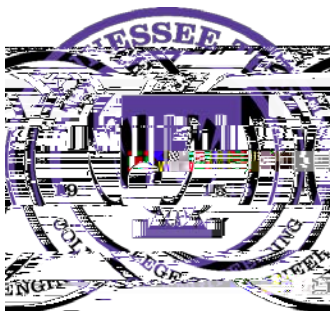


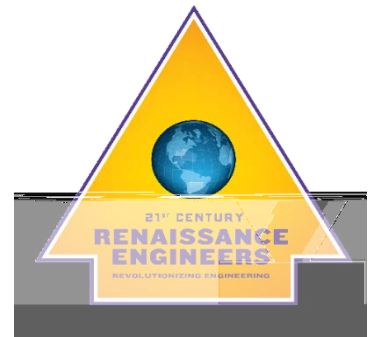
ANNUAL REPORT FY 2015 2016



College of Engineering Tennessee Tech University



*Renaissance Engineers are
adaptive professionals who are
inquisitive, creative and make
significant contributions for the
betterment of humanity.*



Dr. Jeffrey Rice, Asst. Professor, ChE
Dr. Jonathan (Robby) Sanders, Asst. Professor, ChE
Dr. Stephen Scott, Professor, CSC/ECE
Dr. Pezhman Shirvanian, Asst. Professor, ME
Dr. Ambareen Siraj, Assoc. Professor, CS
Dr. Holly Stretz, Assoc. Professor, ChE
Dr. Meenakshi Sundaram, Professor, ME

Dr. Doug Talbert, Assoc. Professor, CS
Dr. Chris Wilson, Assoc. Professor, ME
Dr. Dale Wilson, Professor, ME
Dr. Jeanette Wolak, Asst. Professor, Earth Sciences
Dr. Liqun "Laura" Zhang, Asst. Professor, ChE
Dr. Ying Zhang, Professor, ME
Dr. John Zhu, Professor, ME

EXECUTIVE SUMMARY

Center Research Areas

The CMR focuses on several research areas:

Advanced Manufacturing focuses on improving manufacturing processes and methodology through the innovative application of technologies to product design and production.

Materials for Energy Storage and Conversion addresses the need to develop the material for next generation of energy storage/conversion devices and energy efficiency technologies.

Networking and Algorithms for Big Data offers changing opportunities to assist advanced manufacturing in use of sensors and automation in large networks and Big Data in manufacturing processes.

Industry Support provides Tennessee manufacturers with technical expertise in problem-solving challenges faced in materials, design, testing, and processes.

Education and Outreach efforts enhance the Tennessee workforce development and outreach in the CMR's research areas

CMR supported 55 graduate students during the past FY. Twenty-six M.S. students and 29 Ph.D. students were funded from both State appropriations and grants received by faculty. Specifically external grants funded 17 of the M.S. students and 16 of the Ph.D. students. Among the graduate students funded by CMR, six M.S. and three Ph.D. students were from underrepresented minorities. This is a 56% increase of graduate students funded as compared to the previous year 2014-2015.

CMR supported a total of 67 undergraduate students during this past fiscal year from both State Appropriations and externally funded projects.

CMR continues to invest in new faculty with a manufacturing focus hired into the College of Engineering. As a result of this investment, 21 proposals for external funding were submitted by new faculty members in the Departments of Chemical, Electrical and Computer, and Mechanical Engineering.

CMR continued to see a significant increase in external funding of graduate research assistant support as shown in Table 3 below. Table 3 provides a summary of various sources of external revenues for the past three years that were used to “release” or “free up” State appropriations for other strategic investment areas. It is the CMR’s goal to continue to increase the amount of income (resources), both internally and externally, that can be used to expand research in the Center’s research focus areas as described on page 4.

