

**OKLAHOMA STATE REGNETS FOR
HIGHER EDUCATION
STATE CAPITOL COMPLEX, OKLAHOMA CITY**

**ACADEMIC UNIT/
DEGREE PROGRAM REVIEW**

FOR

**DEPARTMENT OF BIOSYSTEMS AND AGRICULTURAL
ENGINEERING**

**COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY
OKLAHOMA STATE UNIVERSITY
STILLWATER, OK 74078**

March 1, 2005

OKLAHOMA STATE UNIVERSITY
ACADEMIC PROGRAM REVIEW
EXECUTIVE SUMMARY

DEPARTMENT OR DEGREE PROGRAM: Biosystems and Agricultural Engineering

The Biosystems and Agricultural Engineering (BAE) Department is unique in that it is an integral part of both the Division of Agricultural Sciences and Natural Resources, and the College of Engineering, Architecture and Technology. The department has a strong multidisciplinary flavor and BAE faculty embrace opportunities to work across departmental, college, and institutional lines. The department currently has 13 tenure-track faculty serving teaching, research, and extension missions; over the past four years there has been a net loss of 7 faculty positions, primarily due to retirements in a time of serious budget pressures.

In the instructional arena, the department has approximately 100 students enrolled in its ABET-accredited B.S. program in Biosystems Engineering. This program, which has nearly doubled in enrollment over the past five years, has four options: Biomechanical, Bioprocessing and Biotechnology, Environment and Natural Resources, and Food Processing. Each option encompasses a common set of general education, pre-engineering, and professional school courses, along with 21 credit hours of option-specific coursework that are largely taken from other departments. A comprehensive review and revision of the undergraduate curriculum was undertaken in 2001-2002 and has appeared to have a positive impact on student retention. During the 2003-2004 school year, Biosystems Engineering students won four major national student competitions sponsored by ASAE, the professional society for the bio/ag engineering discipline.

The department has approximately 30 M.S. and Ph.D. students enrolled in its Biosystems Engineering graduate program, and BAE faculty advise students in the interdisciplinary Environmental Science program. The department also teaches about 12 MCAG and AG service courses per year in support of agricultural degree programs. The B.S., M.S. and Ph.D. programs in Biosystems Engineering are the only ones of their type offered in the state of Oklahoma.

In alignment with OSU's land-grant mission, the department conducts significant research and extension programs through the Oklahoma Agricultural Experiment Station and Oklahoma Cooperative Extension Service. In FY04 external funding for these programs totaled about \$2.5 million in expenditures and \$3.6 million in new awards. Over the past five years, there has been a strong and consistent upward trend in both measures of productivity.

The Academic Program Review process was undertaken by the BAE faculty with leadership provided by the department head and the chair of the ABET and Undergraduate Curriculum Committee. All faculty contributed data for the report and were provided with an opportunity to review and comment on the draft document.

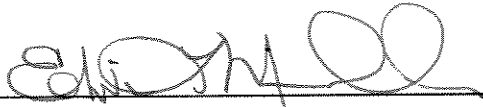
The overall objective of the B.S. program in Biosystems Engineering is to provide the comprehensive education necessary to prepare students for successful, productive, and rewarding careers in engineering for agricultural, food, and biological systems. Specifically, it is expected that graduates of the program will: (1) be able to apply the mathematical, physical, engineering, and biological principles needed to understand, analyze, and solve problems in food, agricultural,

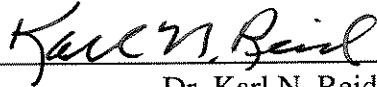
environmental, and biological systems; (2) be effective in oral, written, and visual communication; (3) be self-motivated in accomplishing tasks, both as an individual, and as a contributor to multi-disciplinary teams; (4) be able to understand the social, environmental, safety, and economic impacts of their work in local and global contexts, and to perform in a professional and ethical manner; and (5) be committed to enhancing knowledge and skills through continuing education.

The objective of the M.S. program is to provide students, who have a Bachelor of Science in Biosystems Engineering, or equivalent, with education and experience in conducting in-depth analysis of engineering problems and in conducting and reporting supervised scientific research. The objective of the Ph.D. program is to provide students, who have a Master of Science in Biosystems Engineering, or equivalent, with education and experience in identifying, planning, conducting, and reporting relevant and beneficial scientific research.

The department employs a varied set of methods for assessing the achievement of desired student outcomes. At the undergraduate level, the methods include: (a) student performance on the Fundamentals of Engineering Exam (a nation-wide instrument assessing a student's comprehension of engineering fundamentals); (b) student performance in Senior Design (a comprehensive, two-semester, capstone experience); (c) graduating senior exit interviews (written questionnaire and individual face-to-face meeting with the department head); (d) alumni surveys (conducted bi-annually by the Office of University Assessment); (e) annual review by the departmental advisory committee; (f) ABET accreditation review; and (g) informal student feedback. For the M.S. and Ph.D. programs, methods include: (a) program self-assessment by the faculty; (b) alumni surveys; and (c) graduate committee and advisor assessment. The results of the various outcomes assessment methods are compiled and analyzed in an integrated fashion by the faculty. Changes are made in the program as appropriate, thereby closing the "feedback loop" of program assessment.

Based on this Academic Program Review, a recent accreditation self-study, and the results of departmental strategic planning and unit action planning, the following actions are recommended: (a) "Restore, Reward, and Grow" the BAE faculty; (b) improve the teaching laboratory infrastructure; (c) increase the number of graduate students; (d) expand the portfolio of departmental graduate courses; (e) identify additional office space; (f) increase private giving; and (g) maintain the undergraduate enrollment.

Dean  Date 3/4/2005
Dr. Edwin L. Miller
Interim Dean and Director
Division of Agricultural Sciences & Natural Resources

Dean  Date 3/4/05
Dr. Karl N. Reid
Dean
College of Engineering, Architecture and Technology

Note: Complete one of these forms for each degree program

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

2004 - 2005

ACADEMIC PROGRAM REVIEW

BACCALAUREATE, MASTERS & DOCTORAL DEGREES

OKLAHOMA STATE UNIVERSITY

Bachelor of Science in Biosystems Engineering

Title of unit or degree program reviewed (Level III)

With options (Level IV) in: Biomechanical
Bioprocessing and Biotechnology
Environment and Natural Resources
Food Processing

Bachelor of Science
Degree designation as on diploma (Level II)

B.S.
Formal degree abbreviation (Level I)

Degree-granting academic unit Biosystems and Agricultural Engineering Department C2185
(Name) (Cost Center)

CIP code 1 4 0 3 0 1

HEGIS code 0 9 0 3

Instructional Program code 0 1 0

Name of department head
(person who oversees degree program listed above) Ronald L. Elliott

Program holds specialized accreditation from Accreditation Board for Engineering and Technology

Name and title of contact person Ronald L. Elliott
(Name)
Professor & Department Head
(Title)

Date of Institutional Governing Board Review: _____

President _____ Date: _____
(Signature)

Note: Complete one of these forms for each degree program

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

2004 - 2005

ACADEMIC PROGRAM REVIEW

BACCALAUREATE, MASTERS & DOCTORAL DEGREES

OKLAHOMA STATE UNIVERSITY

Master of Science in Biosystems Engineering

Title of unit or degree program reviewed (Level III)

With options (Level IV) in: _____

Master of Science

Degree designation as on diploma (Level II)

M.S.

Formal degree abbreviation (Level I)

Degree-granting academic unit Biosystems and Agricultural Engineering Department C2185
(Name) (Cost Center)

CIP code 1 4 0 3 0 1

HEGIS code 0 9 0 3

Instructional Program code 0 1 1

Name of department head
(person who oversees degree program listed above) Ronald L. Elliott

Program holds specialized accreditation from _____

Name and title of contact person Ronald L. Elliott
(Name)
Professor & Department Head
(Title)

Date of Institutional Governing Board Review: _____

President _____ Date: _____
(Signature)

Note: Complete one of these forms for each degree program

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

2004 - 2005

ACADEMIC PROGRAM REVIEW

BACCALAUREATE, MASTERS & DOCTORAL DEGREES

OKLAHOMA STATE UNIVERSITY

Doctor of Philosophy in Biosystems Engineering

Title of unit or degree program reviewed (Level III)

With options (Level IV) in: _____

Doctor of Philosophy
Degree designation as on diploma (Level II)

Ph.D.
Formal degree abbreviation (Level I)

Degree-granting academic unit Biosystems and Agricultural Engineering Department C2185
(Name) (Cost Center)

CIP code 1 4 0 3 0 1

HEGIS code 0 9 0 3

Instructional Program code 0 1 2

Name of department head
(person who oversees degree program listed above) Ronald L. Elliott

Program holds specialized accreditation from _____

Name and title of contact person Ronald L. Elliott
(Name)
Professor & Department Head
(Title)

Date of Institutional Governing Board Review: _____

President _____ Date: _____
(Signature)

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OVERVIEW

A. Description of the Departmental/Program Review Process

This review was conducted by the Biosystems and Agricultural Engineering faculty, with leadership provided by the department head and the chair of the department's ABET and Undergraduate Curriculum Committee. This committee has five members, all of whom are tenure-track teaching and research faculty. As appropriate, all BAE faculty were asked to submit data needed for certain sections of the review report. Committee members and the department head compiled, edited, and analyzed this information, and also assumed responsibility for writing other sections of the report. A draft report was prepared and then made available to all faculty for review and comment.

Less than two years ago, the department had prepared a comprehensive self-study report and participated in an on-site visit as part of the accreditation process for the B.S. program in Biosystems Engineering. This recent experience aided the department in conducting its Academic Program Review (APR), although there are considerable differences in the focus, content, and format of the APR report and the ABET accreditation report. The department's recent strategic planning exercise was also a helpful backdrop for conducting the APR.

B. Recommendations from Previous Program Reviews

Eight recommendations and seven goals were identified in the 1998-1999 Academic Program Review (APR), with some overlap between the recommendations and goals. They are listed below, along with a brief discussion of actions taken. It should be noted that six tenure-track faculty have retired, and one has resigned, since the time of the last APR. There has also been a change in departmental leadership.

Recommendations for Action

1. Develop an interdisciplinary graduate program in biotech engineering with chemical engineering and biochemistry and recruit new faculty and staff to support that area. A faculty member specializing in bioprocess engineering was recruited to the department and began making important contributions. However he has since left the university. Approval has recently been granted to recruit for a very similar position; hopefully the successful candidate can begin work prior to the start of the 2005 fall semester. A Department of Energy grant based in BAE provided funding for the establishment of an innovative "Biobased Products Graduate Program." Although an interdisciplinary degree program in this area is not formalized at OSU, graduate education and research continue to benefit from the cross-department linkages that were enhanced by the grant. OSU and Mississippi State University have recently submitted a highly interdisciplinary, \$18 million proposal to the National Science Foundation for a Biobased Product Development Center.
2. Increase emphasis on the recruitment of quality undergraduate and graduate students. Dedicated recruitment activities have been one important factor in the undergraduate program's dramatic increase in enrollment. Graduate recruitment continues to receive some emphasis, but enrollment has not changed significantly over the past five years. This can be primarily attributed to a reduction in faculty numbers, an improving job market for graduates, and the impact of 9/11 on international student enrollment.

3. Develop programs to involve high school science and math teachers and prepare students to pursue biosystems engineering degrees. Programs aimed directly at teachers have not been developed, but occasional presentations in high school classrooms and at educational and career fairs have been continued. These activities, coupled with extensive written correspondence and one-on-one visits, have resulted in a good number of new freshmen and transfer students enrolling in the program each year.
4. Add additional faculty in the biomechanical area to enhance the precision ag and sensors program. A new tenure-track faculty member in biomechanical teaching/research joined the department in 2000. Currently being advertised is a tenure-track, extension/research position in site-specific technologies and machinery systems.
5. Start delivery of graduate classes in Tulsa by two-way video and on-site instruction. Graduate offerings in Biosystems Engineering at OSU-Tulsa did not materialize, and there are currently no plans to pursue such a program.
6. Increase office space. The department continues to be deficient in overall office space for faculty, staff, and graduate students. Over the past few years, needs have been met through the reallocation of office space vacated by seven faculty who retired or resigned. As the department begins to hire new faculty, this flexibility will be greatly reduced.
7. Add additional laboratory space for biotech and bioconversion programs. Significant progress has been made. DASNR and CEAT have collaborated closely on the establishment of a bioengineering research facility in the Advanced Technology Research Center. These labs are well equipped with an array of instruments supporting research and education in bioprocessing and bioconversion. The primary players are faculty in Chemical Engineering and Biosystems & Agricultural Engineering. Also, the department's "BAE West" facility has been significantly enhanced to support research in a gasification/fermentation process to produce ethanol and other products from biomass. This same facility has been equipped to study treatment/conversion of animal waste under controlled conditions.
8. Make the distance education master's program sustainable. This experimental program did not prove to be viable. This was largely due to insufficient demand for the program, at least as it was packaged at that time.

Five-Year Goals for the Program

1. Maintain current high quality of faculty, staff and students. The quality of the department's human capital continues to be a strength, but institutional budget pressures have unfortunately led to decreases in the number of "hard-funded" faculty and staff.
2. Re-evaluate undergraduate curriculum and modify as necessary to meet the changing demands of the profession. An in-depth review of the undergraduate curriculum was undertaken in 2001-2002, and the recommended changes have been implemented. These include the addition of a Bioprocessing and Biotechnology option, and a comprehensive restructuring of the BAE core courses common to all four options. Student retention in the degree program appears to have been positively influenced by the curriculum revision.
3. Increase enrollment in the undergraduate program to more than 100 high quality students. This goal has been achieved, with a 90% increase in undergraduate enrollment between Fall 2000 and Fall 2004. Student quality remains very high.
4. Launch an interdisciplinary graduate program in biotech engineering with chemical engineering and biochemistry and provide appropriate faculty and staff. See Recommendation #1 above.
5. Increase emphasis on the development of sensors for precision ag and provide appropriate

faculty and staff. For over a decade, the department's multidisciplinary work in variable rate technology and real-time sensing has been at the cutting edge of research in this area. See Recommendation #4 above.

6. Develop, in cooperation with CEAT, applied research back-up for the existing applications engineering extension program. Applications engineers periodically draw upon the expertise of engineering faculty in meeting the special needs of manufacturing clients. At a broader scale, DASNR and CEAT, with the BAE department playing a major role, have launched an exciting new venture – the New Product Development Center (NPDC). The NPDC partners existing small rural manufacturers with university-based research teams to develop and commercialize new products. The goal is to help these manufacturers remain sustainable and competitive, creating new and enhanced jobs and stronger rural communities.
7. Increase the professional support staff needed to provide assistance to the faculty. Budget pressures have not allowed this to happen. Any increases in support staff have been provided by the faculty themselves, using grant and contract funds.

CRITERION I Program Centrality

A. Goals & Objectives of Degree Programs

Bachelor of Science in Biosystems Engineering

Clientele

Students in the B.S. program are primarily full-time, traditional college-age students. The majority are Oklahoma residents, but there are also some out-of-state students. The program is offered in Stillwater.

Objectives

It is our objective to provide the comprehensive education necessary to prepare students for successful, productive, and rewarding careers in engineering for agricultural, food, and biological systems. We expect that graduates of our program will:

- Be able to apply the mathematical, physical, engineering, and biological principles needed to understand, analyze, and solve problems in food, agricultural, environmental, and biological systems.
- Be effective in oral, written, and visual communication.
- Be self-motivated in accomplishing tasks, both as an individual, and as a contributor to multi-disciplinary teams.
- Be able to understand the social, environmental, safety, and economic impacts of their work in local and global contexts, and to perform in a professional and ethical manner.
- Be committed to enhancing knowledge and skills through continuing education.

Expected Student Outcomes

We expect that students graduating from our program will have:

- a. An ability to apply knowledge of mathematics, science, and engineering.
- b. An ability to design and conduct experiments, as well as to analyze and interpret data.
- c. An ability to design a system, component, or process to meet desired needs.
This includes the ability to synthesize system specifications, make decisions based on partial knowledge, account for uncertainty and risk in design, apply engineering principles to accomplish an outcome, develop recommendations for decision makers based on engineering principles, and promulgate standards, regulations, and engineering practices.
- d. An ability to function on multi-disciplinary teams.
- e. An ability to identify, formulate, and solve engineering problems.
- f. An understanding of professional and ethical responsibility.

This includes an understanding of the issues of safety, law, and reliability.

- g. An ability to communicate effectively.

This includes oral, written, and graphical communications.

- h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.

This includes an understanding of the economic impacts, both internal and external, of the implementation of engineering solutions.

- i. A recognition of the need for, and an ability to engage in life-long learning.

- j. A knowledge of contemporary issues.

Students must have the body of knowledge related to societal issues in order to demonstrate the broad education necessary to understand the impact of engineering solutions in a global and societal context and an understanding of professional and ethical responsibility.

- k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

- l. A knowledge of appropriate agricultural and/or biological sciences, and/or natural resource topics.

This applies to both engineering sciences and contemporary issues.

Master of Science in Biosystems Engineering

Clientele

Enrollment in the M.S. program is approximately evenly divided between U.S. and international students. Most U.S. students in the program received their B.S. degrees from Oklahoma State University. The program is based in Stillwater.

Objectives

Provide students, who have a Bachelor of Science in Biosystems Engineering, or equivalent, with education and experience in conducting in-depth analysis of engineering problems and in conducting and reporting supervised scientific research.

Expected Student Outcomes

In addition to those outcomes given above for the Bachelor of Science program, we expect students graduating from our program with a Master of Science degree in Biosystems Engineering to demonstrate, under the supervision of an advisor, an ability to conduct, evaluate, and report scientific research in a Biosystems Engineering subject matter area.

Doctor of Philosophy in Biosystems Engineering

Clientele

International students currently comprise the majority of the enrollment in the Ph.D. program, with some U.S. students as well. The program is based in Stillwater.

Objectives

Provide students, who have a Master of Science in Biosystems Engineering, or equivalent, with education and experience in identifying, planning, conducting, and reporting relevant and beneficial scientific research.

Expected Student Outcomes

In addition to those outcomes given above for the Master of Science program, we expect students graduating from our program with a Doctor of Philosophy degree in Biosystems Engineering to demonstrate, by supporting research or by designs, the ability to identify a problem, define alternatives, propose a solution, organize a design or an experimental investigation, carry it to completion, and report the results.

B. Linkage of the Program to Institution's Mission

OSU-Stillwater Mission: Proud of its land grant heritage, Oklahoma State University - Stillwater advances knowledge, enriches lives, and stimulates economic development through instruction, research, outreach, and creative activities.

DASNR Mission: The mission of the Oklahoma State University Division of Agricultural Sciences and Natural Resources is to discover, develop, synthesize, and disseminate knowledge.

CEAT Mission: The College of Engineering, Architecture, and Technology provides students with exceptional academic experiences, conducts scholarly research and other creative activities that advance fundamental knowledge and contribute to technology development, and disseminates knowledge to the people of Oklahoma and throughout the world.

BAE Mission: The Biosystems and Agricultural Engineering Department enhances the production and profitability of agricultural and biological products and the conservation and management of natural resources through teaching, research, and outreach.

The teaching, research, and extension programs in the Biosystems and Agricultural Engineering Department align directly with, and are fully supportive of, the missions of OSU, DASNR, and CEAT. Unique among academic departments at OSU, BAE is a part of two different college units – the Division of Agricultural Sciences and Natural Resources, and the College of Engineering, Architecture and Technology. These units represent the "Agricultural & Mechanical" heritage of the land grant university. Furthering this legacy into the 21st century, BAE provides relevant and responsive programs in undergraduate and graduate instruction, basic and applied research, and technology transfer and economic development.

CRITERION II Program Curriculum and Structure

A. Program Structure

The 133-hour B.S. program is structured as a single degree (Bachelor of Science in Biosystems Engineering), with specialization through one of four option areas: Biomechanical, Bioprocessing and Biotechnology, Environment and Natural Resources, and Food Processing. The 2004-2005 degree requirement sheets for these four options are attached. Common to each option are 41 hours of general education courses (including 13 hours of mathematics), 27 hours of pre-engineering courses, and 44 hours of professional school courses (including 31 hours of BAE courses). Also required for each option are 21 hours of coursework specific to that option.

The degree program is offered and accredited through the College of Engineering, Architecture and Technology, but funding for the program comes through the College of Agricultural Sciences and Natural Resources. Under the "MCAG" and "AG" prefixes, the department also teaches a number of service courses for CASNR degree programs.

B. Distance Education

No distance education courses are offered.

C. Articulation Agreement

There are no articulation agreements specific to the Biosystems Engineering program. Any pre-engineering articulation agreements in force at the College level are honored.

OKLAHOMA STATE UNIVERSITY

GENERAL REQUIREMENTS

COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY

For students matriculating:

Academic Year 2004-05

BACHELOR OF SCIENCE IN BIOSYSTEMS ENGINEERING

Total hours 133

DEGREE

BIOSYSTEMS ENGINEERING

MAJOR

(BIOMECHANICAL)

OPTION

Minimum overall grade-point average 2.00
Other GPA requirements, see below.

General Education Requirements <u>41</u> Hours			Major Requirements <u>65</u> Hours		
Area	Hrs	To Be Selected From	Common Professional School <u>44</u> Hours		
Underlined courses below are Pre-Engineering requirements used simultaneously to meet General Education requirements.			Mathematics		
English Composition and Oral Communication	6	ENGL 1113 or 1313, and 1213 or 1413 or <u>3323</u> . Total hours for degree is based on substitution of 3323 for 1213 as per Academic Regulation 3.5.	3		STAT 4073
American History and Government	6	HIST 1103 POLS 1113	Engineering Science	3	ENSC 3233
Analytical and Quantitative Thought (A)	13	MATH 2144, 2153, 2163, 2233	Basic Science	4	BIOL 1114
Humanities (H)	6	Courses designated (H) at Oklahoma State University. Consult the college and departmental requirements.	Engineering Economics	3	IEM 3503
Natural Sciences (N)	4	CHEM 1414	Biosystems Engineering	31	BAE 1012, 1022, 2012, 2022, 3013, 3023, 3113, 3213, 3313, 3413, 4001, 4012, 4022
Social and Behavioral Sciences (S)	6	Courses designated (S) at Oklahoma State University. Consult the college and departmental requirements.	Specific Option Requirements <u>21</u> Hours		
International Dimension (I)	-	Any course designated (I). Students are encouraged to meet the requirement in their selection of (H) or (S) course work.	Admitted to the Professional School of Biosystems Engineering. (See Professional School Admission Requirements in the catalog)		
Scientific Investigation (L)	-	Any course designated (L). Normally met by Natural Science and/or Basic Science requirements.	Biosystems Engineering	3	BAE 4223
College/Departmental Requirements Pre-Engineering <u>27</u> Hours			Material Science	3	ENSC 3313
Basic Science	8	PHYS 2014, 2114	Mechanical Engineering	3	MAE 3323, or MAE 3043, or MAE 3723
Engineering	4	ENGR 1322, 1412	Controlled Electives	12	Engineering and/or science electives to be selected from an approved list upon consultation with an advisor. At least 3 credit hours must be from engineering electives.
Engineering Science	15	ENSC 2113, 2123, 2143, 2213, 2613			
Other Requirements: A 2.00 GPA is required in all course work listed in the right hand column above. A "C" or better is required for all courses that are prerequisite to BAE courses.					
Students will be held responsible for degree requirements in effect at the time of matriculation (date of first enrollment) and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.					

