A REPORT
TO THE
ARIZONA LEGISLATURE

Performance Audit Division

Performance Audit

Arizona's Universities—

Technology Transfer Programs

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REPORT NO. 08-02

STATE OF ARIZONA
OFFICE OF THE
AUDITOR GENERAL

Debra K. Davenport
Auditor General

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STATE OF ARIZONA
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AUDITOR GENERAL

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May 22, 2008

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Arizona Board of Regents

Transmitted herewith is a report of the Auditor General, a Performance Audit of Arizona's Universities—Technology Transfer Programs. This report is in response to Arizona Revised Statutes (A.R.S.) §41-2958 and was conducted under the authority vested in the Auditor General by A.R.S. §41-1279.03. I am also transmitting with this report a copy of the Report Highlights for this audit to provide a quick summary for your convenience.

As outlined in their responses, Arizona State University, the University of Arizona, Northern Arizona University, and the Arizona Board of Regents agree with all of the findings and plan to implement all of the recommendations directed at each of them respectively.

My staff and I will be pleased to discuss or clarify items in the report.

This report will be released to the public on May 23, 2008.

Sincerely,

Debbie Davenport
Auditor General

Enclosure

cc: Mr. Fred Boice, President
Arizona Board of Regents

SUMMARY

The Office of the Auditor General has conducted a performance audit of the technology transfer programs at Arizona State University (ASU), the University of Arizona (UA), and Northern Arizona University (NAU), pursuant to Arizona Revised Statutes (A.R.S.) §41-2958. This audit was conducted under the authority vested in the Auditor General by A.R.S. §41-1279.03 and is the first in a series of three performance audits of the universities. The other two audits focus on capital project financing and information technology security.

Technology transfer is the process by which universities move faculty inventions from academic research labs to industry for further development so that new products such as medicines, educational tools, electronic devices, safety equipment, and health services can become available to the public. For example, Gatorade, one of the most well-known technology transfer successes, was developed at the University of Florida. Since 1973, Gatorade has brought more than $80 million to the university, which has used the money to support research. However, this type of success is not typical. According to literature, only one in 4,850 university technologies becomes a big income producer for its institution.

Federal and state laws encourage university participation in technology transfer, and the universities do so using somewhat different approaches for facilitating their efforts. ASU and NAU contract with Arizona Technology Enterprises (AzTE), a limited liability company whose sole member is the ASU Foundation, to administer their programs, whereas UA uses an internal unit, the Office of Technology Transfer, to perform this function.[1, 2]

This audit focused on three key areas of technology transfer efforts: disclosing commercially viable inventions, marketing them to potential commercial partners, and managing conflicts of interest that could arise in university-industry collaborations.

1 The ASU Foundation is a nonprofit organization that supports ASU through fundraising and other efforts.

2 As of April 2008, NAU and AzTE were reevaluating their agreement, and NAU was considering obtaining some technology transfer services from a different provider. According to NAU officials, they anticipate entering into a new agreement with AzTE and/or another provider by the end of 2008.

Although performance varies, universities can take steps to increase commercially viable invention disclosures (see pages 17 through 32)

All three universities can work to increase the number of disclosures submitted by university inventors. An invention disclosure is an inventor's official declaration to the university that he or she has created an invention. Disclosures are key to a technology transfer program's success because they constitute the pool of potential technologies available for licensing to outside industry partners.

ASU has consistently compared favorably with its peer institutions in the number of invention disclosures received.[1] However, organizational transition and multiple vacancies in 2007 within ASU's technology transfer provider, AzTE, may have reduced outreach to ASU's inventors. As these vacancies are filled, ASU should ensure that AzTE takes the steps necessary to maintain organizational focus.

Research Expenditures and Disclosures
Fiscal Year 2006

University	Research Expenditures	Disclosures
UA	$535 million	90
ASU	$132 million	154
NAU	$ 21 million	6

Inventors at UA have submitted a significantly lower rate of disclosures compared to inventors at the university's peer institutions. UA can strengthen its program by increasing interactions between its Office of Technology Transfer (Office) and university inventors, thereby improving the ability to identify promising research and obtain disclosures. UA can also build on the success of the approach taken in its Bio5 Institute, where a staff member from the Office is stationed part-time. This staff member helps inventors identify an invention's potential, encourages them to disclose, and locates possible industry partners. In fiscal year 2007, the Bio5 Institute produced the highest number of invention disclosures at UA. UA plans to replicate the model in its Optical Sciences department in fiscal year 2009.

Unlike ASU and UA, NAU is not a research-intensive university. As a result, it does not produce many invention disclosures each year. However, NAU has departments that conduct research with commercial potential, and it can work more closely with its technology transfer provider to encourage disclosures so that the work of its inventors can benefit the public.

Finally, the universities should consider implementing or expanding their use of certain other improvements that experts have found can increase the quantity of commercially viable invention disclosures submitted by university inventors. These practices include:

- considering participation in technology transfer when making promotion and tenure decisions;

[1] The Arizona Board of Regents has designated a list of peer institutions for each of the three universities based on mission, research emphasis, and/or other factors. (See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.)

- recognizing successful inventors through award ceremonies such as UA's Innovation Day; and
- educating inventors about the technology transfer process.

All three universities—particularly UA—should improve aspects of marketing and all three should review their negotiation practices (see pages 33 through 48)

The universities have some components of successful technology transfer marketing programs discussed in the literature, but all three should improve their marketing practices and encourage more industry-sponsored research. Successful technology transfer requires not only that inventions be disclosed, but licensed to a partner and brought into production. Licensing can stem from several types of efforts, including marketing to potential commercial partners, enlisting companies to sponsor research, or working with researchers and investors to build start-up businesses.

As with its work in disclosures, ASU's licensing activity has historically exceeded that of its peers. AzTE's structure and comparatively larger resources allow for a specialized and well-qualified staff who focus on developing relationships with industry, and these staff are aware of marketing practices that are recommended by industry experts. However, AzTE's vacancies in 2007 have hampered these efforts. To better ensure future success, ASU should ensure that AzTE continues to rebuild and strengthen its marketing program under its new leadership and staff.

UA's licensing activity has consistently fallen below that of its peers. With its smaller though experienced and qualified staff, UA follows some recommended marketing practices, such as Internet advertising and drawing on faculty contacts in industry. However, UA could improve its evaluation of technologies' commercial potential and increase its market research. To this end, UA secured a grant from the Kauffman Foundation to invest in market research resources. UA should also increase its industry contacts.

NAU, which uses AzTE to market technologies that NAU inventors develop, is disadvantaged by its location far from AzTE staff. NAU should work with AzTE or another technology transfer provider to ensure NAU's commercially viable technologies are marketed effectively.

Beyond the marketing activities of AzTE and UA's Office, all three universities should also enhance their relationships with companies that provide research monies. Industry-sponsored research, which can involve more than one office representing the university, is an important way to transfer technology by directing research toward industry-specific problems. However, some industry representatives and university inventors auditors interviewed expressed concerns about prolonged negotiations

over the contract terms. Both ASU and UA have begun efforts to evaluate their sponsored research programs; NAU is restructuring its research administration and has hired a new vice president for research to build its research program. As part of their efforts, ASU and UA should work with industry to identify concerns and needs and to determine how the two sides can more effectively work together, and NAU should take preventative steps to ensure streamlined coordination of industry sponsorship. The universities should also develop ways to measure progress in these collaborative efforts.

All three universities—particularly UA and NAU—need to better manage conflicts of interest, and the Board should establish minimum standards (see pages 49 through 59)

To a different extent, ASU, UA, and NAU should take steps to improve conflict-of-interest management, and the Arizona Board of Regents (Board) should provide better guidance to the universities. When participating in the technology transfer process, inventors can develop financial relationships that may compete with their university responsibilities. To ensure the integrity of research and protect university interests, state law and federal regulations require universities to prevent or control conflicts arising from university-industry collaboration.

ASU generally manages conflicts of interest adequately, although it could benefit from some improvements. ASU identifies potential conflicts of interest and manages the conflicts through management plans. However, auditors found that inventors did not always carry out the actions called for in these plans. ASU could improve implementation by better monitoring the plans.

UA needs to more effectively identify and manage conflicts of interest. Although UA policies require faculty inventors to disclose substantial interests, these policies do not adequately provide for ongoing identification and management of conflicts and lack criteria for when to require management plans and what they should include. In addition, the policies do not state who should be responsible for ensuring that conflict-of-interest management plans are monitored. As a result, cases with potential conflicts of interest continued without being monitored. UA has created a new position, Assistant Vice President for Research Compliance and Policy, whose responsibilities will include developing new conflict-of-interest policies for the university. UA could improve conflict-of-interest management by (a) developing and implementing policies and procedures that require initial and continuous identification of conflicts of interest, (b) developing criteria for when to recommend a conflict-of-interest management plan and what the plan should include, and (c) clearly identifying responsibilities for the different aspects of the adopted policies to include better coordination of university-wide conflict of interest management.

Further, to address outstanding conflicts, UA should develop and implement a plan to identify and manage existing potential conflicts of interest for inventors participating in sponsored research.

NAU lacks comprehensive conflict-of-interest policies and procedures for adequate management of conflicts of interest. In June 2007, NAU created the Office of the Vice President of Research, whose responsibilities include managing research-related conflicts of interest. According to university officials, NAU will develop more complete conflict-of-interest policies following discussions all three universities are having with the Arizona Board of Regents' General Counsel. The Board is considering updating its own conflict-of-interest policies.

Because the universities inconsistently manage technology transfer conflicts of interest, the Board should review its intellectual property and technology transfer policies and establish minimum standards that each university has to meet in its conflict-of-interest policies and procedures.

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INTRODUCTION & BACKGROUND

The Office of the Auditor General has conducted a performance audit of the technology transfer programs at Arizona State University (ASU), the University of Arizona (UA), and Northern Arizona University (NAU), pursuant to Arizona Revised Statutes (A.R.S) §41-2958. This audit was conducted under the authority vested in the Auditor General by A.R.S. §41-1279.03 and is the first in a series of three performance audits of the universities. The other two audits focus on capital project financing and information technology security.

Technology transfer at Arizona's universities

Technology transfer is the process by which universities move inventions from academic research labs to industry for further development so that new products such as medicines, educational tools, electronic devices, safety equipment, and health services can be made available to the public. Gatorade is one of the most well-known technology transfer successes. In 1965, an assistant football coach at the University of Florida asked a team of university physicians why his players were suffering heat-related illnesses. The physicians determined that the fluids the players lost through sweat and exercise were not being adequately replaced. The researchers formulated a carbohydrate-electrolyte beverage that would replace the key components lost by the football players. Since 1973, Gatorade has brought more than $80 million to the university, which it has used to support research. However, this type of success is not typical. According to a 2006 book on research administration, only one in 4,850 university technologies becomes a big income producer for its institution.[1]

Arizona's universities have achieved a wide variety of technology transfer successes, as illustrated in the textbox on page 2. Although none have been as lucrative as Gatorade, in each case valuable products and ideas have been licensed to companies with the intent of transferring them to the marketplace, where they can be used to benefit the economy, industry, and the public. The examples shown in the textbox all generated revenue, but technology transfer can also offer other benefits. For example, at UA a group of graduate students in the theater department

1 Weeks, Patricia Harsche. How to Organize a Technology Transfer Office. Elliott C. Kulakowski and Lynne U. Chronister, Ed. *Research Administration and Management*. Sudbury, MA: Jones & Bartlett Publishers, 2006. 641-649

developed a program that uses drama to help children in grades K-6 improve their reading and writing skills. The students created a nonprofit company in 2006 to distribute the program to public schools. As of December 2007, 7 elementary schools in two Pima County school districts had adopted the program. Their students had written more than 2,100 stories, 185 of which were brought to life for them by the 33 performing artists contracted by the nonprofit to do so. Another 5 middle and high schools participated in the nonprofit's new story-sharing curriculum.

Successful Technology Transfer Examples from Arizona's Universities

ASU—A professor of chemistry and biochemistry developed a method to determine the sequence of DNA that may result in the creation of a commercial machine that can sequence the whole genome in 3 days with a low cost. Practical applications for this sequencing method could include diagnosis and other types of DNA analysis that require accurate and high-speed results. The technology was licensed to a life-science company committed to developing instruments for the high-speed sequencing of single DNA molecules. The inventor's research team's discovery resulted in a $1.7 million grant from the National Institute of Health received in October 2004 to continue their research. AzTE, on behalf of ASU, has received approximately $580,000 in licensing revenues for this technology as of February 2008.

NAU—A professor in the Chemistry Department and a professor in the Physics and Astronomy Department developed a micro-sensor with uses in detecting environmental pollutants, diagnostic medicine, robotics, and combating bioterrorism. Practical applications for these micro-sensors could include equipping soldiers so they can detect the presence of nerve agents or biological molecules that could be used in warfare or terrorist actions. The invention was licensed to a start-up company in 2006, and AzTE, on behalf of NAU, has received $200,000 in license revenues and stock options as of March 17, 2008.

UA—A professor of material sciences and engineering developed a process for producing a solar-grade silicon that can reduce the cost of producing photovoltaics. The invention is the result of combined efforts by the UA professor and a professor from Norway. Practical applications include developing less-costly solar panels for converting sunlight into electricity. The technology was licensed to a start-up company in December 2007, and UA has received approximately $32,500 in option/licensing fees and patent costs. With Science Foundation Arizona funding, the company purchased specialized equipment necessary to study the patented silicon refining process in a pilot scale. As of February 2008, equipment is being installed in the company's Tucson facilities, and pilot scale tests of the process are scheduled to begin in late spring.

Laws and research sponsorship encourage technology transfer

Federal funding agencies cede ownership of new inventions to the universities and in exchange, universities commit to their commercialization.

Both federal and state laws encourage university participation in technology transfer, and federal, state, and industry monies support the research that generates transferable inventions. The 1980 federal Bayh-Dole Act encourages universities to participate in technology transfer in order to increase the public benefit realized from federally sponsored research. It created a process whereby federal agencies cede ownership of new inventions to the universities and in exchange, the universities commit to moving the technologies to the market for public use. In 1986, the Arizona Legislature enacted A.R.S. §15-1635.01 to encourage industry sponsorship of

research at the universities and the commercialization of faculty innovations. The intent of the legislation was to foster a partnership between the public and private sectors by encouraging the exchange of technological expertise and other valuable information between private enterprise and the university system.

A combination of federal, state, and industry monies pay for university research. Specifically, the majority of UA's and ASU's research monies come from federal agency grants, whereas in fiscal year 2006, industry monies provided 6.1 percent and 7.4 percent, respectively, of the total research expenditures at each university. In that year, according to an Association of University Technology Managers (AUTM) report, UA had federal and industry research expenditures totaling more than $301.6 and $32.6 million, respectively. According to the National Science Foundation, these expenditures, with other funding sources, placed UA in the top 15 public universities nationally for research expenditures, as shown in Table 1. During fiscal year 2006, ASU had federal and industry research expenditures totaling approximately $112.9 and $9.7 million, respectively. Finally, at NAU, which generally emphasizes undergraduate education rather than research, overall research expenditures totaled approximately $21.2 million in the same fiscal year.

Table 1: Total Research Expenditures Of the Top 15 U.S. Public Universities Fiscal Year 2006 (In Thousands) (Unaudited)

1.	University of Wisconsin—Madison	$831,895
2.	University of California—Los Angeles	811,493
3.	University of Michigan—all campuses	800,488
4.	University of California—San Francisco	796,149
5.	University of Washington	778,148
6.	University of California—San Diego	754,766
7.	Ohio State University—all campuses	652,329
8.	Pennsylvania State University	644,182
9.	University of Minnesota—all campuses	594,877
10.	University of California—Davis	573,002
11.	University of Florida	565,491
12.	University of California—Berkeley	546,035
13.	University of Arizona	535,847
14.	University of Pittsburgh—all campuses	530,162
15.	University of Colorado—all campuses	512,794

Source: Auditor General staff analysis of National Science Foundation data of total research and development expenditures of public universities for fiscal year 2006.

In addition to federal and industry sponsorship monies, the universities receive state monies that help support research. First, the Technology and Research Initiative Fund (TRIF), administered by the Arizona Board of Regents (Board), provides monies to the universities that can be used to invest in new technologies or support research initiatives.[1] Altogether, from fiscal year 2002 through January 2008, TRIF received approximately $371.9 million. During fiscal year 2007, the universities' available TRIF monies totaled approximately $104.3 million, including board awards of approximately $71.8 million and monies carried forward from previous years. During the same year, the universities' TRIF expenditures totaled approximately $77.3 million. TRIF monies were used to support several university initiatives. For example, UA and ASU used approximately $33 million for projects at two research institutes. In addition to the TRIF monies, the Arizona Biomedical Research Commission granted state monies totaling approximately $4.1 million, $513,000, and $237,000 to UA, ASU, and NAU, respectively, during fiscal year 2007 for several research projects.

The Technology Research Initiative Fund provides monies to the universities to support research activities.

[1] A.R.S. §15-1648 established the Technology and Research Initiative Fund (TRIF) to receive a portion of Proposition 301 revenues. Voters approved Proposition 301 in November 2000, increasing the State's sales tax by 0.6 percent and dedicating a portion of the increase to help promote university research. The Board, the universities' oversight body, administers TRIF monies and the universities submit funding requests. The Board makes awards to the universities based on specific criteria.

Intellectual Property—Creative and scholarly works, including materials, devices, and processes, that may be protected under a variety of mechanisms including copyrights, patents, trade secrets, trademarks, and plant variety protection.

Source: Arizona Board of Regents policy statement 6-908.

In addition to the laws encouraging technology transfer, other policy and legal requirements affect the program. First, under the Board's policy statement 6-908, except for some excluded works, the Board owns all intellectual property developed by university employees using university resources, including those developed with federal or industry sponsorship.[1] Second, Article IX, Section 7, of Arizona's Constitution prohibits state agencies, including the universities, from owning equity in companies, which may be offered in payment for licensing an invention.[2] Finally, federal tax law restricts the amount of privately controlled research allowed in buildings constructed using tax-exempt bond proceeds. All of these requirements affect how the universities negotiate with industry regarding intellectual property and collaborate with industry sponsors of university research.

Technology transfer process

Although the universities have different models to facilitate the phases of technology transfer, literature describes four common stages that universities generally follow. Specifically:

- Disclosing an invention—The first step in the technology transfer process occurs when a university inventor formally reports the creation of an invention through a disclosure form. The disclosure of intellectual property to the institution is necessary to reserve the legal rights to such discoveries prior to scientific publication or public discussion.

- Evaluating the disclosure—University technology transfer offices typically evaluate disclosures to determine if the invention is patentable and commercially viable. Also, an initial market analysis is often performed at this time to identify potential barriers to marketing the intellectual property.

- Obtaining a patent—Universities can obtain legal protection for the intellectual property by seeking patents or copyrights. A provisional patent application safeguards the invention for 12 months, during which universities must file a full utility patent application to fully protect the invention. Copyright, rather than patent protection, is sought for computer software code or other authored technology.

- Licensing the technology—Once legally protected, the university works with an industry partner to license the intellectual property and develop it into a

1 Excluded works include traditional publications, artistic works, academic software, and student works. Electronic publications are evaluated on a case-by-case basis.

2 In 2004, Arizona voters were asked to decide on Proposition 102, a proposed amendment to the Constitution. If approved, this proposition would have allowed state universities to legally accept equity in private organizations in lieu of payments when licensing technologies. This measure failed by a vote of 48 percent to 52 percent.

commercial product. Alternatively, the inventor can create a new start-up company to license the intellectual property from the university to develop the invention. Although the financial terms of licensing agreements can vary, they typically contain provisions for patent/legal fee reimbursement, development milestone payments, and royalty payments. These royalties are typically divided amongst the inventor, the inventor's department, and the university according to university policy.

The inventor can create a new start-up company to license and develop the invention.

In carrying out this process, universities must also take care to avoid conflicts of interest. Technology transfer encourages collaboration between university inventors and companies that can lead to potential financial conflicts of interest. Specifically, when participating in the technology transfer process, inventors can develop financial relationships that may compete with their university responsibilities. To ensure research integrity and protect university interests, state law, the Arizona Board of Regents policy, and federal regulations require universities to prevent or control potential conflicts that can arise from university-industry collaboration.

Organization and staffing

Nation-wide and in Arizona, universities use different models and organizational structures to manage technology transfer. As illustrated in the textboxes, each model and structure has some unique features. ASU and NAU adopted one model and structure; UA uses another.

ASU and NAU use an external technology transfer organization—ASU and NAU use an external organization called Arizona Technology Enterprises (AzTE) to manage their technology transfer processes. AzTE was established in 2003 as a limited liability company whose sole member is the ASU Foundation, which is a nonprofit organization that supports ASU through fundraising and other efforts. AzTE's responsibilities include soliciting and evaluating invention disclosures, seeking patents, negotiating licenses, and creating start-up companies. As a separate legal entity, AzTE is not bound by the constitutional prohibition on owning equity and therefore can accept company equity as payment for a license. As of fiscal year 2006, AzTE's records indicate that it held equity in 1 NAU and 12 ASU start-ups.

Organizational Models for Technology Transfer Offices

- **In-house office**—A university's technology transfer office operates as an office within the university. This model provides the least amount of independence from university administration.
- **External organization**—A university uses either a for-profit or not-for-profit freestanding organization with an obligation to commercialize technologies arising from university administration. This model allows for the most independence.

Staffing models for technology transfer offices

- **Generalist**—A licensing officer oversees the management of a technology from the lab to the market. According to literature, the generalist model can be more effective in serving faculty inventors, but it requires each licensing officer to have a wide range of expertise, including scientific knowledge and business skills.
- **Specialist**—Specialized staff have dedicated marketing personnel. This model can be more effective for commercialization efforts because employees can focus on tasks in which they have expert knowledge, but it can hamper communication among staff, industry, and the inventor.

However, the relationship between NAU and AzTE may be changing or terminating. As of April 2008, NAU and AzTE were reevaluating their agreement, and NAU was considering obtaining some technology transfer services from a different provider. According to NAU officials, they anticipate entering into a new agreement with AzTE and/or another provider by the end of 2008.

AzTE's primary mission focuses on "providing core services to ASU's faculty and research enterprises in the following areas: (i) identification and development of intellectual property, (ii) evaluation of invention disclosures from a legal and commercial perspective, (iii) patent protection of inventions, where appropriate, (iv) marketing and licensing activities, and (v) industry-university relations."

