"University partnerships are essential to Mission Success."

Paul Robinson, Sandia
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Note: The conference presentations are summarized. Unless indicated, the summary statements are not direct quotes.
On January 14–15, 1999, Sandia National Laboratories sponsored Deans' Day, a conference for the Deans of Engineering and other executive-level representatives from 29 invited universities. Sandia considers these universities strategic partners in Sandia's Campus Executive Program. The Campus Executive Program, established in September 1997 by Laboratory Development Vice President Dan Hartley and Human Resources Vice President Charlie Emery, focuses on strategic research collaborations and the alignment of recruiting activities at selected schools. The conference goals were to identify opportunities and means for

Members of Sandia's executive management presented information on Sandia's missions, capabilities, and collaborative interests. Tours and demonstrations highlighted some of Sandia's world-class research and development (R&D) facilities and opportunity tools.

Through breakout sessions and a wrap-up discussion, university and Sandia participants identified activities to further develop their strategic relationships. The four primary activities are:

A) Concentrate joint efforts on current and future research strengths and needs.
B) Attract the best students (at all grade levels) to science and engineering.
C) Promote awareness of the need for and work together to influence a national science and technology R&D policy.
D) Enable the universities and Sandia to be true allies, jointly pursuing research opportunities and funding from government agencies and industry.

To address these opportunities, Sandia intends to commit to significantly increase the "bottoms-up" R&D funding to universities; to use Laboratory Directed Research and Development (LDRD) funds to seed new areas of R&D collaboration; to commit executive involvement to define areas for "top-down" focus; to commit people and resources to jointly pursue new R&D sponsors; to expand and focus internships, sabbaticals, and summer programs for faculty and students; and to share opportunity tools. In return, Sandia asks the universities to work with their Campus Executive to define focus areas; encourage visits to Sandia for exploratory partnering; help define new and better ways to interact; encourage the best students to consider Sandia as an employer of choice; and identify Sandia as a strategic partner.

"Research can be focused with an end in mind, and that doesn’t have to mean it is bad research."
Al Romig, Sandia

strengthening the relationships between the universities and Sandia and to build a strategic framework for collaboration.
Welcome and Opening Remarks

After welcoming the guests at Thursday night’s dinner, Ambassador C. Paul Robinson, Sandia Corporation President and Laboratories Director, discussed the similarities in research among Sandia and their 29 strategic university partners. A prime aspect of this conference will be to develop ways to align and strengthen those increasingly important partnerships.

Special Remarks

Dr. John Crawford, Sandia’s Executive Vice President and Deputy Director, introduced Dr. Gilbert E. Weigand, Deputy Assistant Secretary of Energy for Defense Programs, Computing Research and Development. Dr. Weigand discussed the role of science in disarmament treaties. The President considers using Science-Based Stockpile Stewardship to replace nuclear testing to be of supreme national interest. Dr. Weigand urged the national laboratories to partner with the universities to develop and enhance new technologies. He cited as an example the alliances between DOE and five universities in the Advanced Strategic Computing Initiative (ASCI) program. Dr. Weigand considers the universities "very important to the Department of Energy" and is looking for innovative ways to expand the scope of participation with the universities. The DOE holds the resources that the universities possess in very high regard. He invited the Deans to contact his office to suggest ways to increase the partnering between themselves and DOE. The universities, DOE, and the national laboratories can team together to set the pace and tone for science in the 21st century.

Ambassador Robinson followed Dr. Weigand’s remarks with a brief history of Sandia and introduced a video, "Solutions from Science for a Changing World."
The conference began on Friday morning with a continental breakfast, followed by "A Brief Overview of Sandia National Laboratories" by C. Paul Robinson, President and Laboratories Director.

In 1949, President Harry S. Truman asked Leroy Wilson, President of AT&T, if they would manage Sandia National Laboratories. Truman suggested that AT&T would be performing "exceptional service in the national interest." Sandia has continued to provide that exceptional service to the country for 50 years, first under the management of AT&T and now Lockheed Martin Corporation.

Sandia is a distributed lab, with sites in Albuquerque and Carlsbad, New Mexico; Livermore, California; Tonopah and Yucca Mountain, Nevada; and Kauai, Hawaii. The Labs employ 7,500 people, including 1,400 Ph.D.'s and 1,700 Masters, and operate 600 buildings with over 5,000,000 square feet on an annual budget of $1,400,000,000.

**CORE COMPETENCIES**

Sandia's mission emphasizes broadly defined national security issues that are supported by its core competencies, which are computational and information sciences, engineering sciences, materials processing, pulsed power, and microelectronics and photonics. Key recent developments within these areas include the completion of the massively parallel teraflop computer, strides in automatic mesh generation, modeling chemical vapor deposition reactors in conjunction with SEMATECH, state-of-the-art work with vertical-cavity surface-emitting lasers (VCSELs), and the ability to simulate events occurring within a nuclear explosion, a success that was featured in *National Geographic* magazine.

Sandia was also in the news for its efforts in the Unabomber case. Two Sandia employees dismantled the bomb found in Kaczynski's cabin, with no loss of evidence. This was the first forensic use of counterterrorism techniques.