Karen M. Reid
DEAN

Ronald T. Elliott
HEAD

OKLAHOMA STATE UNIVERSITY

GENERAL REQUIREMENTS

COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY

For students matriculating:

Academic Year 2004-05

BACHELOR OF SCIENCE IN BIOSYSTEMS ENGINEERING

Total hours 133

DEGREE
BIOSYSTEMS ENGINEERING
MAJOR
(BIOPROCESSING & BIOTECHNOLOGY)
OPTION

Minimum overall grade-point average 2.00
Other GPA requirements, see below.

General Education Requirements <u>41</u> Hours		
Area	Hrs	To Be Selected From
Underlined courses below are Pre-Engineering requirements used simultaneously to meet General Education requirements.		
English Composition and Oral Communication	6	ENGL 1113 or 1313, 1213 or 1413, <u>3323</u> . Total hours for degree is based on substitution of 3323 for 1213 as per Academic Regulation 3.5.
American History and Government	6	HIST 1103 POLS 1113
Analytical and Quantitative Thought (A)	13	MATH <u>2144</u> , <u>2153</u> , <u>2163</u> , <u>2233</u>
Humanities (H)	6	Courses designated (H) at Oklahoma State University. Consult the college and departmental requirements.
Natural Sciences (N)	4	CHEM <u>1414</u>
Social and Behavioral Sciences (S)	6	Courses designated (S) at Oklahoma State University. Consult the college and departmental requirements
International Dimension (I)	-	Any course designated (I). Students are encouraged to meet the requirement in their selection of (H) or (S) course work.
Scientific Investigation (L)	-	Any course designated (L). Normally met by Natural Science and/or Basic Science requirements.
College/Departmental Requirements		
Pre-Engineering <u>27</u> Hours		
Basic Science	8	PHYS 2014, 2114
Engineering	4	ENGR 1322, 1412
Engineering Science	15	ENSC 2113, 2123, 2143, 2213, 2613

Major Requirements <u>65</u> Hours		
Common Professional School <u>44</u> Hours		
Mathematics	3	STAT 4073
Engineering Science	3	ENSC 3233
Basic Science	4	BIOL 1114
Engineering Economics	3	IEM 3503
Biosystems Engineering	31	BAE 1012, 1022, 2012, 2022, 3013, 3023, 3113, 3213, 3313, 3413, 4001, 4012, 4022
Specific Option Requirements <u>21</u> Hours		
Admitted to the Professional School of Biosystems Engineering. (See Professional School Admission Requirements in catalog)		
Biosystems Engineering	3	BAE 4283
Microbiology	5	MICR 2125
Organic Chemistry	3	CHEM 3053
Biochemistry	3	BIOC 3653
Biochemistry Lab	3	BIOC 3723
Controlled Electives	4	Engineering and/or science electives to be selected from an approved list upon consultation with an advisor.

Other Requirements: A 2.00 GPA is required in all course work listed in the right hand column above. A "C" or better is required for all courses that are prerequisite to BAE courses.

Students will be held responsible for degree requirements in effect at the time of matriculation (date of first enrollment) and any changes that these changes do not result in semester credit hours being added or do not delay graduation.

Karl M. Reid
DEAN

Ronald Z. Elliott
HEAD

EN-3

OKLAHOMA STATE UNIVERSITY

GENERAL REQUIREMENTS

COLLEGE OF

ENGINEERING, ARCHITECTURE AND TECHNOLOGY

For students matriculating:

Academic Year 2004-05

BACHELOR OF SCIENCE IN BIOSYSTEMS ENGINEERING

Total hours 133

DEGREE
BIOSYSTEMS ENGINEERING
MAJOR

Minimum overall grade-point average 2.00
Other GPA requirements, see below.

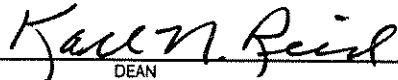
(ENVIRONMENT AND NATURAL RESOURCES)
OPTION

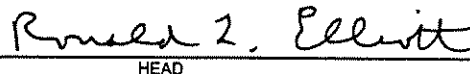
General Education Requirements <u>41</u> Hours		
Area	Hrs	To Be Selected From
Underlined sources below are Pre-Engineering requirements used Simultaneously to meet General Education requirements.		
English Composition and Oral Communication	6	ENGL 1113 or 1313, 1213 or 1413, <u>3323</u> . Total hours for degree is based on substitution of 3323 for 1213 as per Academic Regulation 3.5.
American History and Government	6	HIST 1103 POLS 1113
Analytical and Quantitative Thought (A)	13	MATH <u>2144, 2153, 2163, 2233</u>
Humanities (H)	6	Courses designated (H) at Oklahoma State University. Consult the college and departmental requirements.
Natural Sciences (N)	4	CHEM <u>1414</u>
Social and Behavioral Sciences (S)	6	Courses designated (S) at Oklahoma State University. Consult the college departmental requirements.
International Dimension (I)	-	Any course designated (I). Students are encouraged to meet the requirement in their selection of (H) or (S) course work.
Scientific Investigation (L)	-	Any course designated (L). Normally met by Natural Science and/or Basic Science requirements.
College/Departmental Requirements Pre-Engineering <u>27</u> Hours		
Basic Science	8	PHYS 2014, 2114
Engineering	4	ENGR 1322, 1412
Engineering Science	15	ENSC 2113, 2123, 2143, 2213, 2613

Major Requirements <u>65</u> Hours		
Common Professional School <u>44</u> Hours		
Mathematics	3	STAT 4073
Engineering Science	3	ENSC 3233
Basic Science	4	BIOL 1114
Engineering Economics	3	IEM 3503
Biosystems Engineering	31	BAE 1012, 1022, 2012, 2022, 3013, 3023, 3113, 3213, 3313, 3413, 4001, 4012, 4022
Specific Option Requirements <u>21</u> Hours		
Admitted to the Professional School of Biosystems Engineering. (See Professional School Admission Requirements in the catalog.)		
Biosystems Engineering	3	BAE 4313
Soil Science	4	SOIL 2124
Controlled Electives	14	Engineering and/or science electives to be selected from an approved list upon consultation with an advisor. At least 3 credit hours must be from engineering electives.

Other Requirements: A 2.00 GPA is required in all course work listed in the right hand column above. A "C" or better is required for all courses that are prerequisite to BAE courses.

Students will be held responsible for degree requirements in effect at the time of matriculation (date of first enrollment) and any changes that are made, so long as these changes do not result in semester credit hours being added or do not delay graduation.


DEAN


HEAD

OKLAHOMA STATE UNIVERSITY

GENERAL REQUIREMENTS

COLLEGE OF ENGINEERING, ARCHITECTURE AND TECHNOLOGY

For students matriculating:

Academic Year 2004-05

BACHELOR OF SCIENCE IN BIOSYSTEMS ENGINEERING

Total hours 133

Minimum overall grade-point average 2.00

Other GPA requirements, see below.

DEGREE
 BIOSYSTEMS ENGINEERING
 MAJOR
 (FOOD PROCESSING)
 OPTION

General Education Requirements 41 Hours		
Area	Hrs	To Be Selected From
Underlined courses below are Pre-Engineering requirements used simultaneously to meet General Education requirements.		
English Composition and Oral Communication	6	ENGL 1113 or 1313, 1213 or 1413, 3323. Total hours for degree is based on substitution of 3323 for 1213 as per Academic Regulation 3.5.
American History and Government	6	HIST 1103 POLS 1113
Analytical and Quantitative Thought (A)	13	MATH 2144, 2153, 2163, 2233
Humanities (H)	6	Courses designated (H) at Oklahoma State University. Consult the college and departmental requirements.
Natural Sciences (N)	4	CHEM 1414
Social and Behavioral Sciences (S)	6	Courses designated (S) at Oklahoma State University. Consult the college and departmental requirements.
International Dimension (I)	-	Any course designated (I). Students are encouraged to meet the requirement in their selection of (H) or (S) course work.
Scientific Investigation (L)	-	Any course designated (L). Normally met by Natural Science and/or Basic Science requirements.
College/Departmental Requirements Pre-Engineering 27 Hours		
Basic Science	8	PHYS 2014, 2114
Engineering	4	ENGR 1322, 1412
Engineering Science	15	ENSC 2113, 2123, 2143, 2213, 2613

Major Requirements 65 Hours		
Common Professional School 44 Hours		
Mathematics	3	STAT 4073
Engineering Science	3	ENSC 3233
Basic Science	4	BIOL 1114
Engineering Economics	3	IEM 3503
Biosystems Engineering	31	BAE 1012, 1022, 2012, 2022, 3013, 3023, 3113, 3213, 3313, 3413, 4001, 4012, 4022
Specific Option Requirements 21 Hours		
Admitted to the Professional School of Biosystems Engineering (See Professional School Admission Requirements in catalog.)		
Biosystems Engineering	3	BAE 4413
Organic Chemistry	3	CHEM 3053
Microbiology	5	MICR 2125
Controlled Electives	10	Engineering and/or science electives to be selected from an approved list upon consultation with an advisor. At least 3 credit hours must be from engineering electives.

Other Requirements: A 2.00 GPA is required in all course work listed in the right hand column above. A "C" or better is required for all courses that are prerequisite to BAE courses.

Students will be held responsible for degree requirements in effect at the time of matriculation (date of first enrollment) and any changes that are made so long as these changes do not result in semester credit hours being added or do not delay graduation.

Karl N. Rein
 DEAN

Russell L. Elliott
 HEAD

EN-5

D. Multidisciplinary Programs

Most research and extension activities in the BAE Department have a strong multidisciplinary flavor with faculty typically embracing opportunities to work across departmental, college, and institutional lines. Administratively, the BAE Department is uniquely positioned as a key unit in both the Division of Agricultural Sciences and Natural Resources (DASNR), and the College of Engineering, Architecture, and Technology (CEAT). In addition to the multidisciplinary synergies that are readily available in DASNR and CEAT, BAE faculty collaboration has occurred with nearly all other OSU colleges and externally with a large number of educational institutions, federal/state/local agencies, and the private sector. The following table presents a partial list of multidisciplinary efforts in which the BAE faculty have been involved over the past five years.

Multidisciplinary Program	BAE Faculty	Cooperating Faculty	University/ Agency/ Organization	College	Department
The Oklahoma Mesonet, a world-class weather and soil monitoring network	Elliott Carlson Sutherland	Crawford	University of Oklahoma	Geo-sciences	Oklahoma Climatological Survey
Applications Engineering program	Elliott Barfield Harp	Hoberock	OSU	CEAT	Mechanical Engineering
			Oklahoma Alliance for Manufacturing Excellence, Oklahoma Dept. of Commerce, Rural Enterprises of Okla., SWOSU		
New Product Development Center	Barfield	Hoberock	OSU	CEAT	Mechanical Engineering
		Alexander	OSU	EREDF	
Automated Meat Grading	Kranzler	Morgan	OSU	DASNR	Animal Science
Stored Grain Management	Noyes	Phillips	OSU	DASNR	Entomology, Plant Pathology, Ag. Economics
Biofuel from Food Processing Waste Products	Bowser Weckler	DeWitt	OSU	DASNR	Animal Science
Multi-Spectral Digital Imaging of Crops	Weckler Kranzler Solie Stone	Raun, Maness	OSU	DASNR	Horticulture, Plant and Soil Science
Harvesting, Handling, Processing and Storage Technologies for Horticultural	Weckler Kranzler Solie Stone	Maness, Kahn, Motes	OSU	DASNR	Horticulture

Multidisciplinary Program	BAE Faculty	Cooperating Faculty	University/ Agency/ Organization	College	Department
Products					
Nondestructive Evaluation of Agricultural Products using X-Ray Digital Imaging	Weckler Brusewitz Kranzler	Maness, Morgan	OSU	DASNR	Horticulture, Animal Science
Optical sensor based site-specific management and variable rate application of fertilizers	Solie Stone Whitney Weckler Elliott	Raun, Zhang, Johnson, Peeper, Krenzer	OSU	DASNR	Plant and Soil Science
		Bell, Maness	OSU	DASNR	Horticulture
		Mapp			Ag. Economics
		Schepers	USDA		
		Sayre, Ortiz	CIMMYT - Mexico		
		Taylor	Kansas State University		
		Phillips	Virginia Tech. University		
Weed Control in Cereal Grains	Solie Stone Whitney Weckler Elliott	Peeper	OSU	DASNR	Plant and Soil Science
Golf Course Runoff Control Research Team	Kizer		OSU	DASNR, A&S	Plant and Soil Science, Statistics
DASNR Water Quality Initiative Team	Smolen Kizer Hamilton McCowan Storm Fram	Zhang, Beem, McKinley, Schnelle, B. Carter, Sanders, Sallee	OSU	DASNR, A&S	Ag. Economics, Forestry, Horticulture, Plant & Soil Sciences, Entomology & Plant Pathology
State Nonpoint Source Program	Smolen Storm	Zhang	OSU, Conservation Commission, DEQ, OWRB, other agencies		
Animal Waste Management in Semiarid Agroecosystems Team	Kizer		OSU	DASNR, A&S	Plant & Soil Sciences, Ag. Economics, Animal Science
Oklahoma Manure Management Informantion Team	Hamilton Kizer Smolen Hamilton	Zhang, Hattey Carter, Waldner, Stoecker, Peel, Norwood Fathepure	OSU	DASNR, A&S	Plant and Soil Science, Animal Science, Agricultural Economics, Microbiology and Molecular

Multidisciplinary Program	BAE Faculty	Cooperating Faculty	University/ Agency/ Organization	College	Department
					Genetics
Poultry Waste Management Education	Hamilton Smolen	Zhang	OSU	DASNR	Plant and Soil Sciences
Ammonia Emissions in Regio Piemonte Italy	Hamilton		University of Torino,		Agricultural, Environmental, Forest Engineering and Economics
Value Added to Poultry Litter Through Vermicomposting	Hamilton	Taylor, Roberts, Edelman	OSU	DASNR	Agricultural Economics, Horticulture, Entomology and Plant Pathology
Biomass Conversion	Bellmer Huhnke Bowser Barfield	Lewis, Johannes	OSU	CEAT	Chemical Engineering
		Taliaferro	OSU	DASNR	Plant and Soil Sciences
		Epplin	OSU	DASNR	Ag. Economics
		Tanner	University of Oklahoma	A&S	Botany and Microbiology
Xanthan Gum Fermentation	Bellmer	Reilly	OSU	DASNR	Animal Science
Strength of Veterinary Sutures	Bellmer	Davidson, Greenberg	OSU	Vet. Med.	Vet. Clinical Sciences
Value-Added Watermelon Products	Bellmer	Maness, McGlynn	OSU	DASNR	Horticulture
Livestock Safety for Kids	Huhnke		OSU	DASNR	Animal Science
			OSU	DASNR	Agricultural Communications
			OSU	Vet. Med.	
Oklahoma AgrAbility Project	Huhnke		OSU	A&S	Oklahoma ABLE Tech
Beef Cattle Manual	Huhnke		OSU	DASNR	Ag. Economics
			OSU	DASNR	Animal Science
			OSU	DASNR	Entomology and Plant Pathology
			OSU	DASNR	Plant and Soil Science
			OSU	Vet. Med.	
Material Science Teaching	Field		OSU	CEAT	Technology
Career Development	Field		State Department of Career Technical education		
Phosphorous Index Development	Storm	Zhang	OSU	DASNR	Plant and Soil Science
Center for	Smolen	Fisher, Marston	OSU	DASNR,	Zoology, Geology,

Multidisciplinary Program	BAE Faculty	Cooperating Faculty	University/ Agency/ Organization	College	Department
Enhancing the Value of Urbanizing Stream Corridors	Storm Barfield	Sanders Turton Moseley Focht		CEAT, A&S, EDUC	CE, Forestry, Educ, Political Science,
		Temple	USDA-ARS		
Nutrient Management Decision Support System for the Eucha Basin	Storm Smolen	Matlock Chaubey Focht	University of Arkansas	Agricultural, Food, & Life Sciences	Biological & Agricultural Engineering
		Haggard Arnold	USDA-ARS		
		Focht	OSU	A&S	Political Science
Insect models and disease models	Carlson Sutherland	Mulder, VonBroembsen, Damicone	OSU, Univ. of Oklahoma	DASNR	Entomology & Plant Pathology
Cattle Stress models	Carlson Sutherland	Waldner, Selk, Lalman	OSU, Univ. of Oklahoma	DASNR	Animal Science
Fire danger models	Carlson	Engle, Bidwell	OSU	DASNR	Plant and Soil Science
			USDA Forest Service, Univ. of Oklahoma		
Freeze protection mechanisms in peaches and pecans	Carlson	McCraw, Smith	OSU	DASNR	Horticulture
Evapotranspiration – Irrigation Scheduling	Kizer Carlson Sutherland	Caddel, Taliaferro, Bell, Martin	OSU, Univ. of Oklahoma	DASNR	Plant and Soil Sciences, Horticulture
Atmospheric Dispersion modeling	Carlson		USDA Forest Service, Univ. of Oklahoma		
Development of International Standards for electronic network communications	Stone		International Standards Organization, Society of Automotive Engineers		
Development of wireless weighing systems	Stone	Bertenshaw	OSU	CEAT	Technology
Environmental Science Graduate Program	Smolen Storm		OSU	DASNR, A&S, CEAT	

Multidisciplinary Program	BAE Faculty	Cooperating Faculty	University/ Agency/ Organization	College	Department
Environmental Science Undergraduate Program	Smolien Storm Field		OSU	DASNR, A&S, CEAT	
State Nonpoint Source Program	Smolien Storm	Zhang	OSU	DASNR	Plant & Soil Sciences
			Conservation Commission, DEQ, OWRB, other agencies		
Production, development and marketing of value-added horticultural products	Bowser	Holcomb McGlynn Kelsey Maness	OSU, Univ of Ark, Iowa State	DASNR	Ag Economics Hort & LA Ag Education

The following table presents a partial list of projects involving BAE faculty and the private sector over the past five years:

Type of Activity	BAE Faculty/Staff	Company	Location
Development of wireless weighing systems	Stone	Unibridge	Woodward
Development of control system for hydraulic Bermuda grass sprigger	Weckler, Harp	Bermuda King	Hennessy
Development of truck tire pressure maintenance system	Stone	Airgo	Edmond
Research Project (Sorganol)	Bellmer	Lemax Energy Co	Knoxville, IA
Waste conversion to energy project	Bowser	Bar-S Foods	Altus
Clean-In-Place workshop and optimization	Bowser	BAMA Companies	Tulsa
Plant Expansion	Bowser	CJ Nutracon	Guymon
Plant design and construction	Bowser	Guymon Extracts	Guymon
Process development	Bowser Apps Engineers	Danlin Industries Corp	Thomas
Cooking process optimization	Bowser Reilly –FAPC	Double D Foods	Oklahoma City
Plant design and layout	Bowser Jason Young –FAPC Jim Brooks –FAPC	Eagle Chief Jerky	Alva
Plant expansion	Bowser David Moe –FAPC	VAP, pizza dough plant	Alva
Process development	Bowser Willoughby –FAPC	Griffin Foods	Muskogee
Facility design	Bowser	The Nut House (pecans)	Shawnee
Process optimization	Bowser	Lopez Foods	Oklahoma City
Process development and plant expansion	Bowser McGlynn –FAPC	Trading Companies of America	Tulsa/Mexico
Land Cover	Storm, Smolien	Applied Analysis, Inc.	Billerica, MA

Development using Satellite Imagery			
Senior Design project	Weckler	Charles Machine Works	Perry
		Scotts Pet Products	Tishomingo
		US Army Corps of Engineers	Tulsa
		Bermuda King	Kingfisher
		Honor Farms	Ames
Technical assistance	Weckler	SERTCO, Inc.	Okemah
		Vaughan Foods	Moore
		Republic Paper	Lawton
		Bar-S Foods	Altus

For calendar years 2000 through 2004, the OSU Applications Engineering program completed 366 projects in support of small manufacturers in Oklahoma. This extension program is a joint undertaking of the Division of Agricultural Sciences and Natural Resources, and the College of Engineering, Architecture and Technology. The scope of the projects varied, but each involved the provision of engineering services by professional staff or faculty. The companies served and their locations are listed in Appendix C.

CRITERION III Program Resources

A. New Facilities and Major Equipment

The department has added a special teaching facility to accommodate larger student numbers and to support improved education for students in the use of modern engineering tools. Graduate student offices were sacrificed in order to create a 16-seat engineering workstation laboratory with multimedia instructional capability. All of the computer and projection equipment, as well as the furniture for the room, were funded via BAE and CASNR resources. This laboratory supports engineering computer aided design tools, hydrology and water quality modeling tools, geographic information systems, and project management tools along with conventional software. Undergraduate and graduate classes use the laboratory and some extension programs have also been conducted in the laboratory. The department has also invested significantly in improved technology for its video/teleconferencing John Deere classroom, and has added multimedia capability to another departmental teaching classroom.

In partnership with the Oklahoma Agricultural Experiment Station and the College of Engineering, Architecture and Technology, a new Bioengineering Research facility has been developed within the Advanced Technology Research Center. The 1800 ft² suite of laboratories is a well-equipped biotechnology center with an autoclave, cold room, warm room, gas chromatographs, ion chromatographs, high pressure liquid chromatographs, UV spectrophotometer, four 5-liter fully automated fermenters, several "in-house" designed fermenters, floor and table-top high-speed centrifuges, and water baths. Faculty and students utilizing this facility cooperate on interdisciplinary projects involving biobased product development.

At the BAE West research facility, several additions and improvements have been made. The existing facility was updated with a 1250 ft² addition to house several biomass gasifiers as part of the biomass conversion research project. In 2004, an open-front metal storage shed was built. This 40' x 100' shed with gravel floor consists of five bays and is being used to store biomass feedstocks for the biofuels research program, large machines and demonstration equipment, and other research items requiring protection from the elements.

In addition to equipment for the facilities described above, the department has added the following equipment in support of research, teaching, and extension activities.