AzTE Staff
As of April 2008

- Managing Director (1)
- Vice President of Business Development (2*)
- Vice President of Venture Development (1)
- Director of Business Development (2*)
- Director of Intellectual Assets (2*)
- Director of Finance and Administration (1)
- Director of Operations (1)
- Senior Patent Counsel (1)
- General Counsel (1)
- Legal Assistant (1)
- Assistants (3)
- Total—16 staff

* These staff specialize in either physical sciences or life/health sciences.

Source: AzTE 2008 organizational chart.

As of April 2008, AzTE had 16 full-time employees, and has chosen to implement a specialist staffing model. AzTE has staff responsible for working with university inventors and conducting an initial evaluation, and other staff who specialize in business development. Staff in April 2008 consisted of a Managing Director; a Vice President of Venture Development responsible for helping establish start-up companies; a Vice President for Business Development in the physical sciences; two directors responsible for developing and marketing physical science-related technologies; a Senior Vice President for Business Development in the Life Sciences and two directors responsible for developing and marketing health-related technologies; a General Counsel, a Senior Patent Counsel, and a Legal Assistant responsible for preparing contracts, overseeing external patent lawyers, and managing a technology-tracking database; a Director of Operations; and Director of Finance and Administration, a financial assistant responsible for monitoring contracts and overseeing expenses, and two administrative assistants.

AzTE's employees include individuals with extensive experience in the private sector and/or university technology transfer. In addition, all 6 members of the life and physical science teams have advanced degrees related to their functions. Compared to its peer institutions, AzTE has more licensing officials per $10 million in research spending.[1] During fiscal year 2006, ASU's peer institutions averaged 0.19 full-time licensing officials per $10 million in total research expenditures. Meanwhile, AzTE had a total of 5 full-time licensing officers, or 0.38 licensing officers per $10 million in research expenditures. AzTE also augments its capabilities by using approximately 20 students per semester to help with market research and through the ASU Technopolis program, a university technology entrepreneurship program that helps AzTE develop management teams for start-up companies.

UA uses an internal technology transfer organization—Like most of its peer institutions, UA uses an in-house office to manage its technology transfer

1 See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

process. UA's Office of the Vice President for Research oversees a broad range of research activities, including the Office of Technology Transfer (Office). The Office has implemented what is closer to a generalist model. UA licensing officers are responsible for evaluating invention disclosures, prosecuting patents, marketing technologies, and negotiating licenses with existing and start-up companies. According to university officials, the in-house organizational model allows for on-going coordination with UA's priorities and easy development of services to meet the changing needs of its faculty. Because it is part of the university, the Office is bound by Arizona's constitutional prohibition against universities owning equity in private companies. However, according to the Vice President for Research, UA has established equity-like alternatives it can accept as payment for a license. For example, such an equity-like instrument would permit the university to exchange it in the future for cash under certain circumstances, such as the sale or consolidation of the company or an initial public offering of stock in the corporation.

UA licensing officers are responsible for evaluating invention disclosures, prosecuting patents, marketing technologies, negotiating licenses, and creating start-up companies.

The Office's mission is "to protect, manage, and transfer University of Arizona intellectual property to benefit society, to expand public-private relationships, and to further the University's mission." To accomplish its mission, the Office has developed a program with the intent of balancing three goals: benefiting society, expanding public-private relationships, and furthering the University's mission.

As of April 2008, the Office had 10 full-time employees, including 3.54 licensing officers. Other staff consist of a Director, a Special Projects and Outreach Coordinator responsible for complex agreements and faculty outreach, a Program Coordinator responsible for federal compliance and database management, a Patent and Intellectual Property Specialist responsible for seeking legal protection, a Senior Accountant, a Junior Accountant who helps manage contract deliverables, and a receptionist. The Office uses contracted outside patent attorneys to help office staff obtain patents for UA technologies.

UA Office of Technology Transfer Staff As of April 2008

- Director (1)
- Special Projects and Outreach Coordinator (1)
- Patent and Intellectual Property Specialist (1)
- Database Administration and Sponsor Reporting (1)
- Licensing officers (3.54)
- Senior Accountant (1)
- Junior Accountant (.6)
- Receptionist and Office Support (1)
- Total—10 staff

Source: UA Office of Technology Transfer 2007 organizational chart.

The Office's employees include individuals with private sector and/or university technology transfer experience. In addition, although the Office uses a staffing model that is closer to a generalist model, its licensing officials have specialized knowledge related to their fields and all but one have advanced degrees related to their functions. Compared to its peer institutions, the Office has fewer licensing officials per $10 million in research spending.[1] During fiscal year 2006, UA's peer institutions averaged 0.20 full-time licensing officials per $10 million in total research expenditures. Meanwhile, UA had the equivalent of 4 full-time licensing officers, including a portion of other staff responsible for some licensing duties, or 0.07 licensing officers per $10 million in

[1] See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

research expenditures. In order for UA to reach the level of its peer institutions, it would need approximately 7 more licensing officials. Similar to AzTE, the Office augments its capabilities through partnerships and time-limited appointments. For example, the Office uses four graduate students during different times of the year to assist licensing staff. In addition, students from UA's McGuire Entrepreneurship Program help the Office conduct market assessments of specific technologies.

Budget

AzTE (ASU and NAU)—As indicated in Table 2 (see page 9), AzTE's largest source of revenue consists of service fees paid by ASU, which are intended to cover most of AzTE's operating expenses. In fiscal year 2007, AzTE received over $3.4 million from ASU. Royalty payments represent the second-largest source of revenues during fiscal years 2006 and 2007, and totaled $3.1 million in fiscal year 2007. AzTE retains 15 percent of ASU royalty revenues and distributes the remainder to ASU. In fiscal year 2007, AzTE distributed approximately $2.8 million from the received royalties to ASU. Additionally, NAU pays AzTE administrative fees totaling 25 percent of its royalty income. However, in fiscal year 2007, NAU had no royalty income and therefore did not pay AzTE any administrative fees. In addition to these revenues, AzTE also earns monies from the sale of equity received as a form of licensing payment, and receives reimbursement from some licensees for incurred legal patent expenses.

UA—As indicated in Table 3 (see page 10), the Office's largest revenue sources are commissions and royalty payments from license agreements, which totaled approximately $1.2 million in fiscal year 2007. Transaction privilege taxes (sales taxes) from the Technology and Research Initiative Fund represent the second-largest source of revenues, approximately $600,000 in fiscal year 2007. The Board awarded these monies to UA to help the Office enhance UA's technology transfer infrastructure. The Office used these monies to support its operating and patenting costs. UA's support of the Office, the third-largest source of funding, totaled approximately $500,000 in fiscal year 2007. Other university funding sources include licensees' reimbursement of patenting costs and grants, including a grant from the Kauffman Foundation to support a pilot project that allows the university to market technologies.

Universities oversee receipt of licensing contract deliverables

As part of this audit, auditors reviewed how the universities oversee technology transfer licensing contract deliverables. After a university enters into a technology licensing agreement, its responsibilities include ensuring that the licensee continues

Table 2: Arizona Technology Enterprises (AzTE)[1]
Schedule of Revenues, Expenses, Distributions, Repayments, and Changes in Net Assets
Fiscal Years 2006 through 2008
(Unaudited)

	2006 (Actual)	2007 (Actual)	2008 (Estimate)
Revenues:			
Service agreement fees	$3,448,475	$3,448,475	$4,640,099
Royalties	2,801,223	3,107,589	886,244[2]
Net investment return[3]	599,881	562,221	270,931
Licensee legal expense reimbursements	228,880	687,866	434,745
Option fees	119,700	61,779	60,000
Sponsored research fee	15,138	5,860	
Other	10,500	28,600	578
Total revenues	7,223,797	7,902,390	6,292,597
Expenses:			
Salary and benefits	1,732,469	2,321,723	2,407,373
Technology portfolio[4]	1,023,888	1,552,086	1,809,921
General and administrative	509,471	751,071	785,551
Arizona State University Foundation services	72,000	72,000	72,000
Total operating expenses	3,337,828	4,696,880	5,074,845
Net income available for distribution	3,885,969	3,205,510	1,217,752
Distributions:			
Arizona State University	2,801,773	2,796,632	1,009,853[2]
Third parties[5]	193,206	314,787	24,746[2]
Success-based bonus pool to AzTE employees	312,066	325,119	32,512[2]
Total distributions	3,307,045	3,436,538	1,067,111
Net income (loss)	578,924	(231,028)	150,641
Repayments:			
ASU Foundation capital contribution[6]	5,774		
Arizona State University[7]	99,391	109,815	36,515
Total repayments	105,165	109,815	36,515
Net increase (decrease) in net assets	473,759	(340,843)	114,126
Net assets, beginning of year	523,077	996,836	655,993
Net assets, end of year	$ 996,836	$ 655,993	$ 770,119

1 AzTE's legal name is Arizona Science and Technology Enterprises, LLC but it is known as Arizona Technology Enterprises or AzTE.

2 AzTE reported that it is difficult to predict new licensing agreements that will be made and result in revenue to AzTE; therefore, the fiscal year 2008 royalty and distribution amounts are based on contractual minimum amounts as of February 4, 2008, and do not include any new agreements that will be entered into during the remainder of fiscal year 2008.

3 Includes proceeds from the sale of equity received as a form of licensing payment.

4 Consists of patent prosecution and maintenance expenses related to the technologies AzTE maintains for ASU. Patent prosecution expenses relate to expenses incurred during the patent application and review process. Maintenance expenses are costs incurred for maintaining the technologies, such as collecting and monitoring the deliverables of licensing contracts.

5 Consists of distributions to third parties, such as NAU, the Arizona Biomedical Research Commission, and the Mayo Foundation, in accordance with inter-institutional or licensing agreements.

6 Consists of the final payment to the ASU Foundation for repayment of capital start-up monies provided to AzTE.

7 Consists of a payment to ASU for repayment of start-up costs.

Source: Auditor General staff analysis of AzTE's Pro Forma Statements of Activity for fiscal years 2006 and 2007; and financial information provided by AzTE on February 4, 2008, for fiscal year 2008.

Table 3: University of Arizona Office of Technology Transfer
Schedule of Revenues, Expenses, and Changes in Net Assets
Fiscal Years 2006 through 2008
(Unaudited)

	2006 (Actual)	2007 (Actual)	2008 (Estimate)
Revenues:			
Commissions and royalties	$1,688,857	$1,223,130	$700,000
Sales taxes[1]	537,207	591,576	454,000
University support[2]	531,423	534,983	615,000
Patent cost reimbursements[3]	423,302	345,189	380,000
Government and private grants	172,817		48,000
Total revenues	3,353,606	2,694,878	2,197,000
Expenses:			
Operating expenses:			
Salary and benefits	896,973	931,273	1,004,000
Travel	29,770	17,578	15,000
Other operating	110,094	92,135	80,000
Equipment	33,451	2,581	
Total operating expenses	1,070,288	1,043,567	1,099,000
Direct expenses:			
Patenting and prototyping expenses[4]	480,851	636,630	600,000
Distribution to creators	696,691	722,568	375,000
Distribution to University of Arizona	603,313	358,400	340,000
Total direct expenses	1,780,855	1,717,598	1,315,000
Total expenses	2,851,143	2,761,165	2,414,000
Net increase (decrease) in net assets	502,463	(66,287)	(217,000)
Net assets, beginning of year	1,494,740	1,997,203	1,930,916
Net assets, end of year[5]	$1,997,203	$1,930,916	$1,713,916

1 Consists of an allocation to the Office of sales tax monies authorized under Proposition 301, a 2000 voter-approved initiative.

2 Consists of an allocation of UA's indirect cost recoveries from sponsored research activities, which is budgeted to the Office to help pay for operating costs.

3 If required under the terms and conditions of the license or option agreements, the Office receives reimbursement for those patent costs from its licensees.

4 Consists primarily of legal costs associated with perfecting intellectual property rights.

5 Approximately $905,000 and $650,000 of the net assets at June 30, 2007, and projected at June 30, 2008, respectively, related primarily to the commissions and royalties revenue received or expected to be received by the Office that were not yet or will not be distributed until after year-end. Holding these monies is necessary to allow for the finalization of contracts, calculations, disagreements with inventors, or other outstanding factors. In addition, approximately $766,000 and $800,000 of the net assets at June 30, 2007, and projected at June 30, 2008, respectively, was designated by policy to the Fund for Promotion of Research, which is administered by the Vice President for Research.

Source: Auditor General staff analysis of information provided by the University of Arizona's Office of Technology Transfer and Comptroller's Office for fiscal years 2006 through 2008.

to develop the technology and that the university receives the agreed-upon financial compensation from the licensee. Licensing agreements include provisions that require industry to submit reports to the university on technology development progress and/or to compensate the university at specified due dates or milestones. Auditors' review revealed the following:

- AzTE effectively monitors receipt of deliverables—AzTE's responsibilities include monitoring and collecting licensing contract deliverables for both ASU and NAU. Auditors conducted an in-depth review of 11 of 51 licensing contract files from February 1994 through August 2007, including reading the contracts and verifying the accuracy of contract and licensing data, and determined that AzTE adequately ensured the receipt of licensing contract deliverables for both ASU and NAU.

- UA's Office improving its monitoring of deliverables—During this audit, the Office was making changes to improve its oversight of licensing contract deliverables by improving the quality of the data used to monitor them. Auditors randomly selected and conducted an in-depth review of 10 of approximately 300 licensing contract files from October 1988 through October 2007, including reading the contracts and checking the accuracy of contract and licensing data, and determined that UA's database system lacked accurate information for 1 of the 10 files. However, this file was from the 1990s, when an outside entity was managing contract deliverables for UA. The Office is in the process of reviewing contract management data. As of November 2007, staff had reviewed 103 of the Office's 208 active licensing contracts, including 7 of the 10 files auditors randomly selected. The Director indicated that the Office plans to continue to monitor the accuracy of its licensing contract data. Based on the improvements made during the audit, auditors determined that the Office should be able to adequately ensure the receipt of licensing contract deliverables in the future.

Scope and methodology

This audit focused on the technology transfer programs at ASU, UA, and NAU. It did not address other mechanisms for transferring knowledge gained from university research into the commercial sector for public use, such as publications and presentations at academic conferences. These other mechanisms also make university innovations public knowledge and allow others to expand on their work, potentially leading to a commercial breakthrough.

The report presents findings and recommendations in the following areas:

- ASU has consistently outperformed its peers in number of disclosures submitted, but UA's inventors submit fewer disclosures than inventors from peer

institutions. Arizona's universities can take steps to improve the quantity of commercially viable invention disclosures by increasing interaction between licensing officers and their respective university inventors, improving incentives for participation, and providing further education about the technology transfer process.

- All three universities—particularly UA—should improve aspects of their marketing practices. The universities should also better integrate corporate-sponsored research into their technology transfer missions and goals.

- To a different extent, each of the universities needs to take steps to improve its management of conflicts of interest. The Arizona Board of Regents should continue its efforts to develop a framework for managing conflicts of interest, and the three universities—particularly UA and NAU—need to better manage conflicts.

Auditors used several methods to study the issues addressed in this report, including interviewing university officials, university inventors, and technology transfer employees at each university. In addition, auditors reviewed applicable statutes and ASU and UA databases used for tracking the status of their respective technologies, and conducted limited work to understand database controls and test the databases. Auditors used data supplied by AUTM to evaluate ASU's and UA's technology transfer performance as compared to those of their board-selected peer institutions for fiscal years 1996 through 2006 (see textbox, page 13).

Further, auditors used a number of other specific methods to develop information for the report:

- To identify any organizational or structural barriers that may be affecting the quantity of commercially viable invention disclosures submitted by university inventors, auditors conducted focus groups at each university comprising university inventors who had been active in technology transfer from fiscal years 2004 to 2007. Auditors also interviewed faculty who are conducting research with commercial potential but have filed one or fewer invention disclosures. To understand incentives offered to universities' inventors for their participation in technology transfer and methods used to educate faculty about invention disclosure, auditors reviewed royalty distribution practices, promotion and tenure guidelines, and new-hire orientation material for each university and select schools, colleges, and departments at each university known for high-disclosure output. To identify other universities' incentives, and methods of outreach, auditors reviewed literature (see Bibliography, page b-i through b-ii), and interviewed officials from ASU's and UA's peer institutions (see textbox on page 13 for peer list and which institutions responded to auditor inquiries). To understand disclosure activities of the three Arizona universities and their board-selected peer institutions, auditors analyzed AUTM data from fiscal years 1996 through 2006, including number of disclosures and research expenditures.

Board-approved peers—The Arizona Board of Regents has designated a list of peer institutions for each of the three universities. Each university's peers are comparable to the university based on mission, size, research emphasis, and/or other factors. The Board and the universities use the peers to obtain benchmark information.

ASU peer institutions	UA peer institutions	NAU peer institutions**
•University of Cincinnati	•University of Florida‡	•California State University—Fresno
•University of Colorado—Boulder	•University of Iowa‡	•University of Delaware
•University of Connecticut	•Michigan State University	•University of Central Florida
•Florida State University‡	•University of Michigan‡	•Ball State University
•University of Kansas	•University of Minnesota	•Oakland University
•University of Maryland—College Park‡	•Ohio State University	•University of Minnesota—Duluth
•University of Nebraska—Lincoln†‡	•Texas A&M University	•University of Montana
•Ohio State University	•University of North Carolina—Chapel Hill‡	•University of Nevada—Las Vegas
•University of Oklahoma	•University of Utah‡	•University of Nevada—Reno
•Rutgers University—New Brunswick	•University of Virginia	•University of North Dakota—Main
•Temple University	•University of Washington‡	•Bowling Green State University—Main
•University of Texas—Austin	•University of Wisconsin—Madison	•Miami University—Oxford
•University of Washington‡	•University of California—Berkeley*	•Ohio University—Athens
•University of California—Los Angeles*	•University of Illinois—Urbana-Champaign*	•University of Vermont
•University of Illinois—Chicago*‡	•University of Missouri—Columbia*‡	•George Mason University
		•Old Dominion University
		•University of Wyoming

* Excluded from auditor data analysis because the institution does not report information to AUTM.

** NAU, like many of its peers, does not report information to AUTM; therefore, auditors did not analyze NAU's performance compared to its peer institutions.

† Information for 2003 through 2006 includes data from the University of Nebraska Medical Center.

‡ Peer institution responded to auditors' inquiries.

Source: Auditor General staff summary of information obtained from the Arizona Board of Regents Web site, January 2008.

- To determine efficient and effective technology transfer marketing practices, including industry collaborations, auditors reviewed more than 40 articles and books on the subject (see Bibliography, pages b-ii through b-vi). Auditors also reviewed available ASU, UA, and NAU technology transfer-related mission statements and marketing goals, and interviewed licensing officials, other technology transfer staff, and sponsored research administrators at each university to understand their marketing goals, processes, and tools. Auditors obtained university inventors' perspectives on marketing during the inventor focus groups described above. In addition, auditors obtained industry perspectives by interviewing representatives of an aerospace company, a semiconductor company, and a missile defense company, and a government official involved with sponsoring biomedical research. To document licensing activity, auditors analyzed data maintained by the universities and similar data collected by AUTM.

- To determine the universities' conflict-of-interest management processes, auditors interviewed officials from the offices of technology transfer, university general counsel, sponsored research compliance, and grant and contract accounting, as well as university department and college officials and conflict-of-interest review committees. To evaluate the universities' conflict-of-interest management processes, auditors reviewed the universities' conflict-of-Interest policies, federal conflict-of-interest guidelines, and Arizona Revised Statutes addressing conflicts of interest. Additionally, at ASU, auditors reviewed 15 out of 18 conflict-of-interest case files related to start-up companies. Specifically, auditors reviewed case files from September 1993 through June 2007 based on the dates that the university inventors (investigators) disclosed a potential conflict of interest. At UA, auditors reviewed all 24 technology transfer-related cases reviewed by the Institutional Review Committee (Committee) from December 2006 to November 2007. This includes 1 additional case that the Committee reviewed prior to this time but which contained a conflict that the Committee was not adequately managing. At NAU, auditors reviewed two case files related to start-up or licensing activity identified by reviewing Board Technology Transfer reports for fiscal years 2004 through 2007 and an additional case that the Interim Vice President stated that he handled himself. Finally, to develop recommendations for conflict-of-interest management improvement, auditors reviewed conflict-of-interest literature and interviewed a university peer institution official.

- To assess the disclosure and licensing activity of ASU and UA as compared to that of their peer institutions, auditors analyzed AUTM reports from 1996 through 2006 and evaluated this information in relation to the respective research expenditures for each university (see Appendix, pages a-i to a-iii).

- To gather information for the Introduction and Background, auditors reviewed Arizona's Constitution and statutes, fiscal year 2006 AUTM licensing survey results, AzTE's audited financial statements, and UA Office of Technology Transfer financial information for fiscal years 2006 through 2008. To assess the universities' monitoring of licensing contract deliverables, auditors analyzed two random samples of licensing agreements. At ASU, the random sample included 10 licensing agreements from February 1994 through August 2007. The ASU sample was selected from 51 active licensing agreements in AzTE's database. At UA, a random sample of ten licensing agreements was obtained from approximately 300 files maintained by the Office for October 1988 through October 2007. An NAU licensing agreement was also selected and reviewed from AzTE's database. To learn how AzTE and the Office ensure the accuracy of their licensing contract data, auditors observed staff verifying the accuracy of information in the database, interviewed staff, and obtained documents showing that the review of contract deliverables in licensing agreements is in process. To learn the process of monitoring deliverables, auditors interviewed AzTE and UA staff and obtained term sheets, which the licensing officers use to record deliverables upon the completion of licensing agreements.

This audit was conducted in accordance with government auditing standards.

The Auditor General and staff express their appreciation to the Arizona Board of Regents and its staff, and the universities' presidents, faculty, and staff for their cooperation and assistance throughout the audit.

FINDING 1

Although performance varies, universities can take steps to increase commercially viable invention disclosures

All three universities can take steps to increase the quantity of commercially viable invention disclosures submitted by their university inventors. As research expenditures have increased at Arizona State University (ASU) and the University of Arizona (UA), ASU has consistently outperformed its peers, whereas UA has fallen below its peers in number of disclosures. Comparable data is not readily available to assess Northern Arizona University's (NAU) performance versus its peers. There are specific actions each university can take to improve its disclosure activity, and there are also general actions all three universities could take to help increase the quantity of commercially viable invention disclosures. These actions include better educating faculty about disclosure requirements and the disclosure process and incorporating technology transfer activities in faculty tenure and promotion decisions.

