their teachers suggested that providing some other types of work-based learning experiences would be a strong motivating factor for students.

Recommendation:

1. Consider a broader range of work-based experiences for high school students, such as job shadowing for part of a day or providing workplace tours. Another opportunity might be to have technical staff spend some time in classes talking about their work. This latter option would involve carefully choosing a staff person who is able to talk about his or her work at an appropriate level.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex

Three employees in the advanced manufacturing area have come out of the WMHS program to date.

Photonics Academy

Highlights

- New program to be implemented at WMHS in AY 02/03.

Photonics Academy Intern Participants—Expected

As of the end of the 2001/2002 academic year, it was expected that about 50 students would be enrolled in the Photonics Academy, as shown in Table 10.

Table 10: Expected Photonics Academy Participants AY 02/03 as of summer 02

	Freshman	Sophomore	Junior	Senior	2003 Interns
Photonics Academy	25	25*			

*Insufficient data to determine which class level at this time, but non-freshman

Photonics Academy Program News

In the 2002/2003 school year, the Photonics Academy, based on the WMHS ATA model will be implemented at WMHS. This Academy will have a similar structure, but will allow students to focus in junior year on photonics preparation and to go on to TVI for an AAS in photonics. The program coordinators are "reaching forward" to incorporate local business through work experiences such as internships and business advisory groups and national business by looking for appropriate interactions with professional associations. In addition, the Photonics Academy coordinators are proactively collaborating with the University of New Mexico as it develops a related BS in Optical Science and Engineering. A review of the development of the program has been prepared and is available in Appendix 5.

Photonics Academy Objectives

Objective: Increase the pool of technical staff in DP pipeline programs.
Not applicable this year.

Objective: Identify and recruit promising students in areas of critical skills needs.
Not applicable this year.

Objective: Showcase Sandia as an attractive career option.
Not applicable this year.

Objective: Retain qualified technical students in critical skills areas both at Sandia and in the DP complex.
Not applicable this year.

Appendices

Appendix 1: Information to be collected from ATA

NAME OF SCHOOL AND PROGRAM

Name and contact information of responsible person

Date for which information is provided (End of first semester and end of school year)

Enrollment										
Grades	**# Enrolled***	**Gender**								
9	#	#F, # M								
10	#	#F, # M								
11	#	#F, # M								
12	#	#F, # M								
Total										

GPA					
Grades	**3.0-4.0**	**2.0-2.9**	**1.0-1.9**	**0.0-0.9**	**Total**
9	#F, # M	#F, # M	#F, # M	#F, # M	#
10	#F, # M	#F, # M	#F, # M	#F, # M	#
11	#F, # M	#F, # M	#F, # M	#F, # M	#
12	#F, # M	#F, # M	#F, # M	#F, # M	#

NOTES:

Ethnicity				
Grades	**Anglo**	**Hispanic**	**Other*** **	**TOTAL**
9	#F, # M	#F, # M	#F, # M	#
10	#F, # M	#F, # M	#F, # M	#
11	#F, # M	#F, # M	#F, # M	#
12	#F, # M	#F, # M	#F, # M	#

Additional information to be collected:

Withdrawals from program (number and reasons for withdrawal)

Interns, by grade, at SNL or other (number and where)

Students, by grade, in non-HS classes related to ATA (number and where: TVI, UNM, etc.)

Students employed in ATA-related job (number and where: SNL, etc.)

List of professional development opportunities for teachers/administrators (and number who participate)

Teachers (number and type: metal working, computer, etc.)

Administrators (number and type)

Student resumes submitted for internships (number and where)

Student resumes submitted for jobs (number and where)

Appendix 2: Comments by ATA Teachers, Counselors, & Administrators

Meeting of teachers/counselors/administrators from AHS, PNM, Sandia, WMHS: December 11, 2001. The meeting was held to allow participants in the program to meet each other and to discuss their experience of the ATA program.

Results: While not a formal information gathering meeting, four general and somewhat overlapping questions were asked to gain a perspective on the program. Comments suggest that the ATA has had clearly positive results in encouraging students to pursue focused academic programs in areas of identified technical need. In particular, students who might not have chosen such a technical path have been encouraged to do so through the program. In addition, students in the program appear to be involved and engaged in their academic program at higher levels than are students in the schools as a whole using criteria such as GPA or attendance. Another emergent theme from the meeting was the value in cross-school collaboration. It was also noted that the ATA model integrates well with the direction that the entire school district is taking. Specific comments were also very helpful in identifying areas that merit review for improving the program. The comments clearly reflect that this program is a partnership and suggest areas for review by both the schools and by partnering organizations such as Sandia or PNM. Some suggestions could be handled with relative ease and quickly, while some require more thought as to whether or how they should be implemented.

Recommendations:

1. Representatives of the schools, Sandia, and other interested organizations (for example, PNM) should review these comments for those things that make sense and are feasible for near-term implementation.
2. Hold a more focused working group meeting of teachers, counselors, and administrators to discuss and come to consensus on: a) the critical elements of the program, b) what has worked well in each school regarding these elements, c) what has not worked so well regarding these elements, and d) to develop recommendations for the program.

Comments relative to the four questions:

With the exception of combining similar comments, the following comments appear largely as they were articulated in the meeting. No attempt at "processing" the information has been made as it could provide useful discussion material for future meetings.

What is good about the Advanced Technology Academy at your school?

The size of the program allows for the students to develop an identity, and close relationships with each other and teachers. The program itself allows students choice in the path they take, along with direction in following the path that is chosen. Students are less likely to get "lost" in this program than in the larger school. Students are making strong positive connections that allow them to make confident decisions about their future. Students are developing a strong identification with the educational process.

By enhancing the integration of the existing curriculum and through the development of a sense of identity and purpose, the program encourages attendance and better grades.

Students are coming to school; attendance is great.

Greater enthusiasm among students and teachers. Good for teachers to be able to show how what students are learning is directly relevant to a career.

