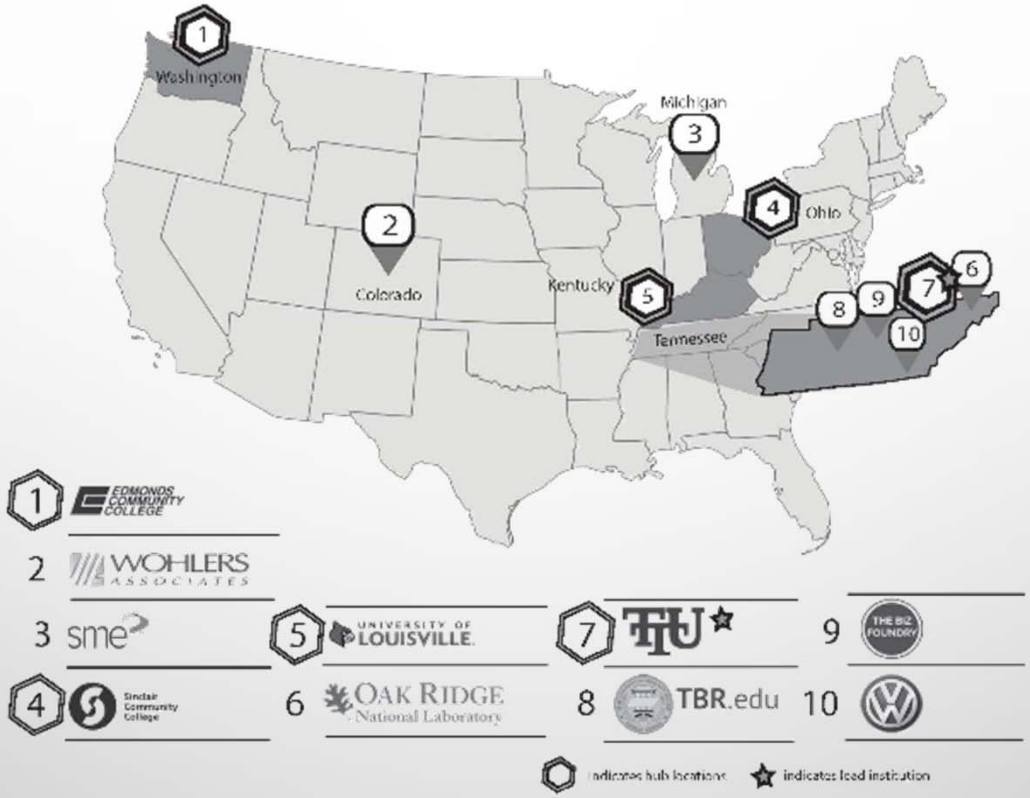
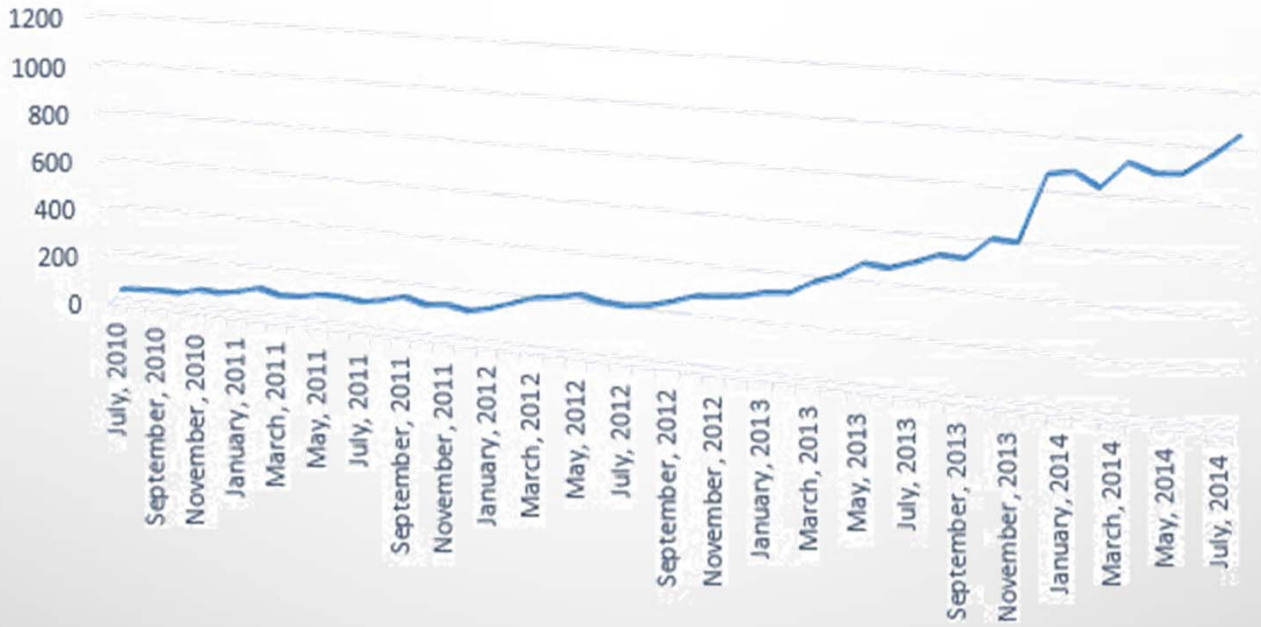
# Utilizing Additive Manufacturing at Your Institutions