Inventors disclosing innovations key to technology transfer success

An invention disclosure, a key input to any technology transfer office, is an official declaration by an inventor to the university that he/she may have developed a piece of intellectual property. Disclosures are important to the success of a technology transfer program because they constitute the pool of potential technologies available for licensing to outside industry partners. Therefore, the success of a university technology transfer program depends upon the university's ability to elicit these disclosures.[1] Inventors are required to disclose their discoveries to the academic institution by both federal law and university policies. The 1980 Bayh-Dole Act requires that public universities obtain written agreements from all employees (except clerical and non-technical personnel) recognizing their obligations to report inventions developed using federal research monies. Similarly, the Arizona Board of Regents' (Board) policies encourage faculty researchers to undertake, receive recognition for, and share in the revenue resulting from their creative endeavors.

Disclosures are key to the success of a technology transfer program because they constitute the pool of potential technologies available for licensing to outside industry partners.

1 See Bibliography, pages b-i through b-ii, for resources used to evaluate disclosure practices.

Because the engine that powers university inventions is the amount of monies the institution receives to conduct research, the number of disclosures divided by total research expenditures is commonly used when comparing institutions. However, some research monies are earmarked toward specific projects or disciplines that may not yield a commercially viable discovery. In addition, the quality of disclosures cannot be assessed based on the raw number of disclosures. Another measure, the number of disclosures that result in licensing agreements, is the focus of Finding 2 (for an analysis of ASU and UA licenses, see pages 33 through 48).

ASU has performed well but organizational change has limited its efforts

ASU has consistently compared favorably with its peer institutions in the number of invention disclosures submitted to Arizona Technology Enterprises (AzTE), the external organization that manages ASU's and NAU's technology transfer processes. Nevertheless, organizational changes that occurred in 2007 within AzTE could lead to a breakdown in the processes that have contributed to its success. Therefore, ASU should ensure that AzTE takes the steps necessary to maintain its organizational focus.

ASU disclosure rates higher than its peers—ASU is a research-intensive institution, and receives a large amount of federal and industry monies to conduct research. The School of Engineering and the Biodesign Institute are particularly prolific in their research output (see textbox).[1] During fiscal year 2007, ASU received disclosures from 21 units, including units such as Chemistry and Biochemistry and the School of Life Sciences. As shown in Figure 1 (see page 19), based on information ASU reported to the Association of University Technology Managers (AUTM), from fiscal years 1996 to 2006 ASU's research expenditures nearly tripled. At the same time, the number of disclosures submitted per $10 million spent for research grew from 7 to 11.7, a 67 percent increase. In fiscal year 2007, ASU received 152 invention disclosures, a decrease from the 154 received in 2006.[2]

ASU's Top Disclosing Research Units
Fiscal Year 2007

Unit Name	Disclosures Received
School of Engineering	68
Biodesign Institute	52
Chemistry and Bio-Chemistry	18
School of Life Sciences	7

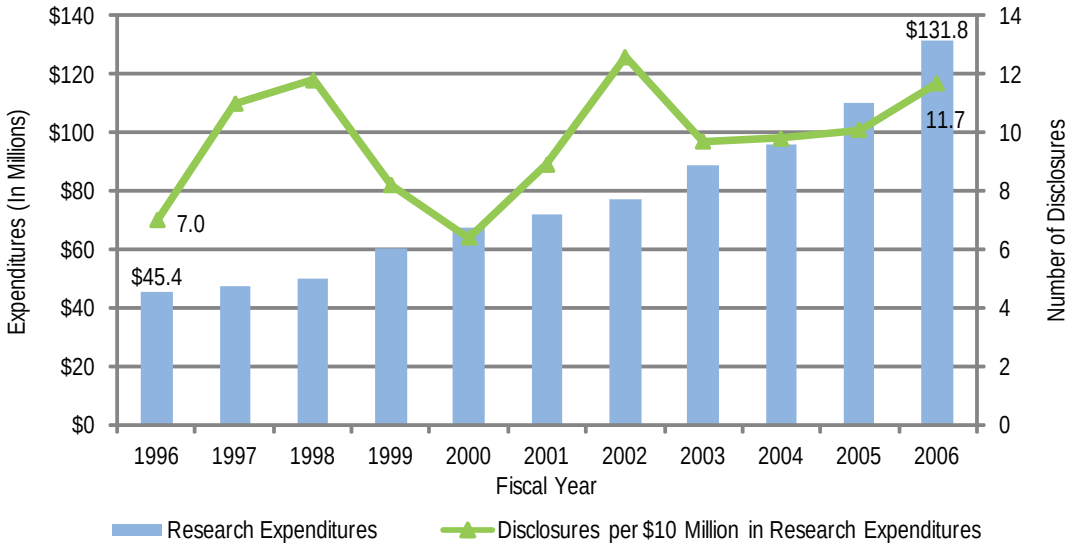
* Many disclosures result from cross-disciplinary efforts and therefore may be included in more than one unit's disclosure count in this table.

Source: Auditor General staff analysis of *FY 2007 Arizona Board of Regents University Technology Transfer Report*.

1 The goal of the Biodesign Institute is to improve human health and quality of life through use-inspired biosystems, research, and effective multidisciplinary partnerships.

2 Fiscal year 2007 data was obtained from the Board's technology transfer report. AUTM data on disclosures and research expenditures for 2007 was not available at the time of this audit. Therefore, auditors were unable to compare ASU to its peer institutions for 2007.

Figure 1: Arizona State University
Research Expenditures and Disclosure Activity
Fiscal Years 1996 through 2006
(Unaudited)



Source: Auditor General staff analysis of research expenditures and number of disclosures presented in the Association of University Technology Managers reports for Arizona State University and its peer institutions for fiscal years 1996 through 2006.

Compared to its peer institutions, ASU receives more disclosures from its faculty researchers per $10 million in research expenditures.[1] As shown in Figure 2 (see page 20), from fiscal years 1996 to 2006 ASU's peer institutions averaged between 3.5 and 5.3 invention disclosures annually per $10 million in total research expenditures. Literature indicates that universities typically receive 4.3 invention disclosures for every $10 million in research expenditures.[2] In fiscal year 2006, ASU's peer group averaged 3.8 disclosures for every $10 million spent. Meanwhile, from fiscal years 1996 to 2006, ASU never fell below 6.4 disclosures per $10 million spent, and in fiscal year 2006 received 11.7 disclosures per $10 million spent.

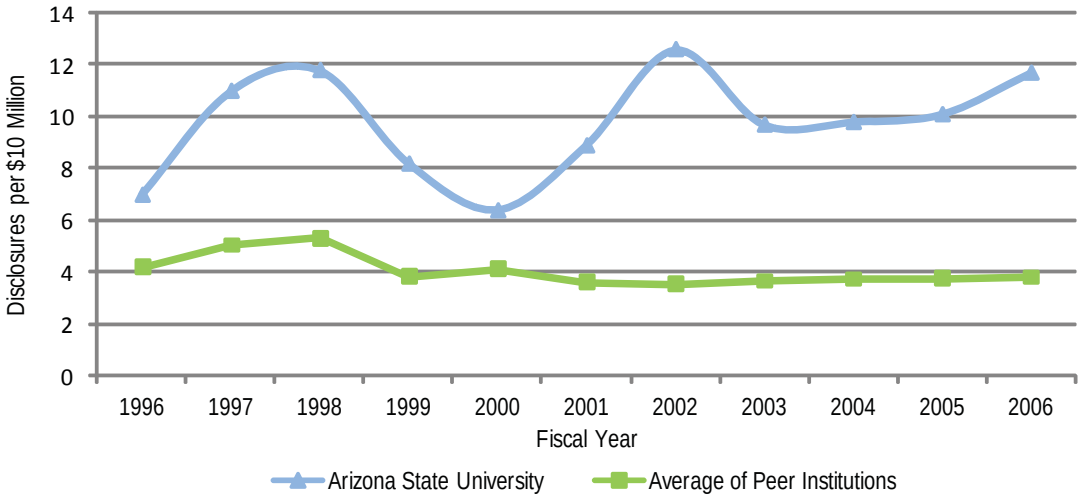
Since fiscal year 1996, ASU has consistently received more disclosures per $10 million in research expenditures than its peer institutions.

AzTE's organization and processes promote participation in technology transfer and help ensure that commercially viable disclosures are submitted—Although many factors can affect disclosure rates, AzTE's frequent interactions with inventors positively influence program results with increased inventor participation and invention disclosures. The two AzTE employees responsible for meeting with inventors both noted the significance of this, stating that they will meet with the inventor to discuss the merits of the invention both before and after the disclosure has been filed. ASU inventors who participated in a focus group conducted as part of the audit noted that they

1 See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

2 Weeks, Patricia Harsche. How to Organize a Technology Transfer Office. Ed. Elliott C. Kulakowski and Lynne U. Chronister, *Research Administration and Management.* Sudbury, MA: Jones & Bartlett Publishers, 2006. 641-652.

Figure 2: Arizona State University and Average of Peer Institutions' Disclosures per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and number of disclosures presented in the Association of University Technology Managers reports for Arizona State University and its peer institutions for fiscal years 1996 through 2006.

see employees from AzTE in their buildings "quite a bit" and have met with them on occasion, with one inventor mentioning that an AzTE employee had contacted him to discuss his research interest shortly after he had been hired at the university. Since AzTE's organizational structure uses specialized positions, its employees focus on specific tasks, such as soliciting disclosures. AzTE's licensing officials' duties emphasize encouraging the inventor to disclose his/her invention, and working with the inventor to ensure that the disclosure covers intellectual property with commercial merit. Once a disclosure is submitted, AzTE also conducts an in-depth commercial and technical evaluation to determine which technologies they will commercialize and allocates resources accordingly (for more information on AzTE's disclosure evaluation see Finding 2, pages 33 through 48).

Organizational changes may have limited AzTE's outreach—AzTE underwent a significant organizational transition and experienced multiple vacancies in 2007, and these factors may have reduced AzTE's outreach to ASU and NAU inventors. Specifically, for 4 months during 2007, three of the four marketing positions at AzTE were vacant, and there were no marketers assigned to life-sciences technologies. One of AzTE's two licensing officials commented that these vacancies required him to spend more time in the office and less time "beating the bushes" by going into labs, attending conferences, and speaking at research meetings trying to convince professors to disclose their inventions. AzTE has taken steps recently to address position vacancies, including the hiring of three new employees responsible for marketing technology and developing industry contacts. According to AzTE officials, AzTE is on track to receive as many disclosures in fiscal year 2008 as it received in fiscal year 2007.

AzTE's turnover appears to have also led to a breakdown of one important process. Specifically, an official from one of ASU's most productive research units, the Biodesign Institute, stated that AzTE no longer issues reports to directors indicating the disclosure activity of their academic or research units per fiscal quarter. In the past, these reports let the directors know if certain disciplines were not performing at the levels they should be, and allowed them to address this by providing additional assistance to the faculty in that field, making inventors less dependent on AzTE personnel. Additionally, according to the Biodesign official, the reports allowed him to determine AzTE's performance in working with inventors. Officials from ASU's School of Engineering and School of Life Sciences also stated that AzTE did not issue these quarterly reports to directors in their respective disciplines. To increase the level of support inventors receive from their departments, ASU should encourage AzTE to reinstitute the practice of providing quarterly reports to deans and department chairs of research-intensive units to keep them abreast of their unit's technology transfer activity. According to ASU officials, ASU and AzTE plan to develop a list of deans, department chairs, and center directors who will receive a quarterly report of invention disclosure activity.

UA needs to improve disclosure activity

UA does not compare favorably with its peer institutions in the number of invention disclosures submitted to its Office of Technology Transfer (Office). In fact, the Office receives a significantly lower rate of disclosures than its peer institutions. The quantity of commercially viable disclosures the Office receives can be improved by ensuring that licensing officers identify promising research and obtain disclosures. Further, UA should replicate a program at one of its institutes that already promotes these activities.

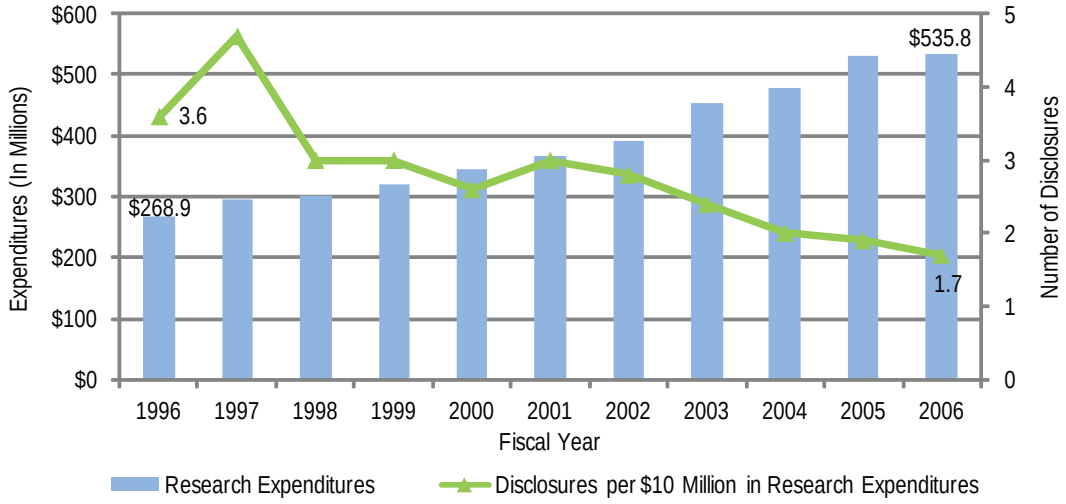
UA disclosure activity lower than peers'—Despite UA's emphasis on research, its university inventors disclose comparatively few inventions. In fiscal year 2006, UA was among the top 15 public universities nationally in research expenditures, according to the National Science Foundation (see Table 1, page 3). In addition, UA has a medical school and other research intensive-units, such as the Bio5 Institute (see textbox), which add to UA's potential for generating invention disclosures. From fiscal years 1996 to 2006, UA's research expenditures nearly doubled, as shown in Figure 3 (see page 22), but the number of disclosures submitted per $10 million in research expenditures decreased from 3.6 to 1.7, a 53 percent decline. In fiscal year 2007, UA received 104 invention disclosures, an increase from the 90 received in 2006.[1]

Bio5 Institute

Brings together scientists from five disciplines—agriculture, medicine, pharmacy, basic science, and engineering—to treat disease, feed humanity, and preserve livable environments. Bio5 creates science, industry, and education partnerships to engage in leading-edge research, translate innovations to the market, and to inspire and train the next generation of scientists.

[1] Fiscal year 2007 data was obtained from the Board's technology transfer report. AUTM data regarding disclosures and research expenditures for 2007 was not available at time of this audit. Therefore, auditors were unable to compare UA to its peer institutions for 2007.

Figure 3: University of Arizona
Research Expenditures and Disclosure Activity
Fiscal Years 1996 through 2006
(Unaudited)



Source: Auditor General staff analysis of research expenditures and number of disclosures presented in the Association of University Technology Managers reports for the University of Arizona and its peer institutions for fiscal years 1996 through 2006.

Compared to its peer institutions, UA receives fewer disclosures from its faculty researchers per $10 million in research expenditures.[1] As shown in Figure 4 (see page 23), from fiscal years 1996 to 2006 UA's peer institutions averaged between 4.1 and 5.2 invention disclosures annually per $10 million in total research expenditures, while UA never matched the peers' average during those years. Similar to auditors' analysis, literature indicates that UA's disclosure rate is less than that of other universities. According to a 2006 book on research administration and management, universities typically receive approximately 4.3 invention disclosures for every $10 million in research expenditures.[2] In fiscal year 2006, UA's peer institutions came close to this number, with an average of 4.1 disclosures per $10 million spent. However, at only 1.7 disclosures per $10 million spent in fiscal year 2006, UA was far below the 4.3 figure and the peer average. That year, UA received 90 invention disclosures. In order for UA to have reached the level of its peer institutions, it would need to have received 220 disclosures.

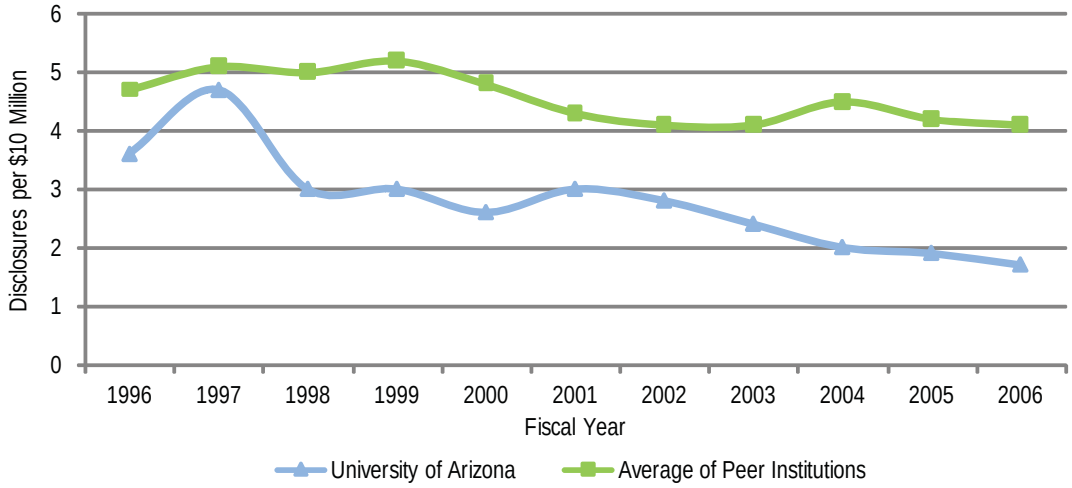
In fiscal year 2006, UA received 1.7 disclosures per $10 million in research; its peers averaged 4.1.

Number of commercially viable disclosures submitted by UA inventors can improve by increasing interactions between them and licensing officers—Literature indicates that increased in-person interaction between the Office and university inventors can lead to more disclosures with commercial potential. According to a Connecticut study, which

1 See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

2 Weeks, Patricia Harsche. How to Organize a Technology Transfer Office. Ed. Elliott C. Kulakowski and Lynne U. Chronister, *Research Administration and Management*. Sudbury, MA: Jones & Bartlett Publishers, 2006. 641-652.

Figure 4: University of Arizona and Average of Peer Institutions' Disclosures per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and number of disclosures presented in the Association of University Technology Managers reports for the University of Arizona and its peer institutions for fiscal years 1996 through 2006.

examined 10 model technology transfer programs, successful universities have close connections with inventors conducting commercially viable research and identify inventions at very early stages.[1] This practice promotes the number of commercially viable disclosures university inventors submit to the technology transfer offices. UA's peer institutions also cited the importance of this, with one noting that the Office works with inventors prior to technology disclosures to try to maximize the quality of the disclosures by evaluating weak areas that might be addressed in the lab.[2] At UA, a senior university official stressed that in order to increase the quality and quantity of disclosures, the level of in-person interaction between the Office and university inventors must be increased.

Licensing officials from the Office visit university inventors in their labs, but these visits usually occur only after a disclosure has been submitted. Two licensing officials stated that they do not typically visit inventors in their office or lab prior to receiving a disclosure. One official indicated that it was not

UA's Top Disclosing Research Units
Fiscal Year 2007

Unit Name	Disclosures Received
Bio5 Institute	37
College of Medicine	31
Optical Sciences	26
School of Engineering and Mining	25
College of Science	7

* Many disclosures result from cross-disciplinary efforts and therefore may be included in more than one unit's disclosure count in this table.

Source: Auditor General staff analysis of *FY 2007 Arizona Board of Regents University Technology Transfer Report*.

1 Palmintera, Diane. *Report to the Connecticut Technology Transfer and Commercialization Advisory Board of the Governor's Competitiveness Council.* Washington, D.C.: Innovation Associates, 2004.

2 Auditors sent questions to 11 of UA's peer institutions; 7 responded to the inquiry.

UA's focus group members stated that office employees' increased presence in the labs would result in more disclosures.

possible given the number of technologies they are responsible for. However, several UA inventors who participated in an auditors' focus group stated that an increased presence in the labs by the Office's employees would encourage more participation in technology transfer and result in a higher number of disclosures. One participant added that inventors feel that they have to "push" their inventions toward the Office, instead of the Office "pulling" them from the labs.

A lack of adequate resources may limit the Office's ability to interact with university inventors. As previously mentioned, the Office's licensing staff are tasked with multiple activities for the technologies assigned to them. When compared to UA's peer institutions, the Office has fewer licensing officials per $10 million in research spending.[1] During fiscal year 2006, UA had a total of 4 full-time licensing officers, or 0.07 licensing officers per $10 million in research expenditures. In order for UA to reach the level of its peer institutions, it would need approximately 7 more licensing officials (see Introduction and Background, page 7, for details). Because the Office's staffing levels appear to be lower than its peers', UA should evaluate whether its technology transfer program staffing levels are adequate and take steps to increase program resources as needed.

Interactions between UA licensing officials and inventors could be improved by replicating the model used in UA's Bio5 Institute in other departments that emphasize commercially viable research. Under this model, a licensing official from the Office is stationed part-time in the Institute. Though university inventors are experts in their respective disciplines, literature notes that they may not always realize the commercial potential of their work. At Bio5, the licensing official helps inventors identify the potential of an invention, encourages them to disclose inventions, and locates possible industry partners. A Bio5 inventor who participated in an auditors' focus group explained that the licensing official has met with him several times, discussed his research, and introduced him to potential licensing partners. Another UA official recommended that this approach be taken in two other areas: Optical Sciences and Engineering. In the Bio5 example, the Office and the Institute share this employee's salary. The Office's Executive Director explained that he has attempted to do something similar in Optical Sciences, but the necessary funding was not available. However, according to university officials, funding has been made available to implement this model in Optical Sciences beginning in fiscal year 2009. To achieve the increased interactions reported by Bio5 researchers and cited in literature, UA should encourage additional appropriate research departments to work with the Office to share the expenses of replicating this model.