Table 3. Salary and Supplies Released by External Funding

Performance Metric	FY 2013-14	FY 2014-15	FY 2015-16
CMR Staff release time	\$82,503	\$99,224	\$128,231

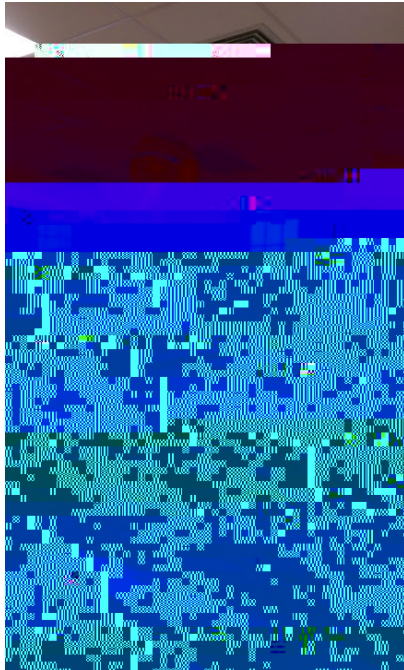
Graduate student stipend and fees from external sponsors

Personnel Highlights

Dr. Vahid Motevalli, Associate Dean for Research and Innovation in TTU's College of Engineering, has continued to serve as the CMR's Interim Director. This appointment is in addition to his regular duties as Associate Dean.

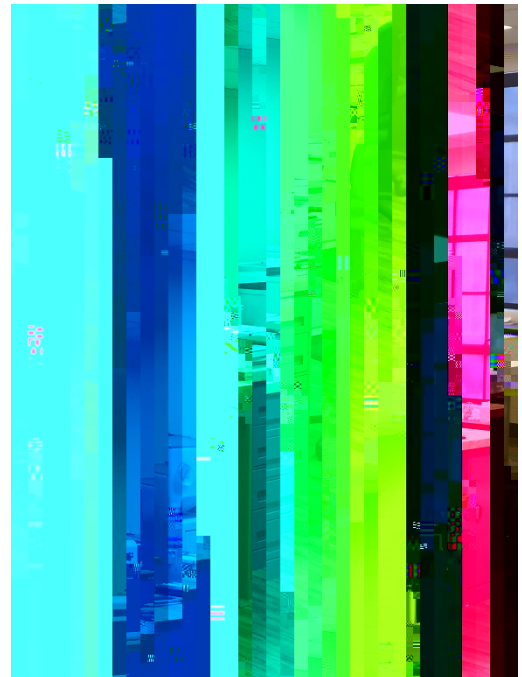
Discussions with CMR Faculty Associates, Faculty, and Staff will be conducted and plans are being made to launch a search for a Center Director during the coming fiscal year.

Dr. Stephen Canfield, Professor of Mechanical Engineering, has continued to serve as Faculty Associate Director. In this role, Dr. Canfield is the Strategic Research Area (SRA) Coordinator for Advanced Manufacturing and has encouragedu.9(i)-6.6(e)N(e)10



CMR supported the establishment of the iMakerSpace. The iMakerSpace was created as a University-wide center under the leadership of the Colleges of Engineering and Business. It is a focal point on campus to provide training, service, partnership, research and evaluation in Innovation and Entrepreneurship to all disciplines. iMakerSpace encourages interdisciplinary teams and provides support and training to extend I&E activities into research and the classroom.

CMR established the Digital Manufacturing Demonstration Lab in PH 227 for use by mostly undergraduate students as a more advanced space to the iMakerSpace, supporting innovation through access to digital manufacturing technologies.



Faculty Associate, Dr. Mohamed Mahmoud, received funding of \$360,000 from NSF for a 3-

Faculty Associate, Dr. Ambareen Siraj organized the Third Annual Women in Cybersecurity Conference (WiCyS) in Dallas, TX. This conference, first established by Dr. Siraj under a grant from the National Science Foundation in 2014, attracted over 800 registered participants. A supplement of \$50,000 was received from NSF to help organize this year's conference along with Program Income of approximately \$320,000, which was generated by over 50 external sponsors of the Conference. Associate Dean Motevalli officially opened the conference on behalf of Tennessee Tech University.



