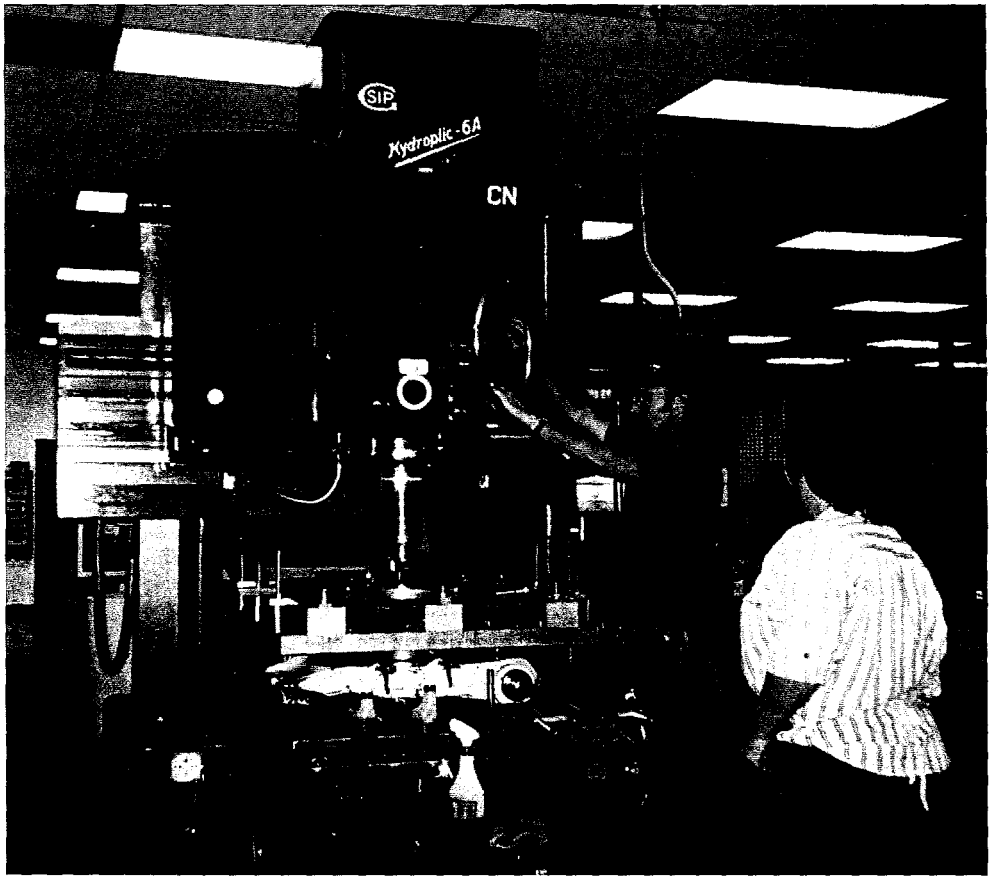
Technology Reinvestment Project
Manufacturing Education and Training

Engineering Education in Manufacturing Across the Curriculum

Submitted by:
New Mexico State University
College of Engineering
College of Business Administration and Economics



September 29, 1995

DOE/AL/98816--T2

TECHNOLOGY REINVESTMENT PROJECT
MANUFACTURING EDUCATION AND TRAINING

ENGINEERING EDUCATION IN MANUFACTURING ACROSS THE CURRICULUM

Submitted by:
New Mexico State University
College of Engineering
College of Business Administration and Economics

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A Program supported in part by
ARPA/NSF Grant DE-FG04-94AL98816 under the
Interagency Technology Reinvestment Project (TRP)
Project Officer: Maria Venegas, US Department of Energy
Project Administrator: Robert D. Lowther, US Department of Energy

Annual Period Covered by this Report:
June 24, 1994--June 23, 1995

Submitted: September 29, 1995

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FIRST ANNUAL SUMMARY OF ACTIVITIES
MANUFACTURING ENGINEERING EDUCATION ACROSS THE CURRICULUM

ARPA/NSF GRANT DE-FG04-94AL98816 under the
Interagency Technology Reinvestment Project (TRP)

SUMMARY
The goal of this project is to impart to engineering and business students, and to students from industry, the broad knowledge and practical skills to immediately help a manufacturing company become more competitive in any global economy while still providing a high quality work force for the 21st century. An integration of innovative, cross-disciplinary, manufacturing engineering and business education provided hand in hand with industry, will enable students, especially minority students, to have a real impact on manufacturing in this depressed region.

The program was shortened and simplified to meet a budget of $2,000,000 versus the $3,000,000 in the Proposal. All major objectives in the revised plan for the first year have been achieved with expenditures somewhat under the revised budget. Curriculum development with the advice and assistance of industry is ahead of schedule. Graduate minor degree curricula have been defined in Engineering and in Business. A summer intern project and guest lecture series have been well supported by industry. Facilities including advanced software have been brought on line. Cash and in-kind matching funds from industry, NMSU and the State total over $6m; this is 920% of the TRP funds expended. Cost sharing of cash is ahead of plan, of in-kind is slightly behind. The first group of 21 students have started one semester sooner than planned. The group is 25% minority and 45% female. Industry requests to interview graduates are coming in anticipation of availability in the spring of 1996.

BACKGROUND
Notification that this TRP proposal would be funded came in December, 1993, and responsibility for administering the grant was assigned to the DOE office in Albuquerque, NM. A detailed budget and cost justification book for a three year, $3,000,000 project was submitted in late February, 1994. Upon being informed that the grant would be less than anticipated, a revised budget and cost justification book was submitted in March for a 30 month, $2,000,000 project.

The NMSU Office of Grants and Contracts received a DOE F4600.1 Notice of Financial Assistance Award on 6/23/94. The budget period and the project period is from 6/24/94 to 12/23/96 (30 months). The award is a grant which implies minimal DOE involvement with the project.

In determining ways to revise the project to fit into the amount of money available, the following rationale evolved:

1. The immediate need was for graduate level courses; a number of graduate students would like to be involved in the project including some displaced and at-risk defense industry employees. It is likely that graduate minors and perhaps a graduate major could be in place and have initial graduates by the end of the grant period.

2. An undergraduate project will take at least three to four years because of the lead time of entering students, the time required for ABET accreditation (which cannot start until at least one class has graduated) and the number of courses to be developed. There is expected to be less defense industry demand for undergraduates.

3. The Industrial Relations project needs to be pursued because it is a key requirement of TRP to involve industry; most of the cost share comes from industry, and there is important spillover to other manufacturing programs at NMSU.

4. As much stability is needed over time to build momentum for the project; thus reducing the term of the project any more than is absolutely necessary is to be avoided.

From these factors and others, it was decided to focus the project on graduate education, to eliminate some staffing, to eliminate Task 3, Summer Programs, and to reduce the period of the project from 36 months to 30 months.

ORGANIZATION OF THIS ANNUAL REPORT

This report is organized by the tasks defined in the Proposal and the negotiated Budget, i.e.:

Task 1: Curriculum Development
Task 2: Industrial Relations
Task 4: Project Management

(Task 3 was eliminated to meet the revised budget.)
In each section the objectives and the milestones in the Proposal are restated and results in the first year are summarized. Supporting documentation is in Appendix A. In a separate document is a statistical report requested by NSF in their format.

TASK 1: CURRICULUM PLANNING

The definition of this task in the Proposal and the first year's milestones are summarized here:

A. A committee of 50% industry people will refine plans for curricula.

B. A faculty member will be responsible for each course to be developed. Two new courses will be developed for each of the first four semesters; two new laboratories and four revisions of

current laboratories will be accomplished during the project.

C. Each new course will be taught the semester after development

Each of these objectives has been achieved.

SUB-TASK 1A: Curriculum Planning

A key part of the project is to do a thorough job of planning so that the more intensive effort to develop courses will be efficient and well directed. Dr. Brian Lambert (Ph.D Manufacturing Engineering) in the Department of Industrial Engineering and Dr. David Wieters (Ph.D Management) in the Department of Management, College of Business Administration and Economics along with Messrs. Powers, Chappelle and Dr. Mulholland met monthly to plan and organize this effort. This planning group was expanded to include four other faculty members from Marketing and Accounting and two others from Industrial and Mechanical Engineering. A weekend retreat was held to concentrate on team building and planning.

The planned curriculum was reviewed with the industry Curriculum Committee of the Manufacturing Advisory Committee and with the full Committee on two occasions. The project was also reviewed by the Industrial Advisory Committee of the Department of Mechanical Engineering. A short presentation was made to the initial meeting of the revised Business Advisory Council of the College of Business Administration and Economics.

The administrative steps necessary to introduce new minor and major degree programs into the curriculum were identified. It is necessary to identify new courses no later than four months before first offering in order to get the information into the next catalog to be published, to advise students during course registration and to commit faculty released time for course development.

Results of a survey of manufacturing engineering needs of over 100 companies were used to define curricula leading to a manufacturing engineering minor for any engineering graduate student and for a concentration in manufacturing management in the MBA project. Required and elective courses were determined. Faculty and administration approval was received for offering these programs.