Ismail Fidan, PhD
Professor and Faculty Fellow in Innovation and Techno-entrepreneurship
Tennessee Tech

AM WATCH
ADDITIVE MANUFACTURING WORKFORCE ADVANCEMENT TRAINING COALITION AND HUB

# AM-WATCH Consortium and Its Hubs

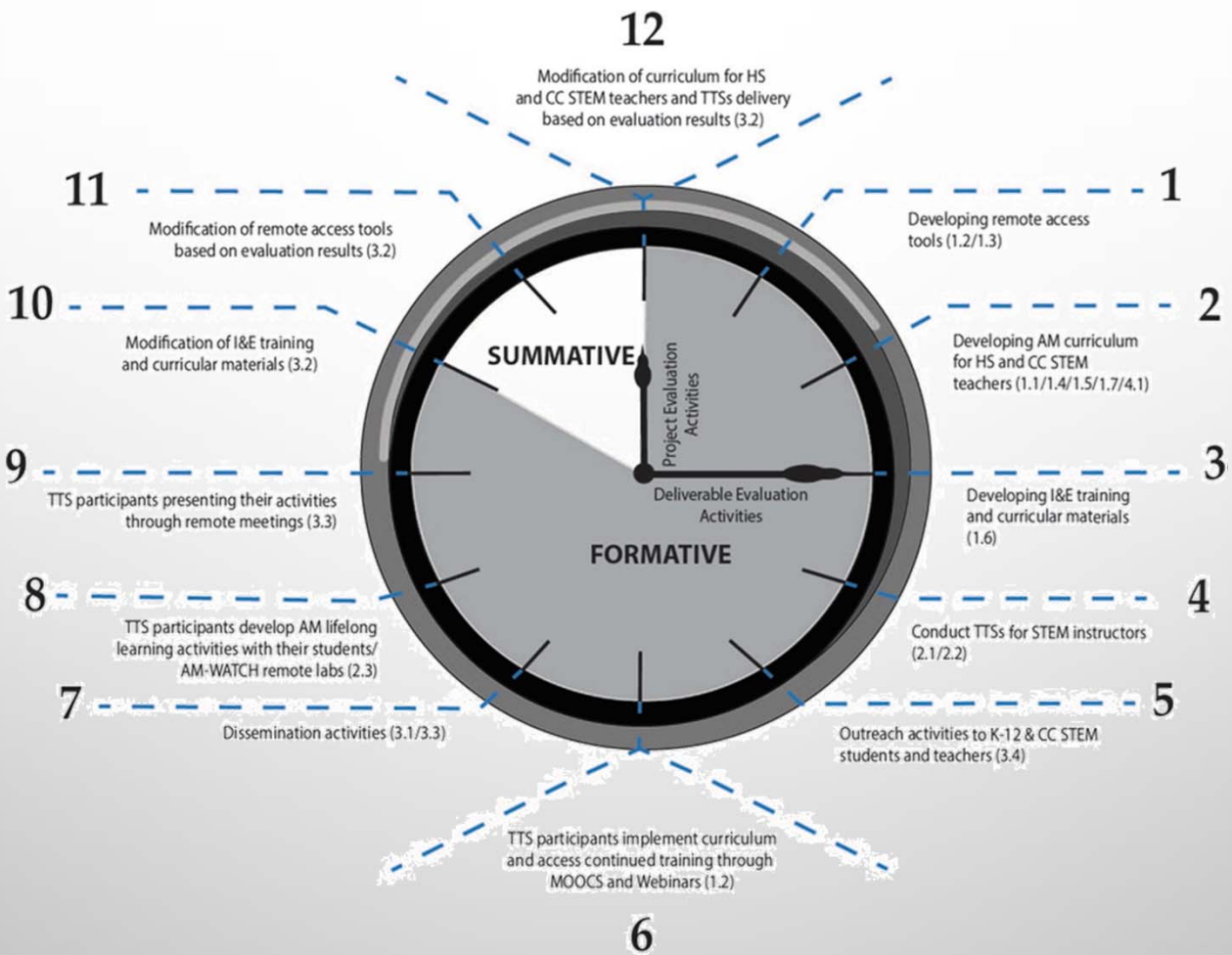

Washington
Michigan
Ohio
Colorado
Kentucky
Tennessee
1 Edmonds Community College
2 Wohlers Associates
3 sme
4 Sinclair Community College
5 University of Louisville
6 Oak Ridge National Laboratory
7 TTU