Third Annual Women in CyberSecurity Conference, March 31-April 2, 2016, Dallas, Texas

Seven CAPSTONE grants funded for a total of \$78,000 during the AY from ORNL, TVA, AEDC, and UT/CIS. These grants allow students the opportunity to correlate their innovative ideas with various industries in a classroom environment.

Center Activities

Tennessee Three-Star Industrial Assessment Center

The Tennessee 3-Star Industrial Assessment Center (IAC) was established in the CMR in 2006 with funding from the U.S. Department of Energy. The mission of the IAC is two-fold: 1) Assist small to medium sized manufacturers

Anthony Taylor, a MS student in Mechanical Engineering, ***submitted an invention disclosure*** resulting from his thesis research on developing a novel compressed air flow meter.

IAC Students Ian Swagerty (ME – MS), Anthony Taylor (ME – MS), and Melissa Moffet (CEE – undergraduate) were the ***winners of the national IAC Video Submission contest***. Students at 24 IAC Centers were invited to contribute a short video on an aspect of assessing energy efficiency. There were 15 submissions and our IAC Center was chosen as one of three winners. Their topic was Safe Methods of Taking Power Readings on Electric Panels.

Four students participated in ***summer internships with manufacturers*** such as Nissan and

Biomaterials and Tissue Engineering Bioengineers' Fantasy, Dilemma, and Bioprinting – Peter Yang, Stanford University

A Quick Tour of Manufacturing Demonstration Facility (MDF) and Opportunities in Additive Manufacturing – Amy Elliott, Oak Ridge National Laboratory

Additive Manufacturing at the University of Waterloo – Ehsan Toyserkani, University of Waterloo, Canada

3-D Printing – Future of Manufacturing. The Fourth Wave of Manufacturing – Ehsan Toyserkani, University of Waterloo, Canada

Detection of Hardware Trojans in the Advanced Encryption Standard, Austin Mitchell – Mississippi State University

Privacy-Preserving Ride Sharing Scheme for Autonomous Vehicles Using Public Key System, Jacob Moran – Tennessee Tech University

Implementing the Internet of Things on 3-D Printers, Cyd Marie Rivera Rodriguez – University of Puerto Rico in Mayaguez

Artificial Neural Network Prediction of Advanced Encryption Standard Key Values, Kameron Wells – Knox College

CMR Student Lightning Round Seminar Series

December 1, 2015

New Trends in Induction Machine Drive, Sima Aznavi, ME

Online Diagnostics of Energy Storage Devices, Chris Ibe Ekeocha, ECE

Modeling Strong Base Anion Exchange for Molecular Imprinted Polymer, Clinton McCullough, ChE

A Unified Scheme for Analysis of Kinematic and Tolerance for Linkage Mechanisms, Kuan-Lun Hsu, ME

Non-Intrusive Compressed Air Flow Measurement, Anthony Taylor, ME

December 3, 2015

Production of Monodisperse Nano-Particles with High Throughput Using Fiber Reactor for Medicinal Use, Sumit Jamkindikar, ChE

Steam Generation by Solar Heat Using Porous Media, Hamidreza Ghasemi Bahraseman, MEMrdikaa G11(Tw (-)Tj -0.005k)-4.3(A)1 Tc 0.(l)-6.6(nt)g ,MEInt4 19.696 0e Nano

Faculty, Staff and Student Accomplishments and Awards

Faculty Associate, ***Dr. Adam Anderson*** received 1st place in Rounds 1 and 2 of the Virginia Tech SHARC (Cognitive Radio Competition) in January and March, 2016.

Faculty Associate, ***Dr. Steven Anton***, received the Young Investigator Award from the Air Force Office of Scientific Research in January 2016. Anton will be representing TTU among 41 other research institutions and small businesses.