The program gives students a purpose for taking course work. Through mentorships, internships, job shadows, the program increases excitement level of students.

Students are employable upon graduation.

Good program for middle-of-the-road students.

Appendix 2

The program is filtering down into the middle schools, which are working with us in preparation of students
Gives students a sense of direction
Teachers get opportunities for professional growth
Teachers are gaining increased comfort with technology as well

What kind of help do you need to make the program work better?
More access to Sandia, through tours for example, would help to interest students.
More specific commitment for post-grant funding, for example from the district through the freedom to re-allocate operational funds in the school, would be a signal of commitment.
Documentation of student success in the program is important.
Need smaller classes.
It would be good to visit other classrooms, down the hall or in another school.
Would like more time to get the program, and for team building. Good to have "official" team building activities.
Need to make sure that we continue to foster a sense of worth and belonging by students.
Would like to have field trips to companies. N.B. A comment made later suggested that funding for field trips can be an issue.
Would like curriculum assistance and counselors on board to limit class and schedule conflicts.
Would like to market the program more to middle schools, and even elementary schools.
Would like to market the program to middle and low-end students.
Would like to bring teachers together for collaboration between the schools, to benefit from each other's experience in order to improve the program at each school. Need time set aside for structured collaboration between teachers. Would like more articulation between schools that have programs.
AHS could consider offering the kinds of pre-engineering/electronics technology based electives that are offered at WMHS
Would like better aptitude testing, funding is one barrier to this.

What types of problems or issues are you encountering that need to be reviewed or resolved and by whom?
There are problems with students who do not have adequate preparation in math. Need better stronger math/science skills in students.
Student motivation
Engagement, attentiveness, and preparation (academic and emotional) of freshmen. (N.B.: AHS will not include freshman in next year's academy. Instead all freshmen will be involved in a single school-wide academy from which students will be recruited for the ATA for their sophomore year.)
Need more time.
Systemic change is a challenge, especially regarding organizing class times for different classes.
Need funding, need to keep the PTR low and to keep academy kids together in at least one/some class (es) each day to promote identity.
There is a real need for more depth in teachers for CAD or electronics. Perhaps one solution may be to partner with Sandia, to have someone come in and teach these courses on a part-time basis.

Appendix 2

What kinds of changes do you see in the students who have participated in the program so far? Do any of these changes suggest areas for improvement or strengthening in the program?

Higher confidence level in students, feel that they can be successful
Higher level of success in students
Greater cooperation, confidence, comfort among students.
Attendance is increasing; absentee-ism is declining
GPA, class average, is up
Students are more focused on their future after high school
Kids are staying in the program.

Pipeline Programs Survey 02
Interns—Responses

Numbers in parentheses show number of responses for that choice by intern program. Comments have been combined without distinguishing between programs and are shown in italics as they were received.

Background

1. Degree Candidate for
    a. High School (CCD: 2)
    b. BS (CCD: 11, MSRI: 1, NCPPRI: 7)
    c. MS (MESA: 3, NCPPRI: 1)
    d. PhD (CCD: 2, MESA: 5)
2. Academic Field: (CCD: 11 CS, 2 N/A;
    MESA: 5 ME, 1 IE, 1 EE, 1 Bio Eng
    MSRI: 1 ME
    NCPPRI: 6 EE, 2 Physics)
3. School:
4. Intern Program:
    a. CCD (15)
    b. MESA (8)
    c. MSRI (1)
    d. NCPPI (8)
5. Prior to this internship, I (circle all that apply)
    a. Have never had an internship or co-op (7: CCD-4, MESA-1, NCPPRI-2)
    b. Have had an internship or co-op before at Sandia (8: CCD-5, MESA-1, MSRI-1, NCPPRI-1)
    c. Have had an internship or co-op before at another national laboratory (2: MESA-1, MSRI-1)
    d. Have had an internship or co-op before at a university (7: CCD-1, MESA-2, NCPPRI-4)
    e. Have had an internship or co-op before in the private sector (13: CCD-6, MESA-4, NCPPRI-3)

Future Plans

6. Has being an intern at Sandia changed your future plans? (Circle all that apply)
    a. No, it has had no effect (2: CCD-1, NCPPRI-1)
    b. Yes, it has reinforced my plans (12: CCD-6, MESA-4, MSRI-1, NCPPRI-1)
    c. Yes, helped me to focus my career objectives (11: CCD-8, MESA-1, MSRI-1, NCPPRI-1)
    d. Yes, changed my career focus to the area related to my work in at Sandia (10: CCD-5, MESA-2, NCPPRI-3)
    e. Yes, changed my career focus to the area related to other work at Sandia (3: CCD-2, NCPPRI-1)
    f. Yes, changed my career focus to an area unrelated to work at Sandia (0)
    g. Yes, encouraged me to pursue further education (10: CCD-6, MESA-1, NCPPRI-3)
    h. Other: (2: MESA-1, NCPPRI-1)
    I started a regular job at SNL/NM on 07/22/02
    Affected graduate school research to work with Sandia.