The Department of Engineering Technology defined a two year Associate of Science in Engineering Technology Manufacturing Project to complement the graduate programs. (The Engineering Technology work is over and beyond the objectives stated in the Proposal.)

These programs are outlined in Appendix A2.

Planning focused on four new core courses:

1. a graduate course to introduce business students to manufacturing engineering concepts. This course, IE570, was developed in the fall, 1994, and taught in the spring, 1995 semester.

2. a graduate course to introduce engineers to business concepts. This course, BA518, is being developed in the summer of 1995 to be taught in the fall, 1995 semester.

3. a graduate level Capstone course to be completed by teams of engineering and business students in which an industrial manufacturing problem will be analyzed and a solution synthesized. This course, BA519/ME 510-1 is being developed in the summer and fall of 1995 and will be offered in the spring, 1996 semester.

4. a Cornerstone course for entering engineering and business students in which a joint manufacturing project would be undertaken. This course development is planned for the spring, 1996 to be offered in the fall, 1996.

SUB-TASK 1B: New Course Development

The following courses and laboratories have been developed:

ET217 Manufacturing Processes
ET217L Manufacturing Processes Lab
ET315 Computer Integrated Manufacturing (revised)
IE570 Introduction to Engineering for Manufacturing
IE572 Manufacturing Systems
IE575 Advanced Manufacturing Processes
IE577 Ergonomics (in Manufacturing)
ME405 Precision Machining (by Los Alamos National Lab)
ENGR301G Manufacturing History and Techniques

This more than meets the objective of four new courses in the first year.

The following courses are under development:

BA518 Integrated Business Concepts
BA519/ME510-1 Joint Project Course
IE576 Control Systems (with a laboratory)
IE531 Operations Research (Techniques for Manufacturing)
ME446 Thermal Design (Issues in Manufacturing)
ME5xx Manufacturing Topics (to be taught by Sandia)

Successful completion of this work will more than meet objectives for the second year.

SUB-TASK 1C: Teaching New Courses

Each of the courses developed has been taught in the following

semester by the faculty member who developed the course, thus tuning up the course and meeting the objective in this sub-task.

TASK 2: INDUSTRIAL RELATIONS

Objectives for this task in the first year included:

1. setting up an industrial relations office
2. setting up an internship project with industry
3. developing industry awareness of the project
4. growing and extending in-kind support

All these objectives have been achieved.

Work began to refine the industry cost share justification to be submitted to the DOE Project Administrator. Only those companies who had submitted written confirmation of their activities were included. For significant donations of equipment and software, an exercise was completed to value equipment according to the depreciation rules established by the government; for software the market value with all usual educational discounts was documented. The only significant change was a reduction in the value of donated CAD/CAM/CAE software to take into account an educational discount.

The cash and in-kind commitments from federal sources were reexamined. Federal contributions from Sandia, Los Alamos, DOE through Allied Signal and from NASA were sorted out using depreciated values. The federal contributions were shown as being available to the project, but were not included in cost sharing. There were no significant changes.

The cash and in-kind commitments from NMSU were examined to eliminate double counting and to eliminate funds which had as their source other federal projects. For example, equipment in the Manufacturing Teaching Factory which was provided by a national laboratory was moved from the in-kind cost share totals to the federal sources totals. Again there were no significant changes in the totals.

The DOE office in Albuquerque requested and received an up-to-date list of industrial partners with contact names and telephone numbers. A summary is included in Appendix A3.

SUB-TASK 2A: Industrial Partnerships

The Industrial Relations office was established under the leadership of Mr. Powers. A work study student is providing part time assistance.

INDUSTRIAL CONTACTS

A series of letters has been sent to industry partners to make

them aware of progress and solicit their continuing involvement. All partners were contacted as part of the guest lecturer series and as part of the summer intern project. A summary of progress was sent out in February, 1995. A number of partners are calling now about recruiting our graduates. This annual report will be distributed to all industry partners.

GUEST LECTURERS FROM INDUSTRY

A series of guest lecturers from industry was started with sessions almost weekly. Industry engineers came to campus for a day or more, interacted with classes, visited informally with students and faculty, and gave at least one open seminar on a topic related to manufacturing. Faculty hosts were assigned to each guest. Twenty-six speakers from eighteen different companies interacted with over 700 student and faculty members. This project was well received and will be expanded in the 1995-1996 school year with more topics in manufacturing management for MBA students. A summary of the first year is in Appendix A4.

VISITING PROFESSORS FROM INDUSTRY

A course in Precision Machining was offered in the spring, 1994, semester with team teaching by Dr. Mulholland and Dr. Dick Rohrer of Los Alamos National Laboratory as promised in the Proposal.

Sandia National Laboratories is planning to offer a course in Manufacturing Topics with experts from their staff in the spring, 1996 semester. This will fulfill the plan for the second year of the project.

PLANT TOURS

This topic is receiving increased emphasis for the second year. In the first year, it was difficult to rearrange faculty schedules for courses to make time for plant tours.

SUB-TASK 2B: MANUFACTURING ENGINEERING INTERNSHIP PROJECT

Students interested in careers in manufacturing were matched with companies who had committed to accept a summer intern. The late start in 1994 hampered this effort; many students were already committed for the summer and many companies had assumed the first interns would not be coming until the summer of 1995.

Thirty-one students of which 58% were minorities were in intern assignments in Summer, 1994. The 1995 numbers will be larger, but are not yet completely known. The goal, on the average over the years of the project, was 36 per year. A summary of this project is included in Appendix A5.

Some large companies such as Intel and Honeywell worked with the NMSU Placement office, interviewed and hired students in a

business-as-usual way, but some of these companies had never had a summer intern before and needed a lot of assistance.

General Motors, Los Alamos National Laboratory and NASA White Sands Test Facility also provided summer positions for three faculty members.

It became clear in this activity that students need help in preparing resumes and in interviewing. Approximately 100 students have been counselled, and some went through many drafts of a resume before arriving at one which fairly presented their skills in a way suitable for someone in industry to review.

SUB-TASK 2C: SCHOLARSHIPS AND FELLOWSHIPS

An initial group of 16 scholarships of $1000 each was awarded in the spring and summer of 1995 from a TRP budget of $19,000. The remainder will be committed in the fall of 1995. Since tuition at NMSU is only $990 a semester, a $1000 grant will be of great assistance to students. Requirements included an interest in manufacturing as a career, a grade point average of 3.2 or better, a need for financial aid and being a senior or graduate student in Engineering or Business. A committee of faculty from both Colleges selected the winning applicants. A summary is included in Appendix A6.

In addition to the TRP funds, General Motors supplied $15,000 for support of three graduate students and Honeywell supplied $5,000 which is planned to be used for scholarships. Thus the total from industry exceeded the TRP amount in the first year.

TASK 3: SUMMER PROGRAMS

This Task was removed from the project in order to reduce the budget to meet the money available through the grant.

TASK 4: PROJECT MANAGEMENT

The objective of the task was to organize and manage the overall effort. Specific Milestones in the first year included:

1. Assignment of Director and deputy directors
2. Two meetings of the Manufacturing Advisory Committee
3. An annual report
4. An annual report of Minority Progress
5. Formation of graduate MFE department
6. Documentation Center on line

All these objectives but one have been achieved.

Dr. Mulholland has given up his responsibilities as Department Head of the Mechanical Engineering Department in order to become director of the NMSU Manufacturing Engineering Project which includes this TRP effort, a project of research in manufacturing

technologies, and an outreach project to support industry within the State of New Mexico. Mr. Chappelle and Mr. Powers are Associate (Deputy) Directors. Mr. Chappelle was to manage the curricula development, facilities and other administrative tasks; and Mr. Powers was to manage the Industrial Relations tasks. All these objectives have been accomplished, although staffing has been slightly different.

Mr. Chappelle has had to devote his time to managing a large research grant during this first year, so Mr. Powers has taken on his duties. It is expected that Mr. Chappelle will be available to the project in October, 1995. Dr. Hensel, who is Associate Director of the Advanced Manufacturing Center and Associate Professor of Mechanical Engineering is devoting some of his time to the management of this project. His resume is included in Appendix A7.

The Manufacturing Advisory Committee met at NMSU in December, 1993, and September, 1994. The TRP activities were discussed. Committees were formed in several areas. (See Appendix A8.) Copies of the presentations to the Advisory Committee have been previously supplied to the Project Officer. The Industrial Advisory Committee of the Department of Mechanical Engineeringmet in February, 1995, and also reviewed the project. Presentations were made to the Business Advisory Council of the College of Business Administration and Economics.

The Annual Report of Minority Progress using the NSF format is provided in a separate statistical report to NSF.

Since the emphasis of this project was to prepare engineers in many disciplines to be able to work in globally competitive manufacturing operations, i.e., Manufacturing Engineering Education Across the Curriculum, it was decided to work with existing engineering departments and not institute a new department of Manufacturing Engineering during the first year. Also, in order to set up a new department, more information on the need for the department, the number of potential students, industry interest in hiring graduates, etc. must be developed. Thus the milestone of establishing a Manufacturing Engineering Department was deferred to later in the project.

