

University of Arkansas Innovation Incubator: Flaming the Sparks of Creativity

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Abstract

One significant area for small business development is in science and technology. In this area, research universities have played a significant role through the students and faculty in establishing start-up companies. For example, many universities have developed small business incubators designed to provide operating space and secretarial support at minimum costs for start-up companies. Many of these small business incubators bring the universities' intellectual resources to arms length of start-ups. What they do not do is nurture ideas. They do not bring together talent to explore, to inquire, to innovate.

The University of Arkansas, in partnership with the Arkansas Science and Technology Authority, has created a new partnership to fill this innovation gap. A partnership that will nurture new ideas by providing the resources needed to move Arkansas into the high technology of today's economies and reaping the benefits of its intellectual capital. And in doing so, this partnership will result in opportunities for University of Arkansas researchers to work with Arkansas businesses, in an increased number of technology business start-ups, in the establishment of an "innovation" culture with students and faculty, in identification of many valuable problems suitable for student research theses, and in demonstrations of the difference the university enterprise can have on the economic well being of the state.

This partnership, known as the Innovation Incubator (I²), has won funding through the NSF Partnership for Innovation program in fall 2000. While I² will focus initially on the expanding field of nano to micro electronics-photonics, it will rapidly grow to encompass all areas of the University. This paper will describe the methods by which this partnership will identify and manage applied on-campus research for small industrial companies, research intended to provide the proof of concept necessary to secure larger developmental funding or private capitalization. Finally, the paper will discuss the early implementation current status of program elements through March 2001.

I. Introduction

The National Science Foundation in fall 2000 funded the University of Arkansas under the

Partnership for Innovation program to initiate a new effort based on the “teaching through doing” paradigm. This effort would produce diverse graduates equipped with and ready to transfer new knowledge; to transfer scientific and technical know-how; and, most importantly, to transfer an innovative “can do” attitude into our general society. Undergraduates (juniors and seniors) and graduate students in chemistry, physics, engineering, biology, and business were the targeted students for this program. Small and developing technology based businesses in the state of Arkansas were the targeted customers of the improvement process.

Throughout the nation small businesses are responsible for our economic growth. One significant area for small business development is in science and technology. In this area, research universities have played a significant role through its students and faculty in establishing start-up companies. For example, many universities have developed small business incubators. At the University of Arkansas this incubator is called “Genesis”. Genesis (<http://genesis.uark.edu>) is designed to provide operating space and business center support at minimum costs for technology companies in transition stages. Genesis also brings the universities’ intellectual resources to arms length for start-ups in the incubator. Indeed, it has nurtured several successful small businesses. What Genesis does not do is nurture ideas. It does not bring together talent to explore, to inquire, and to innovate.

This NSF PFI sponsored program will provide a new partnership to fill this innovation gap. A partnership that will nurture new ideas and provide the resources needed to demonstrate feasibility. And in doing so, this proposal will result in opportunities for University of Arkansas researchers to work with Arkansas industries, in an increased number of technology client companies in Genesis, in the establishment of an “innovation” culture with students and faculty, in identification of many valuable problems suitable for student research theses, and in multiple demonstrations of the difference the university enterprise can have on the economic well being of the state.