Appendix 3

Sandia as an Employer of Choice (an employer that you would prefer or choose)

7. Would you have considered Sandia as an employer of choice before being an intern at Sandia?
   a. Yes (21: CCD-9, MESA-5, NCPPRI-7)
   b. No, why? (11: CCD-6, MESA-3, MSRI-1, NCPPRI-1)
      Lack of knowledge
      Location
      Unfamiliar with laboratories
      Didn't know what they did.
      Did not think I could obtain.
      Did not see it different from any other school.
      I did not know what was done here.
      Didn't think it would appeal to me.
      I really had no idea what kind of work there was here.
      I had never heard of Sandia before.
      Albuquerque is in the middle of nowhere, didn't think research would pay well, didn't want to work for government and was never able to travel.
8. Would you consider Sandia as an employer of choice now that you have been an intern?
   a. Yes, why? (CCD: 14, 6 changed from no to yes,
      MESA: 8, 3 changed from no to yes,
      MSRI: 1, changed from no to yes,
      NCPPRI: 8, 1 changed from no to yes)
      Great work environment
      Novel research
      The environment both on and off work
      Professional atmosphere
      They are very encouraging for young students
      Positive experience in a productive work environment
      Pretty much the reasons in "9"
      Exiting work environment
      Cutting-edge work, good work environment, lots of opportunities.
      The work environment is good.
      Great technology, infrastructure, good atmosphere, great weather.
      State-of-the-art, cutting-edge technology.
      Excellent place to work.
      I have had so much fun.
      I find the work interesting.
      Environment and Special Master's program.
      Great people, very smart people and fun work.
      Promising benefits, vast research opportunities.
      Great environment to innovate.
      I enjoy the work, people, and overall environments.
      Job stability and comfortable work environment.
      Pays well (full time), work really cool, people great, not really technically need too much of a clearance so will still be able to travel.
      Excellent management, great work opportunity.
      This is a great place for me to be there the rest of my life.
      I like the work environment and opportunities.
      R & D is so advance, it will allow me to grow in my career.
      I like working here.

Benefits.
See # 9 below.
I enjoy the opportunities for research.

b. No, why? (CCD: 1, changed from yes to no)
I'm not a fan of Albuquerque and the salary I'm receiving is not comparable to the other employers I'm looking at.

9. If you consider Sandia as an employer of choice, what aspects make it so? (Circle up to 3.)
   a. Flexible research opportunities (23: CCD-11, MESA-6, MSRI-1, NCPPRI-5)
   b. Work on areas that are important to the nation (12: CCD-6, MESA-4, NCPPRI-2)
   c. Challenging and interesting work (26: CCD-13, MESA-7, MSRI-1, NCPPRI-5)
   d. Work with the people at Sandia (10: CCD: 5, MESA-4, NCPPRI-1)
   e. Work on state of the art equipment (14: CCD-5, MESA-4, NCPPRI-5)
   f. Stable funding (4: CCD-1, MESA-2, MSRI-1)
   g. Work on long-term research programs (3: CCD-1, MESA-1, MSRI-1)
   h. The ability to work independently (4: CCD-3, MESA-1)
   i. Financial support for further education (7: CCD-6, NCPPRI-1)
   j. Other: (1: CCD)
   All of the above

10. What aspects would make Sandia less than desirable to you as an employer? (CCD: 11 commented, MESA: 4 commented, MSRI: 1 commented, NCPPRI: 6 commented)

Living in Albuquerque
Large and bureaucratic, very high charges for in house services, very corporate culture
Inflexibility in research, if it occurs
Financial, Research limitations placed by government
Weapons related research
Albuquerque
Paper work! Takes longer than usual to get things orders
Too much concentration on stockpile work and not enough on other potentially significant areas, size of corporation (it's too big to really get to know everyone).
Funding issues, internal politics, I'd rather teach.
Lack of teamwork—too many independent projects/people, lack of communication between departments and organizations.
I would be way from family.
Slow pace of progress, long and slow ordering process, the "manana" attitude.
Albuquerque.
Albuquerque, Red Tape.
Bureaucracy, bad management.
Location.
Albuquerque.
Albuquerque (miss real cities, miss grass, trees, and green, clearances – don't want to be limited in terms of communication and travel.
Offer doing same work in Texas.
Nothing, this is a great place and I really like it here.
Corporate politics.
Not many, possibly bureaucracy.
Not support for further education, non-challenging/uninteresting work.

Appendix 3

Intern Experience

11. Please rank your overall experience in this internship program:
(CCD: avg=4.7
MESA: avg=4.8
MSRI: avg=5
NCPPRI: avg=4.1)

12. Please rank the importance of this program to you in career development
(CCD: avg=4.6
MESA: avg=4.8
MSRI: avg=5
NCPPRI: avg=5)

13. This program has given me an opportunity to learn about the range of career options at Sandia. (Check all that apply)
    a. Not at all (3: CCD-1, MESA-1, NCPPRI-1)
    b. Has introduced me, individually or in a group, to people in different organizations who have talked about their work (29: CCD-14, MESA-7, MSRI-1, NCPPRI-7)
    c. Has provided tours of Sandia's research areas (13: CCD-6, MESA-4, NCPPRI-3)
    d. Has provided me with other ways to learn about different research programs, such as:
    (6: CCD-2 commented, MESA-3 commented, MSRI-1 comment)
    Seminars, more seminars
    Technical conferences, cross-department collaborations
    Reliability
    Through mentors.
    Red Teaming, Dynat s/w program.
    Lunchtime classes.

14. What are the greatest strengths of this intern program from your perspective? (Circle up to 3.)
    a. Flexible research opportunities (16: CCD-6, MESA-7, MSRI-1, NCPPRI-2)
    b. The opportunity to do challenging and interesting work that contributes to Sandia's research program (25: CCD-9, MESA-6, MSRI-1, NCPPRI-5)
    c. Work with the people at Sandia (9: CCD-2, MESA-3, MSRI-1, NCPPRI-3)
    d. Presence of someone to talk with about my field or career options (10: CCD-6, NCPPRI-4)
    e. Work on state of the art equipment (7: CCD-3, MESA-2, NCPPRI-2)
    f. The ability to work independently (10: CCD-6, MESA-2, NCPPRI-2)
    g. Being treated like a responsible adult (7: CCD-4, MESA-2, NCPPRI-1)
    h. Financial support for further education (12: CCD-7, MESA-1, NCPPRI-4)
    i. Other: (1: MESA-1 comment)
    Resources and equipment are great

15. What are the weaknesses or problems with the program (up to three) from your perspective?
(CCD: 9 commented, MESA: 4 commented, MSRI: 1 comment, NCPPRI: 5 commented)
No clear program goal until first MESA meeting.
Organization of work.
One summer is really a short time.
Poor communication, lack of group cohesiveness.
Finding fund to purchase project requirements, seems as though many do not care what results, if any come out of your project.