**NATIONAL SECURITY COMES FIRST**

The national security issues that Sandia addresses include the design and development of the non-nuclear portions (roughly 97 percent of the components) of U.S. nuclear weapons; the safety, security, and use control of nuclear weapons (Sandia is assisting the Former Soviet Union in securing their nuclear stockpiles); and activities supporting verification, nonproliferation, and counterproliferation of other countries' weapons of mass destruction. Sandia's extensive program of satellites is a means of verification. Nonproliferation includes all the activities the U.S. undertakes to convince another country not to make weapons of mass destruction. Counterproliferation is what the U.S. does if nonproliferation fails.

Additional national security issues that Sandia addresses are the surety of critical infrastructures and responses to emerging threats. Sandia technologies play a role in thermal imaging satellites, facility detection and characterization, on-site and remote effluent detection and characterization, chemical micro-sensors, energy supply and distribution, transportation safety, structural vulnerabilities, and risk-assessment methodologies.

**ENERGY AND ENVIRONMENT**

Sandia also is charged with responsibilities for the research to improve utilization of energy, development of alternative energy sources, and protection of the environment. Within the DOE complex, Sandia serves as lead laboratory for crystalline and multicrystalline silicon-cell technologies. Sandia developed a new solar-cell concept that demonstrates an eighteen-percent efficiency for large-area solar cells, while using simpler and less expensive module assembly.
Technology transfer activities for this concept are under way. In addition to energy supply, Sandia also addresses the distribution and end use of energy. Currently, Sandia is analyzing electric power grids in Texas and California. In conjunction with the Environmental Protection Agency, Sandia is fulfilling its role in environmental protection by providing geotechnical analyses and performance assessment models predicting behavior for the Waste Isolation Pilot Plant, the world's first certified repository for disposing of radioactive waste deep underground.

The next major human and political crisis on the earth may be the availability of potable water. Two examples: first, when a resources expert looked at the brokered Bosnia-Herzegovina land division, he discovered that all the sources of water belonged to the Serbs, none to the Moslems; and second, the quality and quantity of the water in the Nile are eroding, with the worst results in Egypt, where 95 percent of the population live along the Nile. With these and other crises looming, Sandia is working with universities and other labs to develop a water resource management tool.

**AN R&D REVOLUTION**

Sandia's science and engineering activities include the advancement of a "Revolution in Engineering" through model-based product and process design. The impact of this revolution will be the optimization of products for performance, manufacture, certification, maintenance, and dismantlement—cradle-to-grave product modeling. This Product Realization Environment is already in place in the pioneering Extreme Ultraviolet Lithography (EUVL) partnership.

The next step for Sandia and its partners can be a "Revolution in Manufacturing" using robotics and intelligent systems. This revolution can use automatic production scheduling and planning, model- and sensor-based process control, direct feedback from manufacturing to design, in-process acceptance of product, and automated programming from computer-aided design to produce very rapid, flexible, scalable manufacturing systems.

Sandia is now actively investigating a "Revolution in Microelectronics" through intelligent, integrated, radiation-hardened microelectromechanical systems (MEMS). At the far edge of Sandia's science and engineering advances is the Z Machine, a unique facility that converts electrical energy into radiation and can simulate radiation effects in nuclear explosions.

**MOST IMPORTANT RESOURCE**

Sandia satisfies its missions in part by attracting and retaining excellent people. Sandia assesses its employees by having them align individual objectives with corporate "line-of-sight" objectives. In the most recent annual assessments, of 68 corporate goals, 53 were met completely and only 3 were missed.

Sandia's employees advance the state of knowledge and apply these advances to solving its customers' technical problems, create an infrastructure that provides competitive advantages, and establish and maintain strategic partnerships with universities, other labs, and industry.

A select group of Sandia people are tasked to pursue new opportunities and means for collaborative relationships with universities. The partnerships they—and you—establish are certain to enhance the vitality and effectiveness of the institutions' scientific and engineering capabilities.

"I didn't know that Sandia had an interest in water quality. That's a good match for us. I see some applications for nondestructive testing."

Don Dickson, Texas A&M
The partnerships between the national laboratories and universities could be the future of R&D in the U.S. Technology migrates from one field to another, and collaboration across disciplines and across institutions is necessary to move quickly, or at all, to solutions. A new era is emerging where the cultural differences between the traditionally security-minded labs and the historically intellectually open universities will fade as they acknowledge their common missions and develop means of partnering with each other and business.

Congress this year will consider a bill enhancing government support of basic and applied research at the national labs. It is important to remember that many useful domestic discoveries have come from research funded by the government, including answers to public health problems like the Hantavirus, and the technological underpinnings for the Internet. Congress is concerned about security issues at the national labs. While this must not deter the labs from collaborating with universities and industry, they will need to employ stronger counterintelligence activities.

Concerning intellectual property rights: while the Bayh-Dole Act addresses intellectual property ownership in collaborative agreements involving universities, it may be more appropriate to negotiate rather than legislate. That is the position industry takes—usually successfully—with the labs. One example of that was a cooperative research and development agreement with a small, entrepreneurial medical equipment supplier. Sandia had invented a sensor that could be further engineered to read blood glucose levels noninvasively. Through negotiation, the intellectual property was made available, and now the company continues to build on its early successes.

Discussions will continue in Congress on the basic versus applied research debate. While the projected budget surplus is likely to be primarily earmarked for social security and tax relief for families, there may be some increased funding for national defense and healthcare research.

