The Future of Work: Integrating Emerging and Cross-Cutting Technologies: Vacuum and Automation

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Project Goals



- 1. Empower community colleges to prepare technicians for the work of the future.
- 2. Promote regional collaboration between community colleges and industry to determine the technical demands of work of the future.
- **3.** Support ATE Regional Networks focused on technician education for the work of the future.
- 4. Foster implementation of the cross-disciplinary STEM core to maximize impact on technician education

What's Happening?

- Nature of work changing at unprecedented speeds
- Technology advancements in machine learning, AI, IoT, and robotics eliminating some jobs, creating others
- Technicians sit at the center of much of this disruption
- Education must keep up
- Our students' career paths will evolve



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Future-proofing STEM Technicians





The Cross-Disciplinary STEM Core: Skill Area 1: Data Knowledge and Analysis Skill Area 2: Advanced Digital Literacy Skill Area 3: Business Knowledge and Processes

By Integrating the Cross-Disciplinary STEM Core into Technical Programs

A Framework for a Cross-Disciplinary STEM Core

Preparing Technicians for the Future of Work

A Framework for a Cross-Disciplinary STEM Core









DATA KNOWLEDGE AND ANALYSIS

Manipulating and interpreting data to resolve issues and using Excel and other common software proficiently to accomplish tasks

> Analytics tools Computational thinking Data analysis Data backup and restoration Databases Data fluency Data life cycle Data management Data modeling Data storage Data visualization Query languages Spreadsheets Statistics

ADVANCED DIGITAL LITERACY

Understanding digital communications and networking, cybersecurity, machine learning, sensors, programming, and robotics at a higher than introductory level

Artificial intelligence/ machine learning Automation/robotics Basic programming Cloud literacy Digital fluency Digital fluency Digital twins Edge computing Function block diagram programming Human-Machine Interface (HMI) Internet of Things (IoT) Network architecture Network communication Security controls

BUSINESS KNOWLEDGE AND PROCESSES

Understanding the value chain and business practices of an enterprise and applying principles of ethical adoption of new technologies

Business cycles Blockchain Communication Continuous process improvement Customer/stakeholder analysis Entrepreneurship Ethics Lean processes Supply chains Market trends Overall Equipment Efficiency (OEE) Return on Investment (ROI) Risk management Supply and demand Vertical and horizontal integration

Welcome Nancy and Tom Image: Comparison of the second se



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Incorporating Cross-disciplinary Learning Opportunities into Curriculum

PREPARING TECHNICIANS FOR THE FUTURE OF WORK – WEBINAR SERIES FEBRUARY 2024 This work was made possible in part by grants from the **National Science Foundation** (ATE DUE #0603175, #1400408, #1700624, #2000454, #2202166)

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Introductions Normandale's Vac Tech Team (DUE #2202166 Project)



Webinar Presenters

Nancy Louwagie, VACT Instructor, PI DUE #2202166 Tom Johnson, VACT Instructor, Co-PI



Other Team Members @ Normandale

Dr. Ruth Robinson, CHEM faculty, VACT Instructor, Co-PI John Lasswell, VACT Instructor, Sr. Personnel Scott Holm-Hansen, Lab and Project Assistant Tim Lapanne, Advisor, Vacuum Tech 3rd Party Student Liaison Support

Team Members outside NCC

Tony Dalessio, Co-PI; Prof of Elect Eng Tech, SUNY Erie Community College **Bob Bailey**, External Evaluator, Outcomes Consulting Services



Why is Vacuum Technology important?

Vacuum technology is critical to a wide range of industries as well as scientific research.

Without vacuum technology, we would not have food with extended shelf-lives, scratch resistant coatings on eyeglasses, computers, flat screen televisions, Thermos flasks, or achieve fusion ignition as demonstrated at Lawrence Livermore National Laboratory.





THERMOS



What is Vacuum Technology?

Vacuum systems are used to establish and maintain a low pressure (sub-atmospheric) environment.

Vacuum conditions are created by removing gas molecules and particulates from a space to create a controlled environment with a <u>molecular density</u> that is less than, and often times much, much less than, atmospheric conditions.





Why create a vacuum?

When the molecular density in a space is reduced, the mean free path increases. This condition makes it possible for molecules to travel directly from a bulk source of material to a substrate on which the molecules condense to form a very thin film of material with high purity.