Appendix 3

The educational value of the experience is rarely determined by the manager's level of involvement and cooperation (good manager = good work experience and vice versa).
Funding issues—where can I get $ for research stuff?
Lack of teamwork—too many independent projects/people, lack of communication between departments and organizations.
The final paper for Symposium.
Peers are too chatty, slow pace of work.
Not having Shirley, corporate housing!
Need better team matching with regards to experience.
Little mentor interacting.
Not enough mentor interaction.
The requirements to work in CCD were not stringent enough; many of my co-workers had a very poor background in computer science.
Housing-expensive! I paid for better housing, for less, in Manhattan (subsidized), also lots of roaches, SIP official activities (expensive) and FEW! Shirley is great; wish to see more of NM and what makes it the "land of enchantment".
We only get to work on one project over the summer.
Mentoring needs to be looked at to ensure student success.
Not enough funding opportunities for a 2 yr. MS program

16. What have you gotten from the program that you would not have gotten if you had not been in the program?
(CCD: 14 commented, MESA: 8 commented, MSRI: 1 comment, NCPPRI: 7 commented)
A regular job after graduation
Receive one on one instruction with first-class mentors
Learned quite a bit about working in corporate environment and about simulating fluid flow in micro devices.
Exposure to real world processing and fabrication issues
One on one instruction from mentor
Experience at a National Lab, more knowledge of Pulse Power
Opportunity to show my work at a non-Sandia conference
Saw large-scale pulse power machines/equipment/experience with expensive computer and software.
Understanding of work in a big company
Hands-on and professional exposure to potential fields of study while still in school, ability to discuss career paths with numerous people.
I wouldn't be able to work with state of the art machines; I wouldn't have gotten into MEMS classes.
Great experience—hands on MEMS work with experts, state of the art equipment, and cutting edge technology.
A positive work environment with very intelligent people and excellent resources.
Pulsed Power.
An understanding of my work field and how to motivate and manage myself.
Much.
Knowing where I went to work and that I want to go to graduate school, more networking knowledge and great experience.
Career experiences, job contacts.
Job contacts.
Many things, most importantly, experience in an interesting field of work.
Education in various fields/areas (not just what I was doing my research on).

Appendix 3

Practical knowledge vs. just theory, more accepting of living in desert.
The Great Work Experience.
Everything about computer networking, cyber security, and many other things, I am grateful that I could be a part of the CCD program.
The opportunity to work with other students from diverse backgrounds on things I would not have otherwise done.
Knowledge about how important Computer Security really is.
A lot of compute experience.
Experience.
Excellent research experience, potential full-time job at Sandia, networking with great people.
The opportunity to meet other students and learn about their experiences and schools

17. Please use the section below, or the back of this page, to write any additional thoughts about or suggestions for improving the intern program in which you participated.
(CCD: 3 commented, MESA: 3 commented, NCPPRI: 1 commented)
Very well run program. Thanks!
Overall, this program was a great experience; I was very impressed with the organization.
I would make the job opportunities known to the interns, i.e. explain how to obtain post-doc and staff positions upon degree completion, help the interns obtain full-time positions.
Peers should be encouraged to keep each other motivated and on task.
I thoroughly enjoyed the program, however I didn't even meet my mentors until I had been here for a month. I think more mentor/intern interaction would improve the program.
CCD is great – Bob and Karen are wonderful! I am grateful for housing, but it was excessively pricey – I had a room (only 1 roommate) w/ AC and furniture and cable and DSL in Manhattan on Wall Street, on the 30th floor for about the same price, Albuquerque shouldn't be and I know it isn't that expensive to live in, I've checked, also many of us from back east aren't too keen about living in the desert in the middle of nowhere – would be advantageous to sell Albuquerque as well as Sandia.
Some students from other parts of the country do not get a chance to experience all the wonderful things New Mexico has to offer.

Pipeline Programs Survey 02
Conversions to SNL Employees—Responses

Background

1. Degree Received
    a. BS--2
    b. AS-1
2. Academic Field: 1-IT, 2-CS
3. School:
4. Year Degree Received: 2 in 2001, 1 in 2002
5. Year Converted to Sandia employee: 3 in 2002
6. In which Intern Program did you participate: CCD--3
7. What role has the internship played in helping you in career planning and development? (Circle all that apply)
    a. It reinforced my desire to be a SNL employee. 3
    b. It helped me to focus my career objectives because I want to work at Sandia. 1
    c. I was not thinking about SNL as an employer of choice before the internship. 1
    d. I didn't really know anything about Sandia before the internship. 2
    e. The internship has encouraged me to pursue further education in areas of interest to Sandia's research program. 3
    f. The internship had no effect on my career planning and development. 0
    g. Other: 0

Sandia as an Employer of Choice (an employer that you would prefer or choose)

8. Would you have considered Sandia as an employer of choice before being an intern at Sandia?
    a. Yes 1
    b. No, why? 2, *because of not knowing about Sandia*
9. If you consider Sandia as an employer of choice, what aspects make it so? (Circle up to 3.)
    a. Flexible research opportunities. 1
    b. Work on areas that are important to the nation. 2
    c. Challenging and interesting work. 3
    d. Work with the people at Sandia. 0
    e. Work on state of the art equipment. 0
    f. Stable funding. 0
    g. Work on long-term research programs. 0
    h. The ability to work independently. 0
    i. Financial support for further education. 3
    j. Other: 0
10. What aspects make Sandia less than desirable to you as an employer?
    Difficult to become familiar with the many and sometimes rigid policies (administrative and operational).
    Waiting for a clearance, amount of time it takes to hire an individual.