[1] See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

NAU should strengthen its technology transfer program

Because NAU is not a research-intensive university it does not produce a large number of annual invention disclosures. For example, in fiscal year 2006, when NAU's research expenditures totaled approximately $21.2 million compared to approximately $132 million at ASU and over $535 million at UA, ten NAU inventors disclosed a total of six technologies to AzTE. This was equivalent to 2.8 disclosures per $10 million in research spending. NAU, like many of its peer universities, does not participate in the annual AUTM licensing survey. Therefore, auditors did not compare NAU's technology transfer activity to that of its peers. However, NAU has units that conduct research with commercial potential, such as the College of Engineering and Natural Sciences and the School of Forestry. Therefore, it is important for the university to encourage disclosure so that the work of its inventors can benefit the public.

NAU's Disclosures by Research Unit
Fiscal Year 2007

Unit Name	Disclosures Received
College of Engineering and Natural Sciences	3
School of Forestry	2
College of Arts and Letters	1

Source: Auditor General staff analysis of *FY 2007 Arizona Board of Regents University Technology Transfer Report*.

To promote disclosure activity, NAU should work to increase AzTE's on-campus presence. According to university officials, AzTE does not have anyone with a permanent assignment to work with inventors on the NAU campus, meet with them to learn about their research, identify commercially viable inventions, and help them decide if something could or should be disclosed. NAU inventors who participated in an auditors' focus group stated that NAU should hire someone to occasionally stop by the labs and discuss commercialization with researchers, since they were aware of AzTE visiting NAU only once in 2007. However, university officials stated that NAU's disclosure activity may not yet warrant a full-time technology transfer liaison. Therefore, NAU should work with AzTE to develop a schedule for AzTE employees to visit NAU's campus periodically throughout the year. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of its technology transfer services to another provider. Any arrangement should ensure that the level of interaction between NAU inventors and technology transfer staff is increased.

Improved incentives and inventor education could increase disclosures at all three universities

All three universities should consider certain improvements that could increase the quantity of commercially viable invention disclosures submitted by university inventors. Specifically, the universities should consider practices experts have found in other model universities that are successful with technology transfer, including appropriate promotion and tenure policies, informal recognition, and program education.

Increased incentives could lead to more disclosures—According to literature, university inventors' participation in technology transfer is related to the incentives they are offered. Royalty compensation to the inventor is required by federal law, and all three universities provide this incentive. For example, ASU uses a formula that allocates the first $10,000 of net royalty monies to the inventor—then evenly distributes additional net royalties between the inventor, the inventor's lab, and the university. However, the universities can increase their use of at least two other incentives.

One incentive the universities can use more extensively to encourage disclosures is considering technology transfer in promotion and tenure decisions. According to the Connecticut study of 10 model university technology transfer programs, credit toward tenure and promotion was a common incentive offered by universities that are successful with technology transfer. In Arizona's universities, some departments consider technology transfer activities in faculty evaluations while others do not. For example, ASU's Department of Electrical Engineering includes technology transfer in its evaluation criteria for tenure and promotion, considering it an example of academic publication, but the Department of Mechanical and Aerospace Engineering does not. Further, select university and departmental guidelines for tenure and promotion at all three universities showed varying degrees of professional recognition for participation in technology transfer. Some university inventors that participated in auditors' focus groups at all three universities expressed concern that participating in technology transfer is not adequately built into the incentive structure for their evaluations, and there appears to be no clear professional benefit for it. Therefore, they explained that faculty may focus more on publishing their research than on working with the universities to move their discoveries into the marketplace. This lack of recognition is not unique to Arizona's universities—promotion and tenure at other universities is still largely based on publications and research grants, not technology transfer activities. However, if increasing participation in technology transfer is an organizational goal, this reward structure is inconsistent with the objective. Therefore, to encourage faculty participation in technology transfer, ASU and UA should encourage research-intensive departments to consider including participation in technology transfer in their guidelines for faculty promotion and tenure.

Some successful universities publicized inventors' accomplishments in the local media and held award ceremonies to acknowledge researchers' achievements.

Informal recognition can also serve as an incentive to disclosing inventions. The Connecticut study reported that informally, some universities made it common practice to publicize the accomplishments of inventors in the local media. Also, department or university-wide award ceremonies were held to acknowledge successful researchers—a practice that was also highlighted by several peer institutions. An official in ASU's School of Engineering cited the importance of these ceremonies and noted that university inventors notice the work of their colleagues, and if one of them has a plaque from AzTE on their wall, they will want one as well. These acts also send a message to the larger academic community that

technology transfer is important to the university. UA's Office of Technology Transfer hosts an annual innovator's reception and invites university inventors who have been active in technology transfer to participate. In addition, according to the Office Director, the Office holds an awards ceremony known as "UA Innovation Day" for university inventors each spring. AzTE has also done this in previous years, although in 2008 it chose to recognize inventors by giving them framed copies of their patents instead. ASU and UA should continue to promote participation in technology transfer by hosting similar events, and awarding university inventors who excel in this process. NAU should consider this as an inexpensive way of encouraging its faculty to disclose their intellectual property.

More faculty education about technology transfer could increase quantity of commercially viable disclosures—ASU and UA peer institutions noted the importance of educating faculty about technology transfer and cited several approaches their technology transfer offices have taken to do so, including hosting intellectual property workshops, attending departmental meetings and orientation sessions, speaking with deans and department chairs, and publishing a quarterly newsletter. A director of one of ASU's peer institutions' technology transfer offices mentioned that his employees spend about one-third of their time engaged in internal marketing activities such as those mentioned above. In a 2003 survey of 62 technology transfer offices, researchers found that educating and convincing faculty to disclose inventions is a major problem, and that many office directors believe that substantially less than half of the inventions with commercial potential are disclosed to their offices, in part because faculty are not always aware of what should be disclosed.[1]

All three of Arizona's universities could better educate faculty. New university inventors receive varying amounts of information about technology transfer depending on their academic units. For example, one of UA's more productive research units, the College of Optical Sciences, does not provide orientation materials that explain technology transfer to new inventors. Likewise, university inventors who participated in auditors' focus groups at all three universities reported deficiencies in university and departmental policies regarding faculty education about technology transfer. They stated that learning the technology transfer process is largely the researcher's responsibility. They reported that the universities provide minimal support or education to new faculty; as a result, faculty have to seek out the information they require.

According to an official in the Biodesign Institute, in the past, AzTE has conducted workshops on intellectual property management to introduce inventors to technology transfer and AzTE's processes. However, these workshops stopped occurring when AzTE management began to change in late 2006. Similarly, NAU and UA have also held events such as these in the past, although officials cited difficulty in generating a strong interest on campus for these workshops. Additionally, representatives from UA's Office have spoken to inventors during departmental meetings and said they would like to be invited to do this more often. ◆

1 Jensen, Richard A., Jerry G. Thursby, and Marie C. Thursby. Disclosure and Licensing of University Inventions: 'The best we can do with the s**t we get to work with.' International Journal of Industrial Organization 21, No. 9 (2003): 1271-1300.

The universities should identify the research units known for producing commercially viable research, and then conduct workshops for the faculty in those areas. In addition, the universities should also encourage their research-intensive departments to invite technology transfer staff to speak during departmental meetings on an annual basis.

Finally, to improve new faculty education about technology transfer, ASU, UA, and NAU should proactively identify new faculty hires in research-intensive disciplines, and inform their respective technology transfer providers and UA's Office of their hiring so they can make initial contact. Department Chairs and the Sponsored Research Office can also help identify inventors who are expected to conduct research or have applied for or received federal research funds. Licensing officers can then visit university inventors to discuss the benefits of participating in the program, learn about the inventors' research activities, and start assessing the commercial potential of the research. In addition, the universities should require their respective technology transfer offices to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, the offices should include information on the services that they offer, what is expected of the researcher, legal matters related to intellectual property, and contact information, and should direct the inventor toward the Office's Web site for further information.

Recommendations:

Arizona State University:

1. To increase the level of support researchers receive from their departments, ASU should encourage AzTE to reinstitute the practice of providing quarterly reports to deans and department chairs of research-intensive units to keep them abreast of their units' technology transfer activity.

2. To encourage more faculty participation in technology transfer, ASU should:

    a. Encourage its research-intensive departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure.

    b. Continue to promote faculty participation in technology transfer by hosting annual recognition ceremonies and awarding university inventors who excel in this process.

3. To better educate faculty and increase their exposure to the technology transfer process, ASU should:

    a. Identify the departments known for producing commercially viable research and encourage AzTE to conduct workshops for department faculty.

    b. Encourage research-intensive departments to invite AzTE staff to their meetings on an annual basis.

    c. Proactively identify new university researchers in disciplines with high commercial potential and notify AzTE of their hiring so that AzTE can make initial contact.

    d. Require AzTE to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, AzTE should include information about the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to AzTE's Web site for further information when required.

University of Arizona:

1. To help ensure that the Office of Technology Transfer can interact with inventors as necessary, UA should evaluate whether its technology transfer program staffing levels are adequate and take steps to increase program resources as needed.

2. To increase the level of interaction between licensing officials and inventors, UA should encourage appropriate research departments to work with the Office of Technology Transfer to share the expenses of replicating the model used in the Bio5 Institute.

3. To encourage more faculty participation in technology transfer, UA should:

    a. Encourage its research-intensive departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure.

    b. Continue to promote faculty participation in technology transfer by hosting annual recognition ceremonies and awarding university inventors who excel in this process.

4. To better educate faculty and increase their exposure to the technology transfer process, UA should:

    a. Identify the departments known for producing commercially viable research and encourage the Office of Technology Transfer to conduct workshops for department faculty.

    b. Encourage research-intensive departments to invite Office of Technology Transfer staff to their meetings on an annual basis.

    c. Proactively identify new university researchers in disciplines with high commercial potential and notify the Office of Technology Transfer of their hiring so the Office can make initial contact.

    d. Require the Office of Technology Transfer to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, the Office of Technology Transfer should include information on the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to the Office's Web site for further information when required.

Northern Arizona University:

1. To promote disclosure activity by increasing in-person interactions with faculty, NAU should work with AzTE to develop a schedule for AzTE employees to visit NAU's campus periodically throughout the year to meet with NAU inventors. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of its technology transfer services to another provider. Any arrangement should ensure that the level of interaction between NAU inventors and technology transfer staff is increased.

2. To encourage more faculty participation in technology transfer, NAU should consider hosting annual recognition ceremonies for their inventors who have been active in technology transfer.

3. To better educate faculty, and increase their exposure to the technology transfer process, NAU should:

    a. Identify the departments known for producing commercially viable research and then conduct workshops for department faculty.

b. Encourage reseach-intensive departments to invite the technology transfer provider to their meetings on an annual basis.

c. Proactively identify new university researchers in disciplines with high commercial potential and notify its technology transfer provider of their hiring so they can make initial contact.

d. Require its technology transfer provider to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, NAU's technology transfer provider should include information on the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to the provider's or NAU's Web site for further information when required.

FINDING 2

All three universities—particularly UA—should improve aspects of marketing and all three should review their negotiation practices

The universities have some standard components of technology marketing programs recommended in licensing guides, but all three should improve their marketing practices and encourage more industry-sponsored research. Arizona State University (ASU) appears farthest along; it has generally licensed more inventions than its peer institutions and received more licensing revenues, but staff vacancies in its technology transfer firm have hampered marketing efforts for ASU inventions. In contrast, the University of Arizona's (UA) licensing activity generally falls below its peer institutions' and UA should strategically increase its active marketing efforts. Additionally, more could be done to market Northern Arizona University (NAU) researchers' inventions. Finally, all three universities should build stronger relationships and improve communications with industry to increase corporate-sponsored research.

Marketing important to technology transfer

Successful technology transfer requires not only that inventions be disclosed, but that they be licensed and brought into production in the marketplace. Some inventions result from corporate-sponsored research. For these inventions, companies that sponsor university research can provide a ready customer and the technology transfer staff's role is to negotiate a favorable license agreement for the university. For other inventions, universities need to actively seek out commercial partners and enter into licensing agreements with those companies to develop market applications for the inventions' public use. Besides transferring an invention to an existing company, universities can work with researchers and investors to build new businesses—called start-ups—based on the inventions.

After disclosing an invention, it is evaluated and marketed to companies that can bring it into production.

To license and bring inventions into the marketplace, universities can follow practices described by several practitioner books and articles that describe how practitioners could market technologies to existing companies.[1] Auditors used these books and

[1] See Bibliography, pages b-ii through b-v, for resources used to evaluate marketing practices.

articles to evaluate the universities' technology marketing programs and determine whether the programs incorporate the key components. Auditors summarized the components into three areas:

- Evaluate the technology—Before marketing, universities should evaluate the technology and create a plan to guide their marketing efforts. Using the inventor's expertise, market data, and staff experience, they should assess patent and commercial viability and identify which industry sectors may have an interest in the technology. To begin marketing, universities protect most technologies that appear to have commercial potential with a provisional patent to establish ownership.

- Conduct market research—Universities should conduct research to identify industry sectors that may have an interest in the technology, information regarding companies active in those industries, and their business strategies, capabilities, and key personnel. Business databases, patent searches, daily news about technology licensing, and industry conferences are important sources of information. The university inventor can be a particularly effective source of companies to contact.

- Network with companies and promote the technology—Universities should establish personal relationships with industry members through one-on-one interaction, such as during trade shows and networking events. They should contact these and other target companies identified during market research and provide them with increasing levels of information about specific technologies. Initial contact can be made by phone, fax, direct mail, or e-mail and the university should eventually meet for face-to-face discussions and demonstrations if industry interest warrants.

  In addition to direct personal contact with company representatives, universities commonly promote available technologies broadly through various forums, including the university and technology brokerage Web sites. They can also advertise more promising technologies through a press release, in trade magazines, or at industry events.

Research on university marketing emphasizes the importance of personal relationships with industry representatives to license inventions.

Academic research on technology transfer emphasizes the importance of personal contact—particularly by the inventor—in marketing, but other practices described above are not as thoroughly researched, and the literature identifies other factors that affect licensing success. Auditors reviewed research literature to determine if specific components or practices were found to be effective. Several articles concurred on the importance of the faculty inventor in licensing. For example, one concluded that personal contact by the faculty inventor or technology transfer staff, targeted marketing efforts, and a dynamic Web site were three of the most effective ways to market technology.[1] Few scholarly articles directly compared the effectiveness of the recommended marketing methods described in practitioner books or articles. Further, the literature identifies historical, institutional, and other factors that affect

[1] Ramakrishnan, Chen and Balakrishnan. Effective Strategies for Marketing Biomedical Inventions: Lessons Learnt from NIH License Leads. *Journal of Medical Marketing* 5, No. 4 (2005): 342-352.

licensing success, such as how long the university's technology transfer office has been in operation, the prestige of individual faculty inventors, whether the university has a medical school, and the entrepreneurial culture established by university leadership.

Marketing university technology presents several challenges. For example, the inventions' commercial potential may not be immediately apparent, and they often require additional monies and faculty participation to fully develop the technology. This is one reason that universities incorporate other commercialization mechanisms, such as industry-sponsored research and working with inventors to create start-up companies, into their marketing programs. In addition, invention disclosures may span several scientific fields, requiring licensing staff to work effectively with a variety of specialized industries. Further, universities typically have multi-faceted missions that may not align with conventional marketing goals. For example, when licensing a technology, a university may be more interested in developing relationships with industry to enhance students' experiences than in seeking revenues from commercialization.

ASU's marketing program appears historically strong and rebuilding efforts are in progress

ASU's licensing activity has historically exceeded that of its peers.

ASU's licensing activity has historically exceeded that of its peers. The structure and budget of its technology transfer office, Arizona Technology Enterprises (AzTE), allows for a specialized and well-qualified marketing staff who are aware of recommended marketing practices. However, AzTE staff indicated that vacancies, which started in 2007, have hampered their practices. To better ensure future success, ASU should see that AzTE continues to rebuild and strengthen its marketing processes under its new leadership and staff.

ASU licensing activity fluctuates but still exceeds its peers'—According to an annual survey of universities conducted by the Association of University Technology Managers (AUTM), ASU license agreements have fluctuated in recent years.[1] The number of agreements rose significantly, from 3 to 28 agreements between fiscal years 2003 and 2005. However, that number has been on the decline, decreasing to 19 agreements in fiscal year 2006. According to an AzTE official, the number of agreements decreased to 14 in fiscal year 2007.[2]

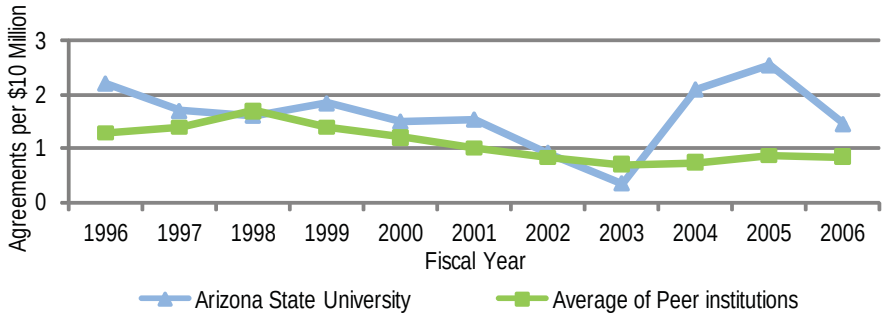
Despite the fluctuation, ASU has out-performed its peer institutions in most years under consideration, as seen in Figure 5 (see page 36).[3] Specifically, ASU entered into 1.5 or more agreements per year per $10 million in research expenditures in 8 of 11 years between fiscal years 1996 and 2006. Peers, however, have rarely entered into 1.5 or more agreements per $10 million spent.

1 License agreements include licenses and options.

2 AUTM data regarding licenses and research expenditures for fiscal year 2007 was not available at the time of the audit. Therefore, auditors were unable to compare ASU to its peer institutions for that year.

3 See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

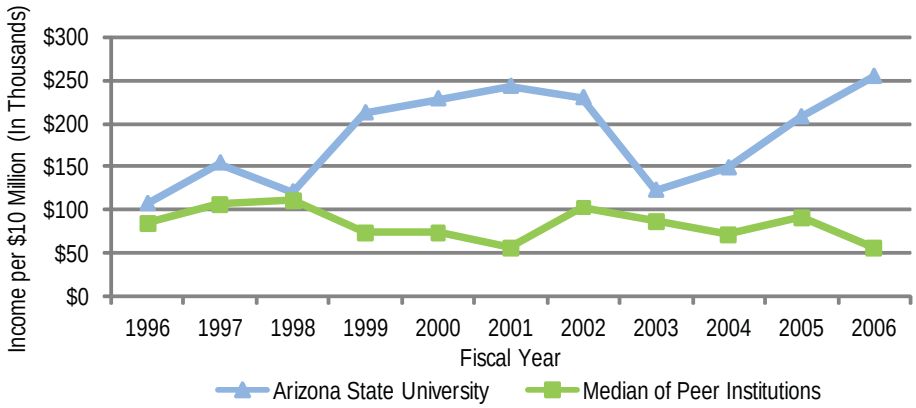
Figure 5: Arizona State University and Average of Peer Institutions' Agreements per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and number of licensing and option agreements presented in the Association of University Technology Managers reports for Arizona State University and its peer institutions for fiscal years 1996 through 2006.

As Figure 6 shows, ASU income from license agreements is also above its peers. From fiscal years 1996 to 2006, ASU received approximately $107,000 to $254,000 in licensing income per year per $10 million in research expenditures, with the amount steadily rising since fiscal year 2003. Peers have had less licensing income, between $56,000 and $111,000 per $10 million spent each year, during the same time period.

Figure 6: Arizona State University and Median of Peer Institutions' Licensing Income per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and licensing and option income presented in the Association of University Technology Managers reports for Arizona State University and its peer institutions for fiscal years 1996 through 2006.

AzTE marketers are aware of recommended practices—At AzTE, marketing responsibilities are split between staff who evaluate the initial market potential of a technology and staff who specialize in developing relationships with industry. An additional staff member facilitates the creation of start-up companies. During fiscal year 2006, AzTE staffing levels appeared higher than the levels at ASU's peers (see Introduction and Background, page 6, for details). AzTE's structure and budget have allowed it to hire staff with private sector licensing experience and business credentials who are dedicated to marketing. Due to vacancies in key marketing positions during the majority of the audit, auditors were unable to confirm AzTE's overall adherence to recommended practices.[1] However, licensing officials interviewed appear to be aware of marketing methods recommended in practitioner literature. Specifically:

- Marketing starts with critical evaluation—According to AzTE's Web site and its licensing officials, AzTE holds an Intellectual Property Review Meeting for most technologies within 2 months of the disclosure to determine whether to focus its marketing efforts on the specific technology. These sources indicated that the decision involves science, business, and legal staff at AzTE and it is supported by a scored assessment on 20 standard criteria such as the growth rate of the market and its synergy with AzTE's technology portfolio. According to an AzTE official, their process was developed in consultation with faculty and what AzTE identified as best practice.

AzTE officials indicated that their decision to market a technology involves their science, business, and legal staff.

- Market research supplements first-hand knowledge—AzTE science staff are primarily responsible for the initial market research, whereas marketing staff have broader business development responsibilities. AzTE marketers reported that they use company and industry information gained through past experience to identify target companies and contacts. To supplement this, AzTE has subscriptions to two market research database services and also requests company suggestions from the university inventor on its disclosure form. Approximately 20 ASU students per semester also help with market research through an internship program called the Technology Ventures Clinic. Further, in November 2007, AzTE hired two graduate-level students to assume some higher-priority market research according to AzTE's Director. AzTE is considering other part- or full-time assistance, partly for additional market research.

- Multi-media advertising is used—AzTE advertises technologies on its Web site and also uses industry events to display promising technologies to a live audience. AzTE is considering hosting a technology expo in San Francisco in 2008 focused on advertising ASU technologies to venture capitalists.

- Industry contacts are a high priority—According to AzTE's marketers, they have personal business contacts gained through experience in private sector licensing. They attend industry conferences and networking events where they

AzTE's marketers indicated that they have personal business contacts gained through experience in private sector licensing.

[1] Auditors interviewed one AzTE marketer who reported that he had been in his current position for 9 months at the time of the interview and one marketer who reported that he had been with AzTE for approximately 2 months as a consultant and 2 months as an employee at the time of the interview. Two additional marketers started at the end of the audit.

can meet with companies to market technologies and develop new contacts. The marketing staff contact industry members by phone or e-mail. One marketer said he contacts 10 to 30 companies, starting with those where he, a team member, or the faculty inventor has a personal relationship. He also sets a target date to follow up with promising company partners if he has not heard from them. A senior marketer said he tries to avoid "cold" calling altogether. Inventors who participated in auditors' focus groups made positive comments about AzTE's marketing efforts. For example, one inventor felt that an AzTE marketer went above and beyond to identify seed funding for his technology, and others appreciated the industry contacts they were able to make through networking events that AzTE has held.

