TECHNOLOGY TRANSFER OF UNIVERSITY RESEARCH

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ABSTRACT

Technology transfer of university research may be considered a form of university outreach as described by Michigan State University [1]: "Outreach is a form of scholarship that cuts across teaching, research, and service. It involves generating, transmitting, applying, and preserving knowledge for the direct benefit of external audiences in ways that are consistent with university and unit missions." The question that needs to be addressed for each university is this: To what extent does the university deem that outreach should be stimulated, supported and rewarded? If outreach is considered a form of scholarship, then universities would logically be anticipated to stimulate, support and reward outreach. The challenge then becomes how to identify, create and develop scholarship within outreach activities. This approach can be productive and creative for both universities and external audiences, and presents qualitative and quantitative challenges that are necessary to identify and solve in order to maintain national productivity.

KEY WORDS

technology transfer, outreach, land grant university

INTRODUCTION

Technology transfer of university research would be described by researchers differently than by university extension specialists or those involved primarily in university teaching. From the point of view of the authors of this paper and academicians involved in research, teaching and extension, technology transfer of university research may be considered a form of university outreach as described by the Provost's Committee on University Research at Michigan State University [1]: "Outreach is a form of scholarship that cuts across teaching, research, and service. It involves generating, transmitting, applying, and preserving knowledge for the direct benefit of external audiences in ways that are consistent with university and unit missions."

University outreach for each university is strongly influenced by the structure and administration of a university, the mission of the university, the political atmosphere within a university, and the expectations and needs of the public. University outreach, however, will be most heavily influenced by the university faculty as they define their role within a university and their roles with regard to external audiences.

The authors of this paper have been involved in significant university outreach activities over the past 13 years as employees of Utah State University (USU). As a land grant university and similar to the other land grant universities in the US, USU was given the charter to "reach out" to the public as part of its mission. As a result, USU has had a considerable impact on the

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technical and economic development of the State of Utah [2]. However, a continuously evolving and challenging theme for land grant universities and recently for non-land grant universities is their relationship with "external audiences." Therefore we present here our views of university technology transfer based on our experiences and on our observations of the evolution of technology transfer primarily within a land grant university context.

TYPES OF UNIVERSITY OUTREACH

Classical and universal forms of university outreach include: (1) professors who train students who graduate and "reach out" to the community for jobs and are hired by employers and in this way add to the knowledge base and productivity of society, and (2) extension agents typically based in land grant universities, usually agricultural specialists or engineers, who assist farmers with crop and animal productivity and disease prevention and assist other members of the public on a one-on-one basis. These models of university outreach are being expanded, refined and diversified to include more frequent and more varied communication between the university and the public.

Other types of university outreach include: (1) research publications, (2) applied research summaries, (3) guidance manuals, (4) training seminars, (5) training tapes and (6) devices such as patents or technologies that may result in spin-off businesses. The frequency and extent of university outreach activities are often a function of the perception as well as the actual importance of this activity within the university promotion system and the support personnel and services available to accomplish university outreach.

Research publications have traditionally been a very high priority for promotion within the university system and will remain a strong and dominant type of university outreach, with external audiences consisting of researchers in non-university settings, consultants, and other specialists in government and private sector positions involved in the generation and application of new knowledge.

Applied research summaries represent an effort by researchers to summarize findings in specific areas of concern. Examples of applied research summaries by the authors are listed below:

- U.S. Environmental Protection Agency. 1990. Transport and Fate of Contaminants in the Subsurface. Chapter 3, In: Ground Water, Volume II, Methodology. EPA/625/6-90-016b.

- U.S. Environmental Protection Agency. 1991. Integrating Site Characterization with Subsurface Remediation. Chapter 1, In: Site Characterization for Subsurface Remediation. EPA/625/4/91/026.

- U.S. Environmental Protection Agency. 1991. Soil and Ground Water Remediation: Basic Approaches. Chapter 14, In: Site Characterization for Subsurface Remediation. EPA/625/4/91/026.

- U.S. Environmental Protection Agency. 1989. Bioremediation of Contaminated Surface Soils. EPA/600/9-89/073.

- U.S. Environmental Protection Agency. 1990. Reductive Dechlorination of Organic Contaminants in Soils and Ground Water. Engineering Issue Paper, EPA/540/4-90/054.

- U.S. Environmental Protection Agency. 1992. In-Situ Bioremediation of Contaminated Ground Water. Engineering Issue Paper, EPA/540/S-92/003.