Intern Experience

11. Please rank your overall experience in this internship program: average=5
12. Please rank the importance of this program to you in career development: average=4.3
13. This program gave me an opportunity to learn about the range of career options at Sandia. (Check all that apply)
    a. Not at all. 0
    b. Introduced me, individually or in a group, to people in different organizations who have talked about their work. 3
    c. Provided tours of Sandia's research areas. 3

d. Provided me with other ways to learn about different research programs, such as: 1
Red Teaming, programs to protect our Nation (Homeland security).

14. What are the greatest strengths of this intern program from your perspective? (Circle up to 3.)
    a. Flexible research opportunities. 2
    b. The opportunity to do challenging and interesting work that contributes to Sandia's research program. 2
    c. Work with the people at Sandia. 1
    d. Presence of someone to talk with about my field or career options. 2
    e. Work on state of the art equipment. 0
    f. The ability to work independently. 0
    g. Being treated like a responsible adult. 0
    h. Financial support for further education. 1
    i. Other: 0
15. What are the weaknesses or problems with the program (up to three) from your perspective? 2 responses
    Process of hiring individuals so that they are qualified people in this field of study that are not necessary have a high grade point average.
16. What have you gotten from the program that you would not have gotten if you had not been in the program? 3 responses
    An opportunity to come to work for the lab full-time, tremendous inspiration to continue along my career path.
    The opportunity to find out about Sandia.
    Insight into the different departments at Sandia, this was useful in deciding what department I wanted to work for.
17. Please use the section below, or the back of this page, to write any additional thoughts about or suggestions for improving the intern program in which you participated. 1 response
    The process of working more with the employees of Sandia so that they know what the work environment is like, maybe explain more about the job they could be doing when and if they become Sandia employees, might also explain the structure of the Sandia how they separate into different organizations, any questions I can explain.

Photonics Academy
Pipeline to the Future

Imagine a program that so engages high school students to pursue a technology career that they want to make sure that middle school students know about the opportunity and about the importance of taking math and science classes. Such a program is up and running in Albuquerque, New Mexico. The Photonics Academy was initiated by Sandia National Laboratories using DOE Defense Programs funding to highlight a "pathway" from high school to careers in photonics and optics—an area of dramatically increasing demand both in defense and in the private sector. It has evolved into a pathway that reaches from high school to Ph.D. level in photonics, optical sciences, and engineering. The pathway has several junctures where students can enter the workforce, refocus their study, and/or continue to further study. The Academy is not a single nor a new institution, but the result of a collaborative effort to use existing resources and to build bridges between existing institutions including high school, technical school, and university in order to provide students with a clear pathway to real well-paying jobs. The Academy has links with local and national industry to ensure ongoing relevance and to support students in gaining workplace and networking experience.

> *"It is amazing to me that the Academy exists. It actually interests students as early as middle school in technology careers. We haven't done a really good job of this in the past. And, it doesn't lock them into a specific trade or profession. It gets their attention and highlights their choices. Even if they go into some technology career other than photonics, we are way ahead."*
>
> Boyd Hunter, Lightpath Technologies
> and former Chairman, NM Optics

Photonics—A Demand-Driven Assessment of Need

Photonics is a fast emerging technology that, according to the National Academies of Science and Engineering, has the potential to drive the nation's economy and to improve its quality of life.[4] Photonics is involved with generating, manipulating, transporting, detecting, and using light information and energy. Its applications are pervasive, enabling developments in fields ranging from biomedicine to information technology, to defense, to manufacturing, energy and the environment. Changes brought about by this technology promise great innovation, but the lack of a skilled workforce could put brakes on the speed of that change. A study carried out by The Center for Occupational Research and Development (CORD)[5] and published in the April 2001 issue of *Photonics Spectra* projects a shortfall of about 25,000 technicians by the year 2005 in photonics, a shortfall of almost half of the expected need.[6]

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[4] National Academies of Science and Engineering. Commission on Physical Sciences, Mathematics, and Applications. *Harnessing Light, Optical Science and Engineering for the 21st Century*. 1998.

[5] www.cord.org. "CORD is a national nonprofit organization providing innovative changes in education to prepare students for greater success in careers and higher education"

[6] Pedrotti, Leno, quoted in: Vorenberg, Sue. *Stairway to High-Tech Heaven*. Albuquerque Tribune. Business Section. March 18, 2002.

Appendix 5

Central New Mexico is a center for photonics technology research, due in large part to the presence of two DOE national laboratories—Sandia and Los Alamos—of the Air Force Research Laboratory at Kirtland Air Force Base, and of the Center for High Technology Materials at the University of New Mexico. In 1991 these organizations formed the Alliance for Photonics Technology. The increasing importance of photonics research and the growing community of New Mexico businesses led to the formation out of this original group of the New Mexico Optics Industry Association. According to Boyd Hunter, former Chairman of the New Mexico Optics Industry Association, Albuquerque has about 100 photonics companies.

As the need for a formal training program in photonics became increasingly clear in the community, the Albuquerque Technical Vocational Institute (TVI) took the initiative and conducted a photonics and optics workforce training needs assessment in 2000. This assessment incorporated input from industry, educational institutions, and research laboratories throughout the State of New Mexico.[7] The result was a clear list of workforce training needs.

Sandia Pipeline Programs

Sandia National Laboratories has developed a suite of "pipeline" programs to ameliorate existing and/or expected workforce shortages in areas of critical skills needs for the nation's security. One such area is photonics and optics training for the microsystems research program. As the need for these skills both within Sandia and in the Albuquerque community became increasingly pronounced, Sandia submitted a successful proposal for DOE Defense Programs funding to develop a photonics pipeline program. The Photonics Academy is focused on photonics training and preparation at the high school and 2-year college level; other pipeline programs are focused on different critical skills needs and academic levels. These pipeline programs encourage US students to focus on the challenging academic training required for careers in very specific areas of identified need and provide interaction between students and Sandia technical staff.