Vacancies have hampered marketing efforts—Although the AzTE officials interviewed indicated that they use recommended marketing practices, they said that staff shortages starting in July 2007 have affected the thoroughness of their marketing efforts. Specifically, AzTE had vacancies in three of its four marketing positions, lasting between 4 and 9 months. In addition, according to the Director who assumed leadership 1 month after the previous director left, he has not been in the office full-time to manage AzTE's day-to-day operations but has been working with ASU's Office of the Vice President for Research and Economic Affairs on issues of broader industry engagement, such as sponsored research. AzTE's fiscal year 2008 license agreements are well below their historic levels, reaching just five by mid-year according to an AzTE official. Other AzTE officials reported that the market research used to support which technologies will be patented and marketed has been less thorough than in the past. Further, AzTE officials estimated that technology advertisements on its Web site are a year behind or the patent status and contact information is outdated. As of November 2007, AzTE had 346 available technologies in its tracking database, but according to AzTE officials, many had not been marketed or reassessed to determine if they still have market potential. The only marketer assigned to physical science industries stated that he is marketing approximately 30 technologies and believes another 30 to 40 in his industry areas have commercial potential. According to a senior AzTE staff member, less than 10 life science technologies were actively marketed between July and November 2007, and AzTE was using a consultant for this work. However, in November 2007 AzTE hired the consultant as a full-time employee.

AzTE has taken steps to fill vacancies and ASU should ensure that AzTE continues to rebuild and strengthen its marketing practices. With two marketing positions filled by January 2008, AzTE officials stated that they have started to evaluate and prioritize technologies in the life sciences. They are also evaluating a different division of responsibilities in the life sciences. A senior marketer in the physical sciences started in April 2008, which brought AzTE to its former marketing staff levels. In addition, the Director hired a Chief Operating Officer to manage day-to-day activities beginning March 2008, which should free the Director to continue his focus on engaging with industry. ASU should ensure that AzTE fully rebuilds and strengthens its marketing program in accordance with recommended practices.

UA marketing efforts need improvement

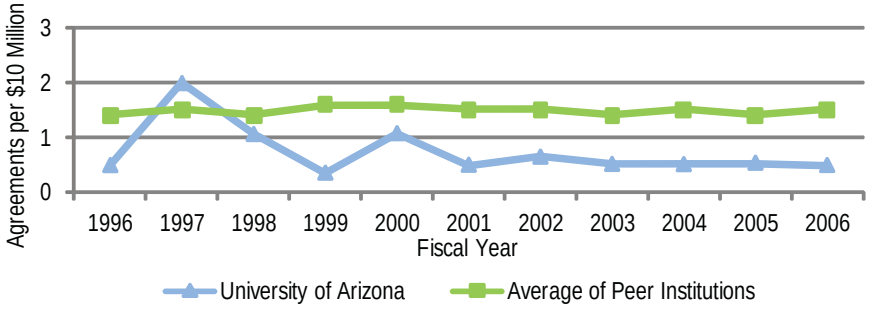
UA's licensing activity consistently falls below its peers'. UA appears to follow some recommended marketing practices, such as Internet advertising and drawing on faculty contacts in industry. However, UA should improve its evaluation of technologies' commercial potential and increase its market research and industry contacts. It should also determine whether staffing levels are adequate and increase resources to the program as needed.

UA licensing activity falls below peers'—According to an annual survey of universities conducted by AUTM, UA license agreements have remained constant in recent years.[1] After significant fluctuation in the 1990s, the number of agreements UA executes has remained fairly steady, ranging from 23 to 28 per year since fiscal year 2002. According to UA's Office of Technology Transfer (Office) Director, the number of agreements rose to 30 in fiscal year 2007.[2]

The number of UA license agreements is generally less than half that of its peers'.

UA license agreements have been low when compared to its peer institutions.[3] As shown in Figure 7, during most of the past 11 years, UA has entered into less than one agreement per $10 million in research expenditures, whereas on average, its peer institutions have consistently entered into more than one agreement.

Figure 7: University of Arizona and Average of Peer Institutions' Agreements per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and number of licensing and option agreements presented in the Association of University Technology Managers reports for the University of Arizona and its peer institutions for fiscal years 1996 through 2006.

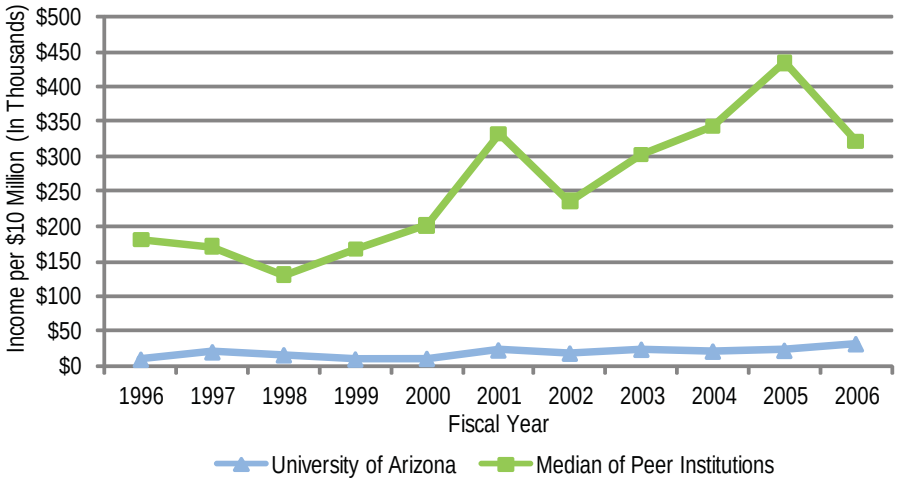
1 License agreements include licenses and options.

2 AUTM data regarding licenses and research expenditures for fiscal year 2007 was not available at the time of this audit. Therefore, auditors were unable to compare UA to its peer institutions for that year.

3 See textbox in Introduction and Background, page 13, for more information on board-approved peer institutions.

UA income from license agreements is also below its peers', with peers often earning more than 10 times as much licensing income as UA. As shown in Figure 8, from fiscal years 1996 to 2006, UA received between $9,400 and $31,600 in licensing income per $10 million in research expenditures per year. By comparison, its peer institutions received approximately $130,000 to $435,000 per $10 million spent each year during the same period.

Figure 8: University of Arizona and Median of Peer Institutions' Licensing Income per $10 Million in Research Expenditures Fiscal Years 1996 through 2006 (Unaudited)



Source: Auditor General staff analysis of research expenditures and licensing and option income presented in the Association of University Technology Managers reports for the University of Arizona and its peer institutions for fiscal years 1996 through 2006.

Start-up companies present a special challenge for UA. Specifically, the company may offer an equity stake in its future profits in exchange for the right to license the technology. However, the Arizona Constitution prevents public entities, including the universities, from entering into these arrangements. Because ASU uses a private corporation, AzTE, to perform its technology transfer functions, ASU and NAU start-ups can provide equity to AzTE as payment for a license. Although UA cannot accept equity as a form of payment for a license, it has established alternatives to facilitate the creation of start-up companies. For example, such an equity-like instrument would permit the university to exchange it in the future for cash under certain circumstances, including the sale or consolidation of the company or an initial public offering of stock in the corporation.

UA marketers appear to follow some but not all recommended marketing practices—Through interviews with all office staff who license technology, it appears that UA does not follow all of the recommended marketing practices for technologies. Specifically:

- **Market evaluation not systematic or well defined**—Although UA has fewer disclosures than its peers, the Office does not appear to systematically focus

on technologies with higher market potential. As a result, limited marketing resources are spread thin and priority technologies are chosen using little market criteria. According to UA licensing officials, they evaluate disclosures to determine if the University owns the technology and whether prior public disclosure or existing technology prevents patenting, and they file provisional patents on most disclosures. The Office's Director stated that licensing officials also consider market factors such as the uniqueness and utility of the technology and whether it is in a new or emerging market. However, it appears that this evaluation is informal and priority technologies are often determined by other factors. For example, one licensing official primarily relies on the faculty member's interest and participation level to determine which technologies to actively market. Another licensing official has focused on technologies with impending patent deadlines.

UA should implement a system to weigh technologies against standard criteria.

To better ensure that it focuses its resources appropriately, UA should develop and implement a system to weigh technologies against standard criteria. *How to Organize a Technology Transfer Office* and universities such as Florida State University and ASU offer some examples.[1] Standard criteria include market factors, like the existence of a definable niche market and the absence of direct competitive products, as well as factors related to the inventor's participation level and patent feasibility. The technologies' fit with Tucson's 10 strategic industry clusters, which public and private sector leaders identified in a regional economic plan, offer UA another criterion to target its limited resources.[2] UA should use these criteria to prioritize new disclosures and routinely reassess old ones. The assessments could be done in-house or by market experts and UA should determine which is suitable based on relative cost and the industry expertise available throughout the university. UA can consider other means to mitigate costs. For example, the University of Iowa recruits alumni consultants to evaluate specific technologies on a pro bono basis.

- **Market research limited**—According to UA licensing officials and the Office's Director, limited time and market information sources for the breadth of technology subfields disclosed to the Office hamper their marketing efforts. Most UA staff reported that they primarily rely on the university inventor, Google, and the U.S. Patent and Trade Office Web site to identify and understand companies in the relevant industry segments. Soliciting ideas for target companies and contacts from inventors is a recommended practice. However, university inventors who participated in auditors' focus groups felt the Office over-relied on inventors for marketing. The group also noted that the Office was improving in this area. The Director secured a grant from the Kauffman Foundation, partly to increase the market information available in the Office and to hire a temporary, part-time market research assistant. The Office is evaluating the types and cost of information provided through

1 Weeks, Patricia Harsche. How to Organize a Technology Transfer Office. Ed. Elliott C. Kulakowski and Lynne U. Chronister. *Research Administration and Management.* Sudbury, MA: Jones & Bartlett Publishers, 2006. 641-652.

2 Tucson Regional Economic Opportunities, *Securing Our Future Now: An Economic Blueprint for the Tucson Region*. Tucson, AZ: Tucson Regional Economic Opportunities, 2007.

different proprietary databases and it is also considering outsourcing their market research needs, according to the Director. Three graduate student interns also help with market research and UA started a graduate fellowship program in 2007, which supports one fellow per year. UA should continue to increase its market research in strategic industry areas to adequately evaluate technologies and to identify and understand the target companies.

The Office focuses its marketing resources on advertising technologies through the Internet.

- Internet advertising a high priority—The Office has focused its marketing resources on advertising technologies through the Internet. For example, the Office automated its Web site so that it uploads one-page summaries of available technologies for companies to search or receive through an e-mail subscription. The Office Director noted that Internet advertising helps ensure market exposure for technologies without readily apparent commercial value. University inventors who participated in auditors' focus groups agreed that the Office's Web site provides good information. UA uses other advertising efforts, like displaying invention summaries at trade shows and through press releases, less frequently. It should consider using these methods more often with promising technologies.

It appears that most UA licensing officials have few industry contacts to draw on when marketing.

- Direct marketing under-utilized—For selected technologies identified through the evaluation process as having commercial potential, direct contact with industry officials is an important part of the marketing process. Although UA staff attend the university licensing professionals' conference where they can network with other technology transfer professionals, most of the Office's licensing officials do not regularly attend industry events, such as the Biotechnology Industry Organization convention or Interlop, a trade show for the computer industry, where they could develop contacts with industry representatives. Coupled with the lack of market information sources, it appears that they have few industry contacts to draw on when marketing. Licensing officials reported that they devote a varied amount of time to contacting potential licensees. One licensing official indicated that she contacts one to six companies for every technology and provides them with a one-page summary of the invention. She may revise her search terms and identify a second round of companies if she does not get a response. The Director has set a goal to identify a minimum of 10 companies for physical science technologies and is testing different contact strategies to increase the chance of a response. According to licensing officials, they are willing to meet face to face with potential licensees, but doing so depends on different factors. One official reported that he does not have time for general relationship building with industry members and in one year had met with industry representatives on three occasions to negotiate specific technologies. Another sees her role as a facilitator of relationships between industry and the inventors, so she indicated that she mainly works with companies that have a pre-existing relationship with the university inventor.

To better adhere to recommended practices, the Office should increase its direct marketing efforts for selected technologies, once it has developed a systematic market evaluation process and improved its market research. Specifically, it should increase personal relationships with industry and face-to-face meetings or networking at industry events. According to the Office's Director, resource constraints limit the number of conferences licensing officials can attend. However, the Director indicated that he plans to use information from the market research improvements mentioned above to identify the most effective industry events to attend. Given resource constraints, the Office could send full-time licensing staff to an industry conference every other year in place of the professional conference they reported attending annually. Alternatively, the Office could shift business development responsibilities fully to senior staff with business credentials and assign them technologies with the highest market potential. Finally, the Office should use the information it gains from improving its market research to increase its efforts to identify and contact companies for the technologies it selects as high-priority through a systematic market evaluation.

A lack of adequate resources may limit the Office's ability to follow all recommended marketing practices. As previously mentioned, the Office's licensing staff are tasked with multiple activities for the technologies assigned to them, including the noted marketing practices. When compared to its peer institutions, the Office has fewer licensing officials per $10 million in research spending. During fiscal year 2006, UA had the equivalent of four full-time licensing officers, or 0.07 licensing officers per $10 million in research expenditures. In order for UA to reach the level of its peer institutions, it would need approximately seven more licensing officials (see Introduction and Background, page 7, for details). Because the Office's staffing levels appear to be lower than its peers', UA should evaluate whether its technology transfer program is adequately staffed and take steps to increase program resources as needed.

More could be done to market NAU technology

In addition to marketing ASU technologies, AzTE staff market technologies that NAU inventors develop. Therefore, improvements to AzTE's program should positively affect the marketing of NAU technologies. However, interviews with an AzTE official suggest that NAU technologies do not always receive the same priority because of their Flagstaff location. NAU faculty also expressed this concern and said that after AzTE's initial evaluation of a specific technology, they are unclear as to whether their patented technologies are being marketed. Although NAU has a small research budget and few disclosures to support creating an in-house technology transfer office, faculty inventors have produced some important and commercially viable technologies. For example, NAU researchers developed the first diagnostic tool to detect biofilm that can attach to living tissue and cause chronic infections.

NAU faculty have produced some important and commercially viable technologies.

NAU should work with AzTE to take steps to mitigate the disincentive that NAU's physical distance creates and ensure that appropriate marketing efforts are pursued. For example, NAU inventors with patented technologies could receive AzTE's disclosure visitation schedule and request a face-to-face update to increase the transparency of AzTE's marketing efforts. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of its technology transfer services to another provider. Any arrangement should ensure that NAU technologies are appropriately evaluated, adequately researched for marketing purposes, and discussed with industry contacts as appropriate.

Universities should review industry negotiation practices

In addition to the technology transfer facilitated by AzTE and the Office, industry-sponsored research is another important means to transfer technology because it directs research toward industry-specific problems. However, some industry representatives and some university inventors expressed concerns about prolonged negotiations over the contract terms related to potential inventions. The universities have begun to review their sponsored research programs and in doing so, they should work with industry to identify their concerns and to determine how they can more effectively work together.

Industry-sponsored research helps build relationships, but negotiations can be difficult— During the course of the audit, stakeholders raised concerns to auditors about the negotiation process for industry-sponsored research agreements, especially master agreements that cover intellectual property generated in all the research a company sponsors. Negotiating these agreements can involve more than one office representing the universities. Industry-university collaborations are important to transfer technology because they direct research toward identified problems. In these cases, the technology transfer staff's role is to negotiate a favorable license agreement for the university when a project does not conform to a standard contract template and the project could result in a new invention. However, according to some industry representatives and some university inventors, negotiations with ASU and UA take longer and are more difficult than their experiences at other universities. Auditors spoke with three industry representatives and held a focus group of inventors at each university to understand their concerns with the technology transfer programs. Industry officials indicated that they have valuable relationships with the universities in terms of sponsoring research, hiring university graduates, and contributing to undergraduate and graduate student education. However, they expressed the following concerns:

- One representative stated that his company wanted to own, rather than license, the inventions created under his company's sponsorship at one of the universities, but the university was unable to grant this because of Internal

Revenue Service regulations. According to the representative, universities in other states have found ways to grant ownership without violating these regulations.

- Another representative reported that his company was willing to license rather than own sponsored inventions, but said that the contract terms did not preclude the company's competitors from licensing the technology and so his company eventually walked away from the deal.

- A third representative felt that the universities follow a pharmaceutical model, where exclusive rights to a single patent are important, and they do not have alternative negotiation and pricing strategies for the computer industry, for example, where the product is based on hundreds of patents and exclusivity is not necessary.

Although the industry representatives' concerns varied and represent some of the typical points of contention discussed in literature, all three representatives felt that extended negotiations significantly delayed their research efforts and some of the university inventors echoed this concern.[1] The representatives told auditors that, because of these issues, they do not do as much sponsored research with ASU and UA as they would like to.

Despite the challenges of reaching agreements that meet industry needs as well as protect university interests, the value of university-industry research partnerships makes it important for the universities to examine their practices and measure their successes. According to literature, the licensing terms in sponsored research are the main stumbling block in negotiations and, because of the number of factors that must be considered in each collaboration, few standards exist. However, universities like MIT and Stanford that have some of the highest annual licensing activity reported that their sustained success is partly the result of not focusing on revenue.[2]

ASU and UA agreed that industry relationships are important, and they are working to enhance these relationships. Both universities participate in the University-Industry Demonstration Partnership, an organization focused on improving university-industry collaborative partnerships, including streamlining negotiations for university inventions. Additionally, both universities said that they have dedicated personnel to review and evaluate their sponsored research programs. For example, according to ASU officials, ASU and AzTE have been working with several companies to develop master agreements that would allow the university to append new covered projects without further negotiation and that better reflect specific industry conditions instead of using a one-size-fits-all approach. The officials also reported that ASU plans to hire a consultant to examine ways to streamline the process for sponsored project agreements, and has created a new position, Associate Vice President for Corporate Engagement. Similarly, UA hired

1 See Bibliography, pages b-v through b-vi, for resources used to evaluate industry collaborations.

2 Palmintera, Diane. *Report to the Connecticut Technology Transfer and Commercialization Advisory Board of the Governor's Competitiveness Council.* Washington, D.C.: Innovation Associates, 2004.

a Director of Corporate and Business Relations in January 2008 to develop an integrated framework for strengthening ties between UA and the private sector. As part of their efforts, ASU and UA should evaluate how they negotiate sponsored research agreements and the positions they take. Specifically, they should work with industry to identify their concerns and needs and to determine how they can more effectively work together. In addition, the universities should develop specific technology transfer goals related to industry collaboration efforts. They should determine how their negotiation process can be improved to meet these goals and they should evaluate their progress by identifying and collecting data on relevant performance measures.

According to NAU officials, the university is restructuring its research administration, which was formerly part of its office of research and graduate studies, and hired a new Vice President for Research, who started in March 2008. As part of building its program, NAU should take preventative steps to help ensure streamlined coordination of industry sponsorship among its technology transfer provider, the faculty inventor, and NAU.

Recommendations:

Arizona State University:

1. ASU should ensure that AzTE fully rebuilds and strengthens its marketing program in accordance with recommended practices.

2. As part of its review of sponsored research practices, ASU should take steps to improve its technology transfer-related negotiations with industry by:

    a. Working with industry to identify their concerns and needs regarding technology transfer and to determine how they can more effectively work together;

    b. Developing specific technology transfer goals related to industry collaboration efforts; and

    c. Determining how its negotiation process can be improved to meet the goals and evaluating its progress by identifying and collecting data on relevant performance measures.

University of Arizona:

1. UA should develop and implement an evaluation system to weigh technologies against standard criteria to determine which technologies to focus its marketing resources on. UA should use these criteria to prioritize new disclosures and

routinely reassess old ones. The assessments could be performed in-house or by market experts and UA should determine which is suitable based on relative cost and the industry expertise available throughout the university.

2. UA should increase its marketing efforts for select technologies, identified through an evaluation, by:

    a. Advertising promising technologies through a press release, at trade shows, or through other literature-recommended forums;

    b. Continuing its efforts to increase market research in strategic industry areas to adequately evaluate technologies and to identify and understand the target companies;

    c. Increasing personal relationships with industry through face-to-face meetings or networking at industry events; and

    d. Increasing its efforts to identify and contact potential licensees.

3. UA should evaluate whether its technology transfer program staffing levels are adequate and take steps to increase program resources as needed.

4. As part of its review of sponsored research practices, UA should take steps to improve its technology transfer-related negotiations with industry by:

    a. Working with industry to identify their concerns and needs regarding technology transfer and to determine how they can more effectively work together;

    b. Developing specific technology transfer goals related to industry collaboration efforts; and

    c. Determining how its negotiation process can be improved to meet the goals and evaluating its progress by identifying and collecting data on relevant performance measures.

Northern Arizona University:

1. NAU should work with AzTE to take steps to mitigate the disincentive that the university's physical distance creates and ensure that appropriate marketing efforts are pursued. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of its technology transfer services to another provider. Any arrangement should ensure that NAU technologies are appropriately evaluated, adequately researched for marketing purposes, and discussed with industry contacts as appropriate.

2. NAU should take preventative steps to streamline coordination of industry sponsorship among its technology transfer provider, the faculty inventor, and NAU. NAU should also consider developing specific technology transfer goals related to industry collaboration efforts and determining how its negotiation process can be improved to meet the goals. It should evaluate its progress by identifying and collecting data on relevant performance measures.

FINDING 3

All three universities—particularly UA and NAU—need to better manage conflicts of interest, and the Board should establish minimum standards

To a different extent, Arizona State University (ASU), the University of Arizona (UA), and Northern Airzona University (NAU) can all take additional steps to improve their management of conflicts of interest related to university-industry collaborations, and the Arizona Board of Regents (Board) should establish minimum standards that would help the universities improve their conflict-of-interest management. The collaboration that technology transfer encourages between universities and independent companies can lead to potential conflicts of interest, such as when inventors develop financial relationships that may compete with their university responsibilities. Although ASU adequately identifies potential conflicts and creates appropriate plans to manage them, it should better ensure that the requirements of these plans are fully implemented. UA is less far along: it needs both to strengthen its conflict-of-interest policies and improve its procedures for identifying, managing, and monitoring them. Further, NAU lacks comprehensive conflict-of-interest policies and should develop and implement them. Finally, because management of conflicts is inconsistent across the university system, the Board should review its policies and establish minimum standards that the universities should meet in their conflict-of-interest policies and procedures.