8 TBR.edu
9 The Biz Foundry
10
indicates hub locations
indicates lead institution



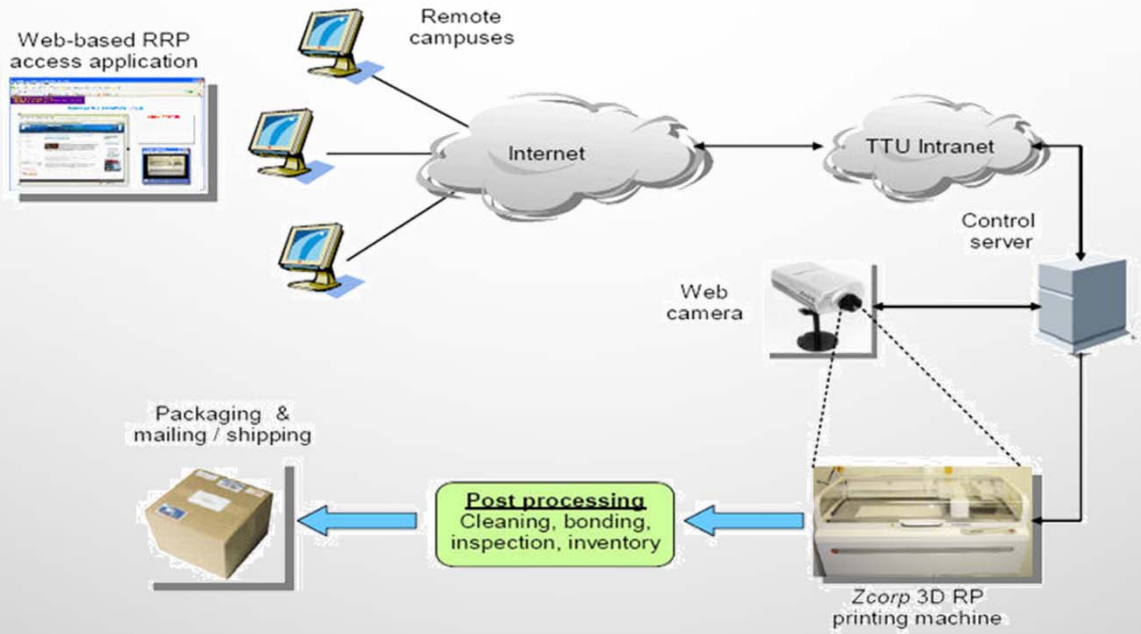

Demand For 3D Printing Skills Is Accelerating Globally, (http://www.forbes.com/sites/louiscolumbus/2014/09/15/demand-for-3d-printing-skills-is-accelerating-globally/#194665424cf7)

AM-WATCH will coordinate with manufacturers using AM technology, and instructors teaching AM, to identify the up to date skills required of AM technicians.