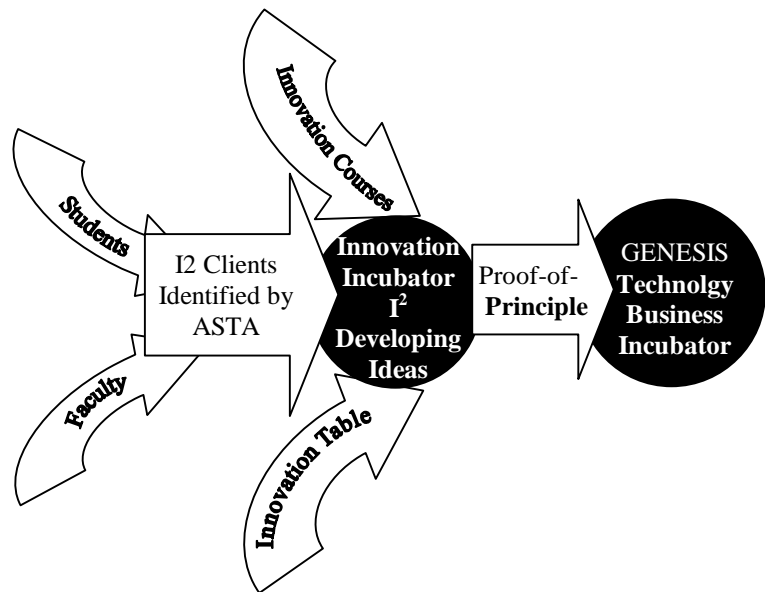
II. Implementation

The partnership implementing this program is between the University of Arkansas College of Engineering, faculty and students in the University of Arkansas System, individuals throughout the state with ideas or venture capital for a small business, and the Arkansas Science and Technology Authority (ASTA). Genesis, also a part of the College of Engineering, will also play a key role as it provides for a smooth transition for incubated ideas into the small business incubator. ASTA has its finger on the pulse of small business in the state, is driven by a vision to increase small business activity (especially in the Mississippi River delta region), and will play the key role of pointing interested and appropriate clients to this partnership. The University of Arkansas College of Engineering will encourage faculty involvement in partnership investigations, as well as providing resources to the investigations through its High Density Electronics Center (HiDEC) and the Arkansas Center for Technology Transfer. Genesis will provide the expertise and resources to smooth the transition from the idea demonstration stage to the early production stage.

This partnership will take the form of a small business on our university campus, the Innovation Incubator - I². The company personnel will be students (undergraduate and graduate) and faculty, a body of expertise strongly centered in the University of Arkansas Fayetteville campus but also including faculty and students from other Arkansas colleges and universities that are active researchers in client areas of interest.

I² will be operated in every way as a small business. Each week the company will invite a potential client who is considering starting or expanding a small business based on a clever new idea. This idea will be brought to the “innovation table” within I² to be discussed, evaluated, improved, and even bread boarded. Students and faculty will provide both technical and business support to explore and develop the merit of proposed ideas. As a result, a small business may get its start in Genesis or an existing small business may target of a new niche market. SBIR proposals will develop and new products will enter the marketplace.

I² has eight important components: (i) personnel; (ii) individuals with ideas for a small business; (iii) voucher program; (iv) pseudo-industry workgroup; (v) innovation courses; (vi) innovation table; (vii) thesis and proof-of-principle; and (viii) Genesis and SBIR’s.



- Personnel - I² personnel is made up of both undergraduate and graduate students and faculty from across the state. Every faculty member and every student will be encouraged to bring clients to I².
- Individuals with ideas for a small business - the clients are individuals all across the state that have a vision for a small business for which they need help to bring to reality. These are individuals in which creativity abound but have no colleagues to dialog with and little resources to try out their vision.
- A voucher program – a means by which a small business could obtain the services of university expertise. This would include expertise reaching across all areas of the university from business, to law, to the arts, to science and engineering, for access to innovation. The voucher would be up to an amount of \$10K. It would require an SBIR to be submitted within 12 months of its authorization or must be fully paid back at the end of that period.
- Pseudo-industry workgroup – This educational methodology will be under the direction of Ken Vickers, who received engineering management experience from 1981 through 1998 in

integrated circuit manufacturing with Texas Instruments. Students will learn and apply standard factory control software and practices to monitor their own educational progress and marketability as well as the progress of all other students in the program. The success of the individual will be judged not only by their personal educational accomplishments, but also by the success of all the students in the group. This methodology will give the students a sense of connection as a team of people working on a common goal, and will demonstrate the benefit of working in a coordinated group rather than as an individual among other individuals. We feel that this is the key training element that will multiply the effectiveness of all other training elements, as well as providing a natural opportunity for students to defend their ideas and share cultures.

