Final Annual Report

Tennessee Tech University

President

Provost

College of Engineering

Manufacturing Research Center

Definition of Unit: Center for Manufacturing Research

Department/Unit Contact: Vahid Motevalli

Mission/Vision/Goal Statement

The Center for Manufacturing Research (CMR) was established in 1984 to leverage resources of the State of Tennessee, the University, industries, and government funding agencies into cooperative efforts to advance manufacturing research. The CMR's Mission stated below is driven by core principles from the College of Engineering's and the University's Mission.

CMR Mission

To advance and support scientific and engineering knowledge in areas related to manufacturing through fundamental research and technology transfer activities, and to impact the instructional program in those areas.

Strategic Research Areas

Using a strategic planning process that was based on national manufacturing roadmap strategies in alignment with the College of Engineering Strategic Research focus areas, the Center for Manufacturing Research has identified three strategic research areas: (1) Advanced Manufacturing, (2) Materials and Devices for Energy Storage and Conversion, and (3) Networking and Algorithm for Big Data.

Core Values

The CMR has established the core values listed below that define the behaviors we seek to reward and recognize.

1. Commitment to Personal and Scholarly Integrity
2. Teamwork
3. Commitment to Excellence
4. Commitment to Personal/Professional Development
5. Valuing Partnerships, Cooperation, and Collaboration
6. Commitment to Continuous Improvement

Goal 1. Increase national and international recognition for TTU manufacturing research

Define Goal
Increase research activity in the CMR by increasing total funding requests through proposals submitted to external sources, and thus, increase funding impact at the University and State levels. The CMR is continuing to invest in new faculty members hired into the College of Engineering with some type of manufacturing-related focus. In addition to this investment, it is our goal that our external proposal activity and externally funded research will increase as a result of the efforts of the new faculty and increased Center activities.

Intended Outcomes / Objectives
Objective 1a. Increase externally funded research and service funding using FY 2011-12 as a baseline ($1,236,826) by 25% annually.

Objective 1b. Increase the dollar amount of proposals submitted using FY 2011-12 as a baseline ($10,895,277) by 25% annually.

Goal 2. Increase student, faculty, & staff capabilities

Define Goal
Increase the participation and capabilities of students, faculty, and staff in manufacturing related research and education via external funding, professional activities, and outreach programs.

Intended Outcomes / Objectives
Ensure productivity of the CMR in scholarly work and graduates.

Enhance professional development of faculty and staff.

Goal 3. Increase resources of the CMR to allow for research expansion

Define Goal
Increase the amount of income (resources), both internally and externally, that can be used to expand research in the CMR strategic research focus areas.

Intended Outcomes / Objectives
Potential sources of additional income for the CMR comes from release time of personnel, graduate student support from externally funded research, gifts, testing/service income, F&A return, and equipment grants or gifts. The level of increase should be 25% annually by FY 2017 using FY 2011-12 as a baseline ($499,477).

Assessment Tool #1: Project Activations

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3
Type of Tool: Tracking Spreadsheet

Rationale

a. Project activations indicate the productivity of both the Center faculty and faculty associates as well as the Center staff in attracting external funding from International, Federal, State, Industry, and Private sources. This is also the measure that the Tennessee Board of Regents uses to measure the vitality of a Center of Excellence.
b. Successful results will indicate a 25% annual increase using FY 2011-12 as a baseline.
c. Project activations are a measure of the value associated by outside agencies to the manufacturing-related research conducted through our Center. Several new faculty have been added and the university has significantly invested to increase research productivity.

Frequency of Assessment: Annually

Assessment Tool #2: External Proposal Submissions

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3
Type of Tool: Tracking Spreadsheet

Rationale
a. Proposal valuations have been shown statistically to be a significant leading indicator of Project Activations. This will help to identify processes that can be implemented or modified to boost proposal activity.
b. Successful results will indicate a 25% annual increase using FY 2011-12 as a baseline.
c. Proposal valuations are a function of both the number of proposals as well as the size of larger collaborative proposals. As the College of Engineering increases their number of new tenure-track faculty, the number of proposals should increase. As the College's Strategic Research Areas grow and become self-sustaining, the number of larger collaborative proposals should increase as well.

Frequency of Assessment: Annually

Assessment Tool #3: Publications and Supported Graduate Student Degree Completion

Goal/ Outcome/ Objective: Goal 1 and Goal 2
Type of Tool: Other

Rationale
1. Publications
2. Graduate Students Completing Degrees
3. Awards & Recognition

Frequency of Assessment: Annually

Assessment Tool #4: Income Generation

Goal/ Outcome/ Objective: Goal 1 and Goal 2 and Goal 3
Type of Tool: Tracking Spreadsheet

Rationale
a. The CMR uses its annual State Appropriation for basic resources including salaries, benefits, graduate assistantships and fees. In order to expand capabilities and increase seed funding in exploratory areas, the CMR must rely on supplementing State appropriations with release of salaries from external projects, testing and service income, and indirect return.
b. This assessment tool is highly correlated to project activations and is less likely to change dramatically. There are specific activities and processes that can be instituted that will positively affect this measure including direct requests for gifts to support graduate assistantships, marketing testing and service capabilities, and requiring Center faculty to claim more release on their funded projects.
c. Sampling includes all sources of additional income. The data comes directly from internal working spreadsheets and data readily available through BANNER.