- U.S. Environmental Protection Agency. 1993. In-Situ Bioremediation of Con-

taminated Vadose Zone Soil. Engineering Issue Paper, EPA/540/S-93/501.

Guidance manuals represent the use of research results for specific applications with regard to engineering or management to accomplish specific tasks. A guidance manual that is currently under preparation for the Great Plains/Rocky Mountain Hazardous Substance Research Center and that is coordinated with an HSRC funded research project on Prepared Bed Treatment of Wood Preserving Waste at the Libby, Montana, Superfund site is listed below:

- Great Plains/Rocky Mountain Hazardous Substance Research Center, U.S. EPA. Guidance Manual for Prepared Bed Land Treatment as a Bioremedial Technology. In preparation.

Other examples of guidance manuals prepared at USU include:

- U.S. Environmental Protection Agency. 1986. Permit Guidance Manual on Hazardous Waste Land Treatment Demonstrations. EPA-530/SW-86-003a.

- U.S. Environmental Protection Agency. 1990. Part 265 Land Treatment Closure/Post Closure Guidance Manual, EPA Directive 9476.00-9. Office of Solid Waste and Emergency Response.

- U.S. Environmental Protection Agency. 1992. Corrective Action Glossary, EPA Directive 9902.3-1a. Office of Solid Waste and Emergency Response.

Training seminars sponsored by a university can be a useful way to accomplish personal interaction between university faculty and staff and external audiences. Examples of training seminars are:

- Bioremediation of Hazardous Waste-Contaminated Soils. USU faculty, Sponsored by the U.S. Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.

- Ground Water Investigations Course, Sponsored by the U.S. Environmental Protection Agency, Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma.

Training videos may be useful when schedules or geographic constraints prevent external audiences from traveling to universities or other central locations where training is offered. Examples of current training videos that were prepared by USU personnel and others as an outreach activity by university personnel include:

- Bioremediation of Contaminated Soil. 41 minutes. Office of Solid Waste, U.S. EPA, Washington, D.C. 1993.

- Conceptual Approach for Characterizing Problems at Hazardous Waste Sites. 48 minutes. Office of Solid Waste, U.S. EPA, Washington, D.C. 1992.

- Bioremediation: A Video Primer. 36 minutes. U.S. EPA, Great Lakes and Mid-Atlantic Hazardous Substance Research Center. 1993.

Devices or applied processes that evolve from university research represent another form of university outreach. Spin-off companies are formed for the specific purpose of applying specific technologies discovered or developed within a university research environment. For example, the company PHYTOkinetics of Logan, Utah, was initiated by a post-doctoral biochemist who conducted research on a process for remediation of contaminated soil using vegetation, referred to as phytoremediation. Another spin-off company, ENVIROL, was created based on applications developed by personnel within the Utah Center of Excellence for Environmental Science and

Technology awarded to Utah State University by the Utah Community Economic Development program. In one specific outreach project of the Utah Center of Excellence a patent was obtained and a U.S. EPA analysis method was developed as a rapid field method for the determination of pentachlorophenol in soil. This outreach activity within the Center of Excellence was initiated in response to the request of environmental engineering researchers at USU for an improved method for characterizing and monitoring bioremediation at field scale.

Other patent applications that evolved based on research sponsored by the Electric Power Research Institute at USU included photoremediation and chemical oxidation processes for the treatment of organic contaminated soil.

UNIVERSITY STRUCTURE AND FUNCTION FOR TECHNOLOGY TRANSFER

University units that may facilitate university outreach, in addition to conventional arrangements of single principal investigators within individual academic departments, include: (1) multidisciplinary centers, (2) institutes and (3) teaming initiatives. An example of a multidisciplinary center with specific university outreach functions at USU is the Utah Water Research Laboratory (UWRL). At the UWRL, civil and environmental engineers and scientists with joint appointments in the academic departments of civil and environmental engineering, biology, chemistry and soil science focus on applied research related to water, land and air quality. Applied research is supported through contracts and grants from the U.S. Government, the State of Utah and private industry. Specifically, the UWRL has been supported by the following institutions within the last six years in the role of university outreach: (1) Atlantic Richfield Co., (2) Champion International Paper Co., (3) Department of Energy, (4) Department of Defense including Eilsen, FE Warren, Hill, March, and Tyndall Air Force Bases, (5) Electric Power Research Institute, (6) Thiokol Corporation, and (7) Union Carbide Chemicals and Plastics Co. In addition to the university outreach achieved for the clients in the form of information and treatment technologies, applied research projects support undergraduate students and provide graduate research assistant support and training for the M.S. and Ph.D. students.