Equipment	Description	Approximate Cost
Optical Sensor Laboratory	An "eye-safe" laser facility with a 50 ft ² vibration-isolated optical table and associated equipment to allow development of optically based sensors.	\$50,000
FAA Certified Airborne Multi-Spectral Digital Camera System	An FAA certified airborne digital imaging system to collect spectral bandpass imagery.	\$40,000
Small-Scale Batch Gasifier for Production of Bio-Energy From Food Processing Waste	A pilot scale waste product gasifier/combustion system for waste to energy research.	\$10,000
Digital X-Ray Imaging System	A digital time-continuous x-ray imaging system for nondestructive evaluation of agricultural products and other biological materials.	\$20,000
Five Self-Propelled Variable Rate Applicators	Field machines equipped for sensor based fertilization research with capacities ranging from research scale to full field scale for field crops, turf grass and vegetables.	\$250,000
Field Laboratory to Test Sediment Best Management Practices	A field site with rainfall simulator, runoff and sediment samplers to test the effectiveness of porous BMPs for sediment control	\$25,000
GPS-Based Surveying System	A cm-scale surveying unit for use in teaching.	\$6,000
Clean-In-Place mobile demonstration system	Mobile demonstration cleaning system for food processing equipment. Can be operated remotely via internet.	\$40,000
Departmental Network Servers	A 1.0 terabyte server system for departmental network support consisting of 5 servers with support for the existing 250 workstations.	\$20,000

B. Academic and Administrative Efficiencies

A comprehensive review and revision of the undergraduate curriculum was undertaken in 2001-2002. In this process, careful attention was paid to efficiency in course offerings. For example, strong emphasis was placed on the core curriculum in BAE (those departmental course offerings required for students in all options). Senior-level, option-specific courses are designed as "dual-level" (i.e., they are available for graduate credit), and one of those courses is also cross-listed and team-taught with Chemical Engineering. As another example, the list of controlled electives

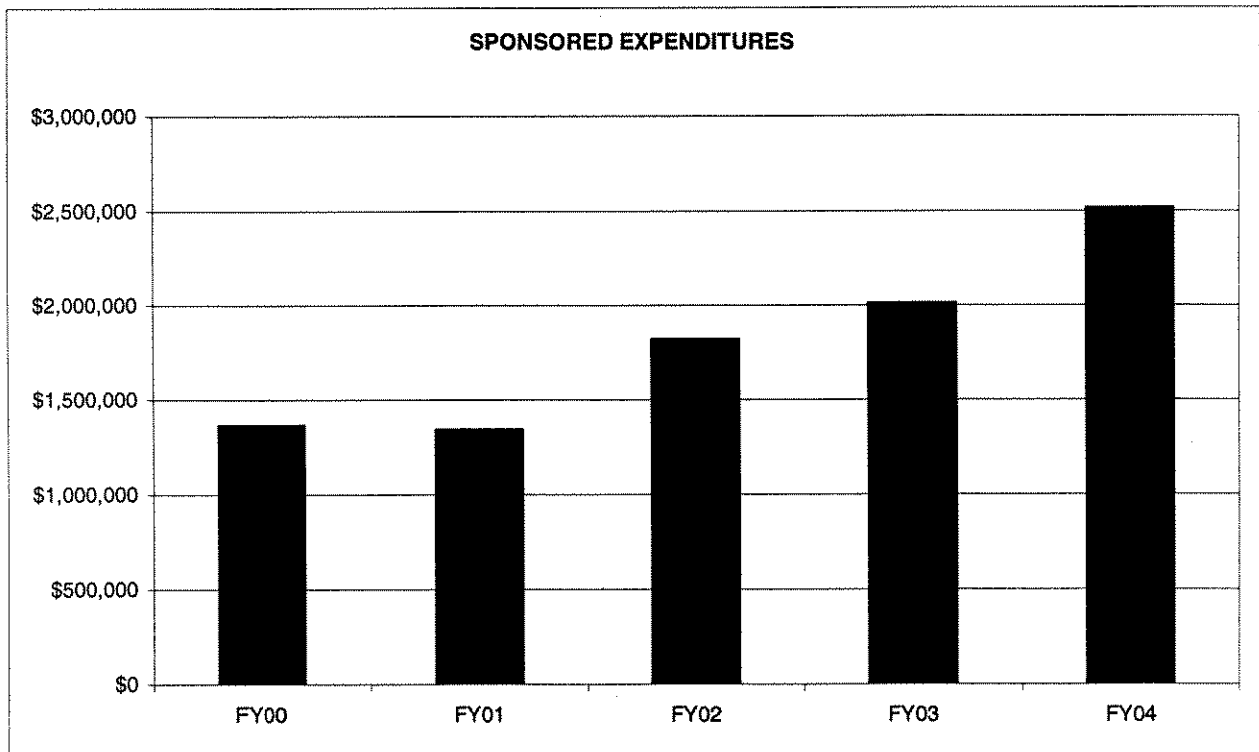
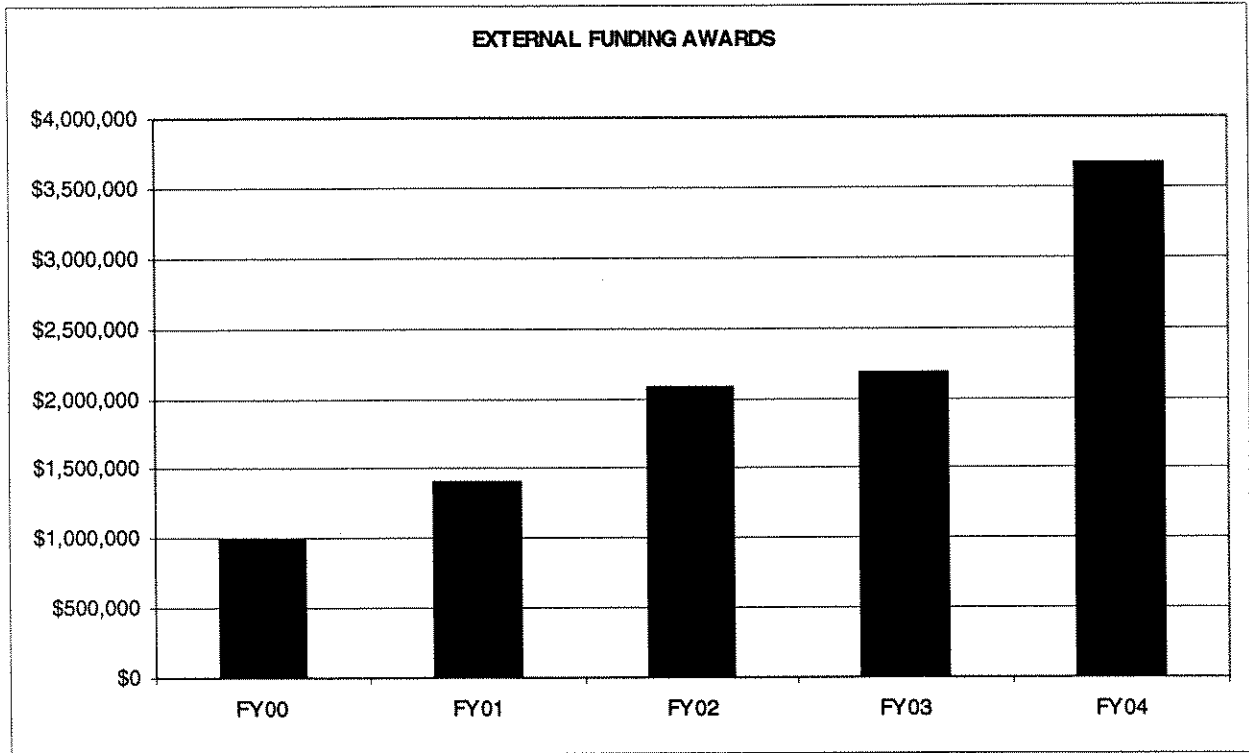
in each option is composed of courses taught by other departments on campus.

A little over one year ago, a strategic decision was made to move to a more distributed system of academic advising of undergraduate students in Biosystems Engineering. The change was necessitated by growth in student enrollment, and by the desire to consider each student's option area when matching the student to a faculty advisor. Currently, five different faculty members advise an average of about 20 undergraduate students each. A staff member has taken on added responsibilities in terms of the record keeping, student tracking, and other logistics associated with the advising process. The new system has enhanced service to students and more equitably distributed the advising load.

The department has seen a greater reliance on external funding to support its research and extension programs. With regard to staff and non-tenure-track faculty positions, between FY01 and FY04, the department experienced a 10% decrease in hard-funded FTEs and a 53% increase in externally-funded FTEs. In FY04, approximately 47% of the salary load for staff and non-tenure-track faculty was funded through grants and contracts (up from 36% three years prior). Due to budget pressures, the department has experienced a one-third reduction in the size of its secretarial staff (from six to four positions). Although this can be viewed as contributing to greater administrative efficiency, the staff reductions have also led to reductions in effectiveness because of the reduced level of support provided to the faculty and department head.

C. External Funding

Appendix A provides a tabulation of external funding received by BAE faculty over the last five years (FY00 through FY04), based upon departmental records. The first chart below shows those award totals by fiscal year. The second chart shows the annual totals of sponsored expenditures, as taken from the Academic Report Card. There is an obvious upward trend in both awards and expenditures. This has occurred despite the department's loss of faculty over this time period.



CRITERION IV Productivity

A. Number of Majors (Headcount), Student Credit Hours, and Average Time to Graduation

Referring to the attached Five-Year Academic Report Card for Biosystems and Agricultural Engineering, the number of undergraduate majors has increased consistently and markedly over the past five years. The Fall 2004 enrollment (99) was 90% greater than the Fall 2000 enrollment (52). This can be attributed to success in both recruitment and retention of students. The student credit hours generated have also increased significantly (42% greater in Fall 2000 than in Fall 2004). This has occurred despite a decrease in the number of teaching faculty in the department. Over the past four years, Biosystems Engineering graduates have on average needed slightly less than 10 full-time semesters to graduate. This figure reflects the rigor of the 133-hour degree program and also the relatively large number of students who are working part-time while pursuing their degree. A period of five years to graduation is not uncommon for other engineering programs at OSU and around the nation.

For the graduate program, enrollment has held fairly steady over the past five years. Fall enrollments have ranged from a low of 28 students to a high of 34 students. Student credit hours generated in Fall graduate classes have declined slightly. The decline in the number of teaching faculty has made it more difficult to sustain graduate course offerings. Also, it should be pointed out the department typically does more graduate teaching in the Spring semester than in the Fall.

B. Faculty Ratio and Class Size

As indicated in the attached Academic Report Card, the student to faculty ratio in the department has more than doubled over the past five years. This is the result of increasing enrollment and a decline in the number of faculty. **Although the temporal trend in student/faculty ratio shown on the Academic Report Card is correct, the magnitudes reported are very misleading.** Specifically, the denominator in the calculation (FTE of instructional faculty) counts each full-time faculty member with any teaching appointment (even at the level of 10%) as a full FTE. For example, for Fall 2004 the calculations showed nine full-time and two part-time instructional faculty, for a total FTE of 9.67. However, the actual total FTE assigned to instructional activities was only about 4.5, meaning that the Report Card's student/faculty ratio (11.6) was less than half what it should be (approximately 25). Another complicating factor is that the numerator in the calculation reflects only students enrolled in Biosystems Engineering, but the denominator reflects faculty who teach MCAG and AG service courses as well as those who teach courses for the Biosystems Engineering major.

The department has a very small percentage of its classes with more than 50 students. Basically, the Fall percentage of approximately 8% reflects just one class (AG 2112, a service course). The percentage of classes with fewer than 20 students has fluctuated a great deal over the past five Fall semesters (anywhere from 38 to 67%).

**Oklahoma State University
FIVE-YEAR ACADEMIC REPORT CARD
BIOSYS & AG ENGR**

Fall Semester	2000	2001	2002	2003	2004	Change						
						Amount	Percent					
Student Information												
Headcount												
Undergraduate	52	62	70	81	89	47	90.4%					
Graduate	32	34	35	28	30	-2	-6.3%					
Professional	0	0	0	0	0	0	-					
Total	84	96	105	109	129	45	53.0%					
Minority	21	28	37	38	40	19	90.5%					
Non-minority	63	68	68	71	89	26	41.3%					
Entry Information												
ACT Average												
ACT 25th - 75th Percentile												
Top 10% High Sch. Class(%)	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%					
Retention/Graduation Rates												
No. of Full-time Semesters	0	9.8	9.5	9.5	10.4	0.8	8.3%					
Semester Credit Hours - State												
Funded												
Undergraduate	553	617	679	807	787	234	42.3%					
Graduate	114	101	105	105	89	-25	-21.9%					
Professional	0	0	0	0	0	0	-					
Total	667	718	784	912	876	209	31.3%					
Number of Lecture Classes Taught - Avg Class Size												
	Number	Avg.	Number	Avg.	Number	Avg.	Number	Avg.				
Undergraduate	12	20.3	12	23.3	13	22.2	16	21.7	13	24.4	1	8.3%
Graduate/Professional	0	0.0	0	0.0	0	0.0	1	11.0	0	0.0	0	-
All Student	12	20.3	12	23.3	13	22.2	16	21.0	13	24.4	1	8.3%
Class Size												
% of Classes < 20	66.7%	41.7%	61.5%	62.5%	38.5%	-28.2%						
% of Classes > 50	8.3%	8.3%	7.7%	6.3%	7.7%	-0.8%						
OSU-Tulsa												
Headcount	0	0	3	0	1	1	-					
Student Credit Hours	0	0	0	0	0	0	-					
Faculty Information												
Instructional-FTE												
Professor-Lecturer	4.53	3.68	3.54	3.43	4.74	0.21	4.6%					
Graduate Assistant	1.00	2.60	1.50	2.21	1.50	0.50	50.0%					
Total	5.53	6.18	5.04	5.64	6.24	0.71	12.8%					
Headcount Professor-Lecturer												
Total	22	22	23	22	19	-3	-13.6%					
Minority	3	5	5	4	4	1	33.3%					
Tenured/Tenure Track	18	17	16	15	11	-7	-38.9%					
Tenured	16	15	14	14	10	-6	-37.5%					
% Tenured	66.9%	68.2%	67.5%	63.3%	50.9%	-6	-2.0%					
% of Faculty Full - Time	97.3%	100.0%	97.3%	97.1%	93.1%	-4.2%	33.3%					
Student Faculty Ratio	5.5	6.8	7.1	8.4	11.8	6.1	110.8%					
Faculty Salaries vs. Peer Inst (Full-time Faculty - 9 mos.)												
	OSU	Big 12	OSU	Big 12	OSU	Big 12	OSU	Big 12	OSU	Big 12		
Professor	\$82,791	\$81,261	\$80,065	\$82,387	\$80,015	\$83,946	\$82,839	\$86,464	\$84,575	\$1,784	2.2%	
Associate	\$57,568	\$60,273	\$48,060	\$63,018	\$48,060	\$65,578	\$52,893	\$68,536	\$60,109	\$2,541	4.4%	
Assistant	\$52,349	\$52,121	\$53,919	\$53,737	\$53,919	\$55,708	\$55,512	\$58,575	\$58,302	\$5,953	11.4%	
Classes Taught by Tenured/Tenure Track												
% Lower Div. Classes	75%	75%	75%	80%	80%	5.00%						
% Undergrad. Classes	92%	92%	85%	87%	77%	-15.00%						

**Oklahoma State University
FIVE-YEAR ACADEMIC REPORT CARD
BIOSYS & AG ENGR**

Fiscal Year	2000	2001	2002	2003	2004	Change	
						Amount	Percent
Financial Information							
Faculty Salaries	\$278,304	\$300,123	\$286,010	\$233,500	\$223,060	(\$55,254)	-19.9%
Other Salaries	\$33,067	\$37,297	\$43,895	\$41,475	\$49,817	\$16,750	50.7%
Fringe Benefits	\$87,802	\$85,139	\$81,837	\$89,452	\$89,814	\$1,812	2.7%
Travel	\$547	\$11,239	\$12,025	\$17,300	\$13,670	\$13,123	2400.1%
Utilities	\$0	\$0	\$0	\$0	\$0	\$0	-
Supplies Other Oper. Exp.	\$30,519	\$25,797	\$35,147	\$39,029	\$33,223	\$2,704	8.9%
Property, Furniture Equip.	\$15,042	\$4,161	\$9,003	\$9,170	\$465	(\$14,577)	-96.9%
Library Books Periodicals	\$372	\$0	\$133	\$382	\$307	(\$65)	-17.5%
Transfers Other Disbur.	\$0	\$0	\$0	\$0	\$0	\$0	-
Total	\$425,654	\$483,758	\$447,849	\$410,288	\$390,148	(\$35,508)	-8.3%
Cost per SCH	\$224.50	\$340.00	\$311.44	\$243.35	\$182.19	(\$32.31)	-14.4%
Cost per SCH in Constant \$	\$224.50	\$330.32	\$297.55	\$226.73	\$173.55	(\$50.95)	-22.7%
Other Revenue							
Other Student Fees	\$860	\$560	\$6,425	\$600	\$2,810	\$1,750	203.5%
Gifts and Grants	\$0	\$0	\$0	\$0	\$0	\$0	-
OSU-Tulsa Fac. Exp. Transfers	\$0	\$0	\$0	\$0	\$0	\$0	-
Fees Related to Educ. Depts.	\$0	\$0	\$0	\$0	\$0	\$0	-
Other Income	\$9,012	\$12,271	\$17,493	\$20,151	\$18,408	\$9,394	104.2%
Total	\$9,872	\$12,831	\$23,918	\$20,851	\$21,018	\$11,144	112.9%
External Funding							
Sponsored Expenditures**	\$1,383,113	\$1,341,821	\$1,818,032	\$2,009,941	\$2,514,741	\$1,151,628	84.5%

**Excludes federal appropriations for College of Agriculture Sciences and Natural Resources.

With regard to the future, it is likely that the undergraduate enrollment will remain fairly stable following the past few years of rapid growth. The graduate enrollment should increase somewhat, but probably not dramatically. It is difficult to predict enrollments in service courses, but those numbers do not affect the student/faculty ratio as it is currently computed. The department expects to restore some of the faculty positions that it lost over the past four years. Considering all of these factors, the student/faculty ratio is likely to decline somewhat in the next few years. With the undergraduate enrollment having reached about 100 students, and barring a downturn in student retention, the percentage of classes with fewer than 20 students is not likely to increase. There should be little change in the percentage of classes with more than 50 students. The plans to restore faculty positions will of course impact the budget, but the instructional (E&G) funds are well leveraged through the use of joint appointments with the Oklahoma Agricultural Experiment Station and/or Oklahoma Cooperative Extension Service.

C. 5 Year Average Number of Degrees Conferred and Majors

Degree	Number of Degrees Conferred		Majors (Headcount) – Fall Semester	
	OSRHE standard	5 yr average	OSRHE standard	5 yr average
Certificate	NA		NA	
Baccalaureate	5	8	12.5	73
Masters	3	5	6.0	16
Doctoral	2	2	4.5	13

The B.S., M.S., and Ph.D. programs in Biosystems Engineering all meet the OSRHE minimum productivity standards for number of graduates and number of majors. For the B.S. program, the number of degrees conferred per year will rise significantly over the next few years. For example, 18 students are expected to graduate during calendar year 2005. The productivity numbers for the graduate program should rise over time, as faculty positions are restored to the department. The visa difficulties that some prospective international students face are a continuing concern.

In addition to the graduate programs in Biosystems Engineering, BAE faculty serve as advisors for graduate students in the interdisciplinary Environmental Science program. Currently there are 3 Environmental Science students (2 M.S. and 1 Ph.D.) being advised by BAE faculty.

CRITERION V Quality

A. Program faculty qualifications

Name	Faculty Status (Regular or Adjunct)	Faculty FTE in Program	Degrees Earned		Related Work Experience (years)
			Highest	Highest in Teaching Area	
			Type	Type	
Barfield, Billy J.	Regular	1.0	Ph.D.	Ph.D.	39
Bellmer, Danielle D.	Regular	1.0	Ph.D.	Ph.D.	9
Bowser, Timothy J.	Regular	1.0	Ph.D.	N/A*	20
Brown, Glenn O.	Regular	1.0	Ph.D.	Ph.D.	26
Brusewitz, Gerald H.	Regular	1.0	Ph.D.	Ph.D.	36
Carlson, J.D.	Regular	1.0	Ph.D.	N/A*	23
Elliott, Ronald L.	Regular	1.0	Ph.D.	Ph.D.	30
Field, Harry L.	Regular	1.0	Ed.D.	Ed.D.	22
Fowler, Steven L.	Regular	1.0	B.S.	B.S.	1
Haan, C.T.	Regular	1.0	Ph.D.	Ph.D.	37
Hamilton, Douglas W.	Regular	1.0	Ph.D.	N/A*	15
Harp, Sam L.	Regular	1.0	M.S.	N/A*	34
Huhnke, Raymond L.	Regular	1.0	Ph.D.	N/A*	31
Kizer, Michael A.	Regular	1.0	Ph.D.	Ph.D.	27
Kranzler, Glenn A.	Regular	1.0	Ph.D.	Ph.D.	28
Lalman, Jerald A.	Regular	1.0	Ph.D.	Ph.D.	19
Ndegwa, Pius	Regular	1.0	Ph.D.	N/A*	9
Noyes, Ronald T.	Regular	1.0	Ph.D.	N/A*	40
Ostermann, Rebecca A.	Regular	1.0	B.S.	B.S.	4
Smolen, Michael D.	Regular	1.0	Ph.D.	N/A*	29
Solie, John B.	Regular	1.0	Ph.D.	Ph.D.	23
Stone, Marvin L.	Regular	1.0	Ph.D.	Ph.D.	25
Storm, Daniel E.	Regular	1.0	Ph.D.	Ph.D.	20
Sutherland, Albert J.	Regular	1.0	M.S.	N/A*	27
Weckler, Paul R.	Regular	1.0	Ph.D.	Ph.D.	16

* No teaching appointment.

The above table lists all "hard-funded" faculty who were employed in the department at any time from 2000 to 2005. The faculty in the shaded rows are those who left the department due to retirement or resignation. As of March 1, 2005, the department has 13 full-time tenure-track faculty, 3 full-time hard-funded non-tenure-track faculty, 3 FTEs of grant-funded non-tenure-track faculty, and 2 emeritus faculty who have been hired back on a part-time basis (approximately 0.2 FTE each). Only about 4.5 faculty FTEs are devoted to instructional activities, with the remaining FTEs assigned to research and extension. The department has several adjunct faculty; their involvement in classroom teaching is limited to occasional guest lectures.

B. Evidence of Regional/National Reputation and Ranking

Although it is only one measure, election to the membership grade of Fellow in one's professional society provides clear evidence of a faculty member's productivity and national reputation. Of the 20 tenure-track faculty who have been employed in the department over the past five years, 9 are Fellows in the American Society of Agricultural Engineers (ASAE). This latter statistic is revealing, given that only about 2% of ASAE members earn the Fellow distinction. Another BAE faculty member was recently recognized as a Teaching Fellow by the North American Colleges and Teachers of Agriculture.