(

2. B. Yu, and K. L. Ting, "Compensated Conjugation And Gear Tooth Design and Modification," J. of Mechanical Design, (in press).
<http://mechanicaldesign.asmedigitalcollection.asme.org/article.aspx?articleid=2478745>

Conference Publications

1. Zetao Yu, Kwun-Lon Ting, Kuan-Lun Hsu, Jun Wang, and Wesley Waggoner, Uncertainty

Proposals Submitted

FY	09-10	10-11	11-12	12-13	13-14	14-15	15-16
 3 Year Moving Avg.	\$10,200,289	\$10,927,246	\$10,072,301	\$10,130,421	\$10,558,412	\$14,227,931	
 Proposals Submitted	\$12,673,820	\$9,212,641	\$10,895,277	\$10,108,985	\$9,387,001	\$12,179,250	\$21,117,542

Grants and Contract Awards

<i>Project/Source/Account Number</i>	<i>Principal Investigators</i>	<i>Amount</i>	<i>Beginning</i>	<i>Ending</i>	<i>Estimated - 12 months</i>
1 CMR Testing and Design - FY2015-2016 Various Industries Account #: 5-38585	Vahid Motevalli	\$47,934	7/1/2015	6/30/2016	\$55,387
2 UT-CIS 2015-16 University of Tennessee Center for Industrial Services Account #: 5-33512	Meenkashi Sundaram	\$20,000	7/1/2015	6/30/2016	\$0
3 UT-CIS 2015-16 Capstone University of Tennessee Center for Industrial Services Account #: 5-33513	Meenkashi Sundaram	\$15,000	7/1/2015	6/30/2016	\$15,000
4 Public-Private Partnership for a Comprehensive Workforce Development Plan to Stimulate Industrial Energy Efficiency and Demand Reduction US Department of Energy Golden Field Office - Award DE-EE0005533 - Mod. #11 Account #: 5-32290	Glenn Cunningham	\$210,000	9/30/2014	9/30/2016	\$210,000
5 Public-Private Partnership for a Comprehensive Workforce Development Plan to Stimulate Industrial Energy Efficiency and Demand Reduction U.S. Department of Energy- Award DE-EE0005533 - Modification #12 Account #: 5-32290	Glenn Cunningham	\$50,000	9/30/2015	9/30/2016	\$50,000
6 Program Income - Fiscal Year 2015-16 - on NSF	Ambareen Siraj	\$319,896	7/1/2015	6/30/2016	\$0

<i>Project/Source/Account Number</i>	<i>Principal Investigators</i>	<i>Amount</i>	<i>Beginning</i>	<i>Ending</i>	<i>Estimated - 12 months</i>
13 Development of Marinized Pt-Modified MCrAlX Coatings with Improved Hot Corrosion and Oxidation Resistance Synthesized via a Low-Cost Electrodeposition Process Office of Naval Research - Award: N0014-14-1-0341, Modification #4 Account #: 5-32367	Ying Zhang	\$140,000	3/25/2016	9/30/2017	\$140,000
14 GOALI: Environmentally-Assisted Reactive Sintering of Conductive Spinel Layers for Solid Oxide Fuel Cell Application National Science Foundation - Year 2 of 3 - Award CMMI-1362680 Account #: 5-31203	Jiahong Zhu	\$129,425	8/15/2015	8/14/2016	\$129,425
15 REU Supplement to: GOALI: Environmentally-Assisted Reactive Sintering of Conductive Spinel Layers for Solid Oxide Fuel Cell Application National Science Foundation - Award CMMI- 1362680 Account #: 5-31203	Jiahong Zhu	\$5,000	12/17/2015	12/8/2016	\$5,000
16 REU Site –Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation National Science Foundation - Award 1461179 - Year 2 of 3 Account #: 531232	Joseph Rencis Vahid Motevalli	\$124,321	3/15/2016	3/14/2017	\$117.155
17 RET Supplement to REU Site - Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation National Science Foundation - Award 1461179 - Year 2 of 3 Account #: 531232	Joseph Rencis Vahid Motevalli	\$124,321	3/15/2016	3/14/2017	\$117.155

3/14/23004 Tc -0.0 <</MCID 265ETc -0.0003(nc)10.7(i)-0.3333 033h /P <</MJ 0 Tc 0 Tw ()Tj8EMC .