First students were enrolled in the manufacturing core course IE570, Introduction to Engineering for Manufacturing, in the spring, 1995, semester, approximately one semester sooner than on the Milestone chart. The second core course, BA518, is enrolling students in the spring, 1995, and will be taught in the fall, 1995, which is on schedule. Twenty-one students are involved so far, with more expected after registration for the fall, 1995, semester.

The Documentation Center has been established by Mr. Chappelle and is a repository of brochures, reports, papers, other programs, etc. concerning manufacturing engineering education.

BRIEFINGS

Briefings were given to a number of faculty meetings to inform faculty members and to enlist their participation.

A summary of the project was given to the Dean's Meeting with Department Heads in the College of Engineering. A planning meeting was held with the Dean of the College of Engineering, the Director of the Engineering Research Center and others to review the overall manufacturing project of which the TRP effort is a key part.

Similar meetings were held with the Dean and the faculty of the College of Business Administration and Economics. A presentation was given to the initial meeting of the revised Business Advisory Council of the College of Business Administration and Economics.

A joint colloquium was held with faculty of both colleges to introduce the project. A briefing package was prepared for student advisors. Brochures were prepared for prospective students and for industry (see inside back cover). Presentations were made in senior level courses to inform prospective students of the new project.

Replies were generated in response to a query from The Honorable Ronald V. Dellums, Chairman, House Armed Services Committee and were copied to the Project Officer.

Senator Bingaman was briefed by Dr. Mulholland in January, 1995.

Also in January the project was discussed with the Industrial Technology Advisory Committee of the Las Cruces Public Schools. It may be possible to develop a project in the middle and high schools to better prepare students to enter the manufacturing project at the University level.

A briefing was given to New Mexico Tech, Socorro, NM, to identify ways to participate in this project.

Dr. Mulholland prepared two briefings for the New Mexico Legislative Committee on Science and Education.

Mr. Powers summarized the project at the June, 1994, annual meeting of the American Society of Engineering Education in Edmonton, Canada in a session organized by NSF. Discussions were held with a number of other teams which had received TRP grants.

Copies of this paper were provided to the Project Officer.

FACILITIES

Objectives in this area were to upgrade the CAD/CAM labs and IBM work stations with new software, to bring a diamond turning machine on line, and to establish a workstation interface to Sandia's Rapid Prototyping System. All these objectives were accomplished except bringing the Diamond Turning Machine on line.

Of great importance to this project was the acquisition by NMSU of a new 42,000 sqft building to house many of the elements of the manufacturing project. In particular the Manufacturing Teaching Factory has been moved into this new space. The building is being arranged to facilitate the use of the Teaching Factory as part of the Education Project as well as to work with industry.

The CAD/CAM laboratories were equipped with the latest version of ANVIL 5000, an advanced software system supplied by MCS, an industrial partner. An IBM RISC lab was set up using work stations donated by IBM and Phillips Petroleum and software from MCS. PC's were obtained from AT&T, IBM and Honeywell.

A Diamond Turning Mill was obtained on loan from Los Alamos National Laboratories and is being installed in the Manufacturing Teaching Factory. Installation and alignment should be complete by the fall of 1995. Although this is later than planned, the delay has no impact on the educational project.

A Silicon Graphics workstation was supplied by Sandia National Laboratories with updated software from ProE. This system was used by a student to design a new consumer product for a local entrepreneur. The file was transmitted to Sandia in Albuquerque and a prototype was made in Sandia's Rapid Prototyping Facility. The entrepreneur has since entered into an agreement with a major American company to produce the product. Costs for the student's time and for Sandia's work were covered by other programs. This is an example of how facilities attracted to NMSU by the TRP activities are enabling students to work on real problems and are aiding local industry which leads to economic growth.

The inventory tag numbers of all equipment included in cost share matching for this project have been documented.

SUMMARY OF FACULTY, STAFF AND GRADUATE STUDENT INVOLVEMENT

A summary of the faculty, staff and graduate student involvement with the project is included in Appendix A9. Also in this Appendix is Table 3: Personnel using the NSF format.

BUDGETS

This program expended $610,749 of TRP funds against a proposal budget of $798,690. A summary of the first year's actual costs is in Appendix A10 with estimated budgets for year 2 and year 3. Some final bills have not been received but are not expected to change the results significantly. There have been some minor shifts among categories within the budget. The budget for Task 1, Curriculum Development, was slightly underrun even though all curriculum development objectives were met. Costs in Task 2, Industrial Relations, and Task 4, Project Management, are under budget because of decisions to delay additional staff in these areas. Permission of the Project Administrator has been requested to roll the surplus into the next two budget years. We now anticipate requesting a no-cost extension of approximately six months for at least a part of the overall project.

CASH AND IN-KIND MATCHING

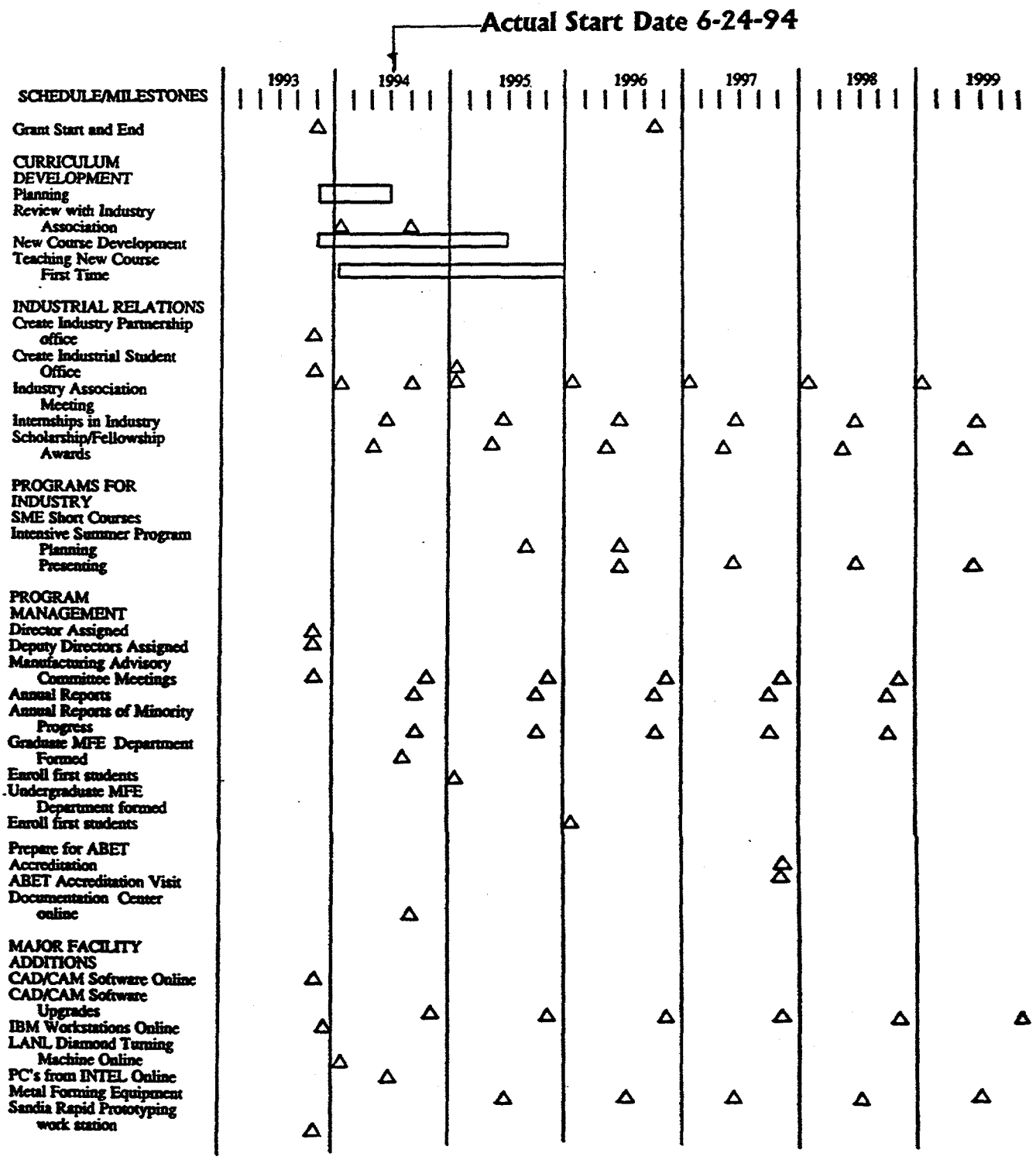
A listing of the actual cash and in-kind matching donations during the first year is included in Appendix A11. Note that the amount of cash from industry exceeded the estimate. The in-kind contributions were slightly less than expected. One reason for this was the lack of an extensive series of factory tours which turned out to be very difficult to merge with faculty course schedules in the first year. In-kind contributions from other federal agencies were also slightly less than expected; however these funds were not used to match TRP funds in the proposal.