# AM-WATCH Model

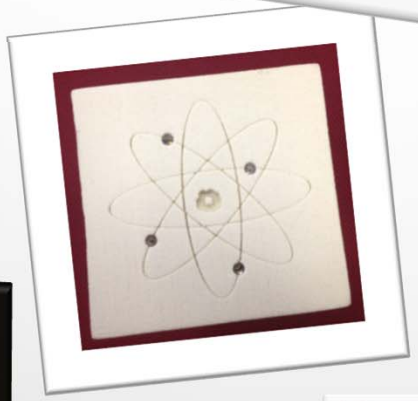


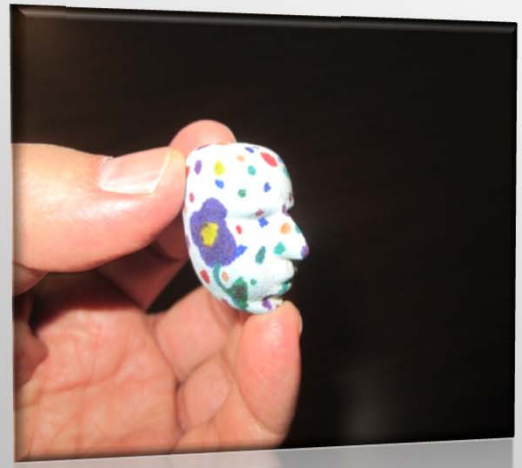
# Remotely Accessible Rapid Prototyping Laboratory





**Develop Remote Access Facilities**






**Innovative and Entrepreneurial AM Projects**

## Case Studies to help students attain ABET Outcomes 3d, 3f, 3g, and 3h

Develop foundational hands-on modules and professional development activities designed to prepare teachers to integrate the modules into their classrooms.

- Ability to function effectively as a member of a technical team (3d);
- Ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and use appropriate technical literature (3f);
- Understanding the need for and ability to engage in self-directed continuing professional development (3g),
- Understanding of and commitment to professional and ethical responsibilities including a respect for diversity (3h);

**Develop and Disseminate MOOC AM Resources**

MOOCs are an emerging strategy for reaching wide and diverse audiences. The MOOCs will serve as a window to AM learning for students that do not have AM curriculum immediately available to them.


https://marketbrief.edweek.org/marketplace-k-12/instructure_inc_known_for_canvas_lms_plans_to_go_public/

canvas
BY INSTRUCTURE

- Fundamentals of AM
- Design for AM
- Building a 3D printer (electronics, software, mechanical design, hands-on mechanics)
- Innovation and Techno-entrepreneurship Pathways and Initiatives in AM (NSF Lean Launchpad Model and Entrepreneurial Initiatives in AM)


Online AM and Train-the-Trainer Studio Resources

As TTSs are being conducted at TTU and partner institution sites, AM lectures, Q&A sessions, and hands-on activities will be video recorded and grouped into modules.

# Golden Eagle Additively Innovative Lecture Series

**11 - 11:30 a.m. CST** **SPRING 2017**

***Join from anywhere via tntech.zoom.us/j/432789883***

**February 9**

***A Technique for Quick Introduction of 3D Design and Prototyping***

with Hugh Jack, Ph.D., Inaugural Cass Ballenger Distinguished Professor of Engineering
Director, School of Engineering and Technology, Western Carolina University

**February 23**

***Additive Manufacturing: Instrumental systems in research, education, and service***

with Bahram Asiabanpour, Ph.D., C.Mfg.E., Editor-in-Chief, International Journal of Rapid Manufacturing,
Associate Professor, Manufacturing Engineering, Ingram School of Engineering Texas State University

**March 23**

***Making it Work***

with Marilyn Barger, Ph.D., P.E., F.ASEE, Executive Director and Principal Investigator
NSF Florida Advanced Technological Education Center (FLATE), Hillsborough Community College