<i>Project/Source/Account Number</i>	<i>Principal Investigators</i>	<i>Amount</i>	<i>Beginning</i>	<i>Ending</i>	<i>Estimated - 12 months</i>
Account #: 5-32812					
32 Collaborative Research: Edge Surface Topography	ChaBum Lee	\$116,138	8/15/2015	8/31/2016	\$100,000

Schedule 7

CENTERS OF EXCELLENCE ACTUAL, PROPOSED, AND REQUESTED BUDGET

Institution	Center								
	FY 2015-16 Actual			FY 2016-17 Proposed			FY 2017-18 Requested		
	Matching	Appopr.	Total	Matching	Appopr.	Total	Matching	Appopr.	Total
Expenditures									
Salaries									
Faculty	397,791	372,301	770,092	400,000	505,954	905,954	450,000	506,000	956,000
Other Professional	52,166	377,496	429,662	40,000	386,117	426,117	40,000	390,500	430,500
Clerical/ Supporting	0	38,093	38,093	0	56,903	56,903	0	3d [(386,)(496)]TJ /TT2	

FY 2017 2018 Budget Request and Justification

The CMR is requesting a 6.5% increase in the FY 2017-18 State appropriations to account for increasing salaries, benefits, student support, tuition and fees, supplies, and travel costs.

Tennessee Tech University had a 1% salary increase as of January 1, 2015 for all faculty and staff. Since this was approved by the State Board of Education in 2014, the State Board of Education has not approved a salary increase for faculty and staff since 2014. The State Board of Education has approved a 1% salary increase for faculty and staff in 2015, 2016, and 2017. The State Board of Education has approved a 1% salary increase for faculty and staff in 2018.

SUPPORTING MATERIALS

CMR Supported Graduate Students Degrees Awarded

Masters

Brita Anderson

“Enhancing Nerve Tissue Regeneration: Optimizing Growth Factors and Extracellular Matrix Proteins with Dimensionally-Specific Culture Parameters”

Fall 2015

Advisor: Dr. Jeffrey Rice

Chemical Engineering

Seth Latture

“The Development and Optimization of a 3D Printed Device for the in Vitro Culture of Cells and Potential Drug Screening”

Summer 2015

Advisor: Dr. Jeffrey Rice

Chemical Engineering

Jonathan Miller

“Electrochemical Performance and Cycle Life of Selected Carbon-Based and Carbon-Free Air Cathodes”

Fall 2015

Advisor: Dr. Jiahong Zhu

Mechanical Engineering

Clint McCullough

“Modeling Spherical Dicyanoargentate Imprinted Anion Exchange Resins”

Spring 2016

Advisor: Dr. Jennifer Pascal

Chemical Engineering

Ian Swagerty

“An Investigation of Natural Gas Fireplace Hear Extractors; Their Applications and Impact”

Spring 2016

Advisor: Dr. Glenn Cunningham

Mechanical Engineering

Linzhu Zhang

“Characterization of Ni-CrAl₃ and NiCo-CrAl₃ Coatings Fabricated by Electrolytic Codeposition”

Fall 2015

Advisor: Dr. Ying Zhang

Mechanical Engineering

CMR Supported Graduate Student Degrees Awarded

Ph.D.

William Aderholdt

"Towards a Framework for Survivable Clouds"

Spring 2016

Advisor: Dr. Stephen Scott

Engineering

Antonio Pistono

"An Investigation of Fuel Cell Subzero Cold Start"

Fall 2015

Advisor: Dr. Cynthia Rice

Chemical Engineering

CMR Graduate Students Supported from State Appropriations

Masters

Surya Teja Gunukula
Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Chin Chris Ibe-Ekeocha
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Patrick Kent
Advisor: Dr. Jeffrey Rice
Chemical Engineering

Seth Latture
Advisor: Dr. Jeffery Rice
Chemical Engineering

Leora Maxwell Loftis
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Sravanthi Mandalapu
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Jonathan Miller
Advisor: Dr. Jiahong Zhu
Mechanical Engineering

Abdul Salam Mohamed
Advisor: Dr. Joe Biernacki
Chemical Engineering

Maheshwar Nunna
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Ph.D.