The Photonics Academy offers students an unprecedented pathway to achievement—from middle school on up! The curriculum ensures that all students receive sufficient math and science to enable academic success. The collaboration between academia, federal facilities, and industry is the backbone of the accomplishment. We are unique in the nation in this respect.

D.F. Wilson
Consultant, DOE DP Critical Skills Development Programs
Sandia National Laboratories

"This program shows you that you can do something big with your life."

"Before, I just wanted to go to college and get a job. This has helped me to focus my school work."

ATA graduates

Guenther, Arthur and Pedrotti, Leno. *Let There Be Light – for Albuquerque Students*. Albuquerque Tribune. Opinion Section. April 25, 2002.

[7] Gonzalez, Salvadora. Program Director. *Needs Assessment: Photonics Technology Program.* TVI Technologies Department. Request for Program Approval dated September 29, 2000.

Appendix 5

The Photonics Academy is based on and integrated with the Advanced Technology Academy (ATA) model—one of the original pipeline programs—developed and implemented five years ago by Sandia in partnership with West Mesa High School (WMHS) and TVI. The model has proven itself to be cohesive and robust and able to encourage and sustain student interest. Originally called Advanced Manufacturing for Education, WMHS students in the program took a strong lead and renamed it the ATA. WMHS, a large urban school with a diverse student population from an economically challenged area, had a high drop out rate historically. Students in the ATA credit the program with providing a motivation to take on and to succeed at academic and life challenges, with generating optimism about the future, and with identifying a clear pathway to career opportunities that was not before obvious to them. These ATA students have been leading proponents of the need to go back to the feeder middle schools and make sure that those students know about technology career opportunities and about the academic preparation needed to take advantage of them.[8] In Academic Year (AY) 01/02 the WMHS drop out rate declined from 15% to 9%.

> *The Academy program provides our students with lifetime options. When those options were made clear, our students showed that they are ready to work hard for the opportunity that is presented.*
>
> Tom Daly, WMHS Academy and ATA Coordinator

Defense Programs funding for the ATA and the Photonics Academy supports dedicated staff that encourage ongoing collaboration within the community, provides professional development activities such as workshops or training, and necessary resources and equipment. Further, they integrate the Academies with Sandia by coordinating the availability of Sandia internships for Academy students. Although primarily focused on WMHS and TVI, program staff works within the community to encourage collaborative teamwork with middle schools, the University of New Mexico, and local business.

Career Pathway

The Academy continues the ATA model by articulating curricula at the high school and at TVI to provide academic background and training to facilitate an AAS degree in Photonics. In parallel with the development of the Photonics Academy the model has been extended in several ways. Both the ATA and the Academy are actively marketing to students in math classes in the middle schools that feed into WMHS. On receiving an AAS, students are able to enter the workforce with skills that have been identified as critical by employers, or are

> *TVI's program is designed to prepare students for hi-tech careers … Graduates will be eligible for entry-level technical positions in a wide range of scientific and technological disciplines utilizing laser, optic and fiber optic technology.*
>
> Robert Hall,
> Director, Electronics & Manufacturing Technologies, Technology Department,

[8] For more information, see 2002 evaluation of the Advanced Technology Academy Program. TBD.

able to pursue upper division study at a university.

An important part of the Academy pathway is the BS in Optical Sciences & Engineering that is currently under development by the University of New Mexico (UNM). Typically, training at a two-year college is focused and lab-intensive, preparing students with the education and tactical skills needed to enter the workplace. In comparison, education at a university is usually broader and more theory- or science-based.

Because of the difference in objectives between the technical education pertinent to an AAS and a university education for a BS, the level of math and physics needed by technicians with an AAS is not the same as that needed by BS graduates. Students entering the AAS program who want to pursue a BS are able to take higher-level math and science courses at TVI to prepare for further upper-division study. Because of the difference in math and science preparation, AAS graduates who do not decide to pursue a BS until completion of their AAS may need to take extra classes, requiring up to a year, to develop the background needed to succeed in the BS program.

Both TVI and UNM are working together to determine how to articulate the two curricula and to meet their respective objectives in preparing students. UNM hopes to have the BS in Optical Sciences and Engineering available within two years and already offers programs for an MS in Optical Science & Engineering and a Ph.D. in Optical Science. When the BS program debuts, Albuquerque will have the only clearly defined pathway from middle school to Ph.D. in the nation that prepares students for a range of careers in photonics manufacturing and research. Figure 1 shows this pathway graphically.