"The universities and labs should go to policymakers together and on a regular basis."
Michael Isaacson, Cornell
Breakout Sessions

Three concurrent breakout sessions addressed the broad topic of providing a framework for strategic partnerships between the universities and Sandia. A Sandia facilitator and a rapporteur focused the conversations and recorded the outcomes in each session.

EIGHT OPPORTUNITIES

To direct the content of the session, Sandia provided three fundamental and five additional questions that the session members could choose to address.
1) What can Sandia do to help the universities achieve their goals?
2) What can universities do to help Sandia achieve its goals?
3) What can we do together that neither Sandia nor universities can do alone?
4) What roles might universities and national laboratories play in meeting engineering challenges for the 21st century?
5) What can national laboratories do to recruit the best and the brightest from universities?
6) How can we work together to build constituencies?
7) What can national laboratories do to interest more students in grades K–12 in pursuing careers in science and math?
8) How can we improve the effectiveness and efficiency of partnering between national labs and universities to pursue work for the government?

FOUR GOALS

As expected, the suggested questions became a take-off point for far-ranging discussions on topics as varied as how to affect national R&D policy, to how many faculty and graduate students constitute a meaningful project commitment. Four major assignments emerged from these discussions.
A) Concentrate joint efforts on current and future research strengths and needs.
B) Attract the best students (at all grade levels) to science and engineering.
C) Promote awareness of the need for and work together to influence a national science and technology R&D policy.
D) Enable the universities and Sandia to be true allies, jointly pursuing research opportunities and funding from other government agencies and industry.

Following the breakout sessions, the facilitators and rapporteurs reviewed the output of their groups and synthesized the findings for presentation.

RECOMMENDATIONS

The prime recommendation at the mission level is that the universities and Sandia should identify the "next big thing(s)" to work on together. There is widespread, though not unanimous, belief that the "next big thing" is biomedical engineering. A few participants suggested that university social scientists be added to the collaborative mix to support modeling efforts of human endeavors and societal dynamics. Others called for increased support for surety science and engineering.

The education of students at all levels about the importance of and career opportunities in science and engineering was recommended as a strong, secondary mission for universities and Sandia. The tactics for this mission reach from workshops for College of Education students through virtual undergraduate engineering class projects to encouraging Ph.D. students to complete their coursework at the university and conduct their research work at Sandia. Some participants acknowledged that the perception of Sandia's position in the nuclear weapons complex prejudices students against it, despite the reality of the wide range of disciplines and career paths available at Sandia. Therefore, Sandia should concentrate on broadcasting the breadth of its competencies through its Website, campus visits, internships, and co-ops. Another often-repeated concern is the low number of women, minority students, and other U.S. citizens pursuing careers in science and engineering. Efforts must continue to provide a focused outreach to these students.

Influencing national science and technology R&D policy is an activity that the participants believe should be tackled jointly. One recommendation stressed first identifying the supporters of a national R&D policy and then forming...

"For these relationships, making it meaningful will make it sustainable."
Dan Hartley, Sandia
action networks among the supporters, universities, industries, and Sandia. A university representative from a populous state expressed his belief that constituents from less-populated states would have easier access to their legislators. He urged his university colleagues to take advantage of those opportunities to advance their agenda.

The joint pursuit of government and industry research opportunities by universities and Sandia is a fertile field for imaginative, innovative approaches.

The strongest message is to bring universities into Sandia's established R&D relationships with industrial partners. Sandia should also continue and expand the efforts under way with the Campus Executive Program; develop a standard approach to handling intellectual property and overhead rates in industry/university/Sandia agreements; and maintain open dialogue on resources and needs.

**COLLABORATION, NOT COMPETITION**

Sandia can demonstrate its true willingness to be collaborative rather than competitive through the open exchange of information on partnership opportunities; by enhancing programs for sabbaticals, reverse sabbaticals, and other personnel exchanges; by offering to chart the progress of Sandia-employed university students and graduates to support accreditation efforts; through collaboration on curriculum; by directing pertinent requests for proposal (RFPs) to the appropriate campuses; and by developing projects where university faculty and students have access to Sandia facilities.

Other proposed activities to show the spirit of collaboration include expanding the contact point between the institutions down to the line manager/assistant professor level; adding partnering expertise as an assessment category for Sandia employees; developing a corporate metric for strategic university interactions; establishing "virtual" labs on the Internet; offering Sandia's opportunity tools to the universities; and putting access-limiting hot buttons on Sandia's Website to share technology and business information with selected campuses.

"This Campus Executive Program is an excellent start. Stay with this for the long term, be consistent, stay constant in purpose."

Mel Branch, University of Colorado
DEANS' FEEDBACK

The first annual Deans' Day conference closed with enthusiastic commitment by the participants to proceed collaboratively in developing new and exciting ways to advance an institutional and national agenda in science and technology. University executives completed conference evaluations immediately upon the close of Friday's session. They reported "extreme satisfaction" with the substance and logistics of the event, awarding the conference a score of 9 out of a possible 10.