**March 30**

***Bioprinting and tissue engineering***

with Yunzhi Peter Yang, Ph.D., Associate Professor, Departments of Orthopedic Surgery, (by courtesy)
Materials Science and Engineering, and Bioengineering, Co-director of Medical Scholar Program in
Bioengineering Scholarly Concentration, Stanford University and Adjunct Associate Professor at
The University of Texas Health Science Center at Houston

**tntech.edu/engineering/imakerspace**

*Golden Eagle Additively Innovative Virtual Lecture Series is partially funded by the NSF Award 1601587, "AM-WATCH: Additive Manufacturing-Workforce Advancement Training Coalition and Hub".*

# Golden Eagle Additively Innovative Lecture Series

## 11 - 11:30 a.m. CST FALL 2017

***Join from anywhere via tntech.zoom.us/j/432789883***

### September 21

***Workflow of the Additive Manufacturing Process***

with Kyle Bates-Green, Subject Matter Expert

National Resource Center for Materials Technology Education, Lynnwood, Washington

### October 12

***3-D printing, Design Thinking, and the Entrepreneurial Mindset***

with Phan Tran, Professor, Center for Architecture, Design, and Engineering

Lake Washington Institute of Technology, Kirkland, Washington

### November 2

***Using 3-D Printed Parts to couple Festo Didatic's MecLab Stations in an Assembly Process***

with Khalid Tantawi, Professor, Department of Career Readiness-Mechatronics

Motlow State Community College, Smyrna, Tennessee

### November 30

***Next Generation Manufacturing: Professional & Technical Skills for the 21st Century workforce***

with Karen Wosczyna-Birch, State Director, College of Technology

Executive Director, Center for Next Generation Manufacturing, Farmington, Connecticut

**www.tntech.edu/engineering/imakerspace**

*Golden Eagle Additively Innovative Virtual Lecture Series is partially funded by the NSF Award 1601587, "AM-WATCH: Additive Manufacturing-Workforce Advancement Training Coalition and Hub".*

Tennessee Tech University is part of the State University and Community College System of Tennessee. #CENGR071-SEL-18

**Diversity and Outreach Objectives**

The AM-Watch resources will be developed and disseminated with the participation of under-served groups (gender, ethnicity, disability, geographic, socioeconomic status). Each hub will be tasked with the identification of these groups of people in their regions and their knowledge/exposure to AM-WATCH deliverables.

blogs.cae.tntech.edu/am-watch/

# AM-WATCH

## Additive Manufacturing Workforce Advancement Training Coalition and Hub

Home | Introduction | Core Skills | MOOCs | Remote Facilities | Studios | Partners | Acknowledgement

## Home

The objective of this Advanced Technological Education (ATE) project is to establish an Additive Manufacturing Workforce Advancement Training Coalition and Hub (AM-WATCH) to address current gaps in the knowledge base of 21st century technicians through the development of AM-WATCH educational modules, delivery of professional development activities and support to 30+ STEM instructors per year, and expanded outreach activities targeting K-12 and Community College teachers and students.

Return to top

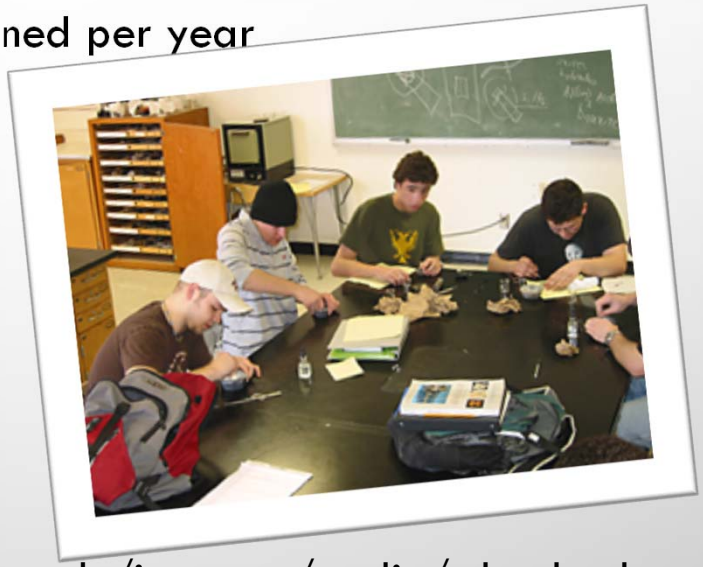
Powered by WordPress and the Graphene Theme.