- Innovation Courses - a two semester special class at the senior undergraduate / first year graduate level, where students from science, engineering, and business work as a team. Business management techniques used to evaluate the feasibility of moving a concept from research to commercial production will be examined in the first semester. This will be followed in the second semester by the creation and characterization of a device and evaluation of its competitive position in the market. This will train the students to recognize the key difference between technology that can be made, versus technology that can be made profitably. The courses will be team taught with business, science, and engineering faculty. The outcome of these courses will be a new generation of undergraduate and graduate students who have applied their knowledge, have worked successfully in teams, have developed their communication and presentation skills, and who have participated in developing a small business.
- Innovation Table – this is a real workbench on which students and potential small business individuals will breadboard evolving ideas to establish feasibility. It is the table where students from different fields will work side-by-side, and around which ideas will flow freely, as a team effort produces the needed proof-of-principle. Equipment within the appropriate departments that could breadboard an idea under consideration will be brought to this table. Initially, such a table will exist in physics and in electrical engineering to focus the proposed effort in Nano and Microelectronics-Photonics. After the first two years the program will be evaluated, which will then indicate any value to expand into other engineering and science areas. These collaborative projects will enrich both the larger community and our own educational mission by integrating students' research, creative work, classroom learning, and practical projects. They also promote collaboration among different generations of students, teachers, and community partners. The innovation table offers a new model of collaborative teaching and learning inside and outside the traditional boundaries of the university.
- Theses and the Proof-of-Principle - Students, if well educated and trained in implementation skills, should be seen as a value-added component of this approach to impact small businesses in the state. University of Arkansas students can play an enormously constructive role by carrying out theses on subjects that can provide the data on which a small business can be formed. Because their thinking is less structured in many ways than established faculty in critical ways - demographically diverse, technologically facile, and of great collaborative spirit - they are wonderful ambassadors for innovative thought and the corresponding transfer of technology. The breadth of their fields and their openness to interdisciplinary fields of study -

indeed, their enthusiasm for trying something new--can be captured to bring to bear on the full range of possibilities for the impact of the university. These students, if we can think of them beyond simply being here to learn, can play a key role in much of the knowledge created outside the formal or traditional classroom.

- Genesis and SBIR's – Genesis is a College of Engineering supported technology business incubator that creates a synergistic business environment at low cost to foster economic development by incubating new enterprises. After the proof-of-principle stage that develops around the innovation table, a potential business is ready to move into the small business incubator. At the same time, I² business, engineering, and physics students and faculty will continue to work with the new small business on SBIR proposals and on technological problems that develop along the way.

III. Innovation Focus

Establishing any new business requires a plan for both initial product focus as well as future product expansion. The initial product focus for the I² business at the University of Arkansas is in the fields of nano to micro electronics-photonics, with later expansion into other fields of research. This utilizes the resource strengths of the physical research facilities and faculty that already share common research themes in nano to micro electronics-photonics, as well as the recent establishment of an interdisciplinary graduate program resulting in both MS and Ph.D. degrees in Microelectronics-Photonics. First stage products produced by I² will be demonstrations of proof of concept, followed by a second stage product of initial commercialization of the most promising first stage products.

I² will begin by using ASTA to search out opportunities for innovation partnerships in the fields of: (1) miniature power electronics, (2) superconducting interconnects and devices, (3) integrated passive components (4) advanced MCM design, and (5) optical links. These areas have the common theme of miniaturization of electronic-photonic systems, and support the state's interest in attracting next generation technology firms to this region.

I² will consider client proposals outside of microelectronics-photonics, but it is expected that these will more likely occur in the latter stages of the three-year grant period. It is at that point that I² is expected to become a fully integrated part of the ASTA continuing programs as a self sustaining program.