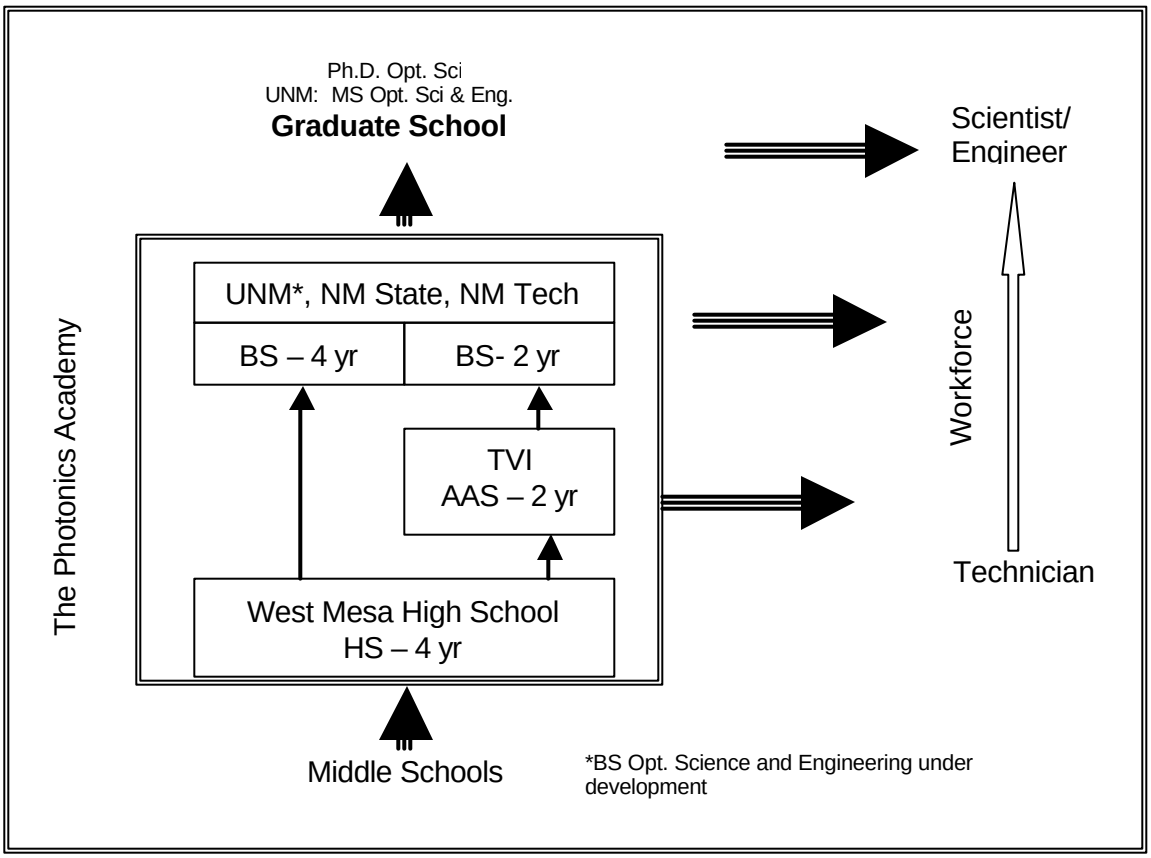

Figure 1. Photonics Academy Career Pathway

Articulating Curricula

A first order of business in creating the pipeline from high school to careers was to identify and integrate the curriculum at each level in the pathway. Following a competitive bidding process, WMHS was chosen to develop the Photonics Academy. Important to this decision was their understanding of the needs of such a program, proven experience, and in-place infrastructure. The Photonics Academy was integrated into the ATA; classes in the first two years of both programs are common. In parallel and coordinated with WMHS efforts, TVI, using information from its needs assessment, built on optics and laser classes begun in the 1970s to develop a photonics technology curriculum that results in an AAS degree in photonics.[9]

> *"A real strength in the Albuquerque area has been the willingness of people to work together as a team to get things done. Sandia's continuing coordination and encouragement have been very important. The willingness of leaders at WMHS and TVI to work together has been crucial. Local industry is interested and involved. There have been no prima donnas."*
>
> Leno Pedrotti,
> Chief Scientist Emeritus, CORD

CORD conducted a workshop for WMHS and TVI teachers and administrators as well as Sandia, the AFRL, and other industry representatives to develop a curriculum that would integrate with the existing school programs and that would meet the identified needs of the industry. This involved identifying a "4-2" course of study: identifying the courses at the high school level and the 2-year college level necessary to prepare for and complete an AAS degree, then clarifying which classes already available satisfy the requirements, and which need to be developed and implemented. According to Leno Pedrotti, Chief Scientist Emeritus at CORD, reluctance on the part of one organization to change to meet another organization's needs has been a barrier in other locations to articulating curricula. In the Albuquerque case, an important aspect to the program's success has been proactive willingness on the part of WMHS and TVI to collaborate in order to make sure that WMHS classes are appropriately preparing students for the AAS program at TVI.

As noted earlier, TVI had existing classes in photonics and optics and developed the classes necessary for an AAS. The first official class in the TVI photonics program began in fall 2001, with graduates expected in spring 2003. WMHS developed the Photonics Academy curriculum during AY 01/02. The first official WMHS Photonics Academy class begun AY 02/03, with 25 freshmen identified from the middle schools that feed into WMHS, and with 25 upper class students that have indicated an interest in photonics. WMHS actively markets the Academy to students in math and science classes at the middle schools that feed into WMHS.

Photonics Academy Timeline

TVI Needs Assessment	2000
SNL request for DP funding for Photonics Academy	2000
Meeting on curriculum Led by CORD	2001
TVI implements Photonics AAS	2001/02
WMHS implements Photonics Academy (built on existing ATA)	2002/03

[9] A certificate after completion of one year of training is also available.

WMHS and TVI coordinated their individual curriculum development activities so that both are appropriately integrated. WMHS students in the Academy receive training necessary for success in the TVI program. In addition, students in the WMHS Academy are able to take classes concurrently at TVI, and upon graduation from the Academy are able to move into the TVI program with up to nine credit hours toward an AAS.

Work Exposure/Experience

An important part of the Photonics Academy is the ongoing involvement of the business sector. Business has been involved from the beginning through assessment of skills needs. Sandia and other interested businesses remain active in the program through an advisory committee, thus maintaining the program's relevance to the job market and making it possible to reduce the need for on-site training for new employees. The AFRL, a member of the advisory committee, provided funding for equipment and scholarships in AY 02/03. Sandia has made internships available—full time in the summer and up to 25 hours per week during the academic year—for which WMHS and TVI students with a grade point average of 2.5 or better can apply. These internships allow students to gain experience in the workplace and allow Sandia to identify promising potential employees.

The demand for photonics technicians is national and expected to increase, therefore Academy coordinators are involved in ongoing discussions with national professional associations in the field of photonics such as the SPIE (International Society for Optical Engineering) and the OSA (Optics Society of America). SPIE will offer high-school-level student memberships to students entering the Academy this fall and will work with the Academy to start an optics club—SPIE's third high school chapter. SPIE has provided access to professional women mentors to high school students in the past, and will provide such access to female Academy students on request. SPIE has an educator's network that will provide industry mentors to Academy teachers. Interaction with SPIE, through these mechanisms and attendance at meetings and career fairs, is meant to give students a broad perspective of career options available and thus extend the reach of the program to national and even international levels.