Deans commented:

- "Consider for the next conference a more detailed presentation on the Sandia Campus Executive team structure and experiences on what works, what doesn't."
- "Define next steps. Define expectations, outcomes."
- "Tour was excellent. I would like to send some faculty to meet with some of the SandiaPIs."
- "Find a clear technical goal(s). Work with four or five universities on each new big 'it.'"
- "It was valuable to have an opportunity to hear first-hand about Sandia activities."
- "It would have been useful to have a list of on-going research collaborations that Sandia and the universities currently have."
- "I appreciate that each one of you, particularly Sandia Directors and VPs, spent time with us throughout."
- "What's next? That will be watched with great interest."
- "Keep up the good work. Universities would like to work more closely with Sandia."
- "Someone mentioned that the number of universities might be increased. I feel the group is large enough."
- "Please follow up on the good ideas discovered."
- "This was my first visit. I really did not have a strong appreciation about how significant a national resource Sandia represents."
- "More time for discussions to address collaborative efforts."
- "Dialogue was most useful."
- "Have technically focused conferences in 'strategic' areas for faculty."
- "[Something I found valuable was] Having highest-level Sandia participation throughout the day and for social events. It's very clear from this that you are serious about collaboration."
- "I'm not sure if an annual event is needed yet. There are other venues where Deans get together (ASEE, etc.) where a short session could be held annually. More individual visits are important."
- "I've attended a similar event for Deans at [a multinational corporation] and this was much better."
- "Smaller breakouts to get more dialogue."
- "Be more focused on means to collaborate. Tell some success stories — maybe narrated by university faculty and Sandia staffers."
- "Very happy with the level of candor and presence of leadership."
- "Set up some joint committees to work problems, such as the number of U.S. physics and engineering grad students."
- "Sandia is clearly interested in making things work with us — the feeling is mutual."
- "Next time, leave some time for one-on-one with Campus Execs."
- "End with a list of action items."

The clear outcome from Deans' Day 1999 is that the universities and Sandia have common goals that can best be met by the application of some shared, some differing capabilities. Each participant can employ these suggestions for identifying programmatic issues, impacting science and technology policy, improving educational outcomes, and developing strategic partnerships. In partnership, the universities and Sandia can truly provide "exceptional service in the national interest."
The university relations program comprises three areas: the Campus Executive Program, research collaboration, and university recruiting.

Established in 1997, the Campus Executive Program develops strategic interactions between Sandia senior scientists and engineers and senior university administrators at 29 selected schools. The Campus Executives link Sandia's research and recruiting activities and focus Labs/university research on Sandia's long-term objectives.

The research collaboration office focuses on identifying and managing the Labs'/universities' research portfolio and ensuring that the collaborative efforts are aligned with Sandia's science and technology mission.

The university recruiting program is a continuing set of planned activities designed to present Sandia to students and to recruit top college graduates or students. Sandia has specialized recruiting teams concentrating on technologist, BS/MS, and Ph.D. candidates. Sandia jointly recruits with Lockheed Martin Corporation at select schools. Sandia's hiring is based on a strategic plan that specifies a yearly personnel requirement and a five-year forecast. This plan focuses the selection of schools, disciplines, and candidates.

HIRING NEEDS

Over the past ten years, Sandia's annual hiring has ranged from a high of 600 to a low of 100. Currently, Sandia is hiring approximately 300 people per year, seventy-five percent of them in the technical staff area. The top ten technical staff occupations are in electrical engineering, technical program/project management, systems engineering, engineering sciences R&D, computer software R&D, programming and analysis, mechanical engineering, computer systems analysis, materials science, and physics. For FY99, Sandia expects seventy percent of its new hires to be within three years or less of obtaining their last relevant degree. Eighty percent of this year's new employees will be working in information technology, and eighty percent of all new hires will have graduate degrees, with an overall GPA of 3.6 or better. Sandia is proud that its acceptance-to-offer rate of eighty-two percent is well above the national average of sixty-two percent.

STUDENT OUTREACH

One concern for Sandia is low minority enrollment in the physical sciences. Another issue is the declining number of U.S. citizens doing graduate work in the physical sciences. Sandia has local programs with elementary and secondary schools to promote an interest in science and math among younger students and would like to develop a geographically broader range of programs with the support of the universities. Sandia averages 800 internships and co-ops per year, with students drawn from high schools through Ph.D. programs. The intern/co-op program focuses on technical disciplines and offers students opportunities for technical work, seminars, mentoring, recruiting, and cultural events. Sandia would also like to increase the sabbatical/reverse-sabbatical programs for faculty and employees.

EMPLOYER OF CHOICE

In a survey conducted for a 1998 Sandia Leadership Conference, employees were asked why they accepted employment at Sandia and why, once hired, they stayed. The key reasons for accepting employment are Sandia's reputation and national focus, continuing education programs, attractive benefits and compensation, great facilities, and Southwest climate. With an amazingly low exit rate of between four and five percent, Sandia employees say they stay because of the challenging work, the quality of life, opportunities for career advancement, outstanding peers, and retraining programs. As one recent forty-four-year employee said at his retirement, "Sandia is an incredible number of companies and you do not have to leave to move into new positions."

Sandia is actively soliciting the help of the universities in defining new and better ways to attract the best students and encourage faculty to come to Sandia for their sabbaticals and research opportunities.

"We need your help to identify and recruit your best students."

Charlie Emery, Sandia
Sandia is a national security laboratory. It is in the charter to worry about nuclear weapons and to worry about proliferation. Under these broad requirements, Sandia concentrates on sustaining the U.S. nuclear weapons stockpile, reducing the nation's vulnerability to weapons of mass destruction, advancing the surety of global infrastructures, and enhancing national security measures. Sandia uses its technologies for detection, surveillance, energy, information, transportation, architectural surety, anti-crime, and anti-terrorism.