Another example of a multidisciplinary center created for university outreach at USU is the Utah Center of Excellence for Science and Technology, a joint venture of university research programs including environmental, electrical and biological engineering, funded in part by the Utah Community Economic Development program. The co-principal investigators, Drs. Ronald Sims and Linda Powers, organized the Center for the purposes of: (1) developing and transferring products, based on university engineering research, to the public, and (2) supporting and training graduate students. The Center was also created to stimulate private business development in Utah.

The Biotechnology Center at USU represents a third multidisciplinary center at USU that is dedicated to university outreach through focusing on the development and application of agricultural biotechnology products. Specific products related to contaminated site remediation, animal disease control, and increased productivity in Utah animal and dairy industries are being developed within the Biotechnology Center. A current outreach project that is jointly funded by the USGS and UWRL, the Biotechnology Center, involves the development of genetically engineered plants for removal of metals from contaminated soil at mining sites in Utah. Faculty from environmental engineering, soil science, agronomy and chemistry departments work together,

while student training at the graduate level involves coursework in environmental engineering and biotechnology.

Institutes represent another university unit that may facilitate outreach to external audiences. The Institute for Land Rehabilitation (ILR) at USU resides within the College of Natural Resources and promotes watershed restoration and mine land reclamation. ILR functions as an information source to government agency personnel throughout the West and accomplishes university outreach by sponsoring workshops, symposia and short courses. The Institute for Natural Systems Engineering (INSE), within the Division of Environmental Engineering at USU, brings together university personnel in the Colleges of Engineering and Natural Resources to provide university outreach training and contract research for U.S. government agencies on the engineering and management of natural aquatic systems for the protection of water quality. A part of the INSE charter is the use of contract funding for the support of graduate student training at USU. Therefore, institutes at USU have been vehicles for accomplishing both university outreach and graduate student training and publication by the University.

Teaming initiatives offer opportunities for universities to work with industry and consulting firms, as well as other universities, with the goal of providing products or services to external audiences. USU has successfully entered into teaming initiatives with consulting firms, industries and other universities where USU staff provided training, third party review of plans and reports, and technical input concerning treatment technology evaluation. In addition, university financial support obtained through industries and consulting firms provides valuable training for undergraduate and graduate students who are funded to work on applied problems. Combining fundamental training in the classroom with applied training with regard to teaming arrangements with industry and consulting firms offers students and faculty unique opportunities to explore the interface of theory and application within the constraints of schedule and budget issues.

Definite challenges exist with regard to teaming initiatives. These include:

- short-term goals of industry/consulting versus long-term goals of universities;
- intellectual property ownerships with regard to patents and devices;
- support of initial development of an idea until it is ready for development or field trials.

There is a need for universities and their non-academic partners to discuss the limitations and constraints as well as the advantages of teaming initiatives. This approach may lead to increased flexibility among all partners as well as an attitude of change to facilitate progress in achieving the goals of the teaming initiative.

Indeed the traditional structure of universities with departments and colleges and single investigators with individual laboratories sometimes inhibits interdisciplinary activities that are critically needed for solving complex environmental problems facing industry and the public. Since structure often determines function with regard to both chemistry and institutions, an evaluation of the value of traditional academic institutional structure is appropriate especially with regard to multidisciplinary centers, institutes and teaming initiatives.

OBSERVATIONS CONCERNING CHALLENGES TO UNIVERSITY TECHNOLOGY TRANSFER

The Provost's Committee Report on University Outreach at Michigan State Uni-

versity [1] presented this challenge: “American universities are facing a major challenge to maintain quality and be more responsive to the needs of society. University outreach activities do play and must continue to play a major role in meeting this challenge.... By broadening its view of outreach and integrating that view more completely into the structure and function of the University, MSU is in a unique position to provide the kinds of outreach activities that will respond to society’s needs while maintaining excellence in all knowledge domains.”

In spite of the classical functions of university technology transfer at land grant universities and other types of technology transfer addressed in this discussion, the question that needs to be addressed for each university is this: To what extent does the university deem that outreach or technology transfer should be stimulated, supported and rewarded? If outreach is considered a form of scholarship, as addressed in the Provost’s Committee Report on University Outreach at Michigan State University [1], then universities would logically be anticipated to stimulate, support and reward outreach. The challenge then becomes how to identify, create and develop scholarship within technology transfer activities. This approach can be productive and creative for both universities and external audiences, and presents qualitative and quantitative challenges that are necessary to identify and solve in order to maintain national productivity.

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