National awards provide further evidence of departmental stature. In addition to the Fellow recognitions noted above, BAE faculty have won the following national awards during the 2000-2004 time period (each is a singular recognition):

- USDA Secretary's Honor Award (twice)
- ASAE John Deere Gold Medal Award
- ASAE Evelyn E. Rosentreter Standards Award
- ASAE Kishida International Award
- Excellence in Natural Resource and Environmental Education Award. from the National Association of Extension 4-H Agents

The performance of students in national competitions, and other student recognitions, are metrics reflecting the quality and reputation of a department. In just the most recent academic year (2003-2004), Biosystems Engineering students had the following successes at the national level:

- An OSU senior design team won the ASAE AGCO National Student Design Competition.
- The OSU team ("Cowboy Motor Sports") won the ASAE ¼ Scale Tractor Student Design Competition, besting 25 other teams from across the United States and Canada. The OSU "X Team" (underclassmen who modify the previous year's tractor) also placed first in their national competition.
- An OSU student received the ASAE Student Engineer of the Year Scholarship (only one award nationally), and another OSU student was the runner-up.
- An OSU student finished her term of office as the President of the ASAE Preprofessionals Council (the highest elected student office in the society).
- The OSU chapter of Alpha Epsilon, the honor society for agricultural and biological engineering, was honored as the outstanding chapter for 2004.

C. Scholarly Activity

Departmental faculty produce scholarly works in diverse categories closely associated with the department's missions in teaching, research and extension. Appendix B provides a compilation of scholarly works as reported by individual faculty. The works are heavily dominated by refereed journal publications, but also include books, patents, and extension publications. Over the past five years, departmental faculty have produced 8 patents, 7 books, 16 book chapters, and 87 refereed journal articles. These totals reflect unique scholarly works (i.e., those authored by more than one BAE faculty member are counted just once). There is no clear temporal trend in the total scholarly work production by the department.

D. Assessment of Student Achievement of Expected Learning Outcomes for Each Degree Program

Degree Program Assessed	(Selected) Key Expected Outcome	Method Used to Assess This Outcome	Years This Assessment Conducted	No. Assessed
Bachelor of Science in Biosystems Engineering	To be proficient in the use of modern engineering tools	Exit interview	2000-2001	8
			2001-2002	3
			2002-2003	7
			2003-2004	9
	To apply mathematical, physical, engineering, and biological principles to understand, analyze, and effect solutions of problems in food, agricultural, and environmental systems	Student performance on the Fundamentals of Engineering (FE) Exam	1999-2004	40
	To be proficient in oral, written, and graphical communication	Student performance in senior design experience	2001 2002 2004	8 7 7
Master of Science in Biosystems Engineering	Ability to conduct, evaluate, and report scientific research in a Biosystems Engineering subject matter area	Graduate program alumni survey	2001	8
			2002	17
			2004	12
Doctor of Philosophy in Biosystems Engineering	Ability to conduct, evaluate, and report scientific research in a Biosystems Engineering subject matter area	Graduate student satisfaction survey	2001	8
			2002	17
			2004	5

E. Overview of Results from Program Outcomes Assessment

Note: For brevity, in most cases the results discussed below are for the most recent assessment cycle.

Exit Interview

The written survey instrument focused on questions corresponding directly to the twelve

expected student outcomes for the degree program. In the survey, each graduating senior was asked: "How well did your OSU education prepare you:

To apply knowledge of mathematics, science, and engineering
To design and conduct experiments, as well as to analyze and interpret data
.....
Etc.

A numerical scale was used (1 = "very well"; 2 = "adequately"; 3 = "not very well"; 4 = "not at all"). The overall mean response for all students and all 12 questions was 1.52, and none of the twelve outcomes had a mean response above 1.88. These results clearly indicate that the graduating seniors felt adequately prepared in the outcome areas.

Using the same numerical scale, the survey also asked about the adequacy of the student's undergraduate studies in preparing him/her for the first job following graduation (mean response = 1.50), the student's satisfaction with the quality of instruction in the major field of study (mean response = 1.22), and the student's satisfaction with the overall educational experience at OSU (mean response = 1.67).

During the individual, private, exit interview with the department head, each graduating student shared observations on such things as instructional quality, adequacy of advising, helpfulness of staff, etc. These confidential observations are evaluated and integrated by the department head and, as appropriate, provide impetus for improvements in departmental programs.

Student Performance on the Fundamentals of Engineering (FE) Exam

The nationally administered Fundamentals of Engineering examination provides a useful assessment tool to evaluate students' knowledge of engineering subject matter. This examination is the first of two examinations that must be passed to obtain registration as a professional engineer. The examination covers subject matter in the categories: chemistry, computers, dynamics, electrical circuits, engineering economics, ethics, fluid mechanics, materials science/strength of materials, mathematics, mechanics of materials, statics, and thermodynamics. This examination is administered in morning and afternoon sessions. The morning session surveys the general knowledge in each category. The afternoon session requires solution of engineering problems in each category. There are twice as many questions in each category in the morning session.

Oklahoma State University Biosystems Engineering Student performance can be compared to the performance of all students nationally in similar majors. In looking at the combined results of the October 2003 and April 2004 exams, 80% of OSU Biosystems Engineering students passed the exam. Nationally, 78% of students in ag/bio engineering curricula passed the exam. With regard to performance in individual subject matter areas, data were pooled over the five-year period because of the small sample size in any one semester. In addition, a weighted composite score was constructed to account for the difference in the number and difficulty of questions in the morning and afternoon sessions. Assuming a normal distribution of scores, a statistical comparison of student performance can be made by category. Results can be used to determine strengths and weaknesses of Biosystems Engineering students' engineering education in each subject matter category over the five-year period.

Results of the analysis are shown in the following table. In nine of the twelve subject matter categories, Oklahoma State University student performance was not significantly different from the national student performance. In the engineering economics category, OSU student performance was significantly better than the national average. In two categories (mathematics and materials), performance was significantly poorer. The students' education in mathematics has been a significant concern within the College of Engineering, Architecture and Technology and in this department. The OSU Mathematics Department has instituted a major restructuring of the calculus sequence, which should improve student performance. The relatively lower performance in the materials science section is likely a direct result of our curricular emphasis on the properties of biological materials. Most of our students do not take the traditional materials science course whose subject matter is tested in the FE examination.

Performance of Oklahoma State University Biosystems Engineering students compared to the performance of all students nationally in similar curricula on the Fundamentals of Engineering Examination administered for the period from Fall 1999 through Spring 2004. Weighted composite scores (morning and afternoon sessions) are compared.				
Subject	Percent Correct OSU Biosys. Eng.	Percent Correct Nat'l. Bio/Ag Eng.	Deviation from Peer Mean	P-value (two-sided not-equal variance test)
Chemistry	59.22%	59.39%	-0.16%	0.9226
Computers	63.96%	63.60%	0.36%	0.8654
Dynamics	47.79%	49.35%	-1.57%	0.3873
Electrical Circuits	53.31%	51.26%	2.05%	0.2028
Engineering Economics	59.30%	51.06%	8.23%	0.0006** *
Ethics	78.11%	75.11%	3.00%	0.1455
Fluid Mechanics	59.34%	57.29%	2.05%	0.2955
Materials Science/ Strength of Materials	48.34%	56.37%	-8.04%	0.0001** *
Mathematics	50.54%	56.46%	-5.93%	0.0000** *
Mechanics of Materials	49.48%	47.70%	1.77%	0.3700
Statics	52.35%	53.22%	-0.87%	0.5873
Thermodynamics	48.01%	49.51%	-1.49%	0.3646
*** Significantly different at the 1% level.				

Student Performance in the Senior Design Experience

The capstone design course sequence (BAE 4012/4022 – Senior Engineering Design Project I & II) allows the student to demonstrate his/her ability to develop design solutions for "real-world" open-ended biosystems and agricultural engineering projects. Student class assignments are "deliverables," much the same as would be found in industry. The assignments include: a project

schedule, functional engineering specifications, concept generation and feasibility analysis, detailed design, fabrication/assembly drawings, working prototype, test plan and report, and final documentation. Project deliverables are presented in writing and orally to the course instructor, industry representatives, other faculty and staff, students and guests.

The purpose of the senior design sequence is to integrate much of the engineering knowledge and skills acquired in the curriculum and apply them to the design and implementation of a “product,” and to give the students an opportunity to experience team-based design under conditions that somewhat resemble those that will be encountered in industry. In order to be successful in this capstone experience, students must develop and sharpen skills in team organization, time management, self-discipline, and technical writing. An important goal is to expose students to a hands-on experience in which they have to specify, design, and produce a comprehensive solution beginning from relatively ill-posed needs as stated by a customer. This has to be accomplished while working as a team, and under time pressure.

The senior design final presentations were given on April 29, 2004 to an audience comprised of faculty, staff, graduate and undergraduate students, project sponsors, members of the BAE Advisory Committee, and other guests. Those in attendance were requested to fill out an evaluation form to assess each group’s presentation. Summaries of those evaluations are presented below. The majority of respondents ranked the student presentations in the outstanding (> 90%) category, with strong performance in each of the individual evaluation categories.

Evaluation results for the final project presentation of the senior design students who developed an automatic system for separating and packaging pig ears for packaging as dog treats.								
Evaluation Category								
	No.	Organization (15 pts)	Transfer of technical information (25 pts)	Poise/skill/professionalism in communicating (20 pts)	Quality of visual aids (15 pts)	Response to questions (15 pts)	Comments (10 pts)	Total (100 pts)
BAE Advisory Committee	6	12.8	21.7	17.7	13.7	14.2	8.8	88.8
Project Sponsors	2	14.5	24.0	15.5	15.0	14.5	9.5	93.0
Faculty	8	11.3	19.3	14.8	11.9	11.6	9.8	78.5
Staff	5	14.0	22.4	17.2	14.6	14.8	9.8	92.8
Students	28	14.6	23.9	19.2	14.5	14.4	9.5	96.0
Others	22	14.4	22.9	18.2	14.2	14.0	8.4	92.1
ALL	71	14.0	22.8	18.0	14.1	14.0	9.1	91.9

Evaluation results for the final project presentation of the senior design students who developed an effective means of silt fence installation.

	No.	Evaluation Category						Total (100 pts)
		Organization (15 pts)	Transfer of technical information (25 pts)	Poise/skill/professionalism in communicating (20 pts)	Quality of visual aids (15 pts)	Response to questions (15 pts)	Comments (10 pts)	
BAE Advisory Committee	6	13.7	21.8	19.5	14.3	12.5	9.7	91.5
Project Sponsors	2	15.0	23.5	17.5	15.0	13.0	9.0	93.0
Faculty	7	13.6	23.1	17.6	13.7	13.9	9.9	91.7
Staff	4	14.8	20.3	17.5	14.5	14.3	9.5	90.8
Students	26	14.6	23.1	18.7	14.9	14.7	9.9	95.9
Others	20	14.4	22.9	19.0	14.4	14.1	8.5	93.1
ALL	65	14.4	22.7	18.6	14.5	14.2	9.4	93.8

In addition to the evaluations of the final project presentations, senior design students are assessed based on the course assignments and reports, other oral presentations, general class participation, and peer feedback. The reports and presentations prepared by the student design teams are evaluated in the areas of technical content, creative application of knowledge, teamwork, student-client interaction, communication skills, and overall professionalism. The senior design experience supports all of the expected outcomes for the Biosystems Engineering program, with particular emphasis in the areas of ability to design systems, teamwork, and communications.

Undergraduate program alumni survey

An undergraduate alumni survey was conducted by the OSU Bureau for Social Research in February 2004, and the report from the Office of University Assessment recently became available. This survey assesses alumni perception for B.S. graduates of 1998 and 2002. Responses from both years were combined. Based on the survey results, the following general observations are made:

1. All Biosystems Engineering undergraduate alumni observed that their academic program prepared them adequately or very well for their current positions. They were universally employed in a position that was either "highly related" or "moderately related" to their field of study.
2. All Biosystems Engineering undergraduate alumni were "very satisfied" or "somewhat satisfied" with their instruction in Biosystems Engineering and with their overall undergraduate experience at OSU. Most felt the same regarding advising in Biosystems Engineering although 25% of the respondents were "somewhat dissatisfied."
3. 37.5% of the Biosystems Engineering undergraduate alumni surveyed were pursuing or have

completed graduate degrees and all observed that their undergraduate training had prepared them "adequately" or "very well" for graduate work. We believe this indicates that the graduates recognize the need for life-long learning and a significant proportion have taken action in that regard.

4. The program-specific portion of the survey addressed ABET outcomes that are an important part of the accreditation process. The Biosystems Engineering undergraduate alumni surveyed were unanimous in observing that they were either "adequately" or "very well" prepared with regard to ABET outcomes, with the exception of one respondent indicating "not very well prepared" in each of the following three areas: designing a system, component, or process to meet desired needs; providing a foundation for understanding and addressing social, political, aesthetic issues in decisions; and communicating effectively in oral, written, and graphical forms.
5. A final question surveyed Biosystems Engineering undergraduate alumni regarding participation in six different types of continuing education. In each of the six categories, half or more of the alumni responded that they had participated in these types of activities.

We conclude from the responses that Biosystems Engineering undergraduate alumni are generally very satisfied with their undergraduate education. Steps have been taken to address the concern regarding advising, and we are confident that the results of those actions will be reflected in future alumni surveys.

For the Master of Science and Doctor of Philosophy Degree Programs

Graduate program alumni survey

A survey of graduate student alumni was conducted in January 2003, and the results became available in August 2003. Coordinated by the Office of University Assessment, the survey targeted alumni who received their graduate degrees in calendar years 1997 and 2001. Among Biosystems Engineering graduate alumni, seven (7) Ph.D. graduates and five (5) M.S. graduates responded to the survey. Based on the survey results, the following general observations are made relative to program assessment:

1. All Biosystems Engineering graduate alumni observed that their program prepared them "very well" for their current positions. They were universally employed in a position that was either "highly related" or "moderately related" to their graduate studies.
2. Eleven of the twelve respondents indicated that they were "very satisfied" with their overall educational experience at OSU, and the other respondent indicated "satisfied."
3. All respondents were "satisfied" or "very satisfied" with the following aspects of their graduate program: instruction in courses; availability of facilities, equipment, and instrumentation; the contributions of their graduate advisor; and preparation for continuing professional and personal development.
4. One of the twelve respondents was "dissatisfied" with the availability of computer resources (the other eleven were "satisfied" or "very satisfied"): A similar response was received with regard to the assistance of technicians and other support staff (only one of twelve was "dissatisfied").

Graduate student satisfaction survey

Biosystems Engineering graduate students were clearly satisfied with the quality and climate of their academic programs, and with their relationships with their advisors and advisory committees.

F. Feedback from Program Alumni / Documented Achievements of Program Graduates

Biosystems and Agricultural Engineering maintains an advisory committee composed of the departments constituents. Alumni are well represented on the advisory committee. The committee meets annually and has an opportunity to voice concerns or advice regarding both the graduate and undergraduate teaching programs. Program Outcomes were developed with input from constituents through the BAE advisory committee. The advisory committee also regularly reviews the program objectives and adjustments are made based primarily on the advisory committee recommendations.

Results of alumni surveys of both undergraduate and graduate programs in Biosystems and Agricultural Engineering were presented above in part D.

G. Other Program Evaluations

Following a self-study report and team visit in 2003, it was announced in August 2004 that the B.S. program in Biosystems Engineering has been accredited for another six years (the maximum possible). This action was taken by the Engineering Accreditation Commission (EAC) of the Accreditation Board for Engineering and Technology (ABET). Information on EAC/ABET and the accreditation process can be found at <http://www.abet.org>.

CRITERION VI Program Demand/Need

A. Occupation Manpower Demand

BAE Advisory Committee

The members of the Biosystems and Agricultural Engineering Advisory Committee meet annually and consistently stress the importance of preparing Biosystems Engineers to enter the workforce. The Advisory Committee has the following purposes:

- to provide feedback and advice to the department head and faculty with the goal of enhancing departmental programs and operations.
- to represent several constituencies important to the BAE teaching, research and extension programs (e.g., employers of BAE graduates, departmental alumni, taxpayers).
- to identify current and future needs of industry and government relative to BAE graduates.
- to serve as an informal communication vehicle to external individuals and organizations.

The following individuals have participated in one or more meetings of the Advisory Committee over the past five years:

Larry Caldwell	USDA Natural Resources Conservation Service
Dr. Floyd Dowell	USDA Agricultural Research Service
Cassie Eigenmann Pierson	Dickey-John Corp.
Mark Farabee	Halliburton Energy Services
Johnny Green	USDA Natural Resources Conservation Service
Joe Greenlee	Charles Machine Works
Mitch Griffin	CH2M Hill
Ricky Heflin	Mobile Products; Davis Precision Design
Scott Henderson	U. S. Army Corps of Engineers
Steve Kennedy	F. W. Murphy
Tim Kraus	New Holland North America
Dr. Otto Loewer	University of Arkansas
Dr. Ron Morgan	Halliburton Energy Services; BeefMaster Cattle Company
Kelvin Self	Charles Machine Works
Dr. Terry Siebenmorgen	University of Arkansas
Harold Springer	OK Water Resources Board; OK Dept. of Agriculture; Consultant
Mark Stacey	CPT Engineers; Terra Technologies
Mike Veltri	NutriSweet Kelco

Other Sources

Bio/Ag Engineering graduates are employed in a number of fields within industry, government, and education. It is not feasible to assess the specific manpower demand within each employment sector. The following sources provide information on employment and salaries of agricultural engineers, and are indicative of current and future demands:

- America's Career INFONET (www.Acinet.org/acinet)
 - Median yearly salary = \$52,400

- 10% increase in employment from 2002 to 2012
- Economic Research Institute (www.erieri.com)
 - Mean salary potential for 2020 = \$98,424
- Texas A&M University 2003 (<http://careercenter.tamu.edu/employers>)
 - Median starting salary for BS Agricultural Engineering = \$52,000
- North Dakota State University (www.ageng.ndsu.edu/jobplace.html)
 - Mean starting salary = \$50,075
- US Dept. of Labor, Bureau of Labor Statistics (www.bls.gov/oco/ocos261.htm)
 - "...employment of agricultural engineers is expected to increase as fast as the average of all occupations through 2012"
 - "Median annual earnings of agricultural engineers were \$50,700 in 2002. Middle 50% earned between \$40,320 and \$70,100."
- Machine Design annual salary and job satisfaction survey 2004 (www.machinedesign.com)
 - For all engineers with less than 3 years experience, mean salary = \$44,400 and median = \$43,800

Placement of Graduates

The Biosystems and Agricultural Engineering Department has had considerable success placing both its B.S. and advanced degree students. The following table lists all graduating students from Fall 2000 through Fall 2004 and their first employers (if known). Starting salaries of these graduates have been competitive with other engineering disciplines as well as with students from other Bio/Ag Engineering programs.

Last Name	First Name	Graduation Term	Degree	Initial Employer
Guy	Travis	Fall 2004	B.S.	
Johnson	Candice	Fall 2004	B.S.	John Deere & Co.
Hornbuckle	Kim	Fall 2004	M.S.	Research Engr., Oklahoma State University
Rao	Bhaskar	Fall 2004	M.S.	
Demissie	Tesfaye	Fall 2004	Ph.D.	Environmental Consulting Firm
Bajracharya	Mahesh	Sum 2004	M.S.	
Choudhary	Ruplal	Sum 2004	Ph.D.	National Dairy Research Institute (India)
Crouch	Carol	Spr 2004	Ph.D. (ES)*	USDA Natural Resources Conservation Service
Evatt	Kent	Spr 2004	B.S.	Halliburton Energy Services
Featherston	Kody	Spr 2004	B.S.	Halliburton Energy Services
Fowler	Steven	Spr 2004	B.S.	Lecturer Oklahoma State University
Johnston	Monica	Spr 2004	B.S.	USDA-NRCS
Steinert	Matthew	Spr 2004	B.S.	M.S. Student in BAE, OSU
Storm	Derek	Spr 2004	B.S.	Plastipak Packaging
Subbiah	Jeyamkondan	Spr 2004	Ph.D.	Faculty University of Nebraska
Kish	Peter	Spr 2004	Ph.D. (ES)*	Oklahoma School for Science and Mathematics
Silitonga	Maifan	Spr 2004	Ph.D. (ES)*	Water Quality Education Coordinator, OSU
Crawford	Mary	Fall 2003	B.S.	M.S. Student, Oklahoma State University
Maitlen	Cash	Fall 2003	B.S.	VMI, Inc.
Ashagarathra	Saleh	Fall 2003	M.S.	Ph.D. Student at Oklahoma State University
Bangalore	Dharmendra	Sum 2003	M.S.	Food and Agricultural Product Center

Gadiware	Paisar	Sum 2003	M.S.	Returned to Philippines
Reed	Stewart	Sum 2003	M.S.	Ntech Industries, Inc.
Kotwaliwale	Nachiket	Sum 2003	Ph.D.	Returned to India
Needham	Duane	Sum 2003	Ph.D.	Consulting
Fisher	Chad	Spr 2003	B.S.	Halliburton Energy Services
Friedrich	Mickey	Spr 2003	B.S.	Halliburton Energy Services
George	Darren	Spr 2003	B.S.	Terracon
Schneider	Scott	Spr 2003	B.S.	USDA Natural Resources Conservation Service
Cross	Chris	Spr 2003	M.S.	City of Owasso Board of Public Works
Mykhalovin	Oleksandr	Spr 2003	M.S. (ES)*	EcoCheese Ltd.
Carment	David	Fall 2002	B.S.	Halliburton Energy Services
Holloway	Jake	Fall 2002	B.S.	FW Murphy
Hood	Autumn	Fall 2002	B.S.	Coordinator OSU New Product Development Center
Simmons	Dustin	Fall 2002	B.S.	Halliburton Energy Services
Komjarova	Irina	Fall 2002	M.S.	Ph.D. Student in Belgium
Kourtchev	Ivan	Fall 2002	M.S.	Ph.D. Student in Belgium
Lakshmikauth	Anand	Fall 2002	M.S.	PhD Student, VPI&SU
Lelo	Mamosi	Fall 2002	M.S.	
Compston Whaley	Christal	Spr 2002	B.S.	Perramar Consulting
Willoughby	Elizabeth	Spr 2002	B.S.	Leggett and Platt
Al Osta	Houssam	Spr 2002	M.S.	Ph.D. Student in BAE
Parker	Shannon	Sum 2002	B.S.	USDA Natural Resources Conservation Service
Kersten	Ted	Sum 2002	M.S.	USDA Natural Resources Conservation Service
Ginger	Meagan	Fall 2001	B.S.	Excel Meats
White	Michael	Fall 2001	M.S.	Research Engineer Oklahoma State University
Daniels-Pearce	Missy	Fall 2001	Ph.D.	
Vogel	Jason	Fall 2001	Ph.D.	U.S. Geological Survey
Cross	Chris	Spr 2001	B.S.	Graduate Student at OSU
Neal	Brandon	Spr 2001	B.S.	FHC, Inc. Consulting
Priest	Nathan	Spr 2001	B.S.	self-employed
Vandale	Kyle	Spr 2001	B.S.	Graduate Student at Oklahoma State University
Adhikary	Mimin	Spr 2001	M.S.	
Landrith	Darcey	Sum 2001	B.S.	FHC, Inc. Consulting
Adams	Jeff	Fall 2000	B.S.	FHC, Inc. Consulting
Washburn	Curtis	Fall 2000	B.S.	USDA Natural Resources Conservation Service
Britton Hunt	Sherry	Fall 2000	M.S.	USDA-ARS Hydraulics Laboratory
Chavez	Rebecca	Fall 2000	M.S.	Department of Transportation
Keyworth	Valerie	Fall 2000	M.S.	Oklahoma Conservation Commission
Popova	Yulia	Fall 2000	M.S.	OSU Agricultural Economics
Tyagi	Aditya	Fall 2000	Ph.D.	CH2MHill

* Interdisciplinary Environmental Science program

B. Societal Needs for the Program

The following discussion summarizes well the critical role that Biosystems Engineers play in our 21st century society. This material is quoted directly from the web site of ASAE – The Society for engineering in agricultural, food, and biological systems.