The first year total of cash and in-kind matching funds from industry, NMSU and State of New Mexico sources was $6,063,409; this is 9.2 times the TRP funds expended in comparison with a proposal estimate of 7.6. With contributions from other federal agencies, the total matching was $7,608,688 which is 11.5 times the TRP expenditures in the first year.

TRPANSUM

APPENDIX A

MANUFACTURING ENGINEERING EDUCATION SCHEDULE INCLUDING MEASURABLE MILESTONES



CURRICULUM REQUIREMENTS
MASTER OF SCIENCE IN ENGINEERING
MINOR IN MANUFACTURING ENGINEERING

To obtain a minor in Manufacturing Engineering as part of a Masters of Science degree in engineering, a student at New Mexico State University must complete the following requirements:

1. All departmental requirements for the MS degree

2. A minimum of 15 credit hours from courses in the Manufacturing Minor list approved by the Department

3. Six credit hours from the College of Business Administration and Economics including:
   BA518 Integrated Business Concepts
   One other elective

4. At least three credit hours of
   ME510-1 Manufacturing Projects
   This course is a variable credit course and may be taken for up to five credit hours; however most engineering programs will allow project credit for only three hours towards the requirements of the MS degree. We strongly encourage all students to take the course for five hours.
   This is a joint course with BA519; engineering and MBA students will work together in teams to produce a product.

5. An internship or co-op assignment in an industrial manufacturing assignment if at all possible. If not, an internship in the NMSU Advanced Manufacturing Center is highly recommended. With departmental approval, three hours course credit is possible.

6. One credit hour ME520 Manufacturing Topics Seminar. This course brings to campus engineers and managers from industry who are involved in manufacturing.

7. No more than three hours of electives should be taken from any one of the following groups:
   Manufacturing Process Management
   - Manufacturing Systems
   - Total Quality Management
   - Team Building
   - Information Systems
   - Concurrent Engineering

   Manufacturing Techniques
   - Manufacturing Processes
   - Process Control
   - Automation
   - Robotics

   Manufacturing Processes
   - Tool Design
   - Simulation
   - Plant Layout and Materials Handling
   - CAD/CAM/CIM

   Design for Manufacturing

CURRICULUM REQUIREMENTS
MASTER OF BUSINESS ADMINISTRATION
CONCENTRATION IN MANUFACTURING MANAGEMENT

To obtain a concentration in Manufacturing Management as part of a Masters of Business Administration degree, a student at New Mexico State University must complete the following requirements:

1. All core requirements for the MBA degree (21 credits)

2. A minimum of 15 credit hours from courses in the Manufacturing Concentration list approved by the College of which six must be from the College of Engineering

3. Six credit hours from the College of Engineering including:
   IE570 Introduction to Engineering for Manufacture
   One other elective

4. At least three credit hours of
   BA519 Manufacturing Projects
   This course is a variable credit course and may be taken for up to five credit hours. We strongly encourage all students to take the course for five hours.
   This is a joint course with ME510-1; engineering and MBA students will work together in teams to produce a product.

5. An internship or co-op assignment in an industrial manufacturing assignment if at all possible. If not, an internship in the NMSU Advanced Manufacturing Center is highly recommended. With departmental approval, course credit is possible.

6. One credit hour BA/ME Manufacturing Topics Seminar. This course brings to campus engineers and managers from industry who are involved in manufacturing.

7. An additional three hours of electives from the approved list.

ASSOCIATE OF SCIENCE IN ENGINEERING TECHNOLOGY
MANUFACTURING PROGRAM
1994-95

Department Head: George D. Alexander

Faculty:
Leon Cox Anthony Hyde

Freshman (34 credits)
ET 101, Introduction to Engineering Technology 1
ET 111, Graphical Communications II 2
ET 117, Industrial Materials I 3
ET 120, Computation and Presentation Software 2
ET 152, Computational Methods I 3
ET 183, Applied DC Circuits 2
ET 183L, Applied DC Circuits Lab 1
ET 217, Manufacturing Processes 2
ET 217L, Manufacturing Processes Lab 1
CHEM 110G, Principles & Applications of Chemistry 4
ENGL 111G, Freshman Composition I 4
MATH 180, Trigonometry 2
MATH 185, College Algebra 3
PHYS 211, General Physics I 3
PHYS 211L, General Physics I Lab 1

Sophomore (33 credits)
ET 184, Applied AC Circuits 2
ET 184L, Applied AC Circuits Lab 1
ET 240, Applied Statics 3
ET 241, Applied Dynamics 2
ET 305, Production & Assembly 3
ET 310, Applied Strength of Materials 3
ET 310L, Applied Strength of Materials Lab 1
ET 315, Computer Integrated Manufacturing 3
COMM 265G, Principles of Human Communication 3
ENGL 218G, Technical and Scientific Communication 3
MATH 235, Calculus for the Technical Student I 3
ET 304, Electrical Machines or ET 327, Tooling Systems 3
Approved humanities or social science elective 3

INDUSTRIAL PARTNERS SUPPORTING TRP ACTIVITIES AT NEW MEXICO STATE UNIVERSITY

June 30, 1995

Mr. Harold Scott, President
Active Technologies, Alamogordo, NM

Mr. W. E. Medcalf, jr., Chief Engineer
Applied Kinetics Corporation, Evanston, IL

Mr. Walter R. Mohn
Metalurgy & Manufacturing Technology Section
Babcock & Wilcox, Alliance Research Center, Alliance, OH

Mr. David Biggs
Bently Rotor Dynamics, Bently Nevada Group, Minden, NV

Mr. William M. McCullough
Seattle Programs Manager, Product Support Division
Boeing Defense & Space Group, Seattle, WA

Mr. Dick Vogel
Bridgeport Machines, Inc., Bristol, PA

Mr. Bob Reisinger
C. G. Tech (Vericut), Irvine, CA

Mr. Harry C. Moser, President
Charmilles Technologies, Lincolnshire, IL

Mr. Mike Gray
Chevron, Warren Petroleum Division
Monument, NM

Mr. Richard L. Kegg
Vice President Technology & Manufacturing Improvement
Cincinnati Milacron Inc., Cincinnati, Ohio

Mr. Ed Bailey
President, Conquest Machines, Las Cruces, NM

Mr. Russell Wilson
Vice President and General Manager
Continental Machining Company, Inc., Albuquerque, NM

Mr. Dietmar F. Pruessmann
Coronado Machine, Inc., Albuquerque, NM

Mr. Joe A. Gomez
Plant Manager, Creamland Dairies, Albuquerque, NM

Mr. Arnold Robinson, President
DeVore Aviation Corp., Albuquerque, NM

Mr. John F. Townsend, Vice President--Marketing
Giddings & Lewis, Fond Du Lac, WI

Mr. Antonio J. Otero
Director of Manufacturing Engineering
General Motors Corporation
Buick City B-O-C Flint Automotive Division, Flint, MI

Mr. C. B. Anderson
Honeywell, Inc.
Defense Avionics Systems Division, Albuquerque, NM

Ms. Libby Davis, Account Representative
IBM--U.S. Marketing & Services, El Paso, TX

Mr. Roger Tonneman
Intel Corporation, Rio Rancho, NM

Mr. Alan Clouse
Karsten Manufacturing Corp., Phoenix, AZ

Mr. Vernon L. Mangold, President
Kohol Systems, Inc, Dayton, OH

Mr. Ron Soliman
Laguna Industries, Laguna, NM

Mr. Scott M. Hanratty
Vice President, Marketing and Sales
Manufacturing & Consulting Services, Inc.,Scottsdale, AZ

Mr. Bill Hegge
Philips Semiconductor, Albuquerque, NM

Mr. John C. Mihm
Vice President, Research and Development
Phillips Petroleum, Bartlesville, OK

Mr. David L. Durgin, Vice President
QUATRO Corp., Albuquerque, NM

Mr. Kenneth P. Freeman, Senior Scientist
Science & Technology Corp., Las Cruces, NM

Dr. Jon E. Sollid, President and CEO
Sollid Optics, Los Alamos, NM

Mr. Jack B. Tillman, Southwest Regional Manager
The S. M. Stoller Corporation, Carlsbad, NM

Mr. Randy Boles, General Manager
Tuscarora Plastics, Inc., Las Cruces, NM

Mr. Donald A. Dalton
United Technologies, Pratt & Whitney Div., Albuquerque, NM

Mr. Jim R. Walls
Westinghouse Electric Corp., Carlsbad, NM

Mr. Stephen F. Blake
Lockheed-Martin, Denver, CO

Mr. Robert Dettinger
Director of Materials and Engineering
Packard Electric, El Paso, TX

Mr. John Gertie
Engineering Manager, Connectorized Products
AT&T Network Systems, Phoenix, AZ

NATIONAL LABORATORIES AND OTHER GOVERNMENT ENTITIES

Mr. M. L. Gessley
Allied Signal Aerospace Co., Kansas City, MO

Mr. Richard Rhorer
Program Manager, Advanced Machining Development
Los Alamos National Laboratory, Los Alamos, NM