Conflict-of-interest management includes:

- **Disclosure**—University inventors disclose outside financial interests that could influence their research or other university responsibilities.
- **Identification**—A university official evaluates the outside financial interest to determine if it creates a conflict.
- **Management**—The university develops a plan to manage, reduce, or eliminate the conflict of interest.
- **Implementation**—The university must establish mechanisms to enforce plan requirements and provide for sanctions if inventors do not comply.

Source: Auditor General staff analysis of A.R.S. §§38-503(A)(B), 42 C.F.R. §§50.601 through 50.607, 2 C.F.R §§215.42 through 215.43, *National Science Foundation Proposal and Award Policies and Procedures Guide*, and conflict-of-interest literature.

Technology transfer can create conflicts of interest universities must manage

Technology transfer encourages collaboration between universities and companies that can lead to potential financial conflicts of interest. When participating in the technology transfer process, inventors can develop relationships that may compete with their university responsibilities. For example, a conflict of interest can occur when a university inventor has a financial interest in a company that licenses a technology created at the university and the company collaborates with the university by sponsoring further research at the university.

Substantial Interest—A.R.S. §38-502 defines a substantial interest as ownership of 3 percent or more of corporate shares, or any number of shares where the income from those shares exceeds 5 percent of the university employee's total annual income and other payments from the corporation exceed 5 percent of the employee's total annual income.

To ensure research integrity and protect university interests, state law, the Board's policies, and federal regulations require universities to prevent or control conflicts arising from university-industry collaboration. Specifically, A.R.S. §38-503(A) requires university employees to disclose their substantial interests in an entity doing business with the university and refrain from participating on behalf of the university in any manner in decisions relating to any contract, sale, or purchase related to that private interest. Intentional violations are subject to felony charges and employment termination. However, to encourage technology transfer to the private sector, A.R.S. §15-1635.01 allows a university officer or employee to establish and maintain a substantial interest in a company doing business with the university once he or she has obtained the approval of the university president and has also received board approval to do so. Therefore, with board approval the officer or employee is permitted to negotiate on behalf of his or her company. Additionally, board policy statements 6-909.10(E)(5) and 6-908(H) require the university president to assure the Board that the university has taken steps to ensure that no employee interest will adversely affect any state interest prior to the Board giving its required approval of a university-industry technology transfer agreement in which inventors have a substantial interest in the industry partner. Further, two federal agencies that provide monies for research, the National Science Foundation and the National Institutes of Health, require universities to establish a mechanism for university inventors to disclose any substantial interests and to manage any conflicts resulting from those interests. If the universities fail to manage the conflicts, the agencies can withhold research grant monies.

Federal agencies can withhold research grant monies if universities fail to adequately manage conflicts of interest.

ASU should better implement and monitor conflict-of-interest management plans

ASU generally manages reported conflicts of interest adequately, although it could benefit from some improvements. ASU identifies potential conflicts of interest and

approves conflict management plans. However, auditors' review of existing plans showed that ASU needs to better ensure that these plans are properly implemented and monitored.

ASU requires self-disclosure of substantial interests and creates management plans to manage conflicts of interest—In line with federal regulations, ASU policies allow for an adequate identification of conflicts of interest. Specifically:

- Policies include several mechanisms to identify conflicts—ASU policies require that university employees submit a form disclosing a potential conflict of interest in research and financial transactions. First, policies require that ASU employees who have a substantial financial interest in a company must file a form disclosing potential conflicts of interest when ASU enters into a contract with that company. Second, policies require that university inventors participating in sponsored research must file an annual questionnaire disclosing financial interests that may influence their objectivity in research. Additionally, prior to submitting a proposal to obtain monies for research or during the research when a conflict arises, policies require university inventors to disclose their relationships with the companies to the university. Finally, as recommended by literature, ASU procedures require different departments to communicate and coordinate their respective responsibilities for the identification of conflicts of interest.

- Management plans used to address conflicts—ASU appropriately identifies conflicts of interest and develops conflict management plans when faculty members report potential conflicts of interest. As recommended by literature, policies require that the inventors disclose their conflict of interest to a committee that will develop a strategy to manage it. Plans may include having independent reviewers monitor the research, modifying the research plan, disqualifying university inventors from participating in the research, requiring university inventors to divest their financial interests, or requiring university inventors to sever relationships that cause conflicts of interest. In a review of 15 out of 18 conflict-of-interest case files in which university inventors disclosed a potential conflict from September 1993 through June 2007, auditors found that ASU properly exempted 9 cases based on federal regulations that define substantial interests and correctly identified all 6 cases that required a conflict management plan. (See textbox on page 50 for Arizona's statutory definition of substantial interest.) Further, auditors found that ASU developed management plans when needed and the plans complied with university policies and federal regulations. The six plans required another researcher—one who had equal or higher university status and had no conflicting financial interests—to monitor and approve all research, financial transactions, and technical reports. In five of the six cases, the plans also required the inventor to include a disclaimer to journal editors

disclosing his or her financial interest when submitting potential publications. Further, these five plans required the inventor to submit copies of the transmittal letters and publication abstracts to the committee that reviews the plans. In five of the six cases, the ASU committee responsible for reviewing the plans gave its approval within approximately 1 month from the inventor's financial interest disclosure date. The one remaining case was approved in 2 months.

ASU should take steps to better implement and monitor conflict-of-interest plans—Although the plans auditors reviewed followed university policies and federal regulations, ASU should improve implementation and monitoring of the plans. In auditors' case file review, all six of the cases that required conflict management plans lacked documentation to show that ASU monitored plan implementation. Specifically, none of the files contained documentation to show, when required, that a principal investigator monitored and approved all financial transactions and technical reports, that the inventor included disclaimers to journal editors when submitting potential publications, and that the inventor submitted transmittal letters and publication abstracts to the committee that reviews the plans. Because implementation was not monitored, in one case ASU did not discover that a required plan had not been implemented for 1 year. Specifically, in that case, the plan required the inventor to implement an advisory board by enlisting ASU officials and staff to independently oversee the inventor's financial management of the research project. However, when ASU's research compliance office (the liaison between the Associate Vice President for Research and Economic Affairs and the committees that monitor and support ASU research activities) requested the mandatory annual report, it discovered that the advisory board had not been completely selected nor had it met. During the December 2007 meeting of the committee that reviews and approves conflict management plans, the Research Compliance Office Director proposed that her office assume responsibility for monitoring implementation of conflict management plans annually, as needed when the inventor reports changes or when university officials refer the plans to her office, and when her office selects them for quarterly random audits in order to ensure that inventors fully implement them. ASU approved these changes in April 2008.

In April 2008, ASU approved follow-up monitoring and auditing of conflict management plan implementation.

To ensure that the university fully implements conflict-of-interest management plans, ASU's Research Compliance Office should perform follow-up monitoring of conflict management plans annually and as needed. Specifically, plans should be monitored when the inventor reports plan changes, university officials refer plans for monitoring, and the Compliance Office selects the plan for quarterly random audits.

UA needs to better identify and manage conflicts of interest

UA does not adequately ensure conflicts of interest are identified and managed. Although UA's conflict-of-interest policy requires university inventors to disclose potential conflicts of interest, the policy does not adequately provide for ongoing identification and management of conflicts. UA has created a new position, Vice President for Research Compliance and Policy, whose responsibility will include developing new conflict-of-interest policies for the university. Besides ensuring that the new policy is developed, UA needs to develop and implement procedures to ensure conflict-of-interest policies are complied with.

UA policy requires that conflicts of interest be self-disclosed but could do more to ensure their identification and management—

By policy, university inventors must disclose substantial interests to UA's Office of the Vice President for Research, which provides staff assistance to the Institutional Review Committee (Committee). The Committee's responsibilities include reviewing disclosures, determining if there is a conflict, and making recommendations to the Vice President for Research to revise the research proposal or develop any other resolution that will result in compliance with conflict-of-interest policies. However, UA policy does not adequately ensure identification and management of conflicts of interest. Specifically:

- **UA policy does not require annual disclosures or disclosure of significant changes**—Conflict-of-interest policies that require annual disclosures of substantial interest and disclosure of relevant changes to previous disclosures help ensure that all potential conflicts are disclosed and reviewed. However, while UA's policy states that university inventors must disclose all conflicts of interest, it does not require annual disclosures or updates to previously disclosed conflicts. For example, the policy does not require a university inventor to update the Committee if the inventor's company enters into a new contract with the UA, which is a potential conflict of interest. This situation should be disclosed to ensure that the inventor's responsibilities to his or her company do not conflict with his university obligations. To help ensure that all conflicts are identified, the UA should adopt and implement policies that require both initial and ongoing identification of research staff's conflicts of interest. In addition to disclosure to the university, an Association of American Universities Task Force report recommends that policies should also require researchers to make disclosure to publications when they submit manuscripts, to their audiences when they present research results, to federal agencies according to their guidelines, and in the human participant review process.[1] Further, UA should determine what UA office or entity will be responsible for ensuring that employees submit the annual disclosures, reviewing the disclosures, and, if necessary, forwarding them to the Institutional Review Committee for review.

[1] Association of American Universities Task Force on Research Accountability. *Report on Individual and Institutional Financial Conflict of Interest: Report and Recommendations*. Washington, D.C.: Association of American Universities, 2001.

Failure to update conflicts of interest may have contributed to university inventor-related companies entering into research contracts with the UA without proper oversight. From December 2006 through November 2007, the Committee reviewed 24 conflict-of-interest cases that were technology transfer related.[1] In 4 of the 24 cases auditors reviewed, inventors did not update the Committee when companies in which they had a financial interest entered into new research contracts with UA. For example, one university inventor disclosed that in 2006 he received $24,800 for consulting services he rendered to a research and development company. In the disclosure, he also reported that in the coming year, he would direct a research project the company planned to contract to UA. The Committee reviewed the situation and decided there was no apparent conflict, but requested an updated disclosure before the start of any contracts. However, as of February 2008, the university inventor had not provided an updated disclosure, although in March 2007 the company had entered into a contract with the university supporting the inventor's research.

- **UA lacks criteria for when to require management plans and what they should include**—To help ensure consistent management of conflicts of interest, institutions should develop criteria for when to develop conflict management plans and guidelines for areas that should be included in the plan. However, UA lacks such criteria in its conflict-of-interest policy. According to an Association of American Universities Task Force, successful financial conflict-of-interest practices include the development of clear policies and procedures for management plans.[2] A management plan allows a university inventor's situation or project to proceed, with oversight, despite a disclosed substantial interest. Further, the degree of management plan requirements should be proportional to the level and the risk created by the conflict.[3] For example, UA peer University of Wisconsin-Madison's conflict-of-interest policies have specific criteria for when to create a conflict-of-interest management plan and what the plan should include. However, while the Committee might request a management plan for an inventor's conflict, UA's policy lacks specific criteria to guide the Committee for when to request such plans or what areas should be included in the plans. As a result, the Committee may be inconsistently managing UA inventor potential conflicts of interest. For example, in one case the Committee requested a management plan for a university inventor who owned several companies that might do business with the university, while in a similar case the Committee did not require a plan. Therefore, to help ensure that the university is consistently managing inventor conflicts of interest, the

1 Auditors reviewed all 24 technology transfer-related cases heard by the Institutional Review Committee from December 2006 to November 2007. This includes one case that the Committee reviewed prior to this time but that auditors determined had a conflict that the Committee was not managing.

2 Association of American Universities Task Force on Research Accountability. *Report on Individual and Institutional Financial Conflict of Interest: Report and Recommendations*. Washington, D.C.: Association of American Universities, 2001.

3 Chinn, John, and Elliott Kulakowski. Conflict of Interest in Research. Ed. Elliott C. Kulakowski and Lynne U. Chronister. *Research Administration and Management*. Sudbury, MA: Jones & Bartlett Publishers, 2006.

university should approve and implement policies with criteria for when to recommend a conflict-of-interest management plan and guidelines for areas that should be included in the plan.

- **UA has not assigned responsibility for monitoring conflict management plans**—UA has not established who should be responsible for ensuring committee-recommended conflict-of-interest management plans are implemented and monitored. As a result, even when conflicts are disclosed, they still may not be adequately managed. According to the Office of Technology Transfer Director, who also serves on the Committee, the inventor's supervisor should be monitoring conflicts. However, not all departments or colleges seem to be aware of this. Specifically, three of four department and college officials that auditors interviewed stated that they do not have a role in managing conflict-of-interest plans. Two of these officials stated that the Committee is responsible for monitoring conflicts. As a result, cases with potential conflicts of interest continued without further oversight.

  To ensure adequate management of identified conflicts of interest, UA should develop and implement conflict-of-interest policies that clearly assign responsibility for implementing and monitoring conflict-of-interest management plans. These policies should address the responsibilities of Sponsored Projects Services, the Office of Research and Contract Analysis, the institutional review board (responsible for oversight of research involving human subjects), the Office of Technology Transfer, the Office of the Vice President for Research, and the UA inventor's dean or department chair. In addition, these policies should clarify how these different offices should communicate and coordinate their respective responsibilities for conflict-of-interest management. Finally, the UA should ensure that it informs all faculty involved in research of these policies, procedures, and sanctions for noncompliance.

  UA has created a new position, Assistant Vice President for Research Compliance and Policy, whose responsibilities will include developing new conflict-of-interest policies for the university. According to the Vice President for Research, the person hired for this position has co-authored peer-reviewed articles on conflict-of-interest policies and processes and joined the UA on March 10, 2008.

  Additionally, UA needs to ensure that action is taken when noncompliance with its policies is discovered. For example, in one case auditors reviewed, the Committee requested a management plan in November 2004. In this case, the university inventor owned a company that was sponsoring research at UA from August 15, 2004 to December 31, 2007, and the inventor was heading the research project. Although the inventor submitted a management plan that specified he would provide annual reports to the Committee, the inventor did not follow through with the plan. As of December 2007, when the research

project ended, the Committee had not received any of the requested reports. According to the committee chair, the inventor ignored the Committee for several months, and then the Committee did not pursue it further when it learned the inventor planned to leave the university. However, UA has means available to enforce its requirements. For example, UA policy states that funded research activities will only begin after any conflicts have been addressed. The Committee and other responsible university officials should take appropriate steps to ensure that inventors comply with UA policies. Further, given that policy development can be a long-term process, UA should establish and implement an immediate short-term plan to identify and manage potential conflicts of interest for inventors actively participating in sponsored research.

NAU should develop and implement more comprehensive conflict-of-interest policies and procedures

NAU lacks comprehensive conflict-of-interest policies and procedures for adequate management of conflicts of interest. NAU policy provides general guidance for the identification and management of conflicts of interest but the policy is outdated and not comprehensive. For example, the policy only requires inventors to disclose substantial interests when submitting sponsored project proposals to the National Science Foundation and the National Institutes of Health, rather than disclosing their interests to the university for all sponsored research. Further, it does not provide guidance for when to recommend a conflict-of-interest management plan or what the plan should include, or enforcement mechanisms or sanctions in the case of researcher noncompliance with the policy. In June 2007, NAU created the Office of the Vice President for Research, whose responsibilities include managing research-related conflicts of interest. According to university officials, NAU will develop more complete conflict-of-interest policies following discussions all three universities are having with the the Board's General Counsel. These discussions are ongoing as the Board considers updating its conflict-of-interest policies that guide the universities. As of June 2007, the Office of the Vice President for Research has managed potential conflicts on a case-by-case basis. According to the Interim Vice President for Research, NAU has only had a couple of faculty members involved in technology transfer and they have had only rare incidences of potential conflict.

Although NAU's inventors are engaging in technology transfer-related activities to a lesser degree than inventors at ASU and UA, the fact that some are doing so means that NAU should have comprehensive policies and procedures to ensure identification, management, and monitoring of conflicts of interest. For fiscal years 2004 through 2007, auditors identified three cases in which NAU inventors were

involved in technology-related activities that could result in potential conflicts. In each case, auditors determined that no actual conflict had occurred. To ensure that it adequately identifies, manages, and monitors conflicts of interest in the future, NAU should continue participating in the Board's General Counsel's review of the Board's policies and should also develop and implement its own comprehensive conflict-of-interest management policies and procedures.

Board should establish minimum standards for universities' conflict-of-interest policies and procedures

Because the universities inconsistently manage technology transfer conflicts of interest, the Board should review its intellectual property and technology transfer policies and establish minimum standards that each university has to meet in its conflict-of-interest policies and procedures. Although the Board's policies guide the universities' management of intellectual property, they lack guidance for how the universities should manage conflicts of interest arising from university-industry collaborations. In December 2007, the Board's General Counsel established a committee composed of university officials to consider revising board policies. To help ensure effective conflict-of-interest management at all universities, the Board should continue these efforts and establish minimum standards for universities' conflict-of-interest policies and procedures, including standards for initial and continuous identification of conflicts of interest and standards for restrictions to manage conflicts of interest, and enforcement of those restrictions.

Recommendations:

Arizona State University:

1. To ensure that the university fully implements conflict-of-interest management plans, ASU's Research Compliance Office should perform follow-up monitoring of conflict management plans annually and as needed. Specifically, plans should be monitored when the inventor reports plan changes, university officials refer a plan for monitoring, and the Compliance Office selects the plan for quarterly random audits.

University of Arizona:

1. To help ensure that all conflicts of interest are identified, UA should adopt and implement policies and procedures that require initial and continuous identification of them. Specifically:

a. At a minimum, UA should require all faculty involved in sponsored research to fill out an annual conflict-of-interest disclosure in which they must disclose any substantial interests related to their research or other university responsibilities, to include disclosure to publications when they submit manuscripts; to their audiences when they present research results; to federal agencies according to their guidelines; and in the human participant review process. Further, UA should require disclosure of relevant changes to previous disclosures.

b. UA should determine what UA office or entity will be responsible for ensuring that employees submit the annual disclosures, reviewing the disclosures, and, if necessary, forwarding them to the Institutional Review Committee for review.

2. To help ensure that UA is consistently managing its inventor conflicts of interest, UA should develop and implement conflict-of-interest policies and procedures that include criteria for when to recommend a conflict-of-interest management plan and guidelines for areas that should be included in the plan.

3. To ensure its policies are followed, UA should:

   a. Assign responsibility for what office or entity will be responsible for implementation and monitoring of management plans.

   b. Coordinate university-wide conflict-of-interest management among the various offices involved, including Sponsored Projects Services, the Office of Research and Contract Analysis, the institutional review board, the Office of Technology Transfer, the Office of the Vice President for Research, and the UA inventor's dean or department chair. In particular, the UA offices that help inventors to obtain research funds and license technologies, Sponsored Projects Services and the Office of Technology Transfer, should identify inventors with potential conflicts of interest and forward this information to the committee responsible for their management.

   c. Ensure that it informs all faculty involved in research of these policies, procedures, and sanctions for noncompliance.

4. To address outstanding conflicts as of March 2008, UA should establish and implement an immediate short-term plan to identify and manage potential conflicts of interest for inventors actively participating in sponsored research.

Northern Arizona University:

1. To help ensure that all conflicts of interest are identified, NAU should adopt and implement more comprehensive policies and procedures that require initial and continuous identification of conflicts of interest. Specifically:

    a. At a minimum, NAU should require all faculty and staff involved in sponsored research to fill out an annual conflict-of-interest disclosure in which they are asked if they have any substantial interests related to their research or other university responsibilities. Further, NAU should require disclosure of relevant changes to previous disclosures.

    b. NAU should determine what NAU office or entity will be responsible for ensuring that employees submit the annual disclosures, reviewing the disclosures, and, if necessary, forwarding them to a committee or other university official for review.

2. To help ensure that NAU is consistently managing NAU inventor conflicts of interest, NAU should develop and implement conflict-of-interest policies and procedures that include criteria for when to recommend a conflict-of-interest management plan and what the plan should include.

3. To ensure clear responsibility for conflict-of-interest management, NAU should:

    a. Determine what NAU university offices or entities will be responsible for implementing and monitoring conflict-of-interest management plans.

    b. Ensure university-wide coordination on conflict-of-interest management among the various offices involved, including the Office of the Vice President for Research, Sponsored Project Services, the Office of Grants and Contracts, the institutional review board, and the office that manages NAU's intellectual property.

Arizona Board of Regents:

1. To help ensure effective technology transfer-related conflict-of-interest management at all universities, the Board should establish minimum standards for universities' conflict-of-interest policies and procedures, including standards for initial and continuous identification of conflicts of interest and standards for restrictions to manage conflicts of interest, and enforcement of those restrictions.

APPENDIX

This Appendix provides detailed information obtained when analyzing Arizona State University's and the University of Arizona's disclosure and licensing activity. It includes research expenditures, number of disclosures per $10 million in research expenditures, revenue from license agreements, and number of license and option agreements per $10 million in research expenditures. Auditors obtained the information presented in the tables from the Association of University Technology Managers' (AUTM) licensing survey for fiscal year 2006 for the noted universities. Fiscal year 2006 was the most recent information available from AUTM at the time the audit was conducted.