In the early twentieth century, even in industrialized countries, production of the world's food supply required the labor of at least half the population. Today, thanks in large part to advancements made by biological and agricultural engineers, developed countries can accomplish this using only a slim 2% of their populations. And engineering efforts have not been limited to food production: fiber, timber, and energy products, for example, as well as the technologies, equipment, and precious natural resources required to produce them, have all benefited from the talents and vision of these devoted individuals.

Now, new challenges present themselves. As world population swells, more food, energy, and goods are required. But our limited natural resources demand that we produce more with less, that higher productivity does not degrade our environment, and that we search for new ways to use agricultural products, byproducts, and wastes. Biological and agricultural engineers are responding with viable, environmentally sustainable solutions, the success of which is expanding career opportunities in such related biological fields as medicine, pharmacy, and bio-instrumentation.

Biological and agricultural engineers ensure that we have the necessities of life: safe and plentiful food to eat, pure water to drink, clean fuel and energy sources, and a safe, healthy environment in which to live. More specifically, biological and agricultural engineering (BAE) is the application of engineering principles to any process associated with producing agriculturally based goods and management of our natural resources.

Biological and agricultural engineers:

- *Devise practical, efficient solutions for producing, storing, transporting, processing, and packaging agricultural products*
- *Solve problems related to systems, processes, and machines that interact with humans, plants, animals, microorganisms, and biological materials.*
- *Develop solutions for responsible, alternative uses of agricultural products, byproducts and wastes and of our natural resources - soil, water, air, and energy.*

C. Graduate Student Applications and Enrollment Changes

The graduate program in Biosystems and Agricultural Engineering is integral with the department's research efforts. Graduate students are expected to contribute directly to ongoing research, and the department is therefore selective in recruiting and admissions. A student is only admitted if a faculty member agrees beforehand to serve as the student's advisor. This commitment to research is demonstrated by the relatively high percentage of Ph.D. students, and the fact that virtually all M.S. candidates submit theses. Non-thesis master's programs are only approved by the faculty in rare instances. The commitment to research is also shown by the financial support provided to nearly all graduate students, either as graduate research assistants or research engineers. The only major exceptions are students on outside governmental support, such as Fulbright fellowships.

Graduate applications, admissions, enrollments and graduations have remained fairly steady during the past three years. [Note: We are unable to verify the numerical statistics provided by

the Graduate College. While the average numbers are similar to our departmental records, there are many discrepancies in individual entries.] Variations from year to year are not considered statistically significant. However, the percentage of international students has slowly increased and is a reflection of the generally good job market for American B.S. and M.S. engineers in our field. Recently all qualified domestic students who applied were admitted and have been offered assistantships. The rate of graduations is consistent with our enrollment numbers and the expected time to earn the degree.

While total graduate student numbers have held constant, we have experienced a dramatic reduction in tenure track faculty numbers over the reporting period. Five faculty have retired and one resigned in the last three years; that represents one-third of the previous total. Thus the current student numbers represent a significant increase in the ratio of students to faculty. Because of this increase, we do not plan or expect any change in graduate enrollment until the vacant faculty positions are refilled. Within two years, new faculty may be expected to support on average two to four new graduate students each.

Beyond the Biosystems Engineering program, some departmental faculty also advise and financially support students enrolled in the interdisciplinary Environmental Science graduate program. Currently, three Environmental Science students are advised within the department.

CRITERION VII Program Duplication

A. Identify other degree programs at OSU with similar titles or functions

There are no other programs at OSU with a similar title or function. Furthermore, this is the only program of its type in the state of Oklahoma.

B. For similar programs, describe how each degree program fulfills unique student needs

N/A.

SUMMARY AND RECOMMENDATIONS

A. Strengths

Strengths of the Biosystems and Agricultural Engineering Department include its:

- **Human resources.** BAE faculty, staff, and students are bright, creative, and dedicated.
- **Preparation of students for the 21st century workplace.** Biosystems Engineering graduates understand engineering theory and application, and demonstrate effective teamwork and communication skills as well as strong technical competence.
- **Relevance and impact.** BAE research and extension programs are cutting-edge and make significant contributions to the state's economic productivity, environmental stewardship, and quality of life.
- **Multidisciplinary culture.** BAE faculty value the contributions of colleagues and the synergy that results from working together across disciplines, colleges, and institutions.
- **Extramural funding.** BAE faculty are effective in obtaining grants and contracts that augment and leverage the resources available through appropriated funds.
- **Growth in undergraduate enrollment.** Through improved student recruitment and retention, the number of Biosystems Engineering undergraduates has nearly doubled in the past five years.
- **Attitude of service.** BAE believes in the land-grant philosophy of benefiting others, including students, research and extension clientele, and the citizens of our state, national, and global communities.

B. Areas for Improvement

The Biosystems and Agricultural Engineering Department would like to see improvements in the:

- **Size of its faculty.** Due to retirements and budget shortfalls, the number of tenure-track faculty in BAE has declined from 20 to 13 over the past four years.
- **Compensation for faculty and staff.** Salaries and benefits need to be nationally competitive, and also the university should identify creative ways to retain productive senior faculty and staff as they seek to phase into retirement.
- **Laboratory facilities and equipment for the teaching program.** With enrollment growth, aging facilities, and rapid evolution in technology, BAE faces a constant challenge in providing an adequate infrastructure for laboratory instruction.
- **Graduate student enrollment.** An improving job market, post-9/11 visa challenges, and marginally competitive stipends have made it more difficult to attract high-quality graduate students, particularly non-OSU domestic students.
- **Number of graduate course offerings.** BAE graduate students ask (legitimately) for more departmental courses in their plans of study, but addressing this need has been very difficult due to reductions in faculty numbers and increases in undergraduate enrollment.
- **Amount of office space.** The availability of departmental office space is very limited due to increases in soft-funded professional staff and non-tenure-track faculty positions, and the conversion of a graduate student "bullpen" to a computer classroom.

C. Recommendations for Action

The Biosystems and Agricultural Engineering Department recommends the following actions:

- **"Restore, Reward, and Grow" the BAE faculty.** The critical shortage of departmental faculty needs to be alleviated (this process has begun with the approval of two restored positions), and faculty and staff compensation levels need to be improved across the university.
- **Improve the teaching laboratory infrastructure.** The department needs to prioritize and identify funding for facility renovations and equipment purchases that will enhance the undergraduate and graduate learning experience.
- **Increase the number of graduate students.** The department should devote increased attention to graduate student recruiting, and work to address any obstacles that might limit the attractiveness of OSU-BAE to prospective students.
- **Expand the portfolio of departmental graduate courses.** The department should do a needs-based assessment of current and potential graduate courses, and explore ways of increasing the number and/or frequency of course offerings in a time of limited faculty resources.
- **Identify additional office space.** The department needs to continue to explore ways of acquiring additional office space in order to adequately accommodate graduate students, professional staff, and non-tenure-track faculty.
- **Increase private giving.** The department should work with its alumni and friends, and with OSU Foundation staff, to cultivate donations for opportunities such as undergraduate scholarships, graduate fellowships, study abroad courses, endowed chairs/professorships, facility upgrades, etc.
- **Maintain the undergraduate enrollment.** The department should sustain, and augment as appropriate, its successful strategies for recruiting and retaining undergraduate students.

D. Five-Year Goals for the Program

The Biosystems and Agricultural Engineering Department seeks to:

- Provide excellent academic and professional continuing education programs that are relevant and state-of-the-art.
- Develop technologies, processes, products, and strategies to support efficiency and sustainability in agricultural, food, biological, and natural resource systems.
- Enhance the economic vitality, natural resource base, and quality of life for Oklahoma's citizens.
- Recruit, retain, and develop faculty and staff who reflect diversity, possess appropriate expertise, and display outstanding productivity.
- Provide the physical infrastructure and fiscal resources necessary to support programs of excellence in instruction, research, and extension.

Appendix A
External Grants, Contracts, and Gifts Awarded to Program Faculty

External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Manufacturing Excellence With Applications Engineers in Rural Areas	Barfield	OCAST	57,885				
Trailer Mounted Stream Hydrology Model	Barfield	EPA	19,982				
Development and Commercialization of Ready-To-Eat Pet Food	Bowser	OCAST	13,237				
Development and Commercialization of Pet Food	Bowser	Granny's Hillside Farm	5,900				
Harvesting, Processing & Storage of Horticultural Alternate Crops	Brusewitz	USDA	92,631				
Geothermal Smart Bridge	Elliott	U.S. Department of Transportation	396,731				
Animal Confinement Facility - Health and Safety Issues	Huhnke	University of Texas / DHHS	30,000				
National Advisory Leadership Team for Extension Water Quality Program	Smolen	USDA	100,142				
Oklahoma Water Quality Education	Smolen	USDA	80,000				
State Water Quality Program	Smolen	Oklahoma Department of Agriculture	35,000				
Harvesting, Processing & Storage of Horticultural Alternate Crops	Solie	USDA	75,411				
Locating & Diagnosing Causes of Wheat Yield Losses	Solie	Oklahoma Wheat Commission	12,000				
Geothermal Smart Bridge	Stone	U.S. Department of Transportation	69,402				
Manufacturing Excellence With Applications Engineers in Rural Areas	Barfield	OCAST		12,443			
EPA Seminar	Barfield	EPA		1,500			
Biobased Products Graduate Program	Bellmer	U.S. Dept of Ed		232,842			
Peanut Butter Slices: A Ready-to-Eat Peanut Product	Bellmer	Oklahoma Peanut Commission		4,500			
Development of Irrigation Scheduling Software for Oklahoma Growers	Carlson	U.S. Bureau of Reclamation		11,966			
Tech Transfer	Elliott	USDA		144,105			
Using IKONOS Satellite Imagery	Elliott	NASA		18,854			

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External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Animal Waste Treatment Lagoon Capability	Hamilton	North Carolina / USDA		12,346			
Conversion of Low-Cost Biomass to Ethanol	Huhnke	USDA/IFAFS		434,931			
Animal Confinement	Huhnke	University of Texas / DHHS		17,500			
Southern Region Water Resources	Smolen	USDA / Texas A&M University		119,388			
Illinois River Basin Education Program	Smolen	Oklahoma Conservation Commission		94,500			
State Water Quality Program	Smolen	Oklahoma Department of Agriculture		35,000			
Little Deep Fork Watershed	Smolen	EPA		20,000			
Harvesting, Handling & Processing Systems for Horticulture	Solie	USDA		82,274			
Harvesting, Handling & Processing Systems for Horticulture	Stone	USDA		76,666			
Evaluation of Soil Indices	Storm	EPA		90,156			
Systems Approach to Maintaining Natural Capital in Rapidly Developing Watersheds	Barfield	Clemson University / NSF			25,000		
Manufacturing Excellence With Applications Engineers in Rural Areas	Barfield	OCAST			12,443		
Biomass-Based Energy Research	Huhnke	USDA			691,237		
Oklahoma AgrAbility Project	Huhnke	USDA			591,811		
Development of a Database in Under-Served Communities	Kizer	EPA			6,000		
Industries of the Future	Norton	OCAST / US Dept of Education			6,227		
Developing Sustainable Stored Grain IPM Systems in Oklahoma and Texas	Noyes	University of Georgia / USDA/SARE			133,371		
Oklahoma Green Country Watershed Education Project	Smolen	USDA			267,000		
State Water Quality Program	Smolen	Oklahoma Department of Agriculture			35,000		

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External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Field Testing of Sensor-Based Applicator for Nitrogen and Phosphorous Fertilization	Solie	NASA			94,800		
Harvesting and Processing of Horticultural and Alternate Agricultural Commodities	Solie	USDA			79,509		
Harvesting and Processing of Horticultural and Alternate Agricultural Commodities	Stone	USDA			78,485		
Nutrient Load & SWAT Model	Storm	City of Tulsa			38,931		
Modeling NPS Components in Ft. Cobb TMDL	Storm	Department of Environmental Quality / EPA			15,000		
New Product Development Center (FY03 funds)	Barfield	Oklahoma Department of Commerce				150,000	
Filter Fence for Sediment Control at Construction Sites	Barfield	EPA				80,000	
New Product Development Center (FY03 funds)	Barfield	Oklahoma Water Resources Board				50,000	
Sedimot III	Barfield	Hayes & Associates				11,967	
Evaluation of a New Dead Fuel Moisture Model in a Near-Real-Time Data Assimilation and Forecast	Carlson	USDA / Forest Service				40,000	
Manufacturing Excellence With Applications Engineers in Rural Areas	Elliott	OCAST				278,712	
Validation of Satellite Estimates of Soil Moisture in the Southern Great Plains	Elliott	USDA				41,510	
Nitrogen Emission	Hamilton	USDA				26,634	
Biomass-Based Energy Research	Huhnke	USDA				713,262	
Comprehensive animal Waste Systems for Semiarid Ecosystems	Kizer	USDA/CSREES				37,056	
Prediction of Beef Tenderness from Spectral Reflections	Kranzler	National Cattlemen's Beef Association				15,000	
Nonpoint Source Education Program in the Stillwater Creek Watershed	Smolen	Oklahoma Conservation Commission / EPA				87,000	

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External Grants, Contracts, and Gifts Awarded to Program Faculty

External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
A Nutrient Management Decision Support System for the Eucha Basin	Smolen	University of Arkansas / USDA				51,293	
Erosion Control on Rural Unimproved Roads in Stillwater Creek	Smolen	Oklahoma Conservation Commission / EPA				28,600	
Harvest, Processing and Storage of Horticultural and Alternate Commodities	Solie	USDA				77,692	
Harvesting, Processing and Storage of Horticultural and Alternate Commodities	Stone	USDA				79,028	
Development of a Wireless Weighing System	Stone	Oklahoma Department of Commerce				74,948	
Development of a Wireless Weighing System	Stone	Oklahoma Water Resources Board				24,983	
Nutrient Management Decision Support system for the Eucha Basin	Storm	University of Arkansas				174,480	
Fort Cobb Basin - Modeling and Landcover Classification	Storm	Oklahoma Conservation Commission / EPA				30,000	
Stillwater Creek - Modeling and Landcover Classification	Storm	Oklahoma Conservation Commission / EPA				30,000	
Modeling Nutrients in the Illinois River Basin Using SWAT	Storm	Department of Environmental Quality / EPA				25,678	
Development of a Control system for New Hydraulic Sprigger	Weckler	Oklahoma Department of Commerce				41,250	
Development of a Control system for New Hydraulic Sprigger	Weckler	Oklahoma Water Resources Board				13,750	
New Product Development Center for Small Rural Manufacturers (FY04 funds)	Barfield	Oklahoma Department of Commerce					300,000
Effective Stormwater and Sediment Control During Pipeline Construction Using a New Filter Fence Concept	Barfield	Integrated Petroleum Environmental Consortium / EPA					229,989

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External Grants, Contracts, and Gifts Awarded to Program Faculty

External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Center for Product and Process Development and Commercialization for Small U.S. Manufacturers	Barfield	NSF					201,435
Model Development and Evaluation of bioretention Cells and Other BMPs	Barfield	John Hayes					100,500
Development of Multi Location Crop/Forage Productivity Database and Analysis of Climatic Impact	Brown	USDA/ARS					15,000
Development of a Weather Based Model for Predicting First Hollow Stem in Winter Wheat	Carlson	Oklahoma Wheat Research Foundation					13,000
Operation and Maintenance of the ARS Micronet	Elliott	USDA/ARS					653,500
Manufacturing Excellence With Applications Engineers in Rural Areas	Elliott	OCAST					221,324
Improved Water Quality Through Production and Utilization of Vermicomposted Poultry Litter	Elliott	Rural Enterprises Inc. / EPA					185,000
Support Services for Product Engineering for Unibridge	Elliott	Unibridge					30,406
Biomass-Based Energy Research	Huhnke	USDA					895,435
Comp Animal Waste Systems	Kizer	USDA					39,945
Drinking Water Education for Under-Served Communities	Smolen	USDA/CSREES					250,000
Postharvest Handling, Storage and Processing of Horticultural and Alternate Commodities	Solie	USDA					74,886
N Tech Research Agreement	Solie	N Tech					7,097
Criteria for Design of Grassed Waters and Diversions	Stevens	USDA					40,000
Development of a tire Inflation and Inflation Management System for Heavy Duty On-Highway Vehicles	Stone	Oklahoma Department of Commerce					95,325
Development of a tire Inflation and Inflation Management System for Heavy Duty On-Highway Vehicles	Stone	Airgo					7,000

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External Funds			Dollar Amounts				
Name of Grant, Contract, or Gift	Principal Investigator	Source of Funds	1999-2000	2000-2001	2001-2002	2002-2003	2003-2004
Method Assessment for Determination of Appropriate Sediment TMDL Endpoints in Oklahoma Streams	Storm	Oklahoma Conservation Commission / EPA					109,000
Selection of Priority Areas in the Turkey Creek Watershed	Storm	Oklahoma Conservation Commission / EPA					98,304
Development of Guidelines for TMDLs with Nonpoint Source Components Using SWAT	Storm	Oklahoma Conservation Commission / EPA					20,000
Postharvest Handling, Storage and Processing of Horticultural and Alternate Commodities	Weckler	USDA					83,912
TOTALS			\$988,321	\$1,408,971	\$2,074,814	\$2,182,843	\$3,671,058

Appendix B

Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Bowser, T.J. and D. Vadder. 2003. Spring-cutter separator. U.S. Patent 6,357,681	Patent Issued	Bowser	2002
Stone, M.L., D. Needham, J.B. Solie, W.R. Raun, and G.V. Johnson. 2003. Optical spectral reflectance sensor and controller. U.S. Patent 6,596,996 B1.	Patent Issued	Solie	2003
Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2003. A process for in-season fertilizer nitrogen application based on predicted yield potential. U.S. Patent. 6,601,341.	Patent Issued	Solie	2003
Stone, M.L., D. Needham, J.B. Solie, W.R. Raun, and G.V. Johnson. 2003. Optical spectral reflectance sensor and controller. U.S. Patent 6,596,996 B1.	Patent Issued	Stone	2003
Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2003. A process for in-season fertilizer nitrogen application based on predicted yield potential. U.S. Patent. 6,601,341.	Patent Issued	Stone	2003
Solie, J.B., M.L. Stone, and S.D. Reed, 2004. Nozzle attitude controller for spot and variable rate application of agricultural chemicals and fertilizers. U.S. Patent 6,702,200.	Patent Issued	Solie	2004
Solie, J.B., M.L. Stone, and S.D. Reed, 2004. Nozzle attitude controller for spot and variable rate application of agricultural chemicals and fertilizers. U.S. Patent 6,702,200.	Patent Issued	Stone	2004
Holcombe, S.L. and M. L. Stone. Dec. 30, 2003. Informational object authoring and distribution system. U.S. Patent No. 6,671,696.	Patent Issued	Stone	2004
Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2004. A process for in-season fertilizer nitrogen application based on predicted yield potential. Serial No. 10,195,138. Allowed (CIP of U.S. Patent 6,601,341).	Patent Allowed	Solie	2004
Stone, M.L., D. Needham, J.B. Solie, W.R. Raun, and G.V. Johnson. 2004. Optical spectral reflectance sensor and controller. Serial No. 10,606,563 Allowed (CIP of U.S. Patent 6,596,996 B1).	Patent Allowed	Solie	2004
Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone. 2004. Use of within-field-element-size CV for improved nutrients fertilization in crop production. Serial No.10, 801,563 Allowed.	Patent Allowed	Solie	2004
Raun, W.R., G.V. Johnson, J.B. Solie, and M.L. Stone. 2004. A process for in-season fertilizer nitrogen application based on predicted yield potential. Serial No. 10,195,138. Allowed (CIP of U.S. Patent 6,601,341).	Patent Allowed	Stone	2004