Dr. Dan E. Arvizu
Director, Advanced Energy Technology Center
Sandia National Laboratories, Albuquerque, NM

Dr. Joseph Fries, Manager
NASA JSC White Sands Test Facility
Las Cruces, NM

T. L. Powers
trpcorpt

NEW MEXICO STATE UNIVERSITY
MANUFACTURING ENGINEERING EDUCATION PROGRAM
1994-1995 GUEST LECTURER SERIES
SUMMARY CHART

DATE	SPEAKER	COMPANY	HOST	# OF STUDENTS	# OF FACULTY	TOTAL
9-14-94	R. Matthews	Honeywell	Powers	20	5	25
9-29-94	J. Stegmuller	Cin. Milicron	Powers	19	5	24
10-5-94	W. McClenahan	Boeing	Steelman	5	5	10
11-9-94	G. Boisvert	Martin Marietta	Chappelle	4	17	21
11-9-94	P. Plomp	Sandia Ntl Labs	Cox	6	7	13
11-29-94	S. Blake	Martin Marietta	Powers	30	5	35
12-2-94	W. Zbdeblick	Inst. Adv. Mfg. Sc.	Cox	47	5	52
1-17-95	W. Rector	Conquest Mach	Futvoye	4	8	12
1-24-95	P. Bernasconi	Charmilles Tech	Hyde	35	16	51
1-30-95	W. Parrish	Phillips Petroleum	Pines	32	4	36
2-7-95	J. Eggart	Bentley Nevada	Ricketts	40	15	55
2-20-95	N. Clark/ N. Doohge	Sandia Ntl Labs	Staffeldt	30	20	50
2-22-95	W. Medcalf	Applied Kinetics	Burchett	70	13	83
2-24-95	T. Stockebrand	DEC	Hills	10	10	20
2-24-95	J. Walls	Westinghouse	Hills	17	5	22
2-24-95	E. Witt	NREL	Hasti	5	8	13
2-28-95	C. Atwood	Sandia Ntl Labs	Cox	45	8	53
3-21-95	V. Mangold	KOHOL Systems	Colbaugh	20	18	38
3-27-95	M. Knoll	Sandia Ntl Labs	Hasti	26	8	34
4-4-95	R. Bates/ J. Niesen	Los Alamos Ntl Laboratory	Mulholland	5	8	13
4-10-95	G. Rodriguez	MCS Corp	Cox	18	3	21
4-18-95	C. Anderson	Los Alamos Ntl Laboratory	Genin	20	8	28
4-25-95	R. Bunker	WSTF/NASA	Glass	30	10	40
4-26-95	K. McCaughey	Sandia Ntl Labs	Powers	10	4	14
			TOTALS	**551**	**215**	**766**

J. Walters 5/5/95

First Year Summary
Industry Summer Interns

STUDENTS DOING INTERNSHIPS WITH INDUSTRY										
		1994		Min	Min	Min	Disp Defs	1995*	(Not yet available)	
				2	4	6				
				Asi	Hisp	Angl				
General Motors		Diane Birch	BSIE			1				
		Ramona Garcia	BSME		1					
		Joe Lucero	BSME		1					
		Hector Mendoza	BSME		1					
		Kyle Muxworthy	BSME			1				
		Alikie Parnham	BSIE		1					
		Brian Salazar	BSME		1					
		Paul Trujillo	BSME		1					
		Andrea Archuleta	BSME		1					
		Danny Bean	BSME		1					
AT&T Phoenix		Nathan Jeffers	BSME			1				
		Frank Romero	BSME		1					
Bayjet		David Bryant	BSME			1	X			
Los Alamos NL		Brian Severson	BSME			1				
		Rodd Linn	BSME			1				
		Jim Shipley	BSME			1				
		Laurie Martinez	BSME		1					
Martin		Paula Burkham	BSIE			1				
NASA		Gordon Morse	MSIE			1	X			
Packard Electric		Chi K. Man	MSEE	1						
		Dave Jernigan	BSME		1					
Intel-Albuq		Jeffery Doub	BSIE			1				
		Erika Edgerly	BSIE			1				
		Matt McLane	MSIE			1				
		Maria Murillo	BSIE		1					
		Monica Romero	BSIE		1					
		Rebecca Soltero	BSIE		1					
		Young Son	BSIE	1						
		Sonya Venzor	BSIE		1					
		Ernest Villas	BSME		1					
Sandia		James F. Arnold	BSME			1				
		Eileen Burch	BSIE			1				
		Sharlene Fiachs	MSME			1				
		Robert Ortiz	BSME		1					
Summary of Minority Participation:				2	17	15				
				6%	50%	44%				
FACULTY DOING INTERNSHIPS WITH INDUSTRY										
General Motors		Anthony Hyde	ET			6				
NASA WSTF		Dr. L. LaFrance	ME			6				
Los Alamos		Dr. G. Mulholland	ME			6				

NMSU ENGINEERING EDUCATION ACROSS THE CURRICULUM

$1,000 TRP MANUFACTURING SCHOLARSHIPS AWARDED

Requirements:

GPA 3.2 minimum
Senior or Graduate Student in Engineering or Business
Interest in a career in Manufacturing

Selection: joint committee of faculty of the College of Engineering and the College of Business Administration and Economics.

Awardees:

Daniel Aranda, Industrial Engineering, Las Cruces, NM
Stan Chavez, Industrial Engineering, Farmington, NM
Eileen Elisoff, Business Administration, Accounting, Tyrone, NM
Lucio Garcia, Mechanical Engineering, Las Cruces, NM
Edna Hakenson, Masters of Business Administration, Las Cruces, NM
Barbara Howell, Business Administration, Accounting, Las Cruces, NM
Daniel Korch, Mechanical Engineering, Alamagordo, NM
Kristina Moore, Mechanical Engineering, Elko, NV
Colm O'Reilly, Electrical Engineering, Albuquerque, NM
Thomas Ortiz, Mechanical Engineering, Albuquerque, NM
Lee Seaton, Business Administration, Accounting, Orieto, FL
Brian Severson, Mechanical Engineering, Alamagordo, NM
Michael Steinzig, Mechanical Engineering, Silver City, NM
Angela Simon, Electrical Engineering, Alamagordo, NM
Jennifer Walters, Business Administration, Management, Alamagordo, NM
Deana Woodward, Business Administration, Marketing, Las Cruces, NM

Summary:

Hispanic	4	Female	8	Business	6
Anglo	12	Male	8	Engineering	10

Tom L. Powers
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Dr. Edward Hensel, New Mexico State University
Associate Professor, Mechanical Engineering

Education
PhD, Mechanical Engineering, 1986
New Mexico State University, Las Cruces, NM

BS, Mechanical Engineering (with Distinction), 1982
Clarkson University, Potsdam, NY,

Experience
Associate Director, Adv Manufacturing Center, 6/94--
Associate Professor, Dept. of Mechanical Engineering, 1990--
Assistant Professor, Dept. of Mechanical Engineering, 1986-1990
New Mexico State University, Las Cruces, NM,

TRW Corporation, Optical Sciences Department, Summer 1989

NSF Undergraduate Research Assistant, Summer 1981
Dept. of Chemical Engineering, Clarkson University,

Invited Lectures
1) Inverse Analysis of Thermal Systems, INSA, France, March 1995

2) Two-Dimensional Nonlinear Inverse Heat Conduction Problem Case Study, International Conference on Identification in Dynamic Systems, Suzdal, USSR, Sept. 10-14, 1990.

3) Sensor Placement Considerations for Multi-dimensional Inverse Problems, International Conference on Finite Elements in Flow Problems, Huntsville, AL, April 3-7, 1989.

4) Inverse Problems for Multi-dimensional Parabolic Partial Differential Equations, International Conference on Inverse Design Concepts and Optimization in Engineering Sciences- II, October 26-28, 1987.

Awards
D.C. Roush Teaching Award, NMSU College of Engineering, 1992
NMSU Comp Center Award for Advances in Academic Computing, 1991
Teaching Award, NMSU Mech.Engr. Students, 1986

Textbooks and Journal Articles (Over 30 publications including:)
Inverse Theory and Applications for Engineers, Prentice Hall 1991

1) Hensel, E., and Dalton, K., Heterogeneous Sensors and Data Interpretation, Proceedings of the ANS Fifth Topical Meeting on Remote Systems and Robotics, American Nuclear Society, April 1993

2) Hensel, E., and Dalton, K., Nonintrusive Characterization of Waste Sites, Spectrum '92, American Nuclear Society, August 1992

3) Dalton, K. and Hensel, E., Feasibility Study of Inverting Near-Field Electromagnetic Scattering Data for Subsurface Characterization, ECOWorld Conference, Washington DC, June 1992.