IV. Management Plan

The I² management plan must encompass several management functions to accomplish the I² business goals while meeting the needs and interests of all partners and interested parties. These levels are as follows:

1. Daily operations management
2. Innovation task specific project management

3. Innovation task selection management
4. Board of Directors policy management

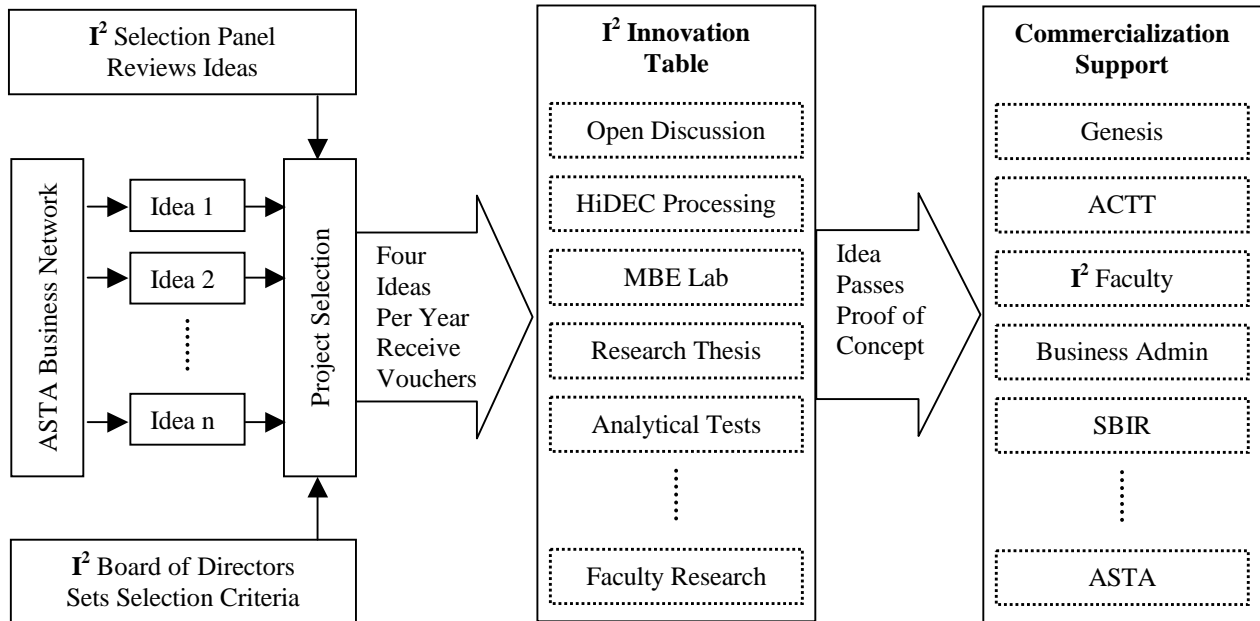
Each of these four management functions must be accomplished in an efficient fashion for I² to demonstrate its value to the statewide community, a demonstration that will be the key to its continued existence after the completion of the grant period. Each of the management functions require I² partners and interested parties to interface together at different levels of activity as shown in the following table:

	Daily Operations	Task Specific Projects	Task Selection	I2 BoD Policy
	1	2	3	4
Director, Innovation Incubator (I2)	High	High	High	High
Senior Professor, College of Arts and Sciences (Co-PI)	Low	Med	High	High
Faculty, Innovation Incubator (I2)	Med	High	Med	Med
Graduate Students, Innovation Incubator (I2)	High	High	Low	Low
Undergraduate Students, Innovation Incubator (I2)	Med	Med	Low	Low
Director, microEP Grad Program (Co-PI)	Low	Med	High	High
Dean, College of Engineering (PI)	Low	Med	High	High
Staff, College of Engineering	High	High	Low	Low
President, ASTA (Co-PI)	Low	Low	High	High
Staff, ASTA	Low	Med	High	Low
Management Team, Genesis Incubation Center	Low	Med	Med	High
Staff, Genesis Incubation Center	High	Med	Low	Low
Management Team, Innovation Incubator (I2) Client Group	High	High	High	Low
Director, Arkansas Center for Technology Transfer	Low	Med	High	Med
Director, U of A Research and Sponsored Programs	Low	Low	Med	High
Director, HiDEC	Low	Med	High	High
Staff, HiDEC	High	Med	Med	Low