Copyright

© 2017 AM-WATCH.

**Host Train the Trainer Studios (TTSs)**

Tennessee Tech and the regionally diverse partner locations host one TTS annually.
Minimum 30 educators will be trained per year



http://serc.carleton.edu/introgeo/studio/what.html

## 2017 AM-WATCH TRAIN-THE-TRAINER STUDIOS

*Learn the utilization of latest 3D Printing Technologies for your STEM Curriculum and Outcome Assessment*

*Own a free 3D Printer and get a Travel Stipend.*

---

**Lynnwood, WA Studio**
July 25-26, 2017

**Knoxville, TN Studio**
May 20-21, 2017

*http://blogs.cae.tntech.edu/am-watch/train-the-trainer-studios/*

# Additive Manufacturing Workshop

## May 20-21, 2017

## 9 a.m. - 5 p.m.

**at the Tennessee College of Applied Technology - Knoxville**

**Build Your Own 3-D Printer, Train-the-trainer Studios, Learn the MOOCs Resources, State of the Industry by Terry Wohlers, Plant Tours, Guest Lectures**

**Breakfast and lunch will be provided.**
**Saturday dinner will be hosted by BB&T and C&J.**

Supporting Organizations

### Application Procedure

Submit your brief resume, letter of intent, and your implementation plan of the workshop subject matters to:

Michelle Davis, Outreach Coordinator at mdavis@tntech.edu
Center for Manufacturing Research, Tennessee Tech University
Phone: (931) 372-6386 or Fax: (931) 372-6345

### Application/Registration Information

Application deadline is Friday, Feb. 24, 2017.
TCAT and CC instructors will be given preference.
Registration is limited to FIFTEEN instructors.
Each workshop participant will receive a $400 reimbursement check and a 3-D Printer.
Since space is limited, accepted candidates will be called/emailed by March 10, 2017.

### Workshop Organizers

Ismail Fidan, Ph.D., Tennessee Tech University
Amy Elliott, Ph.D., Oak Ridge National Laboratory
John Townsend, Ph.D., The College System of Tennessee

### Sponsored by

The National Science Foundation (Award Number 1601587, "AM-WATCH: Additive Manufacturing Workforce Training Coalition and Hub")

TTU is a constituent university of the Tennessee Board of Regents. TTU does not discriminate on the basis of race, color, religion, creed, national origin, sex, sexual orientation, gender identity/expression, disability, age, status as a protected veteran, genetic information, or any other legally protected class. For inquiries regarding non-discrimination policies, contact equity@tntech.edu. The TTU policy on nondiscrimination can be found at www.tntech.edu/eo. CENG127-PRNT-17