PRESENT COMMITTEE ASSIGNMENTS

STRATEGIC PLANNING COMMITTEE

Don Dalton, United Technologies, Albuquerque	505-768-1480
Jim Walls, Westinghouse, Carlsbad	505-234-7400
Tim Lee, General Motors, Flint	313-236-4007
Scott Hanratty, MCS, Scottsdale	602-991-8700
Karen Martin, NM Inc., Las Cruces	505-521-3699
Dr. Ed Hensel, NMSU Mechanical Engineering	505-646-2011

RESOURCES COMMITTEE

Bill Stegmuller, Cincinnati Milacron, Cin.	513-841-8686
Ed Bailey, Conquest Machines, Las Cruces	505-526-3305
Bill Medcalf, Applied Kinetics, Albuquerque	505-344-7198
Joan Woodard, Sandia, Albuquerque	505-845-9917
Don Kidd, Western Commerce Bank	505-887-6686
Tom L. Powers, NMSU Manufacturing Programs	505-646-7749

CURRICULUM COMMITTEE

Mark Barnett, Boeing, Seattle	206-965-3964
Russell Wilson, Continental Machining, Albuquerque	505-345-2483
Larry Gregory, Gregory Environmental, Carlsbad	505-887-1673
Dick Rhorer, LANL, Los Alamos	505-667-6699
Hugh Chappelle, NMSU Manufacturing Programs	505-646-6537

New Mexico State University
Manufacturing Advisory Committee
September 29, 1994

Faculty, Staff and Graduate Student Involvement
Engineering Education in Manufacturing Across the Curriculum

LEVEL:	U. G, P									
Institution:	New Mexico State University, Las Cruces, NM									
			Deliverable	Test	Implement	Description				
TASK 1 CURRICULUM DEVELOPMENT										
Dr. George Mulholland		Col of Engr	Y,D	Y	Y	Curriculum and degree planning				
Dr. Richard Hills		Col of Engr	Y,D	Y	Y	Curriculum and degree planning				
Dr. Edward Hensel		Col of Engr	Y,D	Y	Y	Curriculum and degree planning				
Dr. Satish Kamat		Col of Engr	Y,D	Y	Y	Curriculum and degree planning				
Dr. Brian Lambert		Col of Engr	C,W,Y,D	Y	Y	Curriculum for Mnfg En	gr minor,		fg engr course	
Dr. John Mullen		Col of Engr	C,W	Y	N	Control Systems course				
Dr. Edward Pines		Col of Engr	C,W	Y	Y	Ergonomics course				
Dr. O'Neill Burchett		Col of Engr	O	Y	Y	Planning for joint projects course				
Mr. Hugh Chappelle		Col of Engr	C, Y, D	Y	Y	Planning to meet program needs				
Mr. Tom L. Powers		Col of Engr	C, Y, D	Y	Y	Planning to meet industry needs				
Dr. Sherry Mills		Col Bus Ad	C,W	Y	N	Business principles course				
Dr. Pookie Sautter		Col Bus Ad	C,W	Y	N	Business principles course				
Dr. Arnold Maltz		Col Bus Ad	Y,D	Y	Y	Curriculum for MBA Mnfg Mngt concentration				
Dr. Michael Manning		Col Bus Ad	O	Y	N	Team building facillitator				
Dr. David Wieters		Col Bus Ad	Y,D	Y	Y	Curriculum for MBA Mnfg Mngt concentration				
Grad Stu Prabhu		Col of Engr	W	Y	Y	Course ware for faculty	lead, Engineering			
Grad Stu Radecki		Col of Engr	W	Y	Y	Course ware for faculty	lead, Engineering			
Grad Stu Woods		Col of Engr	W	Y	Y	Course ware for faculty	lead, Engineering			
Grad Stu Shah		Col of Engr	W	Y	Y	Course ware for faculty	lead, Engineering			
Grad Stu Baca		Col Bus AD	W	Y	Y	Course ware for faculty lead, Business Administration				
Dr. Richard Rhorer		LANL	C,W	Y	Y	Course in Precision Machining				
TASK 2: INDUSTRIAL RELATIONS										
Mr. Tom L. Powers		Col of Engr	O	Y	Y	Leading interaction with over 40 companies & Ntnl Labs				
Student Walters		Col Bus AD	O	Y	Y	Assist Associate Director Powers				
Dr. Mary Anne Staffeldt		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Prof. Leon Cox		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Prof Anthony Hyde		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. George Mulholland		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Richard Hills		Col of Engr	Y,D	Y	Y	Host for Industry guest lecturer				
Dr. Edward Hensel		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Mr. Hugh Chappelle		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Mr. Roy Futvoye		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Joseph Genin		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Richard	Colbaugh	Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Kristin Glass		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Craig Ricketts		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Ed Conley		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. O'Neill Burchett		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. Eldon Steelman		Col of Engr	O	Y	Y	Host for Industry guest lecturer				
Dr. David Hasti		Sandia NL	O	Y	Y	Host for Industry guest lecturer				
Task 3: Eliminated by lack of funds										
TASK 4: PROGRAM MANAGEMENT										
Dr. George Mulholland		Col of Engr	O	Y	Y	Director, Manufacturing Engineering Programs				
Dr. Edward Hensel		Col of Engr	O	Y	Y	Associate Director, Manufacturing Engineering Programs				
Mr. Hugh Chappelle		Col of Engr	O	Y	Y	Associate Director, Manufacturing Research Programs				
Sec Susan Vaughn		Col of Engr	O	Y	Y	Secretary to Manufacturing Engineering Program Staff				
Consultant Michel		Consultant	O	Y	Y	Consultant on Advanced Manufacturing				
Comp Spec Connell		Col of Engr	O	Y	Y	Computer specialist for maintenance				

Faculty, Staff and Graduate Student Involvement
Engineering Education in Manufacturing Across the Curriculum

			Minor Stat				
Dr. Brian Lambert	Coll of Engr	Faculty	6				
Dr. John Mullen	Coll of Engr	Faculty	6				
Dr. Edward Pines	Coll of Engr	Faculty	6				
Dr. Mary Anne Staffeldt	Coll of Engr	Faculty	6				
Prof. Leon Cox	Coll of Engr	Faculty	6				
Dr. George Mulholland	Coll of Engr	Other	6				
Dr. Edward Hensel	Coll of Engr	Mngt Staff	6				
Dr. Richard Hills	Coll of Engr	Mngt Staff	6				
Dr. Joseph Genin	Coll of Engr	Faculty	6				
Dr. Richar Colbaugh	Coll of Engr	Faculty	6				
Dr. Kristin Glass	Coll of Engr	Faculty	6				
Dr. Craig Ricketts	Coll of Engr	Faculty	6				
Dr. O'Neill Burchett	Coll of Engr	Faculty	6				
Dr. Eldon Steelman	Coll of Engr	Mngt Staff	6				
Dr. Ed Conley	Coll of Engr	Faculty	6				
Prof Anthony Hyde	Coll of Engr	Faculty	6				
Mr. Roy Futvoye	Coll of Engr	Mngt Staff	6				
Mr. Hugh Chappelle	Coll of Engr	Mngt Staff	6				
Mr. Tom Powers	Coll of Engr	Mngt Staff	6				
Dr. Sherry Mills	Coll Bus Ad	Faculty	6				
Dr. Pookie Sautter	Coll Bus Ad	Faculty	6				
Dr. Arnold Maltz	Coll Bus Ad	Faculty	6				
Dr. Michael Manning	Coll Bus Ad	Faculty	6				
Dr. David Wieters	Coll Bus Ad	Mngt Staff	6				
Grad Stu Prabhu	Col of Engr	Student	2				
Grad Stu Radecki	Col of Engr	Student	6				
Grad Stu Woods	Col of Engr	Student	6				
Grad Stu Shah	Col of Engr	Student	2				
Grad Stu Baca	Col Bus Ad	Student	4				
Stu Assist Walters	Col Bus Ad	Student	6				
Dr. Richard Rhorer	LANL	Vstg Facul	6				
Dr. David Hasti	Sandia	Vstg Staff	6				
STUDENTS IN EXPERIMENTAL MASTER'S DEGREE PROGRAMS							
Will be available in September, 1995. Student regr istration is just starting g for the first semester.							
We expect about 20 students from the College of Engineering and the College of Business Ad.							

Table 3: Personnel

ENGINEERING EDUCATION ACROSS THE CURRICULUM

Personnel Classification	Total	Sex		Race/Ethnicity							Foreign	Disabled
		F	M	US	NA	AA	C	H	P I	A		
Faculty	16	4	12	16			16					
nagement Staff	8		8	8			8					
Experts in he Classroom												
her Educational Personnel												
Visiting Faculty	28	4	24	2			26	2				
ud. in Short-term Technician Training												
ud. in Short-term Professional Training												
ud. in Experimental Lower Division UG (Undergraduate),												
ud. in Experimental Upper Division UG (Undergraduate),												
Students in Experimental Master's Degree	21	9	12	19			16	3		2	2	
Graduate TAs	5		5	4			3	1		1	1	
ndergraduate TAs												

Table 3: Personnel

ENGINEERING EDUCATION ACROSS THE CURRICULUM

Personnel Classification	Total	Sex		Race/Ethnicity								
		F	M	US	NA	AA	C	H	P I	A	Foreign	Disabled
Students Doing Internships in Industry	34	13	21	34			18	14		2		
Active Defense Workers												
Displaced Defense Workers	1		1	1			1					

Race/Ethnicity for U.S. citizens and permanent residents only: (NA) Native American; (AA) African American, not of Hispanic origin; (C) Caucasian, not of Hispanic origin; (H) Hispanic; (PI) Pacific Islander; (A) Asian.