RESEARCH FOUNDATIONS AND APPLICATIONS

The basis for Sandia's science is in its research foundations: processes and materials, computation and information sciences, microelectronics and photonics, pulsed power, and engineering sciences. Building on those through basic research and collaborations with universities and industry, Sandia practices integrated technologies in microsystems, science-based engineering and manufacturing, and surety science and engineering.

The integrated microsystems are able to sense, think, talk, and act, and they find their applications in modular weapons arming, fusing, and firing, in nanosatellites (some baseball-sized), and in coin-sized robots. Sandia's work in photonic crystals is leading toward a fully optical weapon—one where the photonic crystal first steers the light from one channel to another; then a microelectromechanical systems (MEMS) discriminator ensures authorized use and moves a MEMS mirror into arming position, which finally charges a micro fireset for detonation. This significant breakthrough is the result of a lab/university collaboration.

SURETY

Sandia's many years of experience in weapons reliability prepared it for an expanded role in surety science and engineering in normal, abnormal, and malevolent environments. The concept of surety has applications in nuclear power, architecture, schools, electronic-failure analysis, complex engineered systems, and high-consequence engineering. A special area of Sandia interest is critical infrastructures, including telecommunications, banking and finance, continuity of government, transportation, water supply, gas and oil, electric power, and emergency services. At present, Sandia is active in establishing the American Institute of Surety Science and Engineering. This independent, virtual organization will provide an enduring forum to advance the discipline of science-based surety with assistance from universities, industry, and government. Sandia is seeking the support of the National Science Foundation for a series of workshops and a national program at universities for education and training, research on the scientific principles, and the development of engineering tools for surety.

More information on these facilities and others at Sandia is available at www.sandia.gov.
University partnerships are essential to Sandia's mission success. As problems become more complex and resources more limited, Sandia is seeking innovative approaches and solutions. If Sandia needs "a+b" and the university needs "a+c," let's do "a" together.

Sandia has more than 700 research projects at more than 125 universities in over forty states. In FY98, Sandia expended $47.4 million at universities, including $25.8 million on collaborative research. That is more than any other national lab, and a significantly greater commitment than many large corporations. For example, currently Kodak spends $10 million at universities, Dow Chemical $9 million, Lockheed Martin Corporation $7 million, and Hewlett-Packard Labs $5 million.

STRATEGIC PARTNERS

Not all partnerships have the same level of commitment. It is neither practical nor necessary to have strategic relationships with all partners. Sandia's plan for university collaborations is to focus on a few key campuses; build high-level relationships; understand each other's strengths and interests; invest Laboratory Directed Research and Development (LDRD) funds in focused R&D areas; expand faculty/student/employee programs; establish fast-track As-Ordered-Agreements for contracting; and jointly pursue new R&D opportunities. Through these efforts, the university and Sandia will work toward the type of interdependent alliances that Sandia has established with industrial partners like Goodyear and Intel.

The geographically diverse universities invited to the first Deans' Day Conference are those with a good history of research interactions; a good recruiting history; strong, personal inter-institutional ties; and common future interests, for example, the Advanced Strategic Computing Initiative (ASCI). The geographic distribution of Sandia's key university partners is a close match for that of Sandia's major industrial partners.

Sandia proposes that one new role for universities to work with Sandia is in the Labs' growing connection with industry. In the most recent fiscal year, Sandia received approximately $56 million as industry funds-in and projects that sum to grow to $100 million by 2001. Sandia sees these funds-in as opportunities for new university collaborations, especially in technologies for the 21st century: computers, electronic communication, biotechnology, nanotechnology, and alternative fuels.

OPPORTUNITY TOOLS

Sandia has developed and used a variety of tools to identify and pursue opportunities, including VxInsight™ software, technology roadmapping, and Prosperity Games®. A key contributor to the partnerships program is the Sandia Science and Technology (SS&T) Park. Working with the City of Albuquerque and several landowners, Sandia is developing a 240-plus-acre campus-style technology center. SS&T Park is located immediately adjacent to the Labs in Albuquerque and will serve as a next-generation technology community. The Park will provide companies easy access not only to Sandia, but also to a variety of world-class technology centers in what is known as the Gibson Corridor, including the Air Force Research Laboratory, Lovelace Research Institute, the University of New Mexico, and a myriad of smaller, specialized R&D organizations. SS&T Park is also a home for Sandia spinoffs, with priority for tenancy being given to organizations currently partnering with Sandia. SS&T Park will develop a common information infrastructure and will provide opportunities for faculty and students to conduct research along the entire research, development, and application curve.

SANDIA'S COMMITMENT

A goal for Deans' Day 1999 is to determine how to make the relationships between the universities and Sandia more strategic. Sandia intends to commit to significantly increase the "bottoms-up" R&D funding to universities; to use LDRD funds to seed new areas of R&D collaboration; to commit executive involvement to define areas for "top-down" focus; to commit people and resources to jointly pursue new R&D sponsors; to expand and focus internships, sabbaticals, and summer programs for faculty and students; and to share opportunity tools. In return, Sandia asks the universities to work with their Campus Executive to define focus areas; encourage visits to Sandia for exploratory partnering; help define new and better ways to interact; encourage the best students to consider Sandia as an employer of choice; and consider Sandia a strategic partner.
The Microelectronics Development Laboratory Tour

The Microelectronics Development Laboratory (MDL) at Sandia is a world-class facility dedicated to providing the development and engineering capabilities to support industry, government, and universities.