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Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Stone, M.L., D. Needham, J.B. Solie, W.R. Raun, and G.V. Johnson. 2004. Optical spectral reflectance sensor and controller. Serial No. 10,606,563 Allowed (CIP of U.S. Patent 6,596,996 B1).	Patent Allowed	Stone	2004
Raun, W.R., G.V. Johnson, J.B. Solie, M.L. Stone. 2004. Use of within-field-element-size CV for improved nutrients fertilization in crop production. Serial No.10, 801,563 Allowed.	Patent Allowed	Stone	2004
S. Navarro & R.T. Noyes, Co-Editors, 2001. <i>The Mechanics and Physics of Modern Grain Aeration Management</i> . CRC Press, Boca Raton, FL	Book	Noyes	2001
Goering, C. E., M. L. Stone, D. W. Smith, and P. K. Turnquist. 2003. <i>Off-Road Vehicle Engineering Principles</i> . ASAE, St. Joseph, MI	Book	Stone	2003
Clar, M. R., B. J. Barfield, and T. OConnor. 2004. BMP Design Guide Volume 1: Considerations in the Design of Treatment Best Management Practices (BMPs) to Improve Water Quality. EPA Report EPA/600/R-02/XXX, Fall 2004. Vol 1 of a 3 volume series on stormwater BMPs.	Book	Barfield	2004
Clar, M. R., B. J. Barfield, and T. OConnor. 2004. BMP Design Guide, Volume 2: Vegetative Biofilters. EPA Report EPA/600/R-02/XXX Vol 2 of a 3 volume series on stormwater BMPs.	Book	Barfield	2004
Clar, M. R., B. J. Barfield, and T. OConnor. 2004. BMP Design Guide, Volume 3: Impoundments. EPA Report EPA/600/R-02/XXX Vol 3 of a 3 volume series on stormwater BMPs.	Book	Barfield	2004
Wilhelm, L.R., D.A. Suter, and G.H. Brusewitz. 2004. <i>Food and Process Engineering Technology</i> . ASAE	Book	Brusewitz	2004
Landscape Surveying, The Thomson Corporation, Stamford, CT, 2004	Book	Field	2004
Noyes, R.T., et al., 2001. Principal Author, Chapters 6, 7, & 8; Co-Author 4 other chapters. IN <i>The Mechanics and Physics of Modern Grain Aeration Management</i> , CRC Press, Boca Raton, FL.	Book Chapters	Noyes	2001
Chuvieco, E., ed., 2003. <i>Wildland Fire Danger Estimation and Mapping - The Role of Remote Sensing</i> . Series in Remote Sensing, Vol. 4, World Scientific Pub. Co., ISBN-981-238-569-X, Singapore, 264 pp. Contributions to Chapters 1-4.	Book Chapters	Carlson	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Noyes, R.T., 2001. Chapter 23, <i>Grain Dryer Design Standards, Safety, Maintenance and Troubleshooting</i> , IN <i>Handbook of Agricultural Crop Drying and Storage</i> , text book edited by Dr. Fred Bakker-Arkema, Michigan State University and Dr. Dirk Maier, Purdue University. Marcell-Dekker Publications	Book Chapter	Noyes	2001
Hamilton, D.W., Fathepure, B., Fulhage, C.D., Clarkson, W., and Lalman, J.A. 2002. Treatment Lagoons for animal agriculture. National Center for Manure and Animal Waste Management. North Carolina State University.	Book Chapter	Hamilton	2002
Cuperus, G.W., R.C. Berberet, and R.T. Noyes. 2003. Future of integrated pest management towards sustainable development. CHAP 11 IN Koul, Dhaliwal & Cuperus, Eds, <i>Integrated Pest Management: Potential, Constraints and Challenges</i> . CABI Publishing, London, UK.	Book Chapter	Noyes	2003
Noyes, R.T. 2003. Wheat Storage in the U.S.A. Chapter 3 IN <i>Crop Post-harvest: Science and Technology, Volume 2 Durables</i> , Hodges R.J. and Farrell G., Eds. Blackwell Publishing, Oxford, UK	Book Chapter	Noyes	2003
Hamilton, D.W. 2004. Solids Separation. in, <i>Pork Industry Handbook</i> . Des Moines, IA. National Pork Board.	Book Chapter	Hamilton	2004
Armstrong, P. R., G. H. Brusewitz, M. L. Stone, and N. O. Maness. 2000. Rotary drying for threshing petals from marigold flowers. <i>Transactions of the ASAE</i> 43(2):379-384.	Refereed Journal Article	Brusewitz	2000
Hauhouot-O'Hara, M., B. R. Criner, G. H. Brusewitz, and J. B. Solie. 2000. Selected physical characteristics and aerodynamic properties of cheat seed for separation from wheat. <i>Agr Engr Intl: the CIGR J Scientific Research and Development [on-line serial]</i> Vol. II.	Refereed Journal Article	Brusewitz	2000
Puchalski, C., and G. H. Brusewitz. 2000. Apple bruise resistance determination using an electrical universal bridge. <i>Int. Agrophysics</i> 14(4):411-416.	Refereed Journal Article	Brusewitz	2000
Puchalski, C., and G. H. Brusewitz. 2000. Watermelon epicuticle changes related to friction test parameters. <i>Int. Agrophysics</i> 14(1):113-119.	Refereed Journal Article	Brusewitz	2000
Ali, R., R. L. Elliott, J. E. Ayars and E. W. Stevens. 2000. Soil Salinity Modeling over a Shallow Water Table: I. Validation of LEACHC. <i>Journal of Irrigation and Drainage Engineering</i> 126(4):223-233.	Refereed Journal Article	Elliott	2000

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Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Ali, R., R. L. Elliott, J. E. Ayars and E. W. Stevens. 2000. Soil Salinity Modeling over a Shallow Water Table: II. Application of LEACHC. Journal of Irrigation and Drainage Engineering 126(4):234-242.	Refereed Journal Article	Elliott	2000
Senay, G. B. and R. L. Elliott. 2000. Combining AVHRR-NDVI and Landuse Data to Describe Temporal and Spatial Dynamics of Vegetation. Forest Ecology and Management 128(1-2):83-91.	Refereed Journal Article	Elliott	2000
Lalman, J.A. and D. M. Bagley, 2000. Anaerobic degradation and inhibitory effects of linoleic acids. Water Res., 34 (17), 4220-4228.	Refereed Journal Article	Lalman	2000
Lukina, E.V., W.R. Raun, M.L. Stone, J.B. Solie, G.V. Johnson, H.L. Lees, J.M. LaRuffa and S.B. Phillips. 2000. Effect of row spacing, growth stage, and nitrogen rate on spectral irradiance in winter wheat. J. Plant Nutr. 23:103-122	Refereed Journal Article	Solie	2000
Sembiring, H., H.L. Lees, W.R. Raun, G.V. Johnson, J.B. Solie, M.L. Stone, M.J. DeLeon, E.V. Lukina, D.A. Cossey, J.M. LaRuffa, C.W. Woolfolk, S.B. Phillips, and W.E. Thomason. 2000. Effect of growth stage, and variety on spectral radiance in winter wheat. J. Plant Nutr. 23:141-149.	Refereed Journal Article	Solie	2000
Brown, G. O., D. Needham, and M. L. Stone, 2000. Modification of older neutron probes to enable external data processing and control. Trans. of Am. Soc. Ag. Eng., 43(6) 1477-1481.	Refereed Journal Article	Stone	2000
Armstrong, P. R., G. H Brusewitz, M. L. Stone and N. O. Manness. 2000. Rotary Drying for Threshing Petals from Marigold Flowers. Transactions of the ASAE, 43(2): 379-384. ASAE, St Joseph MI.	Refereed Journal Article	Stone	2000
Laruffa, J. M., W. R. Raun, S. B. Phillips, M. L. Stone, J. B. Solie, and G. V. Johnson. In Press. 2000. Optimum Field Element Size for Maximum Yields in Winter Wheat Using Variable Nitrogen Rates. J. Plant. Nutr. 24:313-325.	Refereed Journal Article	Stone	2000
Sembiring, H., H.L. Lees, W.R. Raun, G.V. Johnson, J.B. Solie, M.L. Stone, M.J. DeLeon, E.V. Lukina, D.A. Cossey, J.M. LaRuffa, C.W. Woolfolk, S.B. Phillips, and W.E. Thomason. 2000. Effect of growth stage, and variety on spectral radiance in winter wheat. J. Plant Nutr. 23:141-149.	Refereed Journal Article	Stone	2000
Hession, W.C., and D.E. Storm. 2000. Watershed-level uncertainties: Implications for phosphorous management and eutrophication. Journal of Environmental Quality 29(4): 1172-1179.	Refereed Journal Article	Storm	2000

Appendix B

Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Surjadinata, B., G. Brusewitz, and D. Bellmer. 2001. Pecan texture as affected by moisture content before freezing and thawing rate. <i>Journal of Food Process Engineering</i> 24: 253-272.	Refereed Journal Article	Bellmer	2001
Britton, B. D., P. R. Armstrong, G. H. Brusewitz, and M. L. Stone. 2001. Marigold petal removal with a plate thresher. <i>Applied Engineering in Agriculture</i> 17(1):63-67.	Refereed Journal Article	Brusewitz	2001
Linn, L. L., M. C. Rochat, G. H. Brusewitz, and M. E. Payton. 2001. Extraction resistance of 2.7mm mediolateral placed cortical screws compared with 2.7mm and 3.5mm craniocaudal placed cortical screws in canine cadaver radii. <i>Vet. Comp. Orthop. Traumatol.</i> 14:1-6.	Refereed Journal Article	Brusewitz	2001
Puchalski, C. and G. H. Brusewitz. 2001. Fruit ripeness and temperature affect friction coefficient of McLemore and Gala apples. <i>Int. Agrophysics</i> 15(1):109-114.	Refereed Journal Article	Brusewitz	2001
Reed, S. D., P. R. Armstrong, G. H. Brusewitz, and M. L. Stone. 2001. Resistance of marigold flowers to airflow. <i>Transactions of the ASAE</i> 44(3):639-642.	Refereed Journal Article	Brusewitz	2001
Surjadinata, B. B., G. H. Brusewitz, and D. D. Bellmer. 2001. Pecan texture as affected by moisture content before freezing and thawing rate. <i>J. Food Process Engineering</i> 24(4):253-272.	Refereed Journal Article	Brusewitz	2001
Zou, Y. and G. H. Brusewitz. 2001. Angle of internal friction and cohesion of consolidated ground marigold petals. <i>Transactions of the ASAE</i> 44(5):1255-1259.	Refereed Journal Article	Brusewitz	2001
Lukina, E. V., K. W. Freeman, K. J. Wynn, W. E. Thomason, R. W. Mullen, A. R. Klatt, G. V. Johnson, R. L. Elliott, M. L. Stone, J. B. Solie and W. R. Raun. 2001. Nitrogen Fertilization Optimization Algorithm Based on In-Season Estimates of Yield and Plant Nitrogen Uptake. <i>Journal of Plant Nutrition</i> 24:885-898.	Refereed Journal Article	Elliott	2001
Lalman, J.A. and D. M. Bagley, 2001. Anaerobic degradation and methanogenic inhibitory effects of oleic and stearic acids. <i>Water Res.</i> , 35 (12), 2975-2983.	Refereed Journal Article	Lalman	2001
Bell, G.E., D.L. Martin, S.G. Wiese, D.D. Dobson, M.W. Smith, M.L. Stone, and J.B. Solie. 2002. Vehicle-mounted optical sensing: An objective means for evaluation of turf quality. <i>Crop Sci.</i> 42:197-201.	Refereed Journal Article	Solie	2001
Roberts, J.R., T.F. Peeper, J.B. Solie. 2001. Wheat (<i>Triticum aestivum</i>) row spacing, seeding rate, and cultivar affect interference from rye (<i>Secale cereale</i>). <i>Weed Tech</i> 15:19-25.	Refereed Journal Article	Solie	2001
Stone, A.E., T.F. Peeper, J.B. Solie. 2001. Cheat (<i>Bromus secalinus</i>) control with herbicides applied to mature seeds. <i>Weed Tech.</i> 15:382-386.	Refereed Journal Article	Solie	2001

Appendix B

Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Raun, W.R., G.V. Johnson, M.L. Stone, J.B. Solie, E.V. Lukina, W.E. Thomason and J.S. Schepers. 2001. In-season prediction of potential grain yield in winter wheat using canopy reflectance. <i>Agron. J.</i> 93:131-138.	Refereed Journal Article	Solie	2001
LaRuffa, J.M., W.R. Raun, S.B. Phillips, M.L. Stone, J.B. Solie and G.V. Johnson. 2001. Optimum field element size for maximum yields in winter wheat using variable nitrogen rates. <i>J. Plant Nutr.</i> 24: 313-325.	Refereed Journal Article	Solie	2001
Bell, G.E., D.L. Martin, R.M. Kuzmic, M.L. Stone, and J.B. Solie. 2000. Herbicide tolerance of two cold-resistant bermudagrass cultivars determined by visual assessment and vehicle-mounted optical sensing. <i>Weed Tech.</i> 14:635-641.	Refereed Journal Article	Solie	2001
Bell, G.E., D.L. Martin, M.L. Stone, J.B. Solie, and G.V. Johnson. 2001. Turf area mapping using vehicle-mounted optical sensors. <i>Crop Sci.</i> 42(2): 648-651.	Refereed Journal Article	Stone	2001
Raun, W.R., G.V. Johnson, M.L. Stone, J.B. Solie, E.V. Lukina, W.E. Thomason and J.S. Schepers. 2001. In-season prediction of potential grain yield in winter wheat using canopy reflectance. <i>Agron. J.</i> 93:131-138.	Refereed Journal Article	Stone	2001
Lukina, E.V., K.W. Freeman, K.J. Wynn, W.E. Thomason, R.W. Mullen, A.R. Klatt, G.V. Johnson, R.L. Elliott, M.L. Stone, J.B. Solie, and W.R. Raun. 2001. Nitrogen fertilization optimization algorithm based on in-season estimates of yield and plant nitrogen uptake. <i>J. Plant Nutr.</i> 24: 885-898.	Refereed Journal Article	Stone	2001
Britton, B. D., P. R. Armstrong, G. H. Brusewitz, and M. L. Stone. 2001. Marigold petal removal with a plate thresher. <i>Applied Engineering in Agriculture</i> 17(1):63-67.	Refereed Journal Article	Stone	2001
Reed, S. D., P. R. Armstrong, G. H. Brusewitz, and M. L. Stone. 2001. Resistance of marigold flowers to airflow. <i>Transactions of the ASAE</i> 44(3): 639-642.	Refereed Journal Article	Stone	2001
Haggard, B.E., D.E. Storm, and E.H. Stanley. 2001. Effect of a Point Source Input on Stream Nutrient Retention. <i>Journal of American Water Resources Association</i> 37(5): 1291-1299.	Refereed Journal Article	Storm	2001
Haggard, B.E., D.E. Storm, R.D. Tejral, Y.A. Popova, and V.G. Keyworth, and E.H. Stanley. 2001. Stream Nutrient Retention in Three Northeastern Oklahoma Agricultural Catchments. <i>Transactions of the ASAE</i> 44(3): 597-605.	Refereed Journal Article	Storm	2001
Matlock M. D., G. S. Osborn, W. C. Hession, A. L. Kenimer, D. E. Storm. 2001. Ecological Engineering: A Rationale for Standardized Curriculum and Professional Certification in the United States. <i>Journal of Ecological Engineering</i> 17: 403-409.	Refereed Journal Article	Storm	2001

Appendix B

Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Pearce, M.J.D. and D.D. Bellmer. 2002. Data variability in rheological measurement of semi-solid foods: effects of loading normal force. <i>Applied Rheology</i> 12:282-287.	Refereed Journal Article	Bellmer	2002
Armstrong, P. R., M. L. Stone, and G. H. Brusewitz. 2002. Marigold petal threshing with open versus sectored rotary dryers. <i>Applied Engineering in Agriculture</i> 18(2):213-218.	Refereed Journal Article	Brusewitz	2002
Puchalski, C., G. H. Brusewitz, B. Dobrzaski, and R. Rybczynski. 2002. Relative humidity and wetting affect friction between apple and flat surfaces. <i>Int. Agrophysics</i> 16(1): 67-71.	Refereed Journal Article	Brusewitz	2002
Zou, Y. and G. H. Brusewitz. 2002. Flowability of uncompacted marigold powder as affected by moisture content. <i>J. Food Engineering</i> 55(2):165-171.	Refereed Journal Article	Brusewitz	2002
Carlson, J.D., R.E. Burgan, D.M. Engle, and J.R. Greenfield, 2002. The Oklahoma Fire Danger Model: An operational tool for mesoscale fire danger rating in Oklahoma. <i>International Journal of Wildland Fire</i> , 11:183-191.	Refereed Journal Article	Carlson	2002
Grantham, R.A., P.G. Mulder, G.W. Cuperus, and J.D. Carlson, 2002. Evaluation of pecan nut casebearer <i>Acrobasis nuxvorella</i> (Lepidoptera: Pyralidae) prediction models using pheromone trapping. <i>Environmental Entomology</i> , 31(6):1062-1070.	Refereed Journal Article	Carlson	2002
Sridhar, V., R. L. Elliott, F. Chen and J. A. Brotzge. 2002. Validation of the NOAA-OSU Land Surface Model Using Surface Flux Measurements in Oklahoma. <i>Journal of Geophysical Research</i> 107 (D20), 4418, doi:10.1029/2001JD001306.	Refereed Journal Article	Elliott	2002
Sridhar, V. and R. L. Elliott 2002. On the Development of a Simple Downwelling Longwave Radiation Scheme. <i>Agricultural and Forest Meteorology</i> 112(3-4): 237-243.	Refereed Journal Article	Elliott	2002
Senay, G. B. and R. L. Elliott. 2002. Capability of AVHRR Data in Discriminating Rangeland Cover Mixtures. <i>International Journal of Remote Sensing</i> 23(2):299-312.	Refereed Journal Article	Elliott	2002
Cumba, H. J. and D.W. Hamilton. 2002. Liquid balance model for anaerobic lagoons. <i>Transactions of ASAE</i> . 45(4):973-981.	Refereed Journal Article	Hamilton	2002
Lalman, J.A. and D.M. Bagley. 2002. Effects of C18 long chain fatty acids on acidogens, acetogens and hydrogenotrophic methanogens. <i>Water Res.</i> 36 (13), 3307-3313.	Refereed Journal Article	Lalman	2002

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, R.W. Mullen, K.W. Freeman, W.E. Thomason, and E.V. Lukina. 2002. Improving nitrogen use efficiency in cereal grain production with optical sensing and variable rate application. <i>Agron. J.</i> 94:815-820.	Refereed Journal Article	Solie	2002
Washmon, C.N., J.B. Solie, W.R. Raun, and D.D. Itenfisu. 2002. Within field variability in wheat grain yields over nine years in Oklahoma. <i>J. Plant. Nutr.</i> 25: 2655-2662.	Refereed Journal Article	Solie	2002
Raun, W.R., J.B. Solie, G.V. Johnson, M.L. Stone, R.W. Mullen, K.W. Freeman, W.E. Thomason, and E.V. Lukina. 2002. Improving nitrogen use efficiency in cereal grain production with optical sensing and variable rate application. <i>Agron. J.</i> 94:815-820.	Refereed Journal Article	Stone	2002
Bell, G. E., D. L. Martin, S. G. Wiese, D. D. Dobson, M. W. Smith, M. L. Stone, and J. B. Solie. 2002. Vehicle-mounted optical sensing: An objective means for evaluation of turf quality. <i>Crop Sci.</i> 42(1): 197-201.	Refereed Journal Article	Stone	2002
McGlynn, W.G., D. D. Bellmer, and S.S. Reilly. 2003. Effect of pre-cut sanitizing dip and water jet cutting on shelf life of fresh-cut watermelon. <i>Journal of Food Quality</i> 26 (6): 489-498.	Refereed Journal Article	Bellmer	2003
Davidson, E.B., C. B. Greenberg, D.D. Bellmer, R.J. Morton, M.E. Payton. 2003. In Vitro Tensile Strength of Four Monofilament Absorbable Suture Materials in Sterile and Infected Canine Urine. <i>American Journal of Veterinary Research</i> . In Press.	Refereed Journal Article	Bellmer	2003
Bellmer, D., M. Tilahun, and M. Achour. 2003. Electrical conductivity of ground beef during ohmic heating in an open system. <i>CIGR Journal of the International Commission of Agricultural Engineering</i> . Accepted for publication.	Refereed Journal Article	Bellmer	2003
Lalman, J., H. Alost, D. Jing, and D. Bellmer. 2003. Glucose fermentation in the presence of linoleic, oleic, and stearic acids by a mixed culture. <i>J. Chem Tech Biotech</i> . Accepted for publication.	Refereed Journal Article	Bellmer	2003
Alost, H., Lalman, J.A. R. Bejankiwar and D. Bellmer. 2003. Kinetics of glucose fermentation in the presence of C18 long chain fatty acids. <i>Env. Technol.</i> 24(12), 1471-1478.	Refereed Journal Article	Bellmer	2003
Alost, H., Lalman, J.A. R. Bejankiwar and D. Bellmer. 2003. Kinetics of glucose fermentation in the presence of C18 long chain fatty acids. <i>Env. Technol.</i> 24(12), 1471-1478.	Refereed Journal Article	Bellmer	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Deyhim, F., B. J. Stoecker, G. H. Brusewitz, and B. H. Arjmandi. 2003. The effects of estrogen depletion and isoflavones on bone metabolism in rats. <i>Nutrition Research</i> 23(1):123-130.	Refereed Journal Article	Brusewitz	2003
Puchalski, C., S. Sosnowski, and G. H. Brusewitz. 2003. Non-destructive measurements of apple firmness using friction and impact sensors. <i>Acta Agrophysica</i> 2(1): 161-171.	Refereed Journal Article	Brusewitz	2003
Carlson, J.D. and R.E. Burgan, 2003. Review of users' needs in operational fire danger estimation: The Oklahoma example. <i>International Journal of Remote Sensing</i> , 24(8):1601-1620.	Refereed Journal Article	Carlson	2003
Itenfisu, D., R. L. Elliott, R. G. Allen and I. A. Walter. 2003. Comparison of Reference Evapotranspiration Calculations as Part of the ASCE Standardization Effort. <i>Journal of Irrigation and Drainage Engineering</i> 129(6):440-448.	Refereed Journal Article	Elliott	2003
Oldak, A., T. J. Jackson, P. Starks and R. Elliott. 2003. Mapping Near-Surface Soil Moisture on Regional Scale using ERS-2 SAR Data. <i>International Journal of Remote Sensing</i> 24(22):4579-4598.	Refereed Journal Article	Elliott	2003
Sridhar, V., R. L. Elliott and F. Chen. 2003. Scaling Effects on Modeled Surface Energy-Balance Components using the NOAA-OSU Land Surface Model. <i>Journal of Hydrology</i> 280/1-4:105-123.	Refereed Journal Article	Elliott	2003
Schneider, J. M., D. K. Fisher, R. L. Elliott, G. O. Brown and C. P. Bahrmann. 2003. Spatiotemporal Variations in Soil Water: First Results from the ARM SGP CART Network. <i>Journal of Hydrometeorology</i> 4(1):106-120.	Refereed Journal Article	Elliott	2003
Ndegwa, P.M., J. Zhu, A. Luo, D.W. Hamilton. 2003. Enhanced phosphorus removal from swine manure in aerated batch reactors. <i>Transactions of ASAE</i> 46(3):797-803.	Refereed Journal Article	Hamilton	2003
Tembo, G., F.M. Epplin, and R.L. Huhnke. 2003. Integrative investment appraisal of a lignocellulosic biomass-to-ethanol industry. <i>Journal of Agricultural and Resource Economics</i> 28(3):611-633.	Refereed Journal Article	Huhnke	2003
Jeyamkondan, S., N. Ray, G.A. Kranzler, and S.T. Action. 2003. Computer vision segmentation of the <i>longissimus dorsi</i> for beef quality grading. <i>Transactions of the ASAE</i> .	Refereed Journal Article	Kranzler	2003