Technology Reinvestment Project

BUDGETS:
Year 1 Actual
Year 2 Estimate
Year 3 Estimate

TRP BUDGETS	7/94--6/95	7/95--6/96	7/96--6/97	
	Year 1 Act	Year 2 Est	Year 3 Est	
Task 1, Curriculum Development				
Engineering Salaries	$ 93,862	$ 90,898	$ 41,002	
Engr Student Wages	$ 26,888	$ 36,710	$ 10,390	
Business Salaries	$ 93,734	$ 86,908	$ 41,002	
Business Student Wages	$ 6,136	$ 24,071	$ 10,390	
Travel	$ 1,039	$ 8,000	$ 1,420	
Supplies	$ 6,139	$ 17,000	$ 1,420	
Equipment	$ 2,400	$ 8,000	$ 3,000	
Total	**$ 230,199**	**$271,587**	**$108,624**	
Task 2, Industrial Relations				
Salaries	$ 156,888	$205,142	$215,000	
Student Assistants	$ 1,868	$ 8,888	$ 8,888	
Scholarships	$ 16,000	$ 21,000	$ 25,000	
Travel incl Student Travel	$ 3,247	$ 14,000	$ 7,100	
Supplies	$ 3,387	$ 7,000	$ 1,424	
Equipment	$ 8,276	$ 10,000	$ 2,000	
Total	**$ 189,667**	**$266,030**	**$259,412**	
Task 4, Program Management				
Salaries	$ 158,888	$259,976	$194,500	
Consultants	$ 5,262	$ 2,000	$ -	
Travel	$ 6,358	$ 8,340	$ 4,260	
Supplies	$ 16,876	$ 4,200	$ 2,840	
Equipment	$ 3,500	$ 5,000	$ 2,482	
Total	**$ 190,884**	**$279,516**	**$204,082**	
Grand Total	**$ 610,749**	**$817,133**	**$572,118**	**$ 2,000,000**
Original Budget	**$ 798,690**	**$801,435**	**$399,875**	**$ 2,000,000**
All numbers include fringes and overhead as appropriate.				

New Mexico State University
Mechanical Engineering

Tom L. Powers, 9/19/95, 3:40 PM
trpansum.bud, (505) 646-7749

TABLE 4: FUNCTIONAL BUDGET		7/94-6/95	7/95-6/96	7/96-6/97	
		Current Year	**Next Year**	**Year 3**	**Program**
Functional Category:					Total
New Curricula/Modules:	Task 1: Curiculum Develo	$ 151,462	$ 180,000	$ 109,000	
Educational Tools					
Delivery Systems					
Improving the Teaching/					
Learning Culture:	Task 2: Industrial Relation	$ 126,197	$ 175,000	$ 180,000	
Testing and Implementation					
Instruction					
Administration					
Management:	Task 4: Program Manage	$ 114,726	$ 185,000	$ 110,000	
Travel		$ 10,645	$ 30,000	$ 13,000	
Communications Infrastructure					
and Associated Expenses					
Subtotal		$ 403,030	$ 570,000	$ 412,000	
Indirect Costs		$ 207,719	$ 247,133	$ 160,118	
TOTAL		**$ 610,749**	**$ 817,133**	**$ 572,118**	**$ 2,000,000**
Original Budget		$ 798,690	$ 801,435	$ 399,875	**$ 2,000,000**
Difference		$ (187,941)	$ 15,698	$ 172,243	$ -

Date	Company	In-Kind Personnel Guest Lect/Facul Adv Com Mtgs	In-Knd Pers Value	In-Kind Equipment, & Software	In-Kind Equipment Value	In-Kind Software Value	Other Interns	Other Intern Value	Other In-Kind	Unrestr Cash Scholarships Fellowships	Restr Cash	Total Cash	Total In-Kind	TOTAL VALUE
INDUSTRY														
Sep-93	IBM CIM			Workstations	$ 590,000								$ 590,000	$ 590,000
Sep-93	MCS			Anvil software		$ 1,554,000							$ 1,554,000	$ 1,554,000
Sep-93	Phillips Petr CIM			Workstations	$ 180,000					$ 30,000		$ 30,000	$ 180,000	$ 210,000
Feb-94	CG Tech			Software		$ 221,250						$ -	$ 221,250	$ 221,250
Feb-94	General Motors Grant to COE and COBAE of $15,000 each for Manufacturing									$ 30,000		$ 30,000	$ -	$ 30,000
Apr-94	MCS			Training		$ 8,750						$ -	$ 8,750	$ 8,750
May-94	Westinghouse			Misc	$ 10,000							$ -	$ 10,000	$ 10,000
Jun-94	GMC Truck Div			Truck	$ 12,854							$ -	$ 12,854	$ 12,854
Sumr 94	General Motors			Engines, 5	$ 5,000		11	$ 132,000				$ -	$ 137,000	$ 137,000
	AT&T Phoenix						2	$ 24,000				$ -	$ 24,000	$ 24,000
	Bayjet						1	$ 5,000				$ -	$ 5,000	$ 5,000
	Martin Marietta						1	$ 12,000				$ -	$ 12,000	$ 12,000
	Packard Elec						2	$ 24,000				$ -	$ 24,000	$ 24,000
	Intel-Albuquerq						*9*	$ *108,000*				$ -	$ *108,000*	$ *108,000*
Sep-94	Honeywell	R. Matthews	$ 4,000									$ -	$ 4,000	$ 4,000
Sep-94	C. Milacron W. Stegmuller	W. Stegmuller	$ 5,000									$ -	$ 5,000	$ 5,000
Sep-94	Manufacturing Advisory Committee Meeting											$ -	$ -	$ -
	Boeing		$ 2,000							$500		$ 500	$ 2,000	$ 2,500
	Cin Milacron		$ 2,000									$ -	$ 2,000	$ 2,000
	Conq Machines		$ 500									$ -	$ 500	$ 500
	MCS		$ 2,000									$ -	$ 2,000	$ 2,000
	NM INC, 2		$ 1,000									$ -	$ 1,000	$ 1,000
	Packard Elec 3		$ 2,000									$ -	$ 2,000	$ 2,000
	pneuVentures		$ 2,000									$ -	$ 2,000	$ 2,000
	Univ Prec Mn		$ 500									$ -	$ 500	$ 500
	Westinghouse		$ 1,000									$ -	$ 1,000	$ 1,000
Oct-94	Boeing	W.McClenahan	$ 6,000									$ -	$ 6,000	$ 6,000
Nov-94	Martin Marietta	G. Boisvert	$ 5,000									$ -	$ 5,000	$ 5,000
Nov-94	Martin Marietta	S. Blake	$ 5,000									$ -	$ 5,000	$ 5,000
Nov-94	App Kinetics Co									$50		$ 50	$ -	$ 50
Dec-94	Ins Adv Mfg Sci	W. Zdeblick	$ 5,000									$ -	$ 5,000	$ 5,000
Dec-94	General Motors			Quad Engine	$ 1,000							$ -	$ 1,000	$ 1,000
Dec-94	Honeywell									$ 5,000		$ 5,000	$ -	$ 5,000
Jan-95	Conq Machines	W. Rector	$ 250									$ -	$ 250	$ 250
Jan-95	Charmilles Tech	P. Bernasconi	$ 5,000										$ 5,000	$ 5,000
Jan-95	Phillips Petroleum	W. Parrish	$ 5,000									$ -	$ 5,000	$ 5,000
Feb-95	Bently Nevada	J. Eggart	$ 5,000									$ -	$ 5,000	$ 5,000
Feb-95	ME Academy Ind Adv Committee Meeting											$ -	$ -	$ -
	Applied Kinetics	W.E. Medcalf	$ 1,000									$ -	$ 1,000	$ 1,000
	W. A. Johnson		$ 1,000									$ -	$ 1,000	$ 1,000
	Karsten Mnf Co		$ 1,000									$ -	$ 1,000	$ 1,000
	TU Electric		$ 1,000									$ -	$ 1,000	$ 1,000
	D. C. Walling		$ 1,000									$ -	$ 1,000	$ 1,000
Feb-95	DEC	T. Stockebrand	$ 500.0									$ -	$ 500	$ 500
Feb-95	Westinghouse	J. Walls	$ 500.0									$ -	$ 500	$ 500
Mar-95	KOHOL Systems	V. Mangold	$ 5,000.0									$ -	$ 5,000	$ 5,000
Spring-95	NM INC: Funds for ME Senior Design Course manufacturing										$ 10,000	$ 10,000	$ -	$ 10,000
Apr-95	MCS Corp	G. Rodriguez	$ 2,000									$ -	$ 2,000	$ 2,000
Subtotal		14	$ 71,250		$ 798,854	$ 1,784,000	26	$ 305,000		$ 65,550	$ 10,000	$ 75,550	$ 2,959,104	$ 3,034,654
NEW MEXICO STATE UNIVERSITY														
NMSU	CAD/CAM Lab			Comp & Sftwr	$ 715,000	$ 168,098							$ 883,098	$ 883,098
NMSU	Mnf Sys Lab			Comp & Sftwr	$ 60,500	$ 21,800							$ 82,300	$ 82,300
NMSU	Mnf Tchg Factory			Equipment	$ 1,683,057								$ 1,683,057	$ 1,683,057
NMSU	COBAE Facilities			Equipment	$ 50,000								$ 50,000	$ 50,000
Subtotal					$ 2,508,557	$ 189,898	0	$ -	$ -	$ -	$ -	$ -	$ 2,698,455	$ 2,698,455
STATE OF NEW MEXICO					$ -					$ 330,000		$ 330,000	$ -	$ 330,000
Subtotal					$ -		0	$ -	$ -	$ 330,000		$ 330,000	$ -	$ 330,000
Grand Totals			**$ 71,250**		**$ 3,307,411**	**$ 1,973,898**	**26**	**$ 305,000**	**$ -**	**$ 395,550**	**$ 10,000**	**$ 405,550**	**$ 5,657,559**	**$ 6,063,109**