Tennessee TECH

**2017 NSF Additive Manufacturing Workshop**
**Knoxville, TN**

**AGENDA**

**ALL TIMES ARE EASTERN TIME ZONE**

| DAY ONE: Saturday, May 20, 2017 | | |
|---|---|---|
| **TIME** | **SESSION** | **LOCATION** |
| 8:00-8:30 a.m. | **Breakfast and Welcoming**<br>• All Attendees | TCAT-Knoxville at 1100 Liberty Street, Knoxville, TN 37919<br>Conference Room A |
| 8:30-9:15 a.m. | **Review of the Workshop Agenda, Introductions, & Workshop Deliverables**<br>• Ismail Fidan and Nick Russell, Tennessee Tech University | Conference Room A |
| 9:15-9:45 a.m. | **Makerspaces: Transforming from Consumers to Producers**<br>• David Voetmann, The Facility Makerspace, Edmonds Community College | Conference Room A |
| 9:45-10-15 a.m. | **Where Additive Manufacturing Begins … The Design**<br>• Tom Singer, Sinclair Community College | Conference Room A |
| 10:15-11:00 a.m. | **State of the Additive Manufacturing Industry and Q&A**<br>• Terry Wohlers, Wohlers Associates | ZOOM Connection from Conference Room A |
| 11:00-11:15 a.m. | **Break** | Conference Room A |
| 11:15-Noon | **Additive Manufacturing for Production**<br>• Ed Tackett, University of Louisville | Conference Room A |
| Noon-1:00 p.m. | **Networking Lunch**<br>• All Attendees | Conference Room A |
| 1:00-1:30 p.m. | **AM MOOCs, AM Additively Innovative Lecture Series and Task Assignment for Studio Practices**<br>• Ismail Fidan, Tennessee Tech University | Conference Room A |
| 1:30-2:00 p.m. | **Technology Made Simple**<br>• Brooks Partain, Global Strategic Account Manager | ZOOM Connection from Conference Room A |
| 2:00-3:30 p.m. | **Set up, run, and test participant's 3D printers**<br>• All Attendees | Conference Room A |
| 3:30-4:00 p.m. | **Driving to Protomet** protomet.com<br>1010 Larson Drive, Oak Ridge, TN 37830<br>• All Attendees | Carpool to Protomet |
| 4:00-5:00 p.m. | **Tour of Protomet**<br>• Dan Sherwood, Protomet, Cell 865.696.7217 | Protomet |
| 5:00-5:30 p.m. | **Driving back to TCAT-Knoxville**<br>• All Attendees | TCAT-Knoxville at 1100 Liberty Street, Knoxville, TN 37919 |
| 5:30-7:00 p.m. | **Honorary Dinner provided by Coulter & Justus, P.C. and BB&T**<br>• All Attendees, and Mike Parton and John Harris | Conference Room A |

Tennessee TECH

**2017 NSF Additive Manufacturing Workshop**
**Knoxville, TN**

**AGENDA**

| **DAY TWO: Sunday, May 21, 2017** | | |
|---|---|---|
| **TIME** | **SESSION** | **LOCATION** |
| 8:00-8:45 a.m. | **Breakfast and Review of Day One**<br>• All Attendees | Conference Room A |
| 8:45-9:15 a.m. | **Presenting an innovative and techno-entrepreneurial AM Case Study, Project InnoDino**<br>• Nick Russell, Tennessee Tech University | Conference Room A |
| 9:15-10:30 a.m. | **Assigning a project. Run your 3D Printer. Get together as a group and start working on your project**<br>• Tom Singer, Sinclair Community College, Ismail Fidan, Tennessee Tech University and All Attendees | Conference Room A |
| 10:30-11:00 a.m. | **Driving to MDF of ORNL**<br>web.ornl.gov/sci/manufacturing/mdf<br>2370 Cherahala Blvd. Knoxville, TN 37932<br>• All Attendees | Carpool to MDF of ORNL |
| 11:00 a.m.-Noon | **Tour of ORNL-MDF**<br>• Amy Elliott, Oak Ridge National Laboratory | ORNL-MDF |
| Noon-12:30 p.m. | **Driving back to TCAT-Knoxville**<br>1100 Liberty Street, Knoxville, TN 37919<br>• All Attendees | TCAT-Knoxville |
| 12:30-1:00 p.m. | **Networking Lunch**<br>• All Attendees | Conference Room A |
| 1:00-1:30 p.m. | **AM in Daily Life**<br>• Amy Elliott, Oak Ridge National Laboratory | Conference Room A |
| 1:30-3:30 p.m. | **Work on your team projects**<br>• All attendees | Conference Room A |
| 3:30-4:30 p.m. | **Get ready to present your team projects, presentations, and Q&As**<br>• All attendees | Conference Room A |
| 4:30-5:00 p.m. | **Get ready to present your team projects, presentations, and Q&As**<br>**Closing Remarks and Workshop Evaluation**<br>• Ismail Fidan, Nick Russell, and George Chitiyo, Tennessee Tech University | Conference Room A |