Table 4: Arizona State University and Peer Institutions' Selected Disclosure and Licensing Information Fiscal Year 2006

Institution	Research Expenditures	Institution	Number of Disclosures per $10 Million in Research Expenditures	Institution	Licensing Agreements Revenue	Institution	Number of License and Option Agreements per $10 Million in Research Expenditures
University of Washington	$936,360,325	Arizona State University	11.7	University of Washington	$36,199,485	University of Washington	1.66
Ohio State University	652,328,819	University of Cincinnati	7.8	University of Colorado	21,233,214	Arizona State University	1.44
University of Colorado	632,973,484	Rutgers University	5.0	University of Texas at Austin	8,431,700	Rutgers University	1.33
University of Texas at Austin	446,686,000	University of Oklahoma	4.1	Rutgers University	5,095,023	University of Texas at Austin	1.12
University of Nebraska–Lincoln	323,861,560	University of Connecticut	4.4	Arizona State University	3,349,612	University of Cincinnati	0.94
University of Maryland (CP)	313,826,827	University of Kansas	3.9	University of Maryland (CP)	1,873,489	University of Colorado	0.90
Rutgers University	264,054,649	University of Maryland (CP)	3.6	University of Nebraska–Lincoln	1,277,420	University of Maryland (CP)	0.89
Florida State University	189,229,916	University of Washington	3.3	Florida State University	1,139,604	University of Connecticut	0.85
University of Connecticut	152,500,000	University of Colorado	3.1	Ohio State University	947,000	University of Oklahoma	0.74
University of Cincinnati	148,512,700	University of Nebraska–Lincoln	2.7	University of Connecticut	814,471	University of Kansas	0.68
University of Oklahoma	135,238,856	Florida State University	2.7	University of Oklahoma	548,842	Ohio State University	0.43
University of Kansas	132,106,000	Ohio State University	2.2	University of Cincinnati	481,763	University of Nebraska–Lincoln	0.40
Arizona State University	131,814,265	University of Texas at Austin	2.2	University of Kansas	231,111	Florida State University	0.11

Table 5: University of Arizona and Peer Institutions' Selected Disclosure and Licensing Information Fiscal Year 2006

Institution	Research Expenditures	Institution	Number of Disclosures per $10 Million in Research Expenditures	Institution	Licensing Agreement Revenue	Institution	Number of License and Option Agreements per $10 Million in Research Expenditures
University of Washington	$936,360,325	University of Virginia	7.4	University of Minnesota	$56,193,050	University of Virginia	2.55
University of Wisconsin–Madison	831,895,000	University of Utah	7.3	University of Florida	42,900,000	University of Utah	2.47
University of Michigan	796,963,386	University of Florida	5.7	University of Wisconsin–Madison	42,363,611	University of Wisconsin–Madison	1.91
Ohio State University	652,328,819	University of Wisconsin–Madison	5.6	University of Washington	36,199,485	University of Washington	1.66
University of Minnesota	594,877,000	Michigan State University	4.4	University of Michigan	20,438,727	University of Florida	1.59
Texas A&M University	586,242,199	University of Minnesota	3.9	University of Iowa	16,912,938	University of Minnesota	1.40
University of North Carolina–Chapel Hill	583,996,531	University of Michigan	3.6	University of Utah	16,295,064	Michigan State University	1.26
University of Arizona	**535,846,792**	University of Washington	3.3	Texas A&M University	6,418,994	Texas A&M University	1.25
University of Florida	459,114,540	University of Iowa	2.6	Michigan State University	4,182,565	University of Iowa	1.24
Michigan State University	358,097,000	Ohio State University	2.2	University of Virginia	4,066,727	University of Michigan	1.22
University of Iowa	346,357,000	Texas A&M University	2.0	University of North Carolina–Chapel Hill	2,400,184	University of North Carolina–Chapel Hill	0.84
University of Utah	246,566,451	**University of Arizona**	**1.7**	**University of Arizona**	**1,688,857**	**University of Arizona**	**0.49**
University of Virginia	238,754,000	University of North Carolina–Chapel Hill	1.7	Ohio State University	947,000	Ohio State University	0.43

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AGENCY RESPONSE

ARIZONA STATE UNIVERSITY

May 19, 2008

Debbie Davenport
Auditor General
Office of the Auditor General
2910 North 44th Street, Suite 410
Phoenix, AZ 85018

Dear Ms. Davenport:

On behalf of Arizona State University (ASU), I am pleased to respond to the performance audit on the Technology Transfer Program at ASU. We are in agreement with all of your recommendations. Our responses to your recommendations are enclosed. The report represents a thoughtful analysis of the ASU Technology Transfer Program.

My staff and I wish to thank you and your staff for the professional manner in which this audit was performed. We are constantly looking for ways to improve our programs and operations. The implementation of your recommendations will further improve the Technology Transfer Program at ASU.

Sincerely,

Michael M. Crow
President

MMC:dq
/c

Enclosure

c: Rick Shangraw, Vice President for Research & Economic Affairs
Carol Campbell, Executive Vice President and CFO

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5/19/08

Response from Arizona State University to the Auditor General Report on Technology Transfer

GENERAL

We have reviewed the report regarding university technology transfer programs issued by the Auditor General on May 12, 2008 ("Report"). This letter sets forth our written response to the Report as it pertains to Arizona State University (ASU). We have some general observations regarding the Report, as well as specific responses to the recommendations set forth therein. Additionally, we have included a summary table of the findings, recommendations, responses, metrics and timeline, which can be used by ASU and the Arizona Auditor General to monitor ASU's compliance in the coming months.

The primary mission of Arizona Technology Enterprises (AzTE) is focused on providing core services to ASU's faculty and research enterprise in the following areas: (i) identification and development of intellectual property, (ii) evaluation of invention disclosures from a legal and commercial perspective, (iii) patent protection of inventions, where appropriate, (iv) marketing and licensing activities, and (v) industry-university relations.

The Report appears to draw the conclusion that outreach to ASU's faculty and researchers may have diminished due to recent organizational transition and multiple vacancies. While AzTE has indeed undergone recent organizational changes, it is on track to receiving approximately the same number of invention disclosures as submitted by ASU researchers in fiscal year 2007.

As noted in the Report, AzTE has now filled its staff vacancies. New members of the current team have extensive industry and university experience in the area of technology evaluation and licensing. In addition, AzTE's endeavors in seeking private equity funding have been enhanced by recent hires whose industry contacts and networks have already brought in several venture capital firms to review ASU research and technologies for potential investment.

Current management at AzTE is also placing a much greater emphasis on supporting faculty in terms of industry-sponsored research. AzTE is presently working with ASU's Office of the Vice President for Research and Economic Affairs on streamlining the process for reviewing sponsored research agreements and addressing industry concerns in funding research at ASU. In addition, where requested by ASU, AzTE has played a much greater role than in the past with respect to negotiating research contracts with companies. During fiscal year 2008, for instance, the organization was instrumental in securing approximately $8.5 million in corporate research funding for ASU (which also resulted in a matching grant of $2.2 million from Science Foundation Arizona).

FINDING 1

1. *To increase the level of support researchers receive from their departments, ASU should encourage AzTE to reinstitute the practice of providing quarterly reports to deans and department chairs of research-intensive units to keep them abreast of their units' technology transfer activity.*

   RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   To keep research-intensive units abreast of technology transfer activity, ASU and AzTE will develop a list of deans, department chairs, and center directors who will receive a quarterly report of invention disclosure activity at ASU.

2. *To encourage more faculty participation in technology transfer, ASU should:*

   a. *Encourage its research-intensive departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure.*

   RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   ASU's Office of the Vice President for Research and Economic Affairs will work with the Executive Vice President and University Provost to encourage departments to consider this guideline recommendation.

   b. *Continue to promote faculty participation in technology transfer by hosting annual recognition ceremonies and awarding university inventors who excel in this process.*

   RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   In FY2005, FY2006 and FY2007, AzTE recognized all university inventors by hosting an annual recognition ceremony. In FY2006 and FY2007, AzTE awarded a few university inventors that excelled in the technology transfer process at the ceremony. In FY2008, rather than host a ceremony and award only a few selected inventors, AzTE is awarding all university inventors with a framed copy of his/her issued United States patent. To date, approximately 139 copies of issued United States patents have been framed and are in process of being delivered. AzTE will continue to provide a framed copy of each issued United States patent to university inventors.

3. *To better educate faculty and increase their exposure to the technology transfer process, ASU should:*

a. *Identify the departments known for producing commercially viable research and encourage AzTE to conduct workshops for department faculty.*

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

AzTE regularly conducts workshops on the technology transfer process for department faculty. ASU will work with AzTE to identify, to the extent possible, those departments known for producing commercially viable research, and AzTE will conduct workshops for the faculty in such departments.

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b. *Encourage research-intensive departments to invite AzTE staff to their meetings on an annual basis.*

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

AzTE has attended department meetings in the past and will continue to work with research-intensive departments to attend their meetings on an annual basis. ASU will support such departments with respect to these activities.

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c. *Proactively identify new university researchers in disciplines with high commercial potential and notify AzTE of their hiring so that AzTE can make initial contact.*

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

AzTE has provided materials on the technology transfer process and participated in new faculty orientation for the past three years. ASU will work with AzTE to identify, to the extent possible, those newly-hired university researchers in disciplines with high commercial potential for purposes of introducing such researchers to the technology transfer process. Despite staffing turnover over the past year, AzTE believes that it will receive approximately the same number of disclosures during fiscal year 2008 as it did in fiscal year 2007.

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d. *Require AzTE to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, AzTE should include information about the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to AzTE's Web site for further information when required.*

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Over the past three years, through presentations and meetings, AzTE has provided new faculty with information on the technology transfer process, which has included information about the services that it offers, intellectual property legal matters, and contact information. Over the course of the next several months, AzTE will be developing internal materials containing such information for distribution to the faculty. In addition, AzTE is in the process of significantly improving its website, which will include all of the information listed above. The website will also include an online survey for inventors to provide anonymous feedback and a secure portal for inventors to track the progress of patent applications. ASU will require AzTE to continue to enhance the information it provides to faculty on the technology transfer process and the services it offers.

FINDING 2

1. *ASU should ensure that AzTE fully rebuilds and strengthens its marketing program in accordance with recommended practices.*

   RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   Historically, AzTE has utilized a mix of marketing activities to promote ASU inventions to prospective licensees. This included digital media, conferences, industry trade shows, and direct solicitation to identified key prospects. Current management intends to continue these activities. In addition, AzTE is in the process of launching a new improved website which will allow potential licensees and investors to search its portfolio of ASU inventions. AzTE's new website will also showcase select discoveries through affiliate relationships such as Kauffman Foundation's iBridge network, which is an organization that exclusively markets university technologies to industry. While AzTE has used the Technology Ventures Clinic, an internship program, for marketing research, AzTE will evaluate if its marketing research efforts should employ the use of graduate students rather than interns. ASU will require AzTE to continue to explore and implement, as appropriate, new marketing activities.

2. *As part of its review of sponsored research practices, ASU should take steps to improve its technology transfer-related negotiations with industry by:*

   a. *Working with industry to identify their concerns and needs regarding technology transfer and to determine how they can more effectively work together;*

   RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   In collaboration with AzTE, ASU's Office of the Vice President for Research and Economic Affairs has been working with certain companies to determine how it can more effectively work with them on research projects and collaborations given various policy and legal constraints. AzTE and ASU have identified industry concerns and needs regarding technology transfer, and are in the process of negotiating "master agreements" with certain companies to facilitate future sponsored research.

ASU and AzTE are presently in discussions with certain companies to develop a master research agreement with pre-negotiated terms for future funding arrangements. Once a master research agreement is signed with an industry partner, covered projects will be appended to such agreement without further negotiation.

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b. Developing specific technology transfer goals related to industry collaboration efforts; and

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

With the support and assistance of AzTE, ASU is working to develop specific technology transfer goals that will promote and advance collaborations with industry. In addition, ASU's Office of the Vice President for Research and Economic Affairs has recently created a new dedicated position, Associate Vice President for Corporate Engagement, who is responsible for establishing, building, maintaining and improving university-industry relations.

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c. Determining how its negotiation process can be improved to meet the goals and evaluating its progress by identifying and collecting data on relevant performance measures.

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

As noted earlier, ASU's Office of the Vice President for Research and Economic Affairs is working with AzTE to streamline the process for reviewing sponsored research agreements and to address industry concerns in funding university research. In addition, ASU is in the process of negotiating master agreements with certain companies interested in funding research at the university.

FINDING 3

1. To ensure that the university fully implements conflict of interest management plans, ASU's Research Compliance Office should perform follow-up monitoring of conflict management plans annually and as needed. Specifically, plans should be monitored when the inventor reports plan changes, university officials refer a plan for monitoring, and the Compliance Office selects the plan for quarterly random audits.

RESPONSE: The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

The Research Compliance Office, within ASU's Office of the Vice President for Research and Economic Affairs, has implemented a plan to monitor conflict of interest

management plans annually and as needed after approval. In addition, plans will be monitored when the investigator reports a change, when another university partner refers a plan for monitoring or when a plan is selected for random audit.

Arizona State University
Technology Transfer Performance Audit Table of Findings, Recommendations and Responses

FINDING 1: Although performance varies, universities can take steps to increase commercially viable invention disclosures				
	Recommendation	Response	Metric	Timeline/Status
1	*To increase the level of support researchers* receive *from their departments, ASU should encourage AzTE to reinstitute the practice of providing quarterly reports to deans and department chairs of research-intensive units to keep them abreast of their units' technology transfer activity.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	AzTE provides quarterly reports to deans and department chairs of research-intensive units.	FY 2009
2	*To encourage more faculty participation in technology transfer, ASU should:*			
a	*Encourage its research-intensive departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	ASU's Office of the Vice President for Research and Economic Affairs will work with the Executive Vice President and University Provost to encourage departments to consider this guideline recommendation.	FY 2009
b	*Continue to promote faculty participation in technology transfer by hosting annual recognition ceremonies and awarding university inventors who excel in this process.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	AzTE and ASU will host an annual recognition ceremony and award inventors who excel in the process. AzTE recognizes inventors by providing each inventor with a framed copy of his/her issued US patent.	FY 2009
3	*To better educate faculty and increase their exposure to the technology transfer process, ASU should:*			
a	*Identify the departments known for producing commercially viable research and encourage AzTE to conduct workshops for department faculty.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	ASU will work with AzTE to identify, to the extent possible, those departments known for producing commercially viable research. AzTE conducts workshops for the faculty in such departments.	FY 2009
b	*Encourage research-intensive departments to invite AzTE staff to their meetings on an annual basis.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	On an annual basis, AzTE attends meetings of research-intensive departments.	FY 2009

c	*Proactively identify new university researchers in disciplines with high commercial potential and notify AzTE of their hiring so that AzTE can make initial contact.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	ASU will work with AzTE to identify, to the extent possible, newly-hired university researchers in disciplines with high commercial potential. AzTE will contact such researchers and introduce them to the technology transfer process.	FY 2009
d	*Require AzTE to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, AzTE should include information about the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to AzTE's Web site for further information when required.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	AzTE will develop internal materials containing such information for distribution to the faculty. AzTE's website includes the recommended information, an online survey for inventors to provide anonymous feedback and a secure portal for inventors to track the progress of patent applications. AzTE continues to enhance the information it provides to faculty on the technology transfer process and the services it offers.	FY 2009

FINDING 2: All three universities – particularly UA – should improve aspects of marketing and all three should review their negotiation practices

	Recommendation	Response	Metric	Timeline/Status
1	*ASU should ensure that AzTE fully rebuilds and strengthens its marketing program in accordance with recommended practices.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	Prior to marketing, AzTE evaluates the technology and conducts market research on the technology. AzTE uses digital media, conferences, industry trade shows, and direct solicitation to identified key prospects. AzTE's website (i) allows potential licensees and investors to search its portfolio of ASU inventions and (ii) showcases select discoveries through affiliate relationships.	FY 2009
2	*As part of its review of sponsored research practices, ASU should take steps to improve its technology transfer-related negotiations with industry by:*			

a	*Working with industry to identify their concerns and needs regarding technology transfer and to determine how they can more effectively work together;*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	AzTE and ASU are working to determine how it can more effectively work with them on research projects and collaborations given various policy and legal constraints. AzTE and ASU are identifying industry concerns and needs regarding technology transfer. AzTE and ASU are negotiating "master agreements" with certain companies to facilitate future sponsored research.	FY 2009
b	*Developing specific technology transfer goals related to industry collaboration efforts; and*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	AzTE and ASU have specific technology transfer goals that promote and advance collaborations with industry.	FY 2009
c	*Determining how its negotiation process can be improved to meet the goals and evaluating its progress by identifying and collecting data on relevant performance measures.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	ASU monitors the time it takes to negotiate and execute a sponsored research agreement. ASU and AzTE have developed different approaches to sponsored research collaborations with industry based on the amount of funding, industry sector, and expected commercial value of the intellectual property. ASU has master agreements with certain companies interested in funding research at the university.	FY 2009

FINDING 3: All three universities – particularly UA and NAU – need to better manage conflicts of interest, and the Board should establish minimum standards

	Recommendation	Response	Metric	Timeline/Status
1	*To ensure that the university fully implements conflict of interest management plans, ASU's Research Compliance Office should perform follow-up monitoring of conflict management plans annually and as needed. Specifically, plans should be monitored when the inventor reports plan changes, university officials refer a plan for monitoring, and the Compliance Office selects the plan for quarterly random audits.*	The finding of the Auditor General is agreed to and the audit recommendation will be implemented.	The Research Compliance Office has implemented a plan to monitor conflict of interest management plans annually and as needed after approval. Plans are monitored when the investigator reports a change, when another university partner refers a plan for monitoring or when a plan is selected for random audit.	FY 2009

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May 19, 2008

Debra K. Davenport, CPA
Auditor General
Office of the Auditor General
2910 North 44th Street, Suite 410
Phoenix, Arizona 85018

Re: The University of Arizona – Technology Transfer Programs

Dear Ms. Davenport:

Please find enclosed written comments from The University of Arizona in response to relevant sections of the revised preliminary report draft on technology transfer programs at the three state universities.

Our comments include important contextual information as well as formal responses to each recommendation, as required. For each recommendation, the finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Best regards,

Robert N. Shelton
President

RNS/acc
Enclosures

c: Dr. Leslie P. Tolbert, Vice President for Research, Graduate Studies and Economic Development

University of Arizona Response to the State of Arizona Office of the Auditor General Report: Performance Audit of Technology Transfer

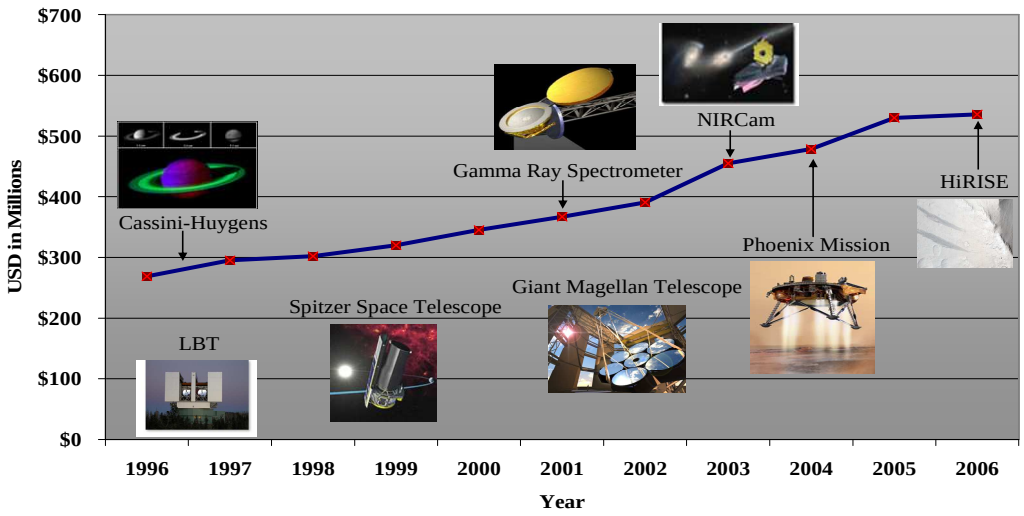
We thank the Auditor General and staff for their efforts to help develop a better understanding of the role of technology transfer within the broader knowledge-transfer activities of the State's public universities.

We agree that further success in increasing technology transfer from the University of Arizona is important, whether in the form of more disclosures from our faculty, greater revenue from licensing, or a greater number of Arizona companies working with the University. Technology transfer is a challenging topic, with many players and complex interactions, so a reader unfamiliar with the context of these audit conclusions might miss the successes of the University in its technology- and knowledge-transfer functions. We hope our comments enhance the Arizona public's understanding of this report and will remind us not only where we can improve, but also where we have done well.

The University of Arizona is the land grant university for Arizona, a top 20 public research institution and, through its medical school and hospitals, a premier provider of medical services to the State. UA takes pride in balancing its missions of education, research and service in its technology transfer endeavors, as it does in all its programs.

- **Land Grant Origins.** As the land grant university for Arizona, UA has a 117-year history of successfully transferring technology through formal courses, cooperative extension, and collaborative research. These are not monetized transfers, but the results are apparent in students we graduate, in all the counties of Arizona, and in our ever expanding research horizons, of which the new $50 Million iPlant Collaborative is but one exciting example.
- **Success in Research, and Relation to Invention Disclosures.** It is tempting to assume that the number of disclosures should rise in proportion to research funding, and that licensing income should increase with the number of disclosures. But, while correlations are expected, the relationship among those metrics is not direct. For example, at UA disclosure counts have been approximately level, while research funding has grown, particularly in space sciences and astronomy -- areas where traditional licensed-based technology transfer is uncommon. The apparent decrease in disclosure rates per research dollar reflects UA's emergence as a premier space sciences university. We highlight some successes below to help illustrate that UA projects are "the science that enables Science".

UA Total Research and Development Expenditures FY 1996-2006
With Major Space Science and Astronomy Projects



- **Public Mission.** Formal technology transfer through intellectual property licensing is a relatively recent development but complements UA's long history as a land grant university. In particular, the UA balances focused technology transfer licensing and its broader knowledge transfer activities, seeking financial return from the use license of State assets while more generally enhancing the lives of Arizona citizens. Some highlights:
  - In licensing, although licensing income is important, the University focuses on a fair deal: disseminating knowledge for societal benefit is more important to the University and its faculty than closely holding knowledge in an attempt to maximize licensing income.
  - UA focuses on the long term in its licensing in order to build a stable, diversified revenue stream. With the well known lag between license execution and receipt of royalties from product sales, UA traces current modest license revenues to the institution's technology transfer history of the 1990s. Increased licensing is definitely the goal, and as home to Arizona's College of Agriculture and Life Sciences, we understand that an abundant harvest requires sowing an ample supply of seeds, and tending the crops as they grow and mature.
  - We have a preference for Arizona first.
    - Between FY 2001 and FY 2006, 20% of the l55 licenses and options done by the OTT supported Arizona's competitiveness.
    - 75% of all University of Arizona start-up companies in that period were located in Arizona. This year all of our start-ups are located within the State, thanks to partners such as Science Foundation Arizona.
    - Our Office of Technology Transfer (OTT) has developed an elegant mechanism to share in the financial growth of spin-outs without taking equity. We are confident that the number of UA start-ups contributing to Arizona's economic development will continue to grow, and that the return from some of them will contribute significantly in the long term to licensing revenues.
- **Marketing Early-stage Inventions.** The University acknowledges that personal contact in technology licensing and consistent documentation of processes are both desirable. In parallel, OTT's implementation of scalable, efficient marketing using the internet and e-commerce attempts to license more than the rare obvious winners, and to address the more common "middle ground" of disclosures. These technologies might well provide benefit to the public if we bring them to the attention of the market, although our experience suggests that they are often not sufficiently advanced to market through direct, personal contacts.
  - One good example is the solar-grade silicon example mentioned in the audit report introduction: a new AZ-based venture start-up is now well along in plans to commercialize an invention whose value presented initially as marginal.
- **A Leader in Industry-Sponsored Research.** The UA is keen to communicate to Arizona citizens our success in working with industry, as well as our desire to continuously improve our interactions with our private sector collaborators. Some highlights:
  - From FY 2001 to FY 2006, UA received an average of 12.5 % of its total externally-funded research *awards* from industry, as reported in our Research Profile publication. For comparison, that is only slightly behind the 13.5% figure for The Ohio State University, which is one of UA's peer institutions, and which the National Science Foundation ranked second nationally in receiving industry-sponsored research funding for FY 2006. In several years in the 2001-2006 period, UA actually received more industry awards than The Ohio State University.
  - From FY 2001 to FY 2006 UA's R&D *expenditures* from industry averaged 6.2% while its peer group averaged 4.7%; the national average of all universities in FY 2006 was 5.1%. It is

important to note that funds awarded to the UA but then transmitted to collaborators and partners are not counted in UA's research expenditures. For example, UA researchers provided an average of $30 Million per year to subcontractors in and out of Arizona through their industry sponsored collaborations, and that amount does not appear in UA expenditures.