Date	Company	In-Kind Personnel	In-Knd Pers	In-Kind	In-Kind	In-Kind	Other	Other	Other	Unrestr Cash	Restr	Total	Total	TOTAL
		Guest Lec/Facul	Value	Equipment,	Equipment	Software	Interns	Interns	In-Kind	Scholarships	Cash	Cash	In-Kind	VALUE
		Adv Com Mtgs		Software	Value	Value		Value		Fellowships				
NATIONAL LABORATORIES AND GOVERNMENT AGENCIES (not used for matching)														
Sum-94	Sandia Nat Labs						4	$ 48,000				$ -	$ 48,000	$ 48,000
Nov-94	Sandia Nat Labs	P. Plomp	$ 4,000	ProE upgrades		$ 2,000						$ -	$ 6,000	$ 6,000
Feb-95	Sandia Nat Labs	Clark & Dhooge	$ 6,000									$ -	$ 6,000	$ 6,000
Feb-95	Sandia Nat Labs	Ind Adv Com Mtg	$ 2,000									$ -	$ 2,000	$ 2,000
Feb-95	Sandia Nat Labs	C. Atwood	$ 4,000									$ -	$ 4,000	$ 4,000
Mar-95	Sandia Nat Labs	M. Knoll	$ 4,000									$ -	$ 4,000	$ 4,000
Mar-95	Sandia Nat Labs					Rapid Prototype for Maese Trading			$ 5,000			$ -	$ 5,000	$ 5,000
Apr-95	Sandia Nat Labs	K. McCaughey	$ 4,000									$ -	$ 4,000	$ 4,000
Sum-95	Sandia Nat Labs						1	$ 12,000				$ -	$ 12,000	$ 12,000
4-1995	Sandia Nat Labs			MSL Equip	$ 10,000							$ -	$ 10,000	$ 10,000
4-1994	Sandia Nat Labs						Advanced Interconnections Project				$ 276,640	$ 276,640	$ -	$ 276,640
4-1995	Sandia Nat Labs			MTF Equip	$ 129,833							$ -	$ 129,833	$ 129,833
	Subtotal	6	$ 24,000		$ 139,833	$ 2,000	5	$ 60,000	$ 5,000	$ -	$ 276,640	$ 276,640	$ 230,833	$ 507,473
Mid-94	Los Alamos NL	Rhorer vst faculty	$ 16,000				5	$ 60,000				$ -	$ 76,000	$ 76,000
Sep-94	Los Alamos NL	Mnf Adv Com	$ 1,000									$ -	$ 1,000	$ 1,000
Feb-95	Los Alamos NL	Ind Adv Com	$ 2,000									$ -	$ 2,000	$ 2,000
Mar-95	Los Alamos NL	Rhorer consult: 5 days	$ 5,000									$ -	$ 5,000	$ 5,000
Feb-95	Los Alamos NL							Precision Machining Grant			$ 20,000	$ 20,000		$ 20,000
Apr-95	Los Alamos NL	Bates/Niesen	$ 8,000									$ -	$ 8,000	$ 8,000
Apr-95	Los Alamos NL	C. Anderson	$ 4,000									$ -	$ 4,000	$ 4,000
May-95	Los Alamos NL						MTF Calibration Team		$ 10,000			$ -	$ 10,000	$ 10,000
Jun-95	Los Alamos NL						ISO 9000 Team		$ 10,000			$ -	$ 10,000	$ 10,000
4-1994	Los Alamos NL			MTF Equip	$ 300,000							$ -	$ 300,000	$ 300,000
	Subtotal	4	$ 36,000		$ 300,000	$ -	5	$ 60,000	$ 20,000	$ -	$ 20,000	$ 20,000	$ 416,000	$ 436,000
4-1995	Allied Signal			MTF Equip	$ 576,106							$ -	$ 576,106	$ 576,106
Sum-94	NASA WSTF	R. Bunker	$ 1,000				2	$ 20,000				$ -	$ 21,000	$ 21,000
Feb-95	NREL	E. Witt	$ 5,000									$ -	$ 5,000	$ 5,000
	Grand Total	**12**	**$ 66,000**		**$ 1,015,939**	**$ 2,000**	**12**	**$ 140,000**	**$ 25,000**	**$ -**	**$ 296,640**	**$ 296,640**	**$ 1,248,939**	**$ 1,545,579**

	In-Kind Personnel Guest Lect/Facul Adv Com Mtgs	In-Kind Guest Value	In-Kind Equipment Value	In-Kind Software Value	Other Interns	Other Interns Value	Other In-Kind	Unrestr Cash Scholarships Fellowships	Restr Cash	Total Cash	Total In-Kind	TOTAL VALUE
Industry	14	$ 71,250	$ 798,854	$ 1,784,000	26	$ 305,000	$ -	$ 65,550	$ 10,000	$ 75,550	$ 2,959,104	$ 3,034,654
New Mexico State University	0	$ -	$ 2,508,557	$ 189,898	0	$ -	$ -	$ -	$ -	$ -	$ 2,698,455	$ 2,698,455
State of New Mexico	0	$ -	$ -		0	$ -	$ -	$ 330,000	$ -	$ 330,000	$ -	$ 330,000
Subtotal	**14**	**$ 71,250**	**$ 3,307,411**	**$ 1,973,898**	**26**	**$ 305,000**	**$ -**	**$ 395,550**	**$ 10,000**	**$ 405,550**	**$ 5,657,559**	**$ 6,063,109**
Nat Labs and Gov Agencies	12	$ 66,000	$ 1,015,939	$ 2,000	12	$ 140,000	$ 25,000	$ -	$ 296,640	$ 296,640	$ 1,248,939	$ 1,545,579
Grand Total	**26**	**$ 137,250**	**$ 4,323,350**	**$ 1,975,898**	**38**	**$ 445,000**	**$ 25,000**	**$ 395,550**	**$ 306,640**	**$ 702,190**	**$ 6,906,498**	**$ 7,608,688**

Cash and In-Kind Matching Funds

TABLE 5: MATCHING FUNDS BY SOURCE OF SUPPORT							
Type	TRP/MET Award	Industry	Univ	Other Fed Agen	State	Other Support	Total
Cash-Unrestricted	$ 661,748	$ 65,550	$ -	$ -	$ 330,000		$ 1,057,298
Cash-Restricted		$ 10,000	$ -	$ 296,640	$ -		$ 306,640
In-Kind Eq, Mtls, Supp		$ 798,854	$ 2,508,557	$ 1,015,939	$ -		$ 4,323,350
In-Kind Personnel		$ 71,250	$ -	$ 66,000	$ -		$ 137,250
In-Kind Software		$ 1,784,000	$ 189,898	$ 2,000	$ -		$ 1,975,898
Other:							
Interns		$ 305,000		$ 140,000			$ 445,000
SNL Rapid Prototype				$ 5,000			$ 5,000
LANL MTF support				$ 20,000			$ 20,000
Other subtotal	$ -	$ 305,000	$ -	$ 165,000	$ -		$ 470,000
Total	**$ 661,748**	**$ 3,034,654**	**$ 2,698,455**	**$ 1,545,579**	**$ 330,000**		**$ 8,270,436**
Proposal	$ 798,690	$ 2,821,150	$ 2,698,455	$ 2,296,106	$ 299,000		$ 8,913,401
Difference	$ (136,942)	$ 213,504	$ -	$ (750,527)	$ 31,000		$ (642,965)
Thus TRP funding requirement was less than budgeted, Industry cost share was more than budgeted,							
NMSU cost share was at budget, State of New Mexico cost share was more than budget, and							
other federal agencies cost share (not used for matching) was less than budget.							
Cost Share proposed for first year:		7.6	759%				
Cost Share actual for first year:		9.2	916%				