The MDL has over 30,000 square feet of clean-room space and state-of-the-art equipment for processing wafers up to 150mm in diameter. The laboratory contains 22 separate, laminar-flow clean-room bays and 12,500 square feet of Class 1 (less than 1 particle 0.5 micron or larger per cubic foot of air) clean-room space.

The modular design allows experimental work in one bay without affecting well-controlled processes in another. The flexible layout also permits MDL engineers to work efficiently on many projects that require some degree of isolation, such as benchmarking of advanced process tools, development of micromachining techniques, and research on chemical vapor deposition of copper and diffusion barriers for next-generation integrated circuit (IC) interconnections.

Recent advances in the development of integrated microelectromechanical systems (IMEMS) at the MDL are demonstrating that broad classes of sensors and actuators can be batch-fabricated to achieve the same levels of performance, manufacturability, low cost, low power requirements, small size, and light weight normally associated with modern microelectronic devices. Among the micromachined sensors in development at Sandia are pressure sensors, accelerometers, volatile organic sensors, combustible-gas sensors, and atomic force microscope sensors.

Sandia's micromachined actuator program focuses on advancing surface-micromachining technologies to overcome the practical limitations of existing technologies. This effort led to the development of a four-level polysilicon process that enables the fabrication of complex mechanical systems with micron feature sizes. The MDL makes micro-machined engines capable of operating at 500,000 rpm with lifetimes in excess of 800,000,000 revolutions. Sandia is already micromanufacturing transmissions, torque converters, linear racks, and pop-up mirrors for use in defense applications.

Al Romig, Director for Microsystems Science, Technology, and Components, believes that "microsystem integration is the key to cost containment and reliability," and that the ability to economically include microsensors in manufactured products will lead to "a tidal wave in military and commercial applications that can measure their own health."

For more information, visit the Website at www.mld.sandia.gov.

VxInsight™ Software Demonstration, presented by Kevin Boyack, member of the Business Tools and Analysis Department

Sandia has developed a knowledge management/visualization tool called VxInsight™ that visually represents the structure of relationships between data. The University Collaborations Program uses this tool to assist the Campus Executives to better understand the linkages between each university’s fields of research and Sandia’s research emphases.

Using the Institute for Scientific Information physical sciences database, VxInsight™ maps the associations among institutions, journals, papers, and authors by utilizing similarity matrices and computing X,Y positions using ordination routines. Then, by generating landscapes with peaks, valleys, and "topographical" distances between data points, VxInsight™ visually illustrates the results of structured query language (SQL) queries, accessing the human capability to process large amounts of information when it is presented graphically.

According to Kevin Boyack, "Humans intuitively use pattern recognition. In navigating and exploring VxInsight's™ 3-D landscape, it's proximity that counts. We can use this software to look for trends, identify focus areas, and confirm our suspicions."

In addition to supporting the University Collaboration Program, VxInsight™ is used to investigate technology and business trends, profile institutions, analyze patents, monitor imports/exports, detect fraud, perform transaction analysis, and collect intelligence for nuclear nonproliferation and counterterrorism programs.

The Lucite Tetrahedron, presented by J. Pace VanDevender, Director, Chief Information Officer

The Lucite Tetrahedron defines the interdependent nature of the relationships among the four facets of science and technology: Pioneering, Integrative, Mission-Directed, and Synergistic. Each facet has unique missions and capabilities, and each benefits from collaborations with the others. The boundaries need to be worked. Deans' Day addressed one of the boundaries in the context of the four facets.
A key goal for the men and women working in the Robotic Manufacturing Science and Engineering Laboratory is the design and delivery of processes that, as Intelligent Systems and Robotics Center (ISRC) Director Pat Eicker says, "keep people out of harm's way." He cites examples in fields as diverse as weapons dismantlement, meat processing, and automobile manufacturing. His is a "very outward-looking organization. Capable of handling the whole spectrum, from fundamental research to operational systems."

ISRC primarily uses standard industrial machines and makes them smart and flexible by adding sensors and algorithms. In a new area of focus, though, "small, smart machines" are designed and fabricated in the lab because commercial products with the desired characteristics do not exist. ISRC works on many different scales. The Micromanipulation Lab carries out research on objects that are microns in length and micrograms in weight. At the other end of the range, the MegaLab works on objects that are tens of feet in length and weigh hundreds of pounds.

Two other leading-edge programs within ISRC are the Agile Manufacturing Prototyping System (AMPS) and the Precision Metallization Laboratory (PML). AMPS is a unique resource that allows manufacturers to test system-level concepts that could quickly update and reconfigure production processes without the traditional, expensive, time-consuming trial-and-error approach. The PML characterizes, models, and deploys high-energy automated manufacturing processes such as welding, plasma spray, laser cutting, heat treating, and ablation. The PML integrated path-planning software, linked to real-time sensor-based control, optimizes the efficiency of automated manufacturing processes by directly fabricating components from computer-aided design-based models, eliminating intermediate prototyping and testing.