Appendix B

Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Alosta, H., Lalman, J.A. R. Bejankiwar and D. Bellmer. 2003. Kinetics of glucose fermentation in the presence of C18 long chain fatty acids. <i>Env. Technol.</i> 24(12), 1471-1478.	Refereed Journal Article	Lalman	2003
Wu, Y., B.A. Kahn, N.O. Maness, J.B. Solie, R.W. Whitney, K.E. Conway. 2003. Densely Planted Okra for Destructive Harvest: I. Effect on Yield. <i>Hort. Sci.</i> 38(7):1360-1364.	Refereed Journal Article	Solie	2003
Wu, Y., B.A. Kahn, N.O. Maness, J.B. Solie, R.W. Whitney, K.E. Conway. 2003. Densely Planted Okra for Destructive Harvest: I. Effect on Plant Architecture. <i>Hort. Sci.</i> 38(7):1365-1369.	Refereed Journal Article	Solie	2003
Wu, Y., B.A. Kahn, N.O. Maness, J.B. Solie, R.W. Whitney, K.E. Conway. 2003. Densely Planted Okra for Destructive Harvest: I. Effect of Nitrogen Nutrition. <i>Hort. Sci.</i> 38(7):1370-1372.	Refereed Journal Article	Solie	2003
Bell, G.E., D.L.Martin. M.L. Stone, J.B. Solie, and G.V. Johnson. 2003. Turf area mapping using vehicle-mounted optical sensors. <i>Crop Sci.</i> 42(2):648-650.	Refereed Journal Article	Solie	2003
Raun, W.R., J.B. Solie, K.L. Marin, K.W. Freeman, M.L. Stone, G.V. Johnson, and R.W. Mullen. 2004. Growth stage, development, and spatial variability in corn evaluated using optical sensor readings. <i>J. Plant Nur.</i> (In Press).	Refereed Journal Article	Solie	2003
Moges, S.M., W.R. Raun, R.W. Mullen, K.W. Freeman, G.V. Johnson, and J.B. Solie. 2003. Evaluation of green, red and near infrared bands for predicting winter wheat biomass, nitrogen uptake, and final grain yield. <i>J. Plant Nutr.</i> (In Press).	Refereed Journal Article	Solie	2003
Freeman, K.W., W.R. Raun, G.V. Johnson, R.W. Mullen, M.L. Stone, and J.B. Solie. 2003. Late-season prediction of wheat grain yield and grain protein. <i>Commun. Soil Sci. Plant Anal.</i> 34:1837-1852.	Refereed Journal Article	Solie	2003
Mullen, R.W., Kyle W. Freeman, William R. Raun, G.V. Johnson, M.L. Stone, and J.B. Solie. 2003. Identifying an in-season response index and the potential to increase wheat yield with nitrogen. <i>Agron. J.</i> 95:347-351.	Refereed Journal Article	Solie	2003
Hodgen, P.J., W.R. Raun, G.V. Johnson, R.K. Teal, K.W. Freeman, K.B. Brixey, K. L. Martin, J.B. Solie and M.L. Stone. 2003. Relationship between response indices measured in-season and at harvest in winter wheat. <i>J. Plant Nutr.</i> (in press).	Refereed Journal Article	Stone	2003
Humphreys, M., W.R. Raun, K.L. Martin, K.W. Freeman, G.V. Johnson, and M.L. Stone. 2003. Indirect estimates of soil electrical conductivity for improved prediction of wheat grain yield. <i>Commun. Soil Sci. Plant Anal.</i> (in press).	Refereed Journal Article	Stone	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Raun, W.R., J.B. Solie, K.L. Martin, K.W. Freeman, M.L. Stone, K.L. Martin, G.V. Johnson, and R.W. Mullen. 2004. Growth stage, development, and spatial variability in corn evaluated using optical sensor readings. <i>J. Plant Nutr.</i> (in press).	Refereed Journal Article	Stone	2003
Freeman, K.W., W. R. Raun, G.V. Johnson, R.W. Mullen, M.L. Stone, and J.B. Solie. 2003. Late-season prediction of wheat grain yield and grain protein. <i>Commun. Soil Sci. Plant Anal.</i> 34:1837-1852.	Refereed Journal Article	Stone	2003
Mullen, R.W., Kyle W. Freeman, William R. Raun, G.V. Johnson, M.L. Stone, and J.B. Solie. 2003. Identifying an in-season response index and the potential to increase wheat yield with nitrogen. <i>Agron. J.</i> 95:347-351.	Refereed Journal Article	Stone	2003
Bell, G.E., B.M. Howell, G.V. Johnson, W.R. Raun, J.B. Solie, and M.L. Stone. 2003. Optical sensing of turf chlorophyll content and tissue nitrogen. <i>HortSci.</i> (accepted).	Refereed Journal Article	Stone	2003
Haggard, B.E., and D.E. Storm. 2003. Effect of leaf litter on phosphorus retention and hydrologic properties at a first order stream in northeast Oklahoma, USA. <i>Journal of Freshwater Ecology</i> 18(4):557-565.	Refereed Journal Article	Storm	2003
P.R. Weckler, T.J. Bowser, K.N. Patil, and C. DeWitt, 2003 Design and testing of a low-cost, pilot-scale batch gasifier for food processing byproducts, <i>Transactions of the ASAE.</i> In review.	Refereed Journal Article	Weckler	2003
N. Kotwaliwale, J. Subbiah, P.R. Weckler, G.H. Brusewitz, G.A. Kranzler, 2003 X-ray Attenuation Coefficients using Polychromatic X-ray Imaging of Pecan Components , <i>Journal of Biosystems Engineering</i> In review	Refereed Journal Article	Weckler	2003
P.R. Weckler, M.L. Stone, N.O. Maness, R.S. Jayasekara, C.L. Jones, T. Kersten, D. Chrz, 2003 Remote Sensing to Estimate Chlorophyll Concentration Using Multi-Spectral Plant Reflectance Sensing, <i>Transactions of the ASAE.</i> In review	Refereed Journal Article	Weckler	2003
N. Kotwaliwale, P.R. Weckler, G.H. Brusewitz, 2003 Development of a Soft X-Ray Digital Imaging System for Biological Materials, <i>ASAE Applied Engineering in Agriculture.</i> In review.	Refereed Journal Article	Weckler	2003
N. Kotwaliwale, P.R. Weckler, G.H. Brusewitz, 2003 Development of a Soft X-Ray Digital Imaging System for Biological Materials, <i>ASAE Applied Engineering in Agriculture.</i> In review.	Refereed Journal Article	Weckler	2003
N. Kotwaliwale, G.H. Brusewitz, P.R. Weckler, 2003. Physical Characteristics of Pecan Components: Effect of Cultivar and Moisture Content, <i>Transactions of the ASAE.</i> Vol. 47(1): 227-231.	Refereed Journal Article	Weckler	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
T.J. Bowser, P.R. Weckler, R. Jayasekara, 2003. Process Design and Operation of a Steam Injection Heater for Viscous Food and Agricultural Products, ASAE Applied Engineering in Agriculture. Vol. 19(4):447-451.	Refereed Journal Article	Weckler	2003
Krushna, P., T.J. Bowser, D.D. Bellmer, and R.L. Huhnke. 2004. Fluidization characteristics of sand and chopped switchgrass-sand mixtures. Submitted to Transactions of the ASAE.	Refereed Journal Article	Bellmer	2004
Ulmer, J.D., R.L. Huhnke, D.D. Bellmer, and D.D. Cartmell. 2004. Acceptance of ethanol blended gasoline in Oklahoma. Biomass & Bioenergy. In press.	Refereed Journal Article	Bellmer	2004
Kotwaliwale, N., G. H. Brusewitz, and P. R. Weckler. 2004. Physical characteristics of pecan components: effect of cultivar and relative humidity. Transactions of the ASAE 47(1):227-231.	Refereed Journal Article	Brusewitz	2004
Huhnke, R.L., L.C. McCowan, G.M. Meraz, S.L. Harp and M.E. Payton. 2004. Using evaporative cooling to reduce the frequency and duration of elevated temperature-humidity indices in Oklahoma. Applied Engineering in Agriculture 20(1):95-96.	Refereed Journal Article	Huhnke	2004
Datar, R.P., R.M. Shenkman, B.G. Cateni, R.L. Huhnke, and R.S. Lewis. 2004. Fermentation of Biomass-Generated Producer Gas to Ethanol. Biotechnology and Bioengineering 86(5):587-594.	Refereed Journal Article	Huhnke	2004
Thorsell, S., F.M. Epplin, R.L. Huhnke and C.M. Taliaferro. 2004. Economics of a coordinated biorefinery feedstock harvest system: lignocellulosic biomass harvest cost. Biomass and Bioenergy 27(4):327-337.	Refereed Journal Article	Huhnke	2004
Ulmer, J.D., R.L. Huhnke, D.D. Bellmer, and D.D. Cartmell. 2004. Acceptance of ethanol-blended gasoline in Oklahoma. Biomass and Bioenergy. 27(5):437-444.	Refereed Journal Article	Huhnke	2004
Bell, G.E., B.M. Howell, B.V. Johnson, W.R. Raun, J.B. Solie, and M.L. Stone. 2004. Optical sensing of turf chlorophyll content and tissue nitrogen. Hort. Sci. 39(5):1130-1132.	Refereed Journal Article	Solie	2004
Raun, W.R., J.B. Solie, M.L. Stone, K.W. Freeman. 2004. Automated calibration stamp technology for improved in-season nitrogen fertilization. Agron. J. (in press).	Refereed Journal Article	Stone	2004
Raun, W.R., J.B. Solie, M.L. Stone, K.L. Martin, K.W. Freeman, R.W. Mullen, H. Zhang J.S. Schepers, and G.V. Johnson. 2004. Optical sensor based algorithm for crop nitrogen fertilization. Commun. Soil Sci. Plant Anal. (in press).	Refereed Journal Article	Stone	2004

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Raun, W.R., J.B. Solie, M.L. Stone, K.L. Martin, K.W. Freeman, R.W. Mullen, H. Zhang J.S. Schepers, and G.V. Johnson. 2004. Optical sensor based algorithm for crop nitrogen fertilization. <i>Commun. Soil Sci. Plant Anal.</i> (in press).	Refereed Journal Article	Stone	2004
R. Choudhary, T.J. Bowser, P. Weckler, N.O. Maness, W. McGlynn, and M. L. Stone, 2004 Rapid and Safe Measurement of Lycopene Concentration in Watermelon Flesh Using Visible Spectroscopy. <i>Transactions of the ASAE.</i> In review	Refereed Journal Article	Weckler	2004
Epplin, F.E. and R.L. Huhnke. 2001. Optimizing the logistics of production, harvest, procurement, storage, and transportation of lignocellulosic biomass for conversion to ethanol. 5 th International Biomass Conference of the Americas, Orlando, FL.	Abstract	Huhnke	2001
Tembo, G., F.M. Epplin, and R.L. Huhnke. 2001. Perspectives Regarding Conversion of Agricultural Biomass to Ethanol. Selected paper presented at the Southern Agricultural Economics Association meetings, Fort Worth, TX, January 27-31. Abstract published in <i>Journal of Agricultural and Applied Economics</i> 33-3:618.	Abstract	Huhnke	2001
Barfield, B. J., G. K. Felton, and M. McCann. 2000. A simple model of karst spring flow using modified NRCS procedures. Paper presented at the American Institute of Hydrology meeting, Raleigh, NC, November 7, 2000.	Conference Proceeding	Barfield	2000
Carlson, J.D. and B. Dean McCraw, 2000. Field investigation of temperature patterns within Oklahoma peach orchards. Preprints, 24 th Conf. On Agricultural and Forest Meteorology, Aug. 14-18, Davis, CA, pp. 144-147.	Conference Proceeding	Carlson	2000
Noyes, R.T., J. Subbiah, J. Criswell and T. Phillips. 2000. Phosphine Fumigation Failures in Concrete Silos in the Southwestern U.S.A. Presented in Session 6, Sealing techniques and methods of determining gas tightness, International Controlled Atmospheres and Fumigation Conference (CAF), Fresno, CA, USA, October 29-November 3, 2000.	Conference Proceeding	Noyes	2000
Britton, S. L., K. L. Robinson, and B. J. Barfield. 2001. Modeling the effectiveness of silt fence. Proceedings 7 th Federal Interagency Sedimentation Conference, Mar. 25-29, 2001, Reno, NV. US. Government Printing Office, Washington, DC	Conference Proceeding	Barfield	2001

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Hayes, J. C., Aldridge, A. L., Barfield, B. J., and Holbrook, K. F. 2001. Simplifying design of sediment controls in Jefferson, County, KY. Proceedings International Symposium on Soil Erosion Research for the 21 st Century, Jan. 3-5, 2001, Honolulu, HA. Published by American Society of Agricultural Engineers, St. Joseph,	Conference Proceeding	Barfield	2001
Barfield, B. J., Stevens, E., Haan, C. T., Hayes, J. C., and Holbrook, K. F. 2001. Engineering design aids for sediment control practices. Proceedings International Symposium on Soil Erosion Research for the 21 st Century, Jan. 3-5, 2001, Honolulu, HA. Published by American Society of Agricultural Engineers, St. Joseph, MI.	Conference Proceeding	Barfield	2001
Hayes, J. C., Aldridge, A. L., Barfield, B. J., and Holbrook, K. F. 2001. Simplifying design of sediment controls in Jefferson, County, KY. Proceedings International Symposium on Soil Erosion Research for the 21 st Century, Jan. 3-5, 2001, Honolulu, HA. Published by American Society of Agricultural Engineers, St. Joseph, MI (In Press)	Conference Proceeding	Barfield	2001
Britton, S. L., Robinson, K. L., and B. J. Barfield. 2001. Modeling the effectiveness of silt fence. Proceedings 7 th Federal Interagency Sedimentation Conference, Mar. 25-29, 2001, Reno, NV. US. Government Printing Office, Washington, DC (In Press)	Conference Proceeding	Barfield	2001
Carlson, J.D., 2001. Operational wildland fire management systems: The Oklahoma example. Preprints, Fourth Symposium on Fire and Forest Meteorology, Nov. 13-15, Reno, pp. 140-147.	Conference Proceeding	Carlson	2001
Carlson, J.D., 2001. Review of user needs in operational fire danger estimation: The Oklahoma example. Proceedings, 3 rd Intern. Workshop on Remote Sensing and GIS Applications to Forest Fire Management, May 17-18, Paris, France, pp. 1-18. <i>[I was an invited speaker for the general session, but could not go due to my father's death]</i>	Conference Proceeding	Carlson	2001
Carlson, J.D., 2002. Results from freeze protection studies in Oklahoma peach orchards. Proceedings of the 21 st Annual Horticulture Industries Show, Jan. 11-12, Tulsa, pp. 32-40.	Conference Proceeding	Carlson	2002

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Huhnke, R.L. 2002. That new swather – Can I afford it? IN: Proceedings of the Intermountain Forage Symposium. Technical Bulletin LTB 02-1. Colorado State University, Boulder, CO.	Conference Proceeding	Huhnke	2002
Lewis R.S., R.P. Datar, R.S. Tanner, B.G. Cateni, T.J. Bowser, D.D. Bellmer, and R.L. Huhnke. 2002. Making the connection: conversion of biomass-generated producer gas to ethanol. Proceedings of Bioenergy 2002 - The Tenth Biennial Bioenergy Conference, Boise, ID.	Conference Proceeding	Huhnke	2002
Hamilton, D.W., Fathepure, B., Fulhage, C.D., Clarkson, W., and Lalman, J.A. 2002. Treatment Lagoons for animal agriculture. National Center for Manure and Animal Waste Management. North Carolina State University.	Conference Proceeding	Lalman	2002
Hayes, J., Barfield, B., Holbrook, K., Gillespie, J., Fersner, J., and Bates, B. "A Model for Assessing the Impact of BMPs on Water Quality," Stormwater Magazine, Sept/Oct 2003.	Conference Proceeding	Barfield	2003
Hayes, J., Barfield, B., Holbrook, K., Bates, B., Gillespie, J., and Fersner, J. "Simplified Detention Model Using Calibrated Design," Proceedings of International Congress on Watershed Management for Water Supply Systems, AWRA, New York City, July 2003.	Conference Proceeding	Barfield	2003
Hayes, J., Barfield, B., Holbrook, K., and Gillespie, J. "Integrated Design and Evaluation Assessment of Loadings (IDEAL)," Proceedings of StormCon, San Antonio, TX, July 2003.	Conference Proceeding	Barfield	2003
Hayes, J., Barfield, B. "Integrated Design and Evaluation Assessment of Loadings for Coastal Watershed," Proceedings of USVI Water Quality Conference, December 4, 2003.	Conference Proceeding	Barfield	2003
Barfield, B.J., J. C. Hayes, K. F. Holbrook, B. Bates, J. Gillespe (2003) IDEAL model, 3 papers presented at the EWRI conference in Philadelphia, American Water Works Association in New York, and Stormcom Meeting in San Antonio.	Conference Proceeding	Barfield	2003
Barfield, B. J., Stevens, E., Haan, C. T., Hayes, J. C., and Holbrook, K. F. 2001. Engineering design aids for sediment control practices. Proceedings International Symposium on Soil Erosion Research for the 21 st Century, Jan. 3-5, 2001, Honolulu, HA. Published by American Society of Agricultural Engineers, St. Joseph, MI. (In Press)	Conference Proceeding	Barfield	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Carlson, J.D., Bradshaw, L.S., Nelson, R.M., Jr., and R.R. Bensch, 2003. Independent field verification of a next-generation model for dead fuel moisture. Preprint CD, Fifth Symposium on Fire and Forest Meteorology, Amer. Meteorol. Soc., Nov. 16-20, Orlando, Paper J11.5, 6 pp.	Conference Proceeding	Carlson	2003
Datar, R., R. Shenkman, B.G. Cateni, R.L. Huhnke, and R.S. Lewis. 2003. Ethanol from Biomass-generated producer gas. Proceedings of the Annual AIChE Meeting, San Francisco, CA.	Conference Proceeding	Huhnke	2003
Frankenberger, J. R. and M.D Smolen. 2003. Land-grant Universities: Research, Education, and Local Leadership to Improve TMDLs. Proceedings of the ASAE Specialty Conference, Total Maximum Daily Load (TMDL) Environmental Regulations II. American Society of Agricultural Engineers, St. Joseph, MI. November 8-12, 2003.	Conference Proceeding	Smolen	2003
Stoodley S., Smolen M.D., Stoecker A. 2003. Economic Feasibility of Riparian Buffer Implementation: An Evaluation of the Conservation Reserve Program for the Sugar Creek Watershed, Oklahoma. Riparian Habitat and Floodplains Conference. California Riparian Habitat Joint Venture. Sacramento, CA.	Conference Proceeding	Smolen	2003
Barfield, B. J., G. F. Felton, and M. R. McCann. 2004. A simple model of karst spring flow using modified NRCS procedures. Journal of Hydrology, 287/1-4: 34-48.	Conference Proceeding	Barfield	2004
Christianson, R., Brown, G., Barfield, B., and Hayes, J. 2004. "Bioretention and Infiltration Devices for Stormwater Control," Proceedings of the 6th International Conference on Hydro-Science and -Engineering, Brisbane, Australia. May 31-June 3. Abstract: p. 291.	Conference Proceeding	Barfield	2004
Hayes, J. C. and B. J. Barfield. 2004. Changing Land Use Applications of IDEAL (Integrated Design Evaluation and Assessment of Loadings). Proceedings of the 6th International Conference on Hydro-Science and -Engineering, Brisbane, Australia. May 31-June 3. Abstract: p. 288,	Conference Proceeding	Barfield	2004
Barfield, B. J., J. C. Hayes and M. Clar.. 2004. Overview of Urban Stormwater and Sediment Control Modeling. Proceedings of the 6th International Conference on Hydro-Science and -Engineering, Brisbane, Australia. May 31-June 3. Abstract: p. 283.	Conference Proceeding	Barfield	2004

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Lewis, R.S., R.P. Datar, A. Ahmed, B.G. Cateni, R.L. Huhnke, D.D. Bellmer, T.J. Bowser, and R.S. Tanner. 2004. Generation of producer gas from biomass followed by conversion to ethanol and other products. Proceedings of the 2nd World Conference and Technology Exhibition on Biomass for Energy, Industry and Climate Protection, Rome, Italy.	Conference Proceeding	Huhnke	2004
P. Weckler, C. Jones, R. Jayasekara, M. Stone, N. Maness, Estimating Water Stress in Greenhouse Grown Plants Using Hyperspectral Sensing, to be presented at the 2004 ASAE/CSAE Annual Int'l Meeting, Aug. 14, 2004, Ottawa, Ontario, Canada. Paper #: 043065	Conference Proceeding	Weckler	2004
H. Banger, P.R. Weckler, T.J. Bowser, and N.O. Maness, Design of a Watermelon Pulp Fruit and Juice Extraction Machine, to be presented at the 2004 ASAE/CSAE Annual Int'l Meeting, Aug. 14, 2004, Ottawa, Ontario, Canada. Paper #: 041026	Conference Proceeding	Weckler	2004
B.R. Rao, P.R. Weckler, and T.J. Bowser, Gasification of Food and Agricultural processing Byproducts -An economic waste handling alternative, to be presented at the 2004 ASAE/CSAE Annual Int'l Meeting, Aug. 14, 2004, Ottawa, Ontario, Canada. Paper #: 046143	Conference Proceeding	Weckler	2004
R. Choudhary, T.J. Bowser, N.O. Maness, W. McGlynn, P. Weckler and M. L. Stone, Estimation of Lycopene Concentration in Watermelon and Tomato Puree by Visual Reflectance Spectroscopy, to be presented at the 2004 ASAE/CSAE Annual Int'l Meeting, Aug. 14, 2004, Ottawa, Ontario, Canada. Paper #: 046119	Conference Proceeding	Weckler	2004
Huhnke, R. L. and J. Langston. 2000. Poultry Litter Storage. Plan No. OK-727-10. OSU Cooperative Extension Service.	Bulletin/Fact Sheet	Huhnke	2000
Cuperus, G.W., R.L. Huhnke, and T.A. Royer. 2000. Harvest Management. IN: Wheat Management in Oklahoma - A Handbook for Oklahoma's Wheat Industry. OSU Extension Circular E-831.	Bulletin/Fact Sheet	Huhnke	2000
MacAllister, C.T., R.L. Huhnke, C.B. Cox, and J.H. Hughes. 2000. Livestock Safety for Kids. VT844.	Bulletin/Fact Sheet	Huhnke	2000
Huhnke, R.L. 2001. Harvest. IN: Soybean Production Guide. OSU Extension Circular E-967.	Bulletin/Fact Sheet	Huhnke	2001
Using Prescribed Fire in Oklahoma, T.G. Bidwell, J.R. Weir, J.D. Carlson, M.E. Moseley, R.E. Masters, P. McDowell, D.M. Engle, S.D. Fuhlendorf, J. Waymire, and S. Conrady, OSU Cooperative Extension Service, E-927, 30 pp.	Bulletin/Fact Sheet	Carlson	2003

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Record of Significant Scholarly, Artistic and/or Creative Work

Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Fire Prescriptions for Maintenance and Restoration of Native Plant Communities, T.G. Bidwell, D.M. Engle, J.R. Weir, R.E. Masters, and J.D. Carlson, OSU Cooperative Extension Service, F-2878, 6 pp.	Bulletin/Fact Sheet	Carlson	2004
Redfearn, D., R. Huhnke, and D. Doye. 2004. Hay Production, Storage, and Feeding. IN: Beef Cattle Manual. OSU Extension Circular E-913.	Bulletin/Fact Sheet	Huhnke	2004
Huhnke, R. and S. Harp. 2004. Cattle Handling and Working Facilities Design. IN: Beef Cattle Manual. OSU Extension Circular E-913.	Bulletin/Fact Sheet	Huhnke	2004
Ulmer, J., R. Huhnke, B. Parr, and D. Bellmer. 2004. Alternative Energy. OSU Extension CD.	Bulletin/Fact Sheet	Huhnke	2004
Irrigation Advisor (Al Sutherland, Mike Kizer, J.D. Carlson), 2 pp.	Bulletin/Fact Sheet	Sutherland, Kizer, Carlson	2004
Yard Watering Advisor (Al Sutherland, Mike Kizer, J.D. Carlson), 2 pp.	Bulletin/Fact Sheet	Sutherland, Kizer, Carlson	2004
Criswell, J.T. & R.T. Noyes, Editors, 2000. 2000 Proceedings, Fumigation Workshop Manual, Circular E-888, OCES, OSU	Extension Publication	Noyes	2000
Noyes, R.T. & J.T. Criswell, Editors. 2000 Oklahoma Elevator Workshop Manual, Circular E-961, OCES, OSU	Extension Publication	Noyes	2000
Criswell, J.T. & R.T. Noyes, Editors, 1999. 1999 Proceedings, Fumigation Workshop Manual, Circular E-888, OCES, OSU	Extension Publication	Noyes	2000
Criswell, J.T. & R.T. Noyes, Editors. 2001. 2001 Proceedings, Fumigation Workshop Manual, Circular E-888, OCES, OSU.	Extension Publication	Noyes	2001
Noyes, R.T. & J.T. Criswell, Editors, 2001. 2001 Oklahoma Elevator Workshop Manual, Circular E-961, OCES, OSU	Extension Publication	Noyes	2001
Hamilton D.W., C.D. Fulhage, B.Z. Fathepure, W. D Clarkson, and J.L. Lalman. 2002. Treatment Lagoons for Animal Agriculture. <i>in</i> , <i>National Center for Manure and Animal Waste Management White Paper Series</i> . Ames, IA: Midwest Plan Service.	Extension Publication	Hamilton	2002
Hamilton, D.W., E.R. Cook, C.A. Woods, T.L. Krehbiel, M.K. Conry, and P.B. Thomas. 2002. <i>Oklahoma Poultry Waste Management Education Video and Curriculum Series</i> .	Extension Publication	Hamilton	2002
Criswell, J.T. & R.T. Noyes, Editors. 2002. 2002 Proceedings, Fumigation Workshop Manual, Circular E-888, OCES, OSU.	Extension Publication	Noyes	2002

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Name of Scholarly, Artistic and/or Creative Work	Type	Program Faculty	Year
Noyes, R.T. & J.T. Criswell, Editors. 2002. 2002 Oklahoma Elevator Workshop Manual, Circular E-961, OCES, OSU	Extension Publication	Noyes	2002
Noyes, R.T. & J.T. Criswell, Editors. 2003. 2003 Oklahoma Elevator Workshop Manual, Circular E-961, OCES, OSU.	Extension Publication	Noyes	2003
Noyes, N.T. 2000. Airflow Resistance Through Grains and Oil Seeds, GEAPS Aeration System Design and Re-Engineering Workshop. GEAPS International Exchange 2000, Kansas City, MO	Publication	Noyes	2000
Noyes, R.T. 2000. Aeration System Components. GEAPs Aeration System Design and Re-Engineering Workshop, GEAPS International Exchange 2000. Kansas City, MO	Publication	Noyes	2000
M. Beem, M. D. Smolen. Natural Creekbank Vegetation. 2001. Video. Agricultural Communications. Oklahoma State Universtiy	Video Tape	Smolen	2001

Appendix C
 Projects Completed by the Applications Engineering (Manufacturing Extension) Program
 2000-2004

Applications Engineer	Company	Location
Adams	Advantage Mfg Group (#1)	Claremore
Adams	Aerotek Industries, Inc.	Muskogee
Adams	Ag-Quip	Ramona
Adams	All State Fabricators	Muskogee
Adams	American Folk Art Furn.	Afton
Adams	American Foundry Group	Muskogee
Adams	ARC Industries	Bartlesville
Adams	Arrow Engine	Tulsa
Adams	Bizzy Beaver Ranch	Cromwell
Adams	Blitz U.S.A.	Miami
Adams	Bravo Foods, Inc.	Claremore
Adams	Briggs Rainbow Buildings, Inc	Ft. Gibson
Adams	Ceramic Art Mfg Co. (#1)	Hulbert
Adams	Cherokee Heritage Pottery	Tahlequah
Adams	Cherokee Nation Industries	Stilwell
Adams	Chromium Plating	Tulsa
Adams	Cinch Connectors	Vinita
Adams	Clear Creek Monastery	Hulbert
Adams	Contech Mfg., Inc.	Claremore
Adams	Eagle Resources	Claremore
Adams	Fansteel, Inc	Muskogee
Adams	Gerber-Coburn	Muskogee
Adams	Greenfield Hardwood Lumber	Wann
Adams	Henderson Coffee	Muskogee
Adams	Hydrohoist International (#1)	Claremore
Adams	Hydrohoist of Grand Lake	Bernice
Adams	Hypower Connections	Claremore
Adams	Inola Castings Works, Inc.	Inola
Adams	J R Birch Cabinets	McAlester
Adams	John Crane, Inc.	Tulsa
Adams	Kannon Cycles	Ketchum
Adams	Keil Enterprises, Inc (#2)	Afton
Adams	Klutts Equipment Co.	Muskogee
Adams	LaCour-Dalton	Henryetta
Adams	Meister Bullets, Inc.	Oologah
Adams	Miracle Heat Saunas	Salina
Adams	Moore Engr'g and Man'g	Catoosa
Adams	Moore Engrg Services Company	Tulsa
Adams	Native American Equipment #3	Muskogee
Adams	NuMark companies ,Inc.	Tulsa
Adams	Numatents, Inc.	Tulsa
Adams	Nupar, Baldor Electric Co.	Claremore
Adams	Oklahoma Pressed Metals (#1)	Miami
Adams	Packaging Corp of America	Muskogee
Adams	Polyvision Corporation	Okmulgee
Adams	PondEco	Tulsa
Adams	Precision Components	Owasso

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Applications Engineer	Company	Location
Adams	Precision Machine and Mfg	Grove
Adams	Purolator Products Company	Tulsa
Adams	Reinforced Earth Company	Catoosa
Adams	Rich Lillard Decoys	Miami
Adams	Rotek	Claremore
Adams	Spectra Press, Inc.	Tulsa
Adams	The Sawdust Factory	Claremore
Adams	Thompson Manufacturing	Tulsa
Adams	Thunderbird Supply	Muskogee
Adams	Tomco-Harwel Industries, Inc.	Tulsa
Adams	Traing and Support Specialists	Muskogee
Adams	UPCO, Inc.	Claremore
Adams	Wedlake Fabricating Inc.	Tulsa
Adams	Wood Systems, Inc	Tulsa
Adams	Young Construction	Tahlequah
Adams	Zeeco	Broken Arrow
Buford	All Terrain Cedar Saw, LLC	Vici
Buford	Armstrong Products, Inc.	Guthrie
Buford	Bale Buggy, Inc.	Perry
Buford	Bermuda King, L.L.C.	Kingfisher
Buford	C & T Machine, Inc.	Tonkawa
Buford	Century Livestock Feeders, Inc	Shidler
Buford	Cherokee Locker Plant	Cherokee
Buford	Clip Key	Stillwater
Buford	DC Case and Cabinet Company	Alva
Buford	Dougherty Forestry Manufacturing	Hinton
Buford	Energy Meter Systems	Hennessey
Buford	Enid Tile & Marble	Enid
Buford	Fabrication Industries	Blackwell
Buford	Farmers Elevator Company	Ames
Buford	Flying W Inc	Watonga
Buford	Frank W. Murphy Manufacturing	Tulsa
Buford	George E. Failing Co.	Enid
Buford	Golf Stuff	Ponca City
Buford	Gooden Specialty Mfg.	Kingfisher
Buford	Grasslander	Hennessey
Buford	Great Lakes Carbon Corp.	Kremlin
Buford	Hallmore Enterprises	Chickasha
Buford	Heartland Quiltworks	Cherokee
Buford	Herschel-Adams	Guymon
Buford	Horizon Structures	Garber
Buford	Hydra Soil International, Inc.	Kingfisher
Buford	K & C Manufacturing	Newkirk
Buford	LT Ranch Supply	Seiling
Buford	Meier Fabrication Industries	Garber
Buford	MEPCO	Enid
Buford	Mitchco Fabrication, Inc.	Ponca City

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Applications Engineer	Company	Location
Buford	Mountain Country Foods	Okeene
Buford	No Man's Land Beef Jerky	Boise City
Buford	Plane Plastics, Ltd	Alva
Buford	Progressive Windows, Inc.	Fairview
Buford	Red Fork Manufacturing	Dover
Buford	Residential Copper, LLC	Ponca City
Buford	Skelton Natural Beef	Texhoma
Buford	Southwest Cupid	Blackwell
Buford	Southwestern Wire Cloth	Broken Arrow
Buford	Speed Demon	Blackwell
Buford	STECO, Inc.	Enid
Buford	TOMCO Chemicals	Tulsa
Buford	Tulsa Power Products, Inc.	Tulsa
Buford	Unibridge Systems Inc.	Knowles
Buford	Value Added Products	Alva
Buford	Wilson Flow Line Products	Chickasha
Buford	Wilson Manufacturing Inc	Cherokee
Enns	3C Cattle Feeders	Mill Creek
Enns	ACI	McLoud
Enns	Airgo Systems	Edmond
Enns	Allen Enterprises	Wynnewood
Enns	Armstrong World Industries	Stillwater
Enns	Artic Temp, Inc.	Meeker
Enns	Atoka Trailer	Atoka
Enns	Bar 19 Foods	McAlester
Enns	Braden-Carco-Gearmatic	Okmulgee
Enns	Bryan Agri Products	Durant
Enns	C & H Manufacturing	Ardmore
Enns	Cammond Industries, Inc.	Ada
Enns	CCobb, Inc.	Ponca City
Enns	Central Expanded Metal, Inc.	CHANDLER
Enns	Choctaw Mfg & Development Corp	McAlester
Enns	Clay Wood Products	Ft. Towson
Enns	CNI Manufacturing	Marietta
Enns	Crain Mfg (Machine Shop)	Durant
Enns	D & J Packaging	Durant
Enns	Double R Manufacturing	Durant
Enns	Easy Rider, Inc.	Wewoka
Enns	Elite Trailer Manufacturing, LLC	Oklahoma City
Enns	Emerald Plastics	Poteau
Enns	Expanded Solutions	Wewoka
Enns	Fab Seal Industrial Liners	Shawnee
Enns	Gateway Homecrafters, Inc.	Holdenville
Enns	General Aviation Mod., Inc.	Ada
Enns	H2OR, Inc	Tulsa
Enns	Hart Tackle, Inc.	Stratford
Enns	Hudson Surfaces	Catoosa

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Applications Engineer	Company	Location
Enns	IMTEC	Ardmore
Enns	JB's Welding	Ada
Enns	Knight's Sign Source, Inc.	Calera
Enns	L & L Trailer Manufacturing	Antlers
Enns	Lektron	Tulsa
Enns	Master Works, Inc.	Bennington
Enns	Mayfield Enterprises	Ardmore
Enns	Oklahoma Custom Coating	Seminole
Enns	Parker-Hannifin Corporation/Racor Division	Henryetta
Enns	PDG Fabrication	Stroud
Enns	Picture Rock Stone and Tile	Wister
Enns	Pooch Paradise	Tishomingo
Enns	PrimePal	Duncan
Enns	Quality Water Services	Ponca City
Enns	Red River Valley Hardwoods	McAlester
Enns	S and H Trailer	Madill
Enns	Scott Pet Products	Tishomingo
Enns	Slaughter Test Systems	Ardmore
Enns	Solo Cup Company	Ada
Enns	Standard Precision Electronics	McAlester
Enns	Technology Development Group I	Shawnee
Enns	TEPCO	Stroud
Enns	Texoma Waste Control, Inc.	Durant
Enns	The Centech Group, Inc.	Hugo
Enns	Thermodynamics	Broken Arrow
Enns	Titan Trailers	Kingston
Enns	Trader Mills, Inc.	Ada
Enns	Tri-Tec Industrial Maintenance	Lone Grove
Enns	Walker Trailers	Tishomingo
Friesen	Accu-Turn , inc.	Weatherford
Friesen	Agri Industries, Inc.	Cordell
Friesen	Allen Technologies, Inc.	Chickasha
Friesen	Bar-S Foods of Altus	Altus
Friesen	Beam's Industries , Inc.	Oklahoma City
Friesen	Burford Corp.	Maysville
Friesen	ChemPac	Lawton
Friesen	Chicago Rawhide Industries	Hobart
Friesen	Dash Covers of Mid America	Weatherford
Friesen	Deaton Oil Field Services	Weatherford
Friesen	Doane Pet Care Company	Clinton
Friesen	Filter Tec	Oklahoma City
Friesen	Frederick Cabinet Company	Frederick
Friesen	GCA Products	Duncan
Friesen	General Pump Manufacturing	Oklahoma City
Friesen	Granna's Chilli	Bessie
Friesen	Hidden Valley Manufacturing LLC	Corn
Friesen	High Plains Manufacturing	Hobart

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Applications Engineer	Company	Location
Friesen	Hinton Truck and Trailer Paint	Hinton
Friesen	HIS Paint Mfg.	Oklahoma City
Friesen	Hollytex Carpet Mills Inc.	Anadarko
Friesen	Hollytex Spinning Mill Inc.	Watonga
Friesen	Hydra-Walk, Inc.	Lindsay
Friesen	Illusion Lures Inc.	Norman
Friesen	Isis Industries, Inc.	Grandfield
Friesen	J. C. Enterprises	Walters
Friesen	J.D. Sutherland, Inc.	Rush Springs
Friesen	Laney Manufacturing	Frederick
Friesen	Larrance Steele	Lawton
Friesen	Lindsey Printing	Rush Springs
Friesen	Metzeler Automotive	Frederick
Friesen	Morris Latex	Noble
Friesen	Multi-Power Products , LLC	Duncan
Friesen	Neal Technology , Inc.	Duncan
Friesen	Optical Works Corporation	Muskogee
Friesen	Owens Corning	Oklahoma City
Friesen	PCI Dyna-Trol Inc.	Elk City
Friesen	Pepper Creek Farms, Inc.	Lawton
Friesen	Progressive Stamping	Oklahoma City
Friesen	Radiotronix	Moore
Friesen	Raven Industries Inc.	Weatherford
Friesen	Republic Paperboard Company	Lawton
Friesen	Robison Solar Systems	Weatherford
Friesen	Ruth Huffman Designs	Blanchard
Friesen	Servalco	Elk City
Friesen	ShapeMaster USA	Oklahoma City
Friesen	Solid Tec Animal Health LLC	Newcastle
Friesen	Southwest Machine and Tool	Chattanooga
Friesen	Steel Fabricators Int'l.	Oklahoma City
Friesen	Stone House Marketing	Norman
Friesen	Striker L.L.C.	Oklahoma City
Friesen	Temple-Inland	Fletcher
Friesen	Tower Tech	Oklahoma City
Friesen	Trend Tec	Snyder
Friesen	Triple H Ranch	Frederick
Friesen	Ulti-Max Power Systems	Oklahoma City
Friesen	Warner Jewelry Case Co.	Lawton
Friesen	Western Hull Inc.	Frederick
Friesen	Wire Wagon	Arapaho
Friesen	Yield Inc.	Lawton
Harp	BootsEdge Corporation	Bethany
Harp	Emu Products and Management, Inc.	Marlow
Harp	Hill Manufacturing Inc.	Broken Arrow
Harp	Jensen International, Inc.,	South Coffeyville
Harp	Nupar, Baldor Electric Co.	Claremore

Appendix C
 Projects Completed by the Applications Engineering (Manufacturing Extension) Program
 2000-2004

Applications Engineer	Company	Location
Harp	Pryer Machine & Tool Co Inc	Tulsa
Harp	REDA Pump Company	Bartlesville
Harp	SciFit Systems, Inc.	Tulsa
Harp	Starline, Inc.	Bethany
Henderson	A-1 Machine Shop	Tulsa
Henderson	Adams Manufacturing Co.	Bartlesville
Henderson	Aggressive Machines Group	Oklahoma City
Henderson	Alpha Products & Systems, LLC	Stillwater
Henderson	Barrett Trailers, Incorporated	Purcell
Henderson	Bea's	Enid
Henderson	Blastcat	Oklahoma City
Henderson	Blumenthal Manufacturing Co	Oklahoma City
Henderson	Brawdy Mushrooms	Midwest
Henderson	BS&B Safety Systems, Inc.	Tulsa
Henderson	Burgess Manufacturing	Guthrie
Henderson	Carpentree	Tulsa
Henderson	Central States Business Forms	Dewey
Henderson	CENTURY INC.	Midwest City
Henderson	Cherokee Industries, Inc	Oklahoma City
Henderson	Cheyenne Innovations, Inc.	Stillwater
Henderson	CMI Corporation	Oklahoma City
Henderson	Concepts Unlimited	Stillwater
Henderson	Control Fire Systems	Oklahoma City
Henderson	Cooley Customized Sportswear	Tulsa
Henderson	Cox Machine & Tool	Oklahoma City
Henderson	Cudd Pressure Control	Lindsay
Henderson	Curry's Spring Valley Farms	Jay
Henderson	Custom Fiberglass Mfg	Oklahoma City
Henderson	Electrical Power Systems, Inc	Tulsa
Henderson	Ernst Rod Holders, Inc.	Drumright
Henderson	Exiss Aluminum Trailers, Inc.	El Reno
Henderson	Exoko Composite Products, LLC	Tulsa
Henderson	FMC Corp	Oklahoma City
Henderson	Frankoma Pottery	Sapulpa
Henderson	Gifts by Handiworkers	Bartlesville
Henderson	Gurkee's International	Tulsa
Henderson	Hale Enterprises	Nicoma Park
Henderson	Hermetic Switch	Chickasha
Henderson	Hypres Equipment	Oklahoma City
Henderson	Image Design, LLC	Bartlesville
Henderson	IMCO Recycling Inc.	Sapulpa
Henderson	Inland Island International	Tulsa
Henderson	International Crystal Mfg	Oklahoma City
Henderson	J & M Machine Shop	Henryetta
Henderson	JA Oilfield Mfg, Inc.	Oklahoma City
Henderson	Jo Rose Fine Cabinets	Tulsa
Henderson	Joyce Fogle - Silk Wearables	Bartlesville

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Applications Engineer	Company	Location
Henderson	Jugs by Bert Inc.	Moore
Henderson	Kaiser Aluminum and Chemical	Tulsa
Henderson	KF Industries, Inc.	Oklahoma City
Henderson	Kraftours	Tulsa
Henderson	Kwikset Industries	Bristow
Henderson	L & C Manufacturing	Tulsa
Henderson	Leavitt Sign & Graphics	Oklahoma City
Henderson	LifeSensors	Noble
Henderson	Lucas Color Card	Oklahoma City
Henderson	Lucas Metal Works	Ochelata
Henderson	Magnesium Products	Tulsa
Henderson	McElroy Manufacturing, Inc.	Tulsa
Henderson	Mesa Products Inc	Tulsa
Henderson	Micron Design, Inc.	Oklahoma City
Henderson	NanoSource Technologies, Inc.	Edmond
Henderson	OMG Tooling Inc.	Oklahoma City
Henderson	Ozark Steel Fab	Tulsa
Henderson	Payne County Conserv. Distr.	Stillwater
Henderson	Pelco Products, Inc.	Edmond
Henderson	Phi Technologies, Inc.	Oklahoma City
Henderson	Plastic Supply and Fabrication	Tulsa
Henderson	Pooch Pass, Inc.	Stillwater
Henderson	Pro-Fab, Inc.	Oklahoma City
Henderson	Pumpstar	Enid
Henderson	Qual-Tron Inc	Tulsa
Henderson	Ramsey Winch Company	Tulsa
Henderson	Red Dirt Soap Company	Bartlesville
Henderson	Research Development Services	Norman
Henderson	RJT Fab	Schulter
Henderson	Roasters Exchange	Oklahoma City
Henderson	SAMCO	Tulsa
Henderson	Sandie's Enterprises	Stillwater
Henderson	SETCO Solid Tire and Rim	Idabel
Henderson	Siemens Applied Automation	Bartlesville
Henderson	SSI Technologies	Edmond
Henderson	Standridge Steel Inc.	Lindsay
Henderson	Sturdy Oak Wood Crafts	Elk City
Henderson	Style & Comfort, Inc.	Oklahoma City
Henderson	Superior Fabrication, Inc.	Elk City
Henderson	SW Porcelain Steel	Sand Springs
Henderson	TechTrol, Inc.	Pawnee
Henderson	Tulsa Boat Sales	Tulsa
Henderson	Tulsa Steel Manufacturing Co.	Tulsa
Henderson	Two Seeds Co., Ltd.	Broken Arrow
Henderson	Wahico Fabricators	Sapulpa
Henderson	Yale Industries, Inc.	Yale
Norton	ADMS Mfg Company, Inc.	Tulsa

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Applications Engineer	Company	Location
Norton	Bailey Tree Farm & Nursery	Prague
Norton	Beale Water Works	McAlester
Norton	Beetle Plastics Inc.	Ardmore
Norton	D & L Manufacturing	Tulsa
Norton	Formcrete	Seminole
Norton	G and W Bodyworks	Durant
Norton	Grayson Woodcarving & Design	Tahlequah
Norton	Harrison Truss	Coleman
Norton	Hearn Machine Tool, Inc.	Seminole
Norton	Hope Minerals	Wetumka
Norton	Indaco Metals	Shawnee
Norton	J&R Manufacturing	Hugo
Norton	J&S Group, L.L.C.	Edmund
Norton	Kerr Manufacturing	Bennington
Norton	Knight Aire, Inc.	Norman
Norton	Legend Trailers, Inc.	Wapanucka
Norton	May Trailer Manufacturing	Ada
Norton	Midwest Industries	Meeker
Norton	National Oilwell	McAlester
Norton	NRCS, SE Ok District	Poteau
Norton	Plasma Technology Company	Tishomingo
Norton	Red Hill Cedar Products	Keota
Norton	River Mountain Mfg.	Broken Bow
Norton	Rosewood Industries	Stigler
Norton	RTS Millwork, Inc.	Frederick
Norton	Rubber Works, Inc.	Norman
Norton	Shawnee Lighting Systems, Inc.	Shawnee
Norton	Specialty Seats, Inc.	Durant
Norton	Team Tooling and Design, Inc.	Shawnee
Norton	Texhoma Truck Bodies, Inc.	Colbert
Norton	Texoma Truss Mfg Co	Durant
Norton	Thompson Pump Co.	Okmulgee
Norton	Tierra Madre Environ. Corp.	Ada
Norton	Valley Forge & Manufacturing	Stigler
Norton	Watonga Cheese Factory	Watonga
Norton	Wewoka Window Works	Wewoka
Norton	Woodarts, Inc.	Collinsville