Frequency of Assessment: Annually

Goal 1: Results/Outcomes/Accomplishments

Goal/Objective/Outcome Number: Goal 1. Increase national and international recognition for TTU manufacturing research

Results
The CMR secured thirty-seven externally funded projects for a total amount of $2,896,320, resulting in an approximate 21% increase from the previous year. These activations included $461,686 of Indirect Costs to be processed through the University. A total of fifty-nine research proposals in the amount of $21,117,542 were submitted to be considered for external funding, some of which will be funded during the next year. This amount is over a 73% increase in the value of proposals submitted during the previous year. Twenty-one of these proposals were submitted by new faculty hires in the Departments of Chemical, Electrical, and Mechanical Engineering. Thus, the refocusing of State Appropriations towards new faculty investment to support the College of Engineering and the University's Strategic Plan as well as the impact of new faculty hires since 2013 are becoming much more evident in proposal activities and external funding.

Included in the externally funded grants this past year were:

- A nearly $4 million grant from the National Science Foundation (NSF) to establish the Tennessee CyberCorps: Scholarship for Service Program. To date, this the the largest grant ever received by CMR and one of the largest grants for TTU, while making TTU one of the highly visible cyber defense education programs in the country.
- CMR Faculty Associate Director Stephen Canfield was awarded an

Innovation Corps Sites Training Grant of almost $300,000 for a three-year period to establish TTU as a training site. Serving as Co-PIs on this grant with Dr. Canfield will be Drs. Ismail Fidan, Sally Pardue, and Curtis Armstrong. This I-Corps program was designed to ease the transition of technological developments to the marketplace and train researchers to evaluate their discoveries for commercial potential.

- CMR Faculty Associate Dr. Ambareen Siraj was awarded approval by the National Security Agency (NSA) and the Department of Homeland Security (DHS) of her submission for TTU to be designated as a National Center of Academic Excellence in Cyber Defense Education (CAE-CD) through AY 2021. In addition to the Research Experiences for Undergraduates (REU) Site - Manufacturing and Techno-Entrepreneurship Preparation being conducted for the second year at TTU, Drs. Mohamed Mahmoud and Syed Hasan received funding of $360,000 from NSF for a three-year grant, entitled "REU Site - Secure and Privacy Preserving Cyber Physical Systems".
- The CMR also received funding of $50,000 from the National Science Foundation this past year for Dr. Ambareen Siraj, CMR faculty associate, to lead the Collaborative Research in Capacity Building in Cybersecurity project and to host the third annual Women in Cybersecurity Conference in Dallas, Texas. Over 800 participants attended the conference. Dr. Siraj also raised $322,000 in matching commitments for this conference from 50 different sponsorships, including Facebook, Google, Microsoft and other large IT-focused corporations.
- The CMR recruited four Visiting International Researchers to TTU during the past year to join the Center's Wireless Communications/Networking Systems Research Group.

Attachments
No items to display.

Goal 2: Results/Outcomes/Accomplishments

Goal/Objective/Outcome Number: Goal 2. Increase student, faculty, and staff capabilities

Results
During this past year the CMR has achieved the following results for enhancing student, staff and student capabilities:

- Tennessee Tech University achieved a higher level of recognition under the Carnegie Classification to a "Doctoral Granting University, Limited Research" (previously classified as "Masters Granting - Large") in December 2015. This reclassification is in large part due to the increase in the number of PhD degrees awarded by the College of Engineering, which in turn has been largely supported by the research grants and state appropriation supporting the graduate students through CMR and CESR.
- Supported a total of 55 graduate students: 26 M.S. and 29 Ph.D. This accomplishment was possible with the Center's revenue provided from externally funded projects that was designated for graduate student support.
- During this past year, degrees were awarded to two Ph.D. students and six M.S. students who were supported by the CMR, both from State

Appropriations and externally funded grants.