Intelligent systems—whatever the size or purpose—bring diverse technologies together: computers, software, sensors, vision systems, and hardware such as robots. The 73,000-square-foot RMSEL facility accommodates the unique needs of robotics and intelligent systems research. One of the main purposes of RMSEL is encouraging collaborative development with industry and academic partners. In an effort to make its resources as accessible as possible, ISRC invests in Virtual Collaborative Engineering (VCE), a matrix of technologies that allows scientists, engineers, technicians, and robotics operators from any location to collaborate with the ISRC staff to solve complex engineering problems. By continually refining VCE technologies, RMSEL will be a model of industry, university, and government teaming.

For more information, visit the Website at www.sandia.gov/isrc.
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C. Paul Robinson

C. Paul Robinson became President of Sandia Corporation and Laboratories Director of Sandia National Laboratories in October 1995.

Previously, Robinson served Sandia as Vice President for Laboratory Development and as Director for Systems Analysis. Robinson spent 18 years at Los Alamos National Laboratory, starting programs in laser spectroscopy, explosives-driven lasers, laser-induced chemistry, and isotope separation.

From 1988 to 1990, Ambassador Robinson served as the Chief Negotiator and Head of the United States Delegation to the Nuclear Testing Talks between the U.S. and the U.S.S.R. These negotiations produced two major agreements: protocols to the Threshold Test Ban Treaty and the Peaceful Nuclear Explosions Treaty.

Robinson is a member of the Strategic Advisory Group for the Commander-in-Chief, U.S. Strategic Command, and is Chairman of the Policy Group, helping to develop new nuclear weapons policy. In 1991, he served as the Chairman for the Presidential Technical Advisory Group on Verification of Warhead Dismantlement and Special Nuclear Materials Controls. Robinson also served on the Scientific Advisory Group on Effects for the Defense Nuclear Agency and was an advisor for other government agencies.

Robinson earned a B.S. in Physics from Christian Brothers College and a Ph.D. in Physics from Florida State University.

Heather Wilson

Heather Wilson is a Member of the United States House of Representatives, representing the State of New Mexico. Prior to joining the Congress, Wilson was President of Keystone International, Inc., a business development company assisting U.S. defense and scientific organizations with their strategic planning and business development efforts in the U.S. and Former Soviet Union.

Wilson served for two years as Director for European Defense Policy and Arms Control on the National Security Council Staff at the White House during the Bush Administration. In the 1980s, she worked as a planner and negotiator for U.S. government programs in the U.K. and with NATO. In 1989, Wilson was the acting representative of the Secretary of Defense at the negotiations with the Soviet Union and the Warsaw Pact on conventional weapons reductions in Europe.

A Rhodes Scholar with Masters and Doctoral Degrees in international relations from Oxford University, she is a distinguished graduate of the U.S. Air Force Academy, where she was the top graduate in her class in Political Science. Wilson was a term member of the Council on Foreign Relations, and Vice Chair of the Secretary of Defense's Senior Advisory Committee on Women in the Services.

Charles E. Emery

Before joining Sandia, Charles E. Emery, Vice President of Human Resources, served for 16 years as Director of Human Resources at Martin Marietta (now Lockheed Martin). He has over 35 years' experience developing comprehensive human resource programs in industry, government facilities, and higher education.

Emery spent 15 years in education, first as a high school football coach and history teacher; he then coached college football and served as Dean of Students at West Virginia Wesleyan College.

He is a member of the Society of Human Resources Management, the Governor's Board of Executives for Education in New Mexico, and the Albuquerque Executive Council on Diversity.

Emery earned his B.S. degree from West Virginia Wesleyan College, M.A. degree from Western Michigan University, and Ed.D. in Personnel and Higher Education Administration from West Virginia University.
Biographies

Robert J. Eagan

Robert J. Eagan, Vice President for Physical Sciences and Components, has held a wide variety of management positions at Sandia in such technical programs as Integrated Circuits Technology; Chemistry and Ceramics; and Physics, Chemistry, and Metrology. He founded the AMMPEC (Advanced Materials and Manufacturing Processes for Economic Competitiveness) Alliance that links New Mexico’s federally funded laboratories, research universities, and economic development organizations to foster economic growth.

Eagan is the president of the Federation of Materials Societies and a member of the National Research Council Board on Manufacturing and Engineering Design. He has served as president of the American Ceramic Society, chair of the Gordon Conference on Glass, president of the Ceramic Educational Council, and chair of the Glass Division of the American Ceramic Society.

Eagan earned a B.S. from Alfred University SUNY College of Ceramics and M.S. and Ph.D. degrees from the University of Illinois.

Dan Hartley

As Vice President of Laboratory Development, Dan Hartley is responsible for institutional planning, discretionary research and development, program development, technology transfer, institutional partnering, information systems development, and reengineering.

From 1986 to 1995, Hartley was Vice President of Energy and Environmental programs, responsible for projects in fossil energy, solar, wind, geothermal, geosciences, fusion, and nuclear reactor safety; and environment-related programs in nuclear and non-nuclear waste management and waste minimization. Previously, he initiated the Combustion Research Program at Sandia's California laboratory, and conceived of the National Combustion Research Facility, a scientific complex dedicated to advanced methods in combustion science.