Michael Adenson
Advisor: Dr. Joe Biernacki
Chemical Engineering

Sima Aznavi
Advisor: Dr. Hicham Chaoui
Electrical & Computer Engineering

Houman Babazadehrokni
Advisor: Dr. Ehsan Languri
Mechanical Engineering

Bo Bonning
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

Kuan-Lun Hsu
Advisor: Dr. Kwun Ting
Mechanical Engineering

Ryan Kettle
Advisor: Dr. Steven Anton
Mechanical Engineering

Clint McCullough
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Koteswara Medidhi
Advisor: Dr. Jennifer Pascal
Chemical Engineering

Gholamreza Mirshekari
Advisor: Dr. Pezhman Shirvanian
Mechanical Engineering

Mohsen Safaei Mohammadabadi
Advisor: Dr. Steve Anton
Mechanical Engineering

Khaled Mohamed Rabieh
Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Ahmed Sherif

Advisor: Dr. Mohamed Mahmoud
Electrical & Computer Engineering

Paige Spencer

Advisor: Dr. Jeffrey Rice
Chemical Engineering

External Funding Proposals Submitted

<i>Status</i>	<i>Title</i>	<i>PI's</i>	<i>Department</i>	<i>Total Funds</i>
1 100MC-13 5-38585	CMR Testing and Design - FY2015-2016 Various Industries	Motevalli	CMR	\$47,934
2 189MC-15 23(15-16) 5-33512	UT-CIS 2015-16 University of Tennessee Center for Industrial Services	Sundaram	ME	\$20,000
3 189-SD2 24(15-16) 5-33513	UT-CIS 2015-16 Capstone University of Tennessee Center for Industrial Services	Sundaram	ME	\$15,000
4 487Sup 8/6/2015 39(12-13) 5-31273	Supplement to: Capacity Building in Cybersecurity Broadening Participation of Women in Cybersecurity through Women in Cybersecurity Conference and Professional Development National Science Foundation - Award DUE-130441 Supplement	Siraj	CompS	\$50,000
5 500RSUP2 2/16/2016 160(15-16) 5-31222	Supplement to: Collaborative Research: A Multi-Scale Environmental and Kinetics Study on the Pyrolysis of Sustainable Biomass Feedstock National Science Foundation - Award CBET-1337033	Biernacki Northrup	ChemE ChemE	\$6,000
6 559MCSUP 4/20/2016 162(15-16) 5-31232	RET Supplement to REU Site - Summer Research Internships in Manufacturing and Techno-Entrepreneurship Preparation National Science Foundation	Rencis Motevalli	COE COE	\$10,000
7 600MC-R3 11/2/2015 75(15-16) 5-39364	Improving Interfacial Strength of 3-D Printed ABS Weld Lines: Compatibilized "Stripe" Deposition Oak Ridge National Laboratory - Subcontract 4000145173	Stretz	ChemE	\$99,336
8 607MC 7/21/2015 19(15-16) Pending	CAREER: Autonomous Wireless Access in Congested Smart City Spectrum National Science Foundation	Anderson	ECE	\$543,039
9 608MC 7/23/2015 16(15-16) 5-39363	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Subcontract 4000140763	Anderson	ECE	\$31,809
10 608MC-M1 5-39363	Consulting in Areas of Applied Signal Processing and Advanced Communications Techniques Oak Ridge National Laboratory - Modification #1 Subcontract 4000140763	Anderson	ECE	\$9,900

<i>Status</i>	<i>Title</i>	<i>PI's</i>	<i>Department</i>	<i>Total Funds</i>
53 655MC	Fabricate Aluminizing Ni-based 31V Alloy	Zhang		