- The CMR received a total award of $260,000 this past year from the Department of Energy to continue the outreach to students and Tennessee industrial facilities via the Tennessee 3-Star Industrial Assessment Center which has been in existence in the Center and at TTU since 2006. One hundred and thirty-nine students have been impacted by this Outreach Program while ten of them have been placed in energy-related summer internships with Tennessee manufacturers and 180 no-cost energy assessments have been conducted for manufacturers.
- The National Science Foundation awarded Dr. Joseph Rencis, Dean, College of Engineering, and Dr. Vahid Motevalli, Interim Director of the Center and the Associate Dean of Research and Innovation in the College of Engineering, a grant for $134,321 to host for the second consecutive year a Research Experiences for Undergraduate (REU) Site - Manufacturing and Techno-Entrepreneurship at TTU this summer from June 6 to August 12, 2016. This REU Program will focus on manufacturing-related research and provide techno-entrepreneurship experiences for a total of nine interns from seven different universities.
- The National Science Foundation awarded CMR Faculty Associates, Dr. Mohamed Mahmoud and Dr. Syed Hasan $360,000 for a three-year grant to host a REU Site - Secure and Privacy Preserving Cyber Physical Systems.
- CMR staff, graduate and undergraduate students actively support the iMaker Space with extensive student use across campus.
- CMR staff support the newly established Digital Manufacturing Demonstration Lab (DMDL).
- Seven CAPSTONE grants totaling $78,000 were funded from ONRL, TVA, AEDC, and UT/CIS. These grants allow students the opportunity to correlate their innovative ideas with various industries in a classroom environment.
- Faculty associates Dr. Ambareen Siraj, Dr. Mohammad Rahman, and Dr. Doug Talbert were awarded a nearly $4 million grant from the National Science Foundation to establish the Tennessee CyberCorps: Scholarship for Service Program. This program provides scholarships for students.
- Several faculty associates and staff of the CMR have received significant honors and awards this past year with some of them being the direct result of successfully manufacturing related research and education supported via external funding.
- The three Center faculty published six journal papers and three conference papers during the past year.

Attachments
No items to display.

Goal 3: Results/Outcomes/Accomplishments
Goal/Objective/Outcome Number: Goal 3. Increase Resources of the CMR to Allow for Research Expansion

Results
During this past year, the Center received the following salaries and supplies in release time from externally funded projects:

1. Faculty & Staff Release Time: $135,375

Note: Six of thirteen Center faculty and staff had some portion of their salary release from external funds. The CMR Interim Director is continuing to make an effort to ensure that ample release time is provided for all Center faculty and staff in proposals submitted for external funding.

2. Graduate Students Stipend & Fees: $282,994.

Note: This level of external funding for graduate students supported 45% of the CMR's students for this past year.

3. The CMR received revenue in our Testing Services Account income this past year of $47,934. This revenue is a direct result of the expanded capabilities of the CMR's staff and resources available in CMR Laboratories.

4. A total of $559,537 of "Soft Money" was received this past year by the CMR in the areas of F&A Return, Testing Services Income, Graduate Student Support, Equipment Usage, and Release Time. This supplemental income allowed the CMR to expand capabilities and resources while also refocusing State appropriations towards the investment of new faculty hires to support the College of Engineering and University Strategic Plan.

During the past year the CMR experienced a 21% increase in research project activations and a 73% increase in proposals generated.

CMR Faculty Associate Director, Dr. Stephen Canfield was awarded an Innovation Corps Sites Training Grant of almost $300,000 for a three-year period to establish TTU as a training site.

Attachments
No items to display.

Goal 1: Modifications and Continuing Improvement

Goal/Objective/Outcome Number: Goal 1. Increase national and international recognition for TTU manufacturing research

Program Changes and Actions due to Results
No modifications are required at this time. Continue current efforts to increase externally funded proposals and project activations by supporting faculty with a manufacturing-related focus.

Link to Assessment
Project Activations, Tracking Spreadsheets

Link to Flight Plan: Multidisciplinary Research Innovation, Improve Undergraduate Student Experience, Create Distinctive Programs and Invigorate Faculty

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Goal 2. Modifications and Continuous Improvement

Goal/Objective/Outcome Number: Goal 2. Increase student, faculty, and staff capabilities

Program Changes and Actions due to Results
No modifications are needed at this time. Efforts should be continued to offer training opportunities for staff, enhance faculty development, improve research equipment, and maintain software and hardware updates.

Link to Assessment
External Proposal Submissions, Tracking Spreadsheets

Link to Flight Plan: Multidisciplinary Research Innovation, Enrollment, Tuition, and Scholarships, Improve Undergraduate Student Experience

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Goal 3. Modifications and Continuous Improvement

Goal/Objective/Outcome Number: Goal 3. Increase resources of the CMR to allow for research expansion and improve staff support for research activities

Program Changes and Actions due to Results
No modifications are required at this time. Efforts should be continued to increase financial resources, which will in turn, allow for research expansion.

Link to Assessment
Publications, improve outreach activities, and support graduate student degree completion

Link to Flight Plan: Multidisciplinary Research Innovation, Create Distinctive Programs and Invigorate Faculty