Hartley chaired the advisory committee for the BYU Combustion Engineering Research Center and is co-founder and Steering Committee Member of the Department of Energy Science and Technology Alliance involving minority institutions. He has served on panels for the International Energy Agency, the National Science Foundation, the National Research Council, National Institutes of Health, National Aeronautics and Space Administration, and Department of Energy, and is a Member of the Board of Directors of the Combustion Institute. He is Chairman of the Georgia Tech Aerospace Engineering Advisory Board and a member of the first class of Georgia Tech’s Academy of Distinguished Engineering Alumni.

Hartley has a Ph.D. in Aerospace Engineering from Georgia Institute of Technology and was a Research Fellow at the von Karman Institute in Brussels.
Conference

Participants

Deans and University Representatives

Alice Agogino, Associate Dean of Special Programs, College of Engineering, University of California, Berkeley
Susan Davis Allen, Vice President for Research, Florida State University
John L. Anderson, Dean of Engineering, Carnegie-Mellon
Melvyn C. Branch, Associate Dean for Research, University of Colorado
Ching-Jen Chen, Dean of Engineering, Florida State University
Michael Corradini, Associate Dean of Engineering – Academic Affairs, University of Wisconsin
Peter E. Crouch, Dean of Engineering, Arizona State University
Narl Davidson, Associate Dean of Engineering, Georgia Institute of Technology
Don Dickson, Executive Director for the Texas Center for Applied Technology, Texas A&M
Paul Fleury, Dean of Engineering, University of New Mexico
Albert Gold, Associate Dean of Engineering and Applied Sciences, Harvard University
John R. Howell, Associate Dean for Research, University of Texas at Austin
Michael Isaacson, Associate Dean of Graduate Studies and Research, Cornell University
James H. Johnson, Jr., Dean of Engineering, Howard University
Thomas L. Kieft, Associate Vice President for Research and Engineering, New Mexico Institute of Mining and Technology
Alan J. Laub, Dean of Engineering, University of California, Davis
William R. Martin, Associate Dean for Academic Affairs, University of Michigan
Larry K. Matthews, Associate Dean/Director of Research, New Mexico State University
Richard W. Miksad, Dean of Engineering and Applied Sciences, University of Virginia
M. Jack Ohanian, Interim Vice President, Research; Dean of Graduate School, University of Florida
Roy J. Peterson, Associate Vice Chancellor of Research, University of Colorado
Thomas W. Peterson, Dean of Engineering and Mines, University of Arizona
Leon J. Radziemski, Dean of College of Sciences, Washington State University
Reza Salami, Assistant Dean for Research, North Carolina A&T
Billy Robert Sanders, Assistant Dean for Academic Affairs, University of California, Davis
William R. Schowalter, Dean of Engineering, University of Illinois
Richard J. Schwartz, Dean of Engineering, Purdue University
Lonnie Sharpe, Dean of Engineering, North Carolina, A&T
Harvey G. Stenger, Jr., Dean of Engineering and Applied Sciences, Lehigh University
Gerald Stringfellow, Dean of College of Engineering, University of Utah
Andrew H. Swift, Dean of Engineering, University of Texas at El Paso
Conference

Participants

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Tour Hosts

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A.D. Romig, Jr., Director for Microsystems Science, Technology, and Components

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Paul E. Shoemaker
J. Pace VanDevender

Sandia Rapporteurs

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Sheryl L. Hingorani
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Engineering deans visit labs, meet with Campus Execs

Deans’ Day continues dialogue on how Labs and universities can collaborate

Engineering deans and other high-level officials from 26 major US universities visited Sandia Jan. 15 to continue the dialogue on how the Labs and universities can better work together.

This inaugural meeting for the deans from the schools participating in Sandia’s 16-month-old Campus Executive Program resulted in four “assignments” for the Labs’ Campus Execs and their university counterparts.

“We all saw this meeting as a way to enhance the vitality and effectiveness of each of our institution’s scientific and engineering capabilities”

Sandia and the universities will concentrate joint efforts on current and future research strengths and needs. They will also work to attract the best students at all grade levels to science and engineering and promote awareness of the need for a national science and technology R&D policy to federal and state legislators. As partners, the Sandia Campus Execs and deans will work to make the universities and Labs true allies, jointly pursuing research opportunities and funding from government and industry. Future meetings will chart the progress of these initiatives and keep the participants current on strategic policy.

“We invited the deans to Sandia so they could see what our interests and ideas are and to get their insights on how to better form strategic partnerships,” says Med Zanner, Manager of University Collaborations Dept. 4328. “We need their advice on ways we can work together on programmatic issues, how we can impact national science and technology policy, and how to develop new opportunities to combine our talents and capabilities. We want their help now to plan our future for the 21st century.”

Deans’ Day featured keynote speaker Rep. Heather Wilson, R-N.M., plus presentations on Sandia’s history, mission focus, capabilities, and future strategies. Breakout sessions emphasized developing frameworks for strategic partnerships. “We all saw this meeting as a way to enhance the vitality and effectiveness of each of our institution’s scientific and engineering capabilities,” Labs President Paul Robinson says. “It laid the groundwork for us to continue valuable exchanges and future collaborations.”

The Campus Executive Program, established in September 1997 by Laboratory Development VP Dan Hartley (4000) and Human Resources VP Charlie Emery (3000), pairs Sandia Campus Executives with top university officials at schools that have synergistic interests and capabilities with Sandia. The Sandia Campus Executives invite all Sandians to play a role in this partnership program. People with specific research interests or ties to these campuses may contact Med or the Campus Executive directly.