UNIVERSITY OF LOUISVILLE

J.B. SPEED SCHOOL OF ENGINEERING

# ADDITIVE MANUFACTURING WORKSHOP

**Friday, December 8th, 2017**

**8 a.m. to 4 p.m.**

Engineering Garage, 1960 Arthur Street, Louisville, KY

*In partnership with* Tennessee Tech

Attendees will receive a **3D Printer Classroom Kit** for their school, software, student exercises, train the trainer assistance, curriculum examples and student modules. **Breakfast and lunch will be provided.**

## 3D PRINTER CLASSROOM KIT

- Monoprice Maker Select Plus 3 OR Monoprice Select Mini
- 2 Spools of PLA Build Material
- 2 Extra .4mm nozzles
- Nozzle Cleaning Filament
- PTFE Tubing
- 3D Printer Toolkit
- 2 Memory Cards
- 1 Memory Card Reader
- CURA 3D Printer Software

## Registration Information

- Application Deadline is Nov. 22, 2017
- Limited to 30 attendees
- Each participant will receive 3D Printer Kit for their classroom
- Accepted candidates will be emailed by Nov. 27

## Online Application Procedure

**https://goo.gl/forms/lf6J7vjncUspGd7r1**

You must provide us with an signed institutional commitment letter from your administration acknowledging your participation in the workshop and implementation of the 3D printer in your educational activities and email the PDF to:
ed.tackett@louisville.edu

Sponsored by the National Science Foundation under Award Number 1601587, AM-WATCH: Additive Manufacturing Workforce Training Coalition and Hub. This material is based upon work supported by the National Science Foundation under Grant No. 1601587. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

# ABET Criteria: Knoxville Studio (N=15)

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| I have increased ability to design a system, component, or process to meet desired needs. [3c] | 60.0% (n=9) | 13.3% (n=2) | 20.0% (n=3) | 6.7% (n=1) | 0.00% |
| I have increased ability to function effectively as a member of a technical team. [3d] | 60.0% (n=9) | 26.7% (n=4) | 6.7% (n=1) | 6.7% (n=1) | 0.00% |
| I have increased ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and use appropriate technical literature. [3f] | 46.7% (n=7) | 40.0% (n=6) | 6.7% (n=1) | 0.00% | 6.67% |
| I have an increased understanding of the need for and ability to engage in self-directed continuing professional development. [3g] | 66.7% (n=10) | 20.0% (n=3) | 6.7% (n=1) | 6.7% (n=1) | 0.00% |
| I have an increased understanding of and commitment to professional and ethical responsibilities including a respect for diversity. [3h] | 66.7% (n=10) | 13.3% (n=2) | 13.3% (n=2) | 6.7% (n=1) | 0.00% |

# ABET Criteria: Seattle Studio (N=15)

| | Strongly agree | Somewhat agree | Neither agree nor disagree | Somewhat disagree | Strongly disagree |
|---|---|---|---|---|---|
| I have increased ability to design a system, component, or process to meet desired needs. [3c] | 40.0% (n=6) | 40.0% (n=6) | 13.3% (n=2) | 0.00% | 6.7% (n=1) |
| I have increased ability to function effectively as a member of a technical team. [3d] | 33.3% (n=5) | 26.7% (n=4) | 33.3% (n=5) | 0.00% | 6.7% (n=1) |
| I have increased ability to apply written, oral, and graphical communication in both technical and nontechnical environments; and use appropriate technical literature. [3f] | 33.3% (n=5) | 40.0% (n=6) | 20.0% (n=3) | 0.00% | 6.7% (n=1) |
| I have an increased understanding of the need for and ability to engage in self-directed continuing professional development. [3g] | 40.0% (n=6) | 46.7% (n=7) | 6.7% (n=1) | 0.00% | 6.7% (n=1) |
| I have an increased understanding of and commitment to professional and ethical responsibilities including a respect for diversity. [3h] | 40.0% (n=6) | 26.7% (n=4) | 26.7% (n=4) | 0.00% | 6.7% (n=1) |

# Acknowledgements

Funding provided by NSF ATE Project,
*AM-WATCH: Additive Manufacturing-Workforce Advancement and Training Consortium and Hub*
is greatly appreciated.