This interaction table also indicates the level of responsibility for all I² partners and their level of resource commitment. For instance, any box that contains an indication of “High” activity also indicates that the person or organization has a high level of responsibility for that management function’s proper operation.

Even though each management function has multiple parties with high levels of activity contributing to its proper operation, each I² partner has specific tasks and resources that are critical

to the successful implementation of the concepts contained in this proposal. The illustration of the I² business flow in the diagram below demonstrates the complexity of the management plan that will be needed to accomplish this proposal's objectives, and the detailed discussions of each participant's roles following the diagram will complete the description of the management method that will be used.



1. Innovation Incubator (I²): This is the organization that has the primary responsibility for operational execution of these concepts. The I² Board of Directors (BoD) includes the NSF proposal's PI and Co-PIs, the Directors of Genesis and the Arkansas Center for Technology Transfer, and the Director of the University of Arkansas Office of Research and Sponsored Programs. The BoD oversees the effectiveness of the I² operation and approves all evaluation documents before submission to funding authorities. The BoD also sets operational policies and boundaries, and defines the mechanism by which I² resources are allocated and innovation tasks selected. Finally, the BoD has the responsibility for recruiting and hiring the I² Director.

The I² Director is hired by the Board of Directors but reports operationally to the Director of the Microelectronics-Photonics (microEP) graduate program. This operational structure assures that the I² business acts as an integral portion of the microEP educational methodology, and also makes good use of the senior industrial management experience of the current microEP director, Ken Vickers. The I² Director works in concert with the microEP program to recruit graduate students with appropriate skills to drive innovative projects to completion. These graduate students will report to both the I² Director and the faculty member that is guiding the innovation project selected for study. The graduate students will work with the I² Director to select and train the undergraduate students supported by this proposal, and will act as their direct supervisor to support a specific innovation project.

The I² director will have significant operational roles and responsibilities. These include maintaining I² physical facilities, recruiting and retaining I² faculty consultants, recruiting and training I² assigned graduate students, advertising I² services through state and regional business channels, matching client needs with University faculty consultants and resources, scheduling client projects on basis of resource matches and benefits to state, tracking impact of I² project completions on client performance, tracking levels of training added to I² client workplace, tracking professional competence of I² grad students in early jobs vs. traditional grad students, and expediting collaboration agreements between clients and faculty. While the I² Director will have responsibility for these activities, he will have access to some staff resources in HiDEC and the College of Engineering to accomplish these activities.

The I² Director also chairs the project selection panel that includes representatives from the faculty, staff, students, and partner organizations. This panel will meet on a quarterly basis.

I² will directly control a level of resources independent of existing organizations on campus. These will include an experimental table and dedicated lab for innovation projects, a faculty consultant expertise database, graduate and undergraduate students assigned to support I² projects and funded by this proposal, and access to all university labs as needed on contract basis.

2. Arkansas Science and Technology Authority (ASTA): This is the organization that has the primary responsibility for identifying potential client relationships between the state's industry and business and I². The I² objectives will be supported by the ASTA staff. This is because the I² objectives are strongly aligned with the ASTA mission, as indicated by the president of ASTA (John Ahlen) serving as a Co-PI of this proposal.