SUCCESS ELEMENTS

Interviews with people involved with creating the Photonics Academy suggest several reasons as to why this program has come together quickly and seems likely to succeed.

- Students are introduced to and actively engaged in pursuing technology careers that have been identified by the business community as a current and ongoing need.
- The program provides a clear and integrated middle school through Ph.D. pathway to well-paying jobs that will be in demand. The pathway allows students to make employment choices at different junctures along the pathway as they gain educational and work experience.
- The ready willingness on the part of leaders at WMHS and TVI to collaborate and to make changes in order to achieve the goal of appropriately prepared students has been of fundamental importance to creating the Academy.
- Dedicated staff—both Sandia staff providing an overall perspective and staff in each institution—who are focused on pushing the effort forward rather than on trying to achieve personal agendas has been a critical part of this process.
- Finally, early and continuing involvement by business, both local and national, keeps the program focused on workplace opportunities and smoothes the pathway from school to careers.

Appendix 6: Gender and Ethnicity Tracking – New Mexico

	NMSIP	NMLCSDP	NM Non Reg.	NM Corp.
	% of total	*% of total*	*% of total*	*% of total*
Male	58	60	56	50
Female	42	40	44	50
Total	100	100	100	100
Males				
Am.Ind.	1	8	2	3
Asian	2	4	8	4
Afric.Am.	1	1	2	3
Hisp.	15	12	12	15
Other	39	34	32	25
Total	58	59	56	50
Females				
Am.Ind.	1	13	1	3
Asian	2	3	2	2
Afric.Am.	1	1	2	2
Hisp.	17	9	15	17
Other	21	15	24	26
Total	42	41	44	50

Gender and Ethnicity Tracking – New Mexico:

Student Internship Program, Laboratory
Critical Skills Development Programs,
Non-Regular Employees, NM Corporate-wide

Distribution

Qty	Organization
2	US Department of Energy Office of University Partnerships Att'n: Dr. Beverly Berger 1000 Independence Avenue, S.W. DP-134 / room 4B-103 Washington, DC 20585
2	Center for Occupational Research & Development Att'n: Darrell Hull Att'n: Leno Pedrotti P.O. Box 21689 Waco, TX 76702-1689
2	NACFAM Att'n: Leo Reddy, CEO & Founder Att'n: Egils Milbergs, President 1201 New York Avenue N.W., Suite 725 Washington, DC 20005-3917
3	Albuquerque High School Att'n: Art Fresquez Att'n: Linda Sink Att'n: Mike Stanton 800 Odelia Road N.E. Albuquerque, NM 87106-1699
4	Albuquerque Technical Vocational Institute Att'n: Steve Benavidez Att'n: Don Goodwin Att'n: Robert Hall Att'n: Nancy Stewart 525 Buena Vista S.E. Albuquerque, NM 87106-4096
1	Lawrence Livermore National Laboratory Att'n Barry Goldman P.O. Box 808, L-428 Lawrence Livermore National Laboratory Livermore, CA 94550
1	Los Alamos National Laboratory Att'n: Kurt Steinhaus P.O. Box 1663 MS M709 Los Alamos, NM 87545

10 Science Policy Research
Att'n: Katherine Clark
P.O. Box 35574
Albuquerque, NM 87176

2 Technology Ventures Corporation
Att'n: Sherman McCorkle
Att'n: Randy Wilson
1155 University Blvd SE
Albuquerque, NM 87106

1 University of Missouri
Att'n: James E. Thompson, Dean of Engineering
W1025 Engineering Bldg East
Columbia, MO 65211-2200

1 UNM Center for High Tech Materials
Att'n: Art Guenther
1313 Goddard SE
Albuquerque, NM 87106

4 West Mesa High School
Att'n: Essel Baca
Att'n: Milton Baca
Att'n: Tom Daly
Att'n: Carmen DiGregorio
6701 Fortuna Road N.W.
Albuquerque, NM 87121

1	MS0841	Bickel, Tom	09100
1	MS0186	Blanton, Don	03000
1	MS0136	D'Antonio, Perry	09713
1	MS0511	Fellerhoff, Rick	01020
1	MS1351	Gallegos, Jerry	3531-2
1	MS0956	Gallegos, Phil	14112
1	MS0821	Gritzo, Lou	09132
1	MS1078	Hanselmann, Kathryn	01314
1	MS0121	Hart, Carolyne	01200
1	MS1023	Harty, Susan	3531
1	MS9904	Hibbs, Norma	08524
1	MS0785	Hutchinson, Bob	06516
1	MS1351	Jackson Connie	3531
1	MS1080	Jakubczak, Jay	01703
1	MS1026	Jones, BJ	03500
1	MS0603	Kemme, Shanalyn	01743
1	MS1352	Moore, Jackie Kerby	14004
1	MS9904	Ketchum, Rose	08524
1	MS1349	Loehman, Ron	01843
1	MS0132	Martinez, Lenny	14000
1	MS1194	McDaniel, Dillon	01640
1	MS0824	Moya, Jaime	09130
1	MS1190	Quintenz, Jeff	01600
1	MS0824	Ratzel, Art	09110
1	MS0513	Romig, Al	01000
1	MS1025	Sanchez, Julian	03532
1	MS9904	Scott, Karen	08524
1	MS0603	Smith, Brad	01743
1	MS0561	Souther, Tom	14186
1	MS0865	Stinnett, Regan	01903
1	MS1194	Struve, Ken	01644
1	MS0139	Wilson, Pete	09902
1	MS1077	Zipperian, Tom	01740
1	MS9018	Central Technical File	8945-1
2	MS0899	Technical Library	9616
1	MS0612	Review & Approval Desk	9612
35	MS1351	Dominique Foley Wilson	3531-2