- UA has recently created and staffed a new position, Director of Corporate and Business Relations, to coordinate and improve our interactions with industry.

- **Conflict of Interest Policy and Process at UA**. The performance **a**udit raises several issues regarding the identification and management of conflicts of interest at UA. Individual recommendations are addressed below. It is important to note that many of these issues have been under review at the UA for some time, and there has been significant progress made in drafting a new conflict of interest policy to address the auditors' points. That effort was temporarily placed on hold until the arrival of the new Assistant Vice President of Research Compliance and Policy, Elizabeth Boyd, PhD. Dr. Boyd arrived on March 10, 2008 with a decade of experience and an international reputation as an expert in conflicts of interest in university settings. Her first priority is to resume the policy revision process and to implement the changes promptly after the Faculty Senate adopts the revised policies.

Responses to Specific Recommendations

Finding 1: Although performance varies, universities can take steps to increase commercially viable invention disclosures.

1. To help ensure that the Office of Technology Transfer can interact with inventors as necessary, UA should evaluate whether its technology transfer program staffing levels are adequate and take steps to increase program resources as needed.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
   Steps have been taken and additional program resources will be made available beginning in FY 2009. These resources are: (i) additional budget for two licensing managers with one position being a joint position with Optical Sciences; and (ii) additional budget for information resources and direct marketing activities.

2. To increase the level of interaction between licensing officials and inventors, UA should encourage appropriate research departments to work with the Office to share the expenses of replicating the model used in the BIO5 Institute.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
   Resources have been made available beginning in FY 2009 to hire an individual to replicate the BIO5 model in Optical Sciences (see F1.1 above). Optical Sciences and BIO5 represent two major programs funded under the TRIF initiative at the University of Arizona.

3. To encourage more faculty participation in technology transfer, UA should:

   a. Encourage its research-intensive departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure.

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
      The Office of the Vice President for Research will identify the most research-intensive departments by FY 2007 research expenditure. The Vice President for Research (VPR) will send a written memo to the Department Heads to encourage the Departments to consider adding participation in technology transfer into their professional evaluation guidelines for faculty promotion and tenure. In addition, the VPR will send a similar memo to the Chairs of the Faculty

Senate and the Committee of Eleven.

b. Continue to promote faculty participation in technology transfer by hosting annual recognition ceremonies and awarding university inventors who excel in this process.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

UA's Innovation Day with its associated Technology Innovation Awards Luncheon has been a true success in promoting awareness, participation and recognition of faculty achievement in technology transfer. Building upon our five years of success, the University will continue UA Innovation Day and the Innovation Awards.

4. To better educate faculty and increase their exposure to the technology transfer process, UA should:

a. Identify the departments known for producing commercially viable research and encourage the Office to conduct workshops for department faculty.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

The OTT tracks new research awards as part of its outreach to identify promising faculty research and will continue to offer to conduct workshops, brown bag lunch meetings and one-on-one meetings to units.

b. Encourage departments to invite Office of Technology Transfer staff to their meetings on an annual basis.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

The VPR will send a written memo to the relevant units, encouraging them to take advantage of the outreach offered and to work with the OTT to explore models of technology transfer suited to their needs (see F1.3.a above).

c. Proactively identify new university researchers in disciplines with high commercial potential and notify the Office of Technology Transfer of their hiring so the Office can make initial contact.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

The University will evaluate how best to incorporate the relevant exposure in new faculty orientation and other established programs that would increase the contact between new faculty and the OTT.

d. Require the Office to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, the Office should include information on the services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to the Office's Web site for further information when required.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Finding 2: All three universities – particularly UA – should improve aspects of marketing and all three should review their negotiation practices.

1. UA should develop and implement an evaluation system to weigh technologies against standard criteria to determine which technologies to focus its marketing resources on. UA should use these criteria to prioritize new disclosures and routinely reassess old ones. The assessments could be performed in-house or by market experts and UA should determine which is suitable based on relative

cost and the industry expertise available throughout the university.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
The OTT will examine the protocols used by at least three other technology transfer offices and create a standardized system to capture its evaluations of technologies.

2. UA should increase its marketing efforts for select technologies, identified through an evaluation, by:
   a. Advertising promising technologies through a press release, at trade shows, or through other literature-recommended forums;

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
      The OTT will continue working with the university news and information services to promote promising technologies and utilize a portion of new funding to increase its presence at selected trade shows.

   b. Continuing its efforts to increase market research in strategic industry areas to adequately evaluate technologies and to identify and understand the target companies;

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   c. Increasing personal relationships with industry through face-to-face meetings or networking at industry events; and

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
      The OTT will utilize a portion of new funding to increase its presence at selected trade shows and showcases.

   d. Increasing its efforts to identify and contact potential licensees.

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
      The OTT will continue its efforts in creating new approaches to marketing technologies that are scalable and cost-effective as well as increasing its licensing efforts through targeted networking at trade shows and showcases.

3. UA should evaluate whether its technology transfer program staffing levels are adequate and take steps to increase program resources as needed.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
   Steps have been taken and additional program resources will be made available beginning in FY 2009. These resources are: (i) additional budget for two licensing managers with one position being a joint position with Optical Sciences; and (ii) additional budget for information resources and direct marketing activities.

4. As part of its review of sponsored research practices, UA should take steps to improve its technology transfer-related negotiations with industry:
   a. Working industry to identify their concerns and needs regarding technology transfer and to determine how they can more effectively work together;

      The finding of the Auditor General is agreed to and the audit recommendation will be implemented.
      The UA receives 12.5% of its contract awards by dollar value for research with industry, on par with the best performing universities in the U.S., and exceeds both the performance of its peers and the national average in expenditures for industry-sponsored research. The UA will continue to look for ways of working more effectively with its industry collaborators. To do this, the

University (i) has hired Nancy Smith as Director, Corporate and Business Relations under the Vice President for Research to enhance communications with industry; (ii) is participating in industry-university forums dedicated to improving understanding on both sides; and (iii) will examine new approaches to industry-sponsored research agreements.

b. Developing specific technology transfer goals related to industry collaboration efforts; and

The finding of the Auditor General is agreed to and audit recommendation will be implemented.

The new Director of Corporate and Business relations has begun to construct a comprehensive approach to the UA's business and corporate relations. This will encompass goals related to industry collaboration efforts.

c. Determining how its negotiation process can be improved to meet the goals and evaluating its progress by identifying and collecting data on relevant performance measures.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

The Office of the Vice President for Research will identify relevant performance measures and initiate data collection.

Finding 3: All three universities – particularly UA and NAU- need to better manage conflicts of interest, and the Board should establish minimum standards.

1. To help ensure that all conflicts of interest are identified, the UA should adopt and implement policies and procedures that require initial and continuous identification of them. Specifically:
   a. At minimum, UA should require all faculty involved in sponsored research to fill out an annual conflict-of-interest disclosure form, in which they must disclose any substantial interests related to their research or other university responsibilities, to include disclosure to publications when they submit manuscripts; to their audiences when they present research results; to federal agencies according to their guidelines; and in the human participant review process. Further, UA should require disclosure of relevant changes to previous disclosures.
   b. UA should determine what office or entity will be responsible for ensuring that employees submit the annual disclosures, reviewing the disclosures, and forwarding them to the Institutional Review Committee for review.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   The current conflict of interest policy is being revised to require annual, continuing, and project-based disclosure by all faculty members involved in sponsored research. Furthermore, all committee communications with faculty shall include language that requires faculty to inform the Institutional Review Committee (IRC) of changes in their relationships to the disclosed entity. To coordinate disclosure of substantial interests in the human subjects review process, a representative of the Human Subjects Protection Program attends all IRC meetings and will verify that faculty have properly disclosed to the HSPP. The IRC shall utilize disclosure of substantial interests in publications, presentations and federal agencies as a regular feature of a management plan. The revised policy shall indicate that the Assistant Vice President (AVP) for Research Compliance and Policy, in the Office of the Vice President for Research, shall collect and review disclosures, forward them to the IRC for review, and maintain records of disclosures, decisions, management plans, and monitoring.
2. To help ensure that UA is consistently managing its inventor conflicts of interest, UA should develop and implement conflict of interest polices and procedures that include criteria for when to recommend a conflict-of-interest management plan and guidelines for areas that should be included in the plan.

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Consistency in management of conflicts of interest is critical and the revised policy will carefully describe what types of financial relationships must be disclosed, when, and to whom; it will also describe why certain financial relationships might be problematic and why management plans are sometimes necessary to protect the integrity of the research; it will also carefully define relationships that are likely to require management plans and what those management plans are likely to entail. It is, however, important to allow the IRC the freedom to exercise its judgment in a case-by-case manner, allowing for different circumstances of individual investigators and allowing for management plans to be specifically tailored to the exact circumstances of the case at hand. We will be guided by the samples suggested, including the University of Wisconsin, Stanford University, University of California, Irvine, and University of Pennsylvania.

3. To ensure its policies are followed, UA should:
   a. Assign responsibility for what office or entity will be responsible for implementation and monitoring of management plans;
   b. Coordinate university-wide management among the various offices involved, including Sponsored Project Services (SPS), The Office of Research and Contract Analysis (ORCA), the Office of Technology Transfer (OTT), the Office of the Vice President for Research, and UA inventor's dean or department chair. In particular, UA offices that help inventors to obtain research funds and license technologies, Sponsored Project Services and the Office of Technology Transfer, should indentify inventors with potential conflicts of interest and forward information to the Committee responsible for their management.
   c. Ensure that it informs all faculty involved in research of these policies, procedures, and sanctions for noncompliance.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   The Office of the Vice President for Research and, specifically, the AVP for Research Compliance and Policy, will provide oversight monitoring of disclosure and management plans. The revised conflict of interest policy will specify the exact reporting lines and the appeal process for investigators perceived as non-compliant. SPS and OTT will provide a list of faculty research agreements and licenses to the AVP for Research Compliance and Policy on a regular basis. Coordination among campus units will be accomplished through revised proposal routing sheets, increased communication, and, within a short time, an electronic system of proposal routing and compliance activities. This system, Kuali, currently in development with a national consortium of universities, will combine in one system all of the compliance requirements for sponsored research and will allow faculty to engage the system as they move through the proposal and research process. Finally, we are in the process of hiring a Research Compliance Training Coordinator who will work with the AVP for Research Compliance and Policy to develop training materials, web sites, and workshops to conduct active and ongoing outreach to the research community regarding its compliance obligations, including conflict of interest.

4. To address outstanding conflicts as of March 2008, UA should establish and implement an immediate short-term plan to identify and manage potential conflicts of interest for inventors actively participating in sponsored research.

   The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

   The AVP for Research Compliance and Policy will establish a short term plan for identifying and managing potential conflicts. With the IRC, the AVP for Research Compliance and Policy will implement the plan and work to identify investigators with potential conflicts and establish management plans as necessary.

NORTHERN ARIZONA UNIVERSITY

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May 16, 2008

Ms. Debra Davenport
Auditor General
State of Arizona
2910 North 44th Street, Suite 410
Phoenix, AZ 85018

Dear Ms. Davenport:

We have received the Auditor General's performance audit report on the technology transfer programs at the three state universities. Northern Arizona University has no significant issues or concerns with the report and, in general, is in full agreement with the report's findings. Attached is Northern Arizona University's response to the recommendations. We have agreed to address and implement all recommendations.

We would also like to provide an overall context of recent events surrounding our technology transfer provider, Arizona Technology Enterprises (AzTE), relevant to our responses.

Since January 19, 2006, AzTE has been providing technology transfer and intellectual property evaluation services to Northern Arizona University under a written "Services and License Agreement," scheduled to remain in effect for five years. We were notified in March that AzTE wishes to change the terms of this agreement and to alter the means in which services are provided. In some respects, the suggested changes would reduce (rather than enhance) Northern Arizona University's provision of technology transfer services to its faculty, staff, and student inventors. Therefore, we are reviewing the AzTE proposed changes and investigating alternative service providers. We anticipate moving to a new services and license agreement, either with AzTE or another vendor, within the next several months. This will enable Northern Arizona University to fully implement the recommendations included in the report.

Sincerely,

John D. Haeger
President

Northern Arizona University
Auditor General's Performance Audit
University Technology Transfer Programs
May 2008

Finding1: Universities can take steps to increase commercially viable invention disclosures.

Recommendation 1.

To promote disclosure activity by increasing in-person interactions with faculty, NAU should work with AzTE to develop a schedule for AzTE employees to visit NAU's campus periodically throughout the year to meet with NAU inventors. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of these technology transfer services to another provider. Any arrangement should ensure that the level of interaction between NAU inventors and technology transfer staff is increased.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. The NAU Vice President for Research has requested written proposals from AzTE as well as other, more local, potential service providers in order to obtain more frequent and dependable visits on campus with NAU inventors.

Recommendation 2.

To encourage more faculty participation in technology transfer, NAU should consider hosting annual recognition ceremonies for their inventors who have been active in technology transfer.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. The Vice President for Research will work with the Provost and the President to identify the most appropriate venue(s) in which to recognize faculty, staff, and student inventors who have been active in technology transfer.

Recommendation 3.

To better educate faculty, and increase their exposure to the technology transfer process, NAU should:

Recommendation 3a.

Identify the departments known for producing commercially viable research and then conduct workshops for department faculty.

Response

The finding of the Auditor General is agreed to and the audit recommendation is being implemented. For example, in April 2008 NAU hosted a workshop organized by the Northern Arizona Center for Emerging Technology, "Invention

to Venture," and invited faculty, staff, and student inventors. The Vice President for Research will plan and conduct regular workshops for current and potential campus inventors aimed at various steps of the technology transfer process.

Recommendation 3b.

Encourage research-intensive departments to invite the technology transfer provider to their meetings on an annual basis.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. The NAU Vice President for Research will work with the service provider selected to ensure research-intensive departments are indentified and the provider meets with them at minimum annually.

Recommendation 3c.

Proactively identify new university researchers in disciplines with high commercial potential and notify AzTE of their hiring so they can make initial contact.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. The NAU Vice President for Research has requested written proposals from AzTE and other potential service providers. We agree to proactively place the service provider selected in contact with new and existing university researchers.

Recommendation 3d.

Require its technology transfer provider to develop a mechanism for informing university inventors of the university's technology transfer process. One possibility may be in the form of a technology transfer reference pamphlet, CD, or DVD to be distributed to new employees and those inventors conducting research in areas of high commercial potential. Among other things, NAU's technology transfer provider should include information on services that it offers, what is expected of the researcher, intellectual property legal matters, and contact information, and should direct university researchers to the provider's or NAU's Web site for further information when required.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented when we identify the provider of Technology Transfer support. NAU has already created an overview document ("Frequently Requested Information on Intellectual Property") and a web site (http://www.research.nau.edu/vpr/techtransfer.html) intended to introduce university inventors to the technology transfer process. The Vice President for Research will work with the selected service provider to create additional materials and mechanisms for informing university inventors and streamlining their interactions with the service provider(s).

Finding 2: All three universities should improve aspects of marketing and review their negotiation practices.

Recommendation 1.

NAU should work with AzTE to take steps to mitigate the disincentive that the university's physical distance creates and ensure that appropriate marketing efforts are pursued. Alternatively, NAU could assign staff to assume some of these technology transfer responsibilities or contract all or some of its technology transfer services to another provider. Any arrangement should ensure that NAU technologies are appropriately evaluated, adequately researched for marketing purposes, and discussed with industry contacts as appropriate.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented as we identify the provider of Technology Transfer support. As part of the vendor selection and negotiation, we will ensure the service provider selected will work more closely with the Vice President for Research to identify and pursue appropriate marketing efforts.

Recommendation 2.

NAU should take preventative steps to streamline coordination of industry sponsorship among its technology transfer provider, the faculty inventor, and NAU. NAU should also consider developing specific technology transfer goals related to industry collaboration efforts and determining how its negotiation process can be improved to meet the goals. It should evaluate its progress by identifying and collecting data on relevant performance measures.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented as we identify the provider of Technology Transfer support. As part of the vendor selection and negotiation, we will establish steps for coordination of sponsorship among industry supporters, faculty inventors, the university, and the service provider. The university will develop specific goals for our technology transfer efforts, identify appropriate metrics, and establish data collection processes to be implemented by June 30, 2009.

Finding 3: All three universities – particularly UA and NAU – need to better manage conflicts of interest, and the Board should establish minimum standards.

Recommendation 1.

To help ensure that all conflicts of interest are identified, NAU should adopt and implement policies and procedures that require initial and continuous identification of potential conflicts of interest. Specifically:

Recommendation 1a.

At a minimum, NAU should require all faculty and staff involved in sponsored research to fill out an annual conflict-of-interest disclosure in which they are asked if they have any substantial interests related to their research or other

university responsibilities. Further, NAU should require disclosure of relevant changes to previous disclosures.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. Currently, the NAU Investigator Financial Disclosure Form is required and submitted with all proposals to NSF and NIH. The disclosure is updated annually for all funded projects. The University is currently exploring the most effective ways of coordinating a general conflict of interest reporting mechanism for all faculty with an annual conflict-of-interest disclosure related to research, including sponsored projects. In that regard, the University recently sent out annual appointment letters to approximately 800 faculty. Included with each appointment letter was a memorandum from President Haeger and Provost Grobsmith explaining faculty member's responsibilities under Arizona conflict of interest laws and a notification form for faculty to complete that describes their ownership and compensation relationships with entities other than the University.

Recommendation 1b.

NAU should determine what NAU office or entity will be responsible for ensuring that employees submit the annual disclosures, reviewing the disclosures, and, if necessary, forwarding them to a committee or other university official for review.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented. The disclosures received from faculty and staff engaged in sponsored research will be reviewed by the employee's immediate supervisor and such review will continue up the supervisory chain with final responsibility residing with the cognizant vice president.

Recommendation 2.

To help ensure that NAU is consistently managing NAU inventor conflicts of interest, NAU should develop and implement conflict-of-interest policies and procedures that include criteria for when to recommend a conflict-of-interest management plan and what the plan should include.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Recommendation 3.

To ensure clear responsibility for conflict of interest management, NAU should:

Recommendation 3a.

Determine what NAU university offices or entities will be responsible for implementing and monitoring conflict of interest management plans.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Recommendation 3b.

Ensure university-wide coordination on conflict-of-interest management among the various offices involved, including the Office of the Vice President for Research, Sponsored Project Services, the Office of Grants and Contracts, the institutional review board, and the office that manages NAU's intellectual property.

Response

The finding of the Auditor General is agreed to and the audit recommendation will be implemented.

Arizona Board of Regents
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Arizona State University *Northern Arizona University* *University of Arizona*

May 16, 2008

Ms. Debra Davenport
Auditor General of the State of Arizona
2910 North 44th Street, Suite 410
Phoenix, AZ 85018

Dear Ms. Davenport:

Thank you for the opportunity to review the revised preliminary report draft of the performance audit of university technology transfer programs. The report is well-done and we believe the system will benefit from the recommendations you have made.

The report includes one recommendation to the Arizona Board of Regents:

RECOMMENDATION:

To help ensure effective technology transfer-related conflict-of-interest management at all universities, the Board should establish minimum standards for universities' conflict of interest policies and procedures, including standards for initial and continuous identification of conflicts of interest and standards for restrictions to manage conflicts of interest and enforcement of those restrictions.

ABOR RESPONSE:

The Arizona Board of Regents agrees with this finding and the audit recommendation will be implemented.

Thank you to you and your staff for their work on this audit. Technology transfer and conflict of interest are important issues for the Arizona University System and we appreciate this thoughtful review.

Sincerely,

Joel Sideman
Executive Director

c: Fred Boice
Richard Gfeller
Nancy Tribbensee

Performance Audit Division reports issued within the last 24 months

06-03 Pinal County Transportation Excise Tax
06-04 Arizona Department of Education—Accountability Programs
06-05 Arizona Department of Transportation—Aspects of Construction Management
06-06 Arizona Department of Education—Administration and Allocation of Funds
06-07 Arizona Department of Education—Information Management
06-08 Arizona Supreme Court, Administrative Office of the Courts—Information Technology and FARE Program
06-09 Department of Health Services—Behavioral Health Services for Adults with Serious Mental Illness in Maricopa County
07-01 Arizona Board of Fingerprinting
07-02 Arizona Department of Racing and Arizona Racing Commission
07-03 Arizona Department of Transportation—Highway Maintenance
07-04 Arizona Department of Transportation—Sunset Factors
07-05 Arizona Structural Pest Control Commission
07-06 Arizona School Facilities Board
07-07 Board of Homeopathic Medical Examiners
07-08 Arizona State Land Department
07-09 Commission for Postsecondary Education
07-10 Department of Economic Security—Division of Child Support Enforcement
07-11 Arizona Supreme Court, Administrative Office of the Courts—Juvenile Detention Centers
07-12 Department of Environmental Quality—Vehicle Emissions Inspection Programs
07-13 Arizona Supreme Court, Administrative Office of the Courts—Juvenile Treatment Programs
08-01 Electric Competition

Future Performance Audit Division reports

Arizona's Universities—Capital Project Financing

Arizona's Universities—Information Technology Security