ASTA supplies significant resources to this I² proposal in both personnel and business contacts. The ASTA staff will perform the majority of networking between Arkansas business interests and the on campus I² personnel. They will identify potential businesses and development groups that might benefit from I² client status, facilitate initial discussions between the two groups, and act as an external monitoring agent to help judge the effectiveness of the relationship. John Ahlen, in his role as Co-PI, will have a seat on the I² BoD, and will actively participate in setting the policies that manage the I² to client relationships.

ASTA will be the agency that will provide continuing funding for I² operations at the end of the funding period, provided that the benefit to the state of Arkansas has been successfully demonstrated.

3. University of Arkansas College of Engineering: This organization is the home organization for several of the key University of Arkansas groups involved with daily operation of I². The College of Engineering will be strongly involved as the resource manager of the majority of the infrastructure supporting I² objectives. The HiDEC research facility, the Arkansas Center for Technology Transfer, and the college support staff that reports to the Dean's office. The staff of these organizations in the College of Engineering will work with I² personnel in innovation project

tasks. The commitment of the College of Engineering to the support of this proposal's objectives is demonstrated by the Dean of Engineering, Otto Loewer, acting as PI of this proposal.

4. University of Arkansas High Density Electronic Center (HiDEC): This research facility is the physical home for advanced microelectronics processing at the University of Arkansas. This facility will provide equipment and staff support to innovation projects that require their processing capabilities. Priority will be given to I² innovation project needs by the HiDEC management group to assure expedited project completion. The cost of using this specialized research equipment will be paid by the proposal through the client voucher system.

5. Genesis Business Incubator: This business center will provide support resources for proof of concept innovation projects that become candidates for commercialization. The Genesis mission is clearly to incubate startup businesses, especially technology businesses based in University research spin-offs. The Genesis staff will not be directly involved in the proof of concept innovation projects, but will become significantly involved in taking any successful innovation projects into small business incubation and early commercialization.

6. I² Innovation Project Clients: The businesses and development groups supported by this proposal's objectives. The purpose of this proposal is to provide a mechanism to bring University level resources to bear on developmental needs to support business development in Arkansas. These clients of the I² business will have the responsibility to work diligently with I² faculty and staff to effectively utilize their short-term, focused efforts to solve their problem or demonstrate feasibility of a new concept. This will require the client firm to commit financial and personnel resources to work with I² faculty and staff to plan and implement the innovation project.

V. Evaluation

The plans to monitor and assess progress toward realizing the partnership goals and related innovation outcomes are outlined below. The I² Director will partner with Professor Ronna Turner of the UA Office of Research, Measurement, and Evaluation in the College of Education and Health Professions to lead the evaluation. The mission of the evaluation will be to assess eight key components of the proposed program: (i) effectiveness of the partnership to nurture new ideas and provide the resources needed for proof-of-principle; (ii) increase in opportunities for university researchers to work with Arkansas small businesses and transfer new knowledge; (iii) increase in the number of start-ups in Genesis; (iv) number of new innovative products reaching the market due to I² partnership; (v) establishment of an "innovation" culture with students and faculty; (vi) identification of problems suitable for student research theses; (vii) improvement in student creativity and related soft-skills, and (viii) demonstrations of the difference the university enterprise can have on the state economic well being.

Assessment of the program effectiveness will focus on these eight features and will be based on quantitative objective measures and by perceptual assessments by students, faculty, small businesses, and student employers. Some quantitative objective measures are easily assessed. For

example, measuring the number of start-ups, new innovative products, student theses, and opportunities to transfer new knowledge, can be counted. However, it is more difficult to determine innovative culture, creativity and related skills, nurturing of new ideas, and impact on the economic well being of the state. Here is where we must rely on perceptual assessment.

For example, perceptual assessment by employers of students graduating from the proposed program and the more traditional programs will be tracked over time for surveying perceptions of student creativity and overall success. After six months, managers will be surveyed regarding their perceptions of early career effectiveness of the students they hired. These evaluations will include characteristics such as job performance, creativity, interpersonal skills, team building effectiveness, and leadership skills. Follow-up questionnaires will continue to be administered to employers at yearly intervals for five years. The longitudinal tracking of student performance is intended to provide a measure of long-term success and career advancement. Program graduates will be also be surveyed on the same schedule regarding their perceptions of their academic preparation for the current job in which they are employed. Survey instruments are scheduled for development and piloting in the first year. A similar survey of students, faculty, and small business clients will assess innovative culture and the nurturing of new ideas while a survey of state and university officials will assess impact on the state.

VI. Current implementation status

The University of Arkansas was notified that it had won this PFI award in the fall 2000 semester. While all grants' success depend on the skill of the personnel working under it, the Innovation Incubator established by the grant would require a unique individual to act as its director.

That person has now been hired after a nationwide search, and we found a person who happened to have personal and career attributes similar to microEP graduate program director Ken Vickers. The limited data from these two people seem to predict a personal profile model that could be used by other institutions to identify potential personnel for like programs:

1. Alumni of University and Department
2. Successful branch level technical manager for several years
3. Approximately 20 years of industrial experience
4. Children are at a normal transition point
5. Aging parents much closer to University than current job location

The I² Director will not report to campus until mid-July due to complex programs in his current industrial job that must be completed to soft-land his career at that location.

One graduate student was put on the payroll before the end of 2000 to give the microEP program director some time relief by handling minor program startup tasks while waiting for the I² Director to arrive home. Until the I² Director begins work, the graduate student will strongly manage the

on-campus tasks and opportunities member.

KEN VICKERS

Ken Vickers is a Research Professor in Physics at the University of Arkansas, and has served as Director of the interdisciplinary Microelectronics-Photonics Graduate Program since April 1998. He worked for Texas Instruments from 1977 through March 1998 in integrated circuit fabrication engineering, the last seven years as Engineering Manager of the TI Sherman IC Wafer Fab. Professor Vickers' technical accomplishments before leaving TI included chairmanship of the Sherman Site Technical Council for six years, election to Senior Member Technical Staff, chairmanship of two corporate level worldwide teams, and authorship of twenty-eight issued patents. He received BS and MS degrees in Physics from the University of Arkansas in 1976 and 1978 respectively.

GREG SALAMO

Greg Salamo is a University Professor of Physics at the University of Arkansas. He leads several interdisciplinary research efforts between universities and industry in photonic materials and semiconductor nanoscience, and has been the leader at the University of Arkansas in promoting interdisciplinary research and education. Dr. Salamo received a BS degree in Physics from Brooklyn College in 1966, an MS degree in Solid State from Purdue University in 1968, and his Ph.D. in Optics from CUNY/Bell Labs in 1973. After a Post-Doc position at the University of Rochester, he joined the faculty of the University of Arkansas in 1975.

OTTO LOEWER

Otto Loewer has been the Dean of the College of Engineering at the University of Arkansas since 1996, with eleven years of prior experience as a departmental chair at the University of Arkansas and the University of Florida. Under his leadership the College of Engineering continues to aggressively expand its role in technology transfer from the University to the State of Arkansas. Dr. Loewer received a BS degree in Agricultural Engineering from Louisiana State University in 1968, an MS degree in Agricultural Engineering from Louisiana State University in 1970, and his Ph.D. in Agricultural Engineering from Purdue University in 1973. He has also completed a MS degree in Agricultural Economics from Michigan State University in 1980 while on sabbatical leave from the University of Kentucky.

JOHN AHLEN

John Ahlen has been president of the Arkansas Science and Technology Authority since 1984, after serving eleven years in science advisory rolls on the Illinois Legislative Council. Dr. Ahlen spent twelve months in 1997-1998 as an ASME State-Federal Technology Fellow to the White House Office of Science and Technology Policy. Dr. Ahlen received a BS degree Bioengineering from University of Chicago at Chicago Circle in 1969 and his Ph.D. in Physiology/Bioengineering from the University of Illinois at the Medical Center in 1974.