<u>A low pressure (high vacuum) condition</u> <u>facilitates the process</u> <u>of coating a surface</u> with a thin film of pure material





What is Normandale's Vacuum and Thin Film Technology program?

<u>The program prepares a student to work as a</u> <u>technician in industries or research organizations</u> <u>which rely on vacuum-based processes</u>.

Normandale offers a 2-year Associate of Applied Science (AAS) degree in Vacuum and Thin Film Technology as well as two certificates (Vacuum Maintenance Technician Certificate (28-29 credits) and/or Vacuum Technology Certificate (9-11 credits)).





Vacuum Technology Program

On-going Program Development Work with Support from NSF-ATE





Normandale collaborates with local industry partners to develop vacuum technology program

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Blending the Instruction of Vacuum Systems with Automation

- DUE #1400408 Custom Vacuum Equipment Trainer (VET) systems were designed and built to provide students with more in-class, hands-on learning opportunities.
- (2) DUE #1700624 Project supported Undergraduate Research Experience (URE) activities. Students participated in the development of the Human Machine Interface (HMI) for the VET systems so the VETs could be operated remotely.
- (3) DUE #2202166 The process of engaging students in the URE inspired the idea of directly linking the instruction of automation to the operation of vacuum systems.





Automation for Vacuum Systems Curriculum



Curriculum Components

(1) Introduction to Vacuum System Automation –

Identify and use types of documentation that specify the intended operations of an automated system and the functions of its underlying components.

- (2) I/O for Vacuum System Automation Identify, set up and exercise the electrical communications interfaces between a controller device and the system's underlying electronic components.
- (3) Automation Capstone Create a Human Machine Interface (HMI) that supports control and data acquisition for a simple vacuum system.



Hands-on Learning Tool: Vacuum Equipment Trainer (VET)





Components

•VC – Vacuum Chamber

- •V1 Roughing Valve
- •P1 Roughing Pump
- •G1 Roughing Gauge
- •G2 Roughing Gauge
- •V2 Venting Valve



Demonstration of Remote Access VET





Q&A?





At the Project Website: <u>Preparingtechnicians.org</u> Tools and Resources to Help You Take Action

- Read and share A Framework for a Cross-Disciplinary STEM Core
- Download, share and implement cross-disciplinary instructional cards in your class
- Listen to podcasts featuring cutting-edge industry interviews
- Share recorded webinars

Cross-Disciplinary Instructional Cards



Data Knowledge and Analysis

Manipulating and interpreting data to resolve issues and using Excel and other common software proficiently to accomplish tasks



Instructional Activity Cards:

- Data Visualization
- Data Literacy/Fluency
- Spreadsheets
- Analytics Tools

Advanced Digital Literacy

Understanding digital communications and networking, cybersecurity, machine learning, sensors, programming, and robotics at a higher than introductory level



Instructional Activity Cards:

- Network Communications –
 Internet of Things
- Automation/Robotics/HMI
- Basic Programming-Python
- Digital Twins
- Network Architecture

Business Knowledge and Processes

Understanding the value chain and business practices of an enterprise and applying principles of ethical adoption of new technologies





Entrepreneurship

- Communication
- Lean Processes
- Supply and Demand

Podcasts





Episode 38: Technicians in the New Blue Economy Podcast Guest: Justin Manley, President of Just Innovation, Inc. April 2022 |

Read More »



Episode 37: Incorporating the Internet of Things Podcast Guests: Kristine Christensen, Director of Faculty Development, Professor of MIS, Moraine

Read More »

Episode 36: Supply Chain Automation In Transition Podcast Guest: Phil Gilkes, Regional Maintenance Manager, Dollar Tree Distribution Centers February 2022

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What Should Educators Know and Do about Preparing Technicians for the Future of Work? Podcast Interviews Provide Direction

www.preparingtechnicians.org/podcasts

- i. Podcasts: Automation, Robotics, and Advanced Manufacturing
- ii. Podcasts: Digital Skills, Digital Mastery. Digital Twins, Simulation
- iii. Podcasts: Industry, Factory, and Education Trends
- iv. Podcasts: New Skills, New Generations of Students

i. Podcasts: Automation, Robotics, and Advanced Manufacturing

AUTOMATION, ROBOTICS, AND ADVANCED MANUFACTURING		
Topic and Episode(s)	Discovery	Recommended Action
1. A Robot for Every Technician? <u>PC13</u> and <u>PC22</u>	A robot for every technician is an emerging trend in the workplace.	Ask yourself if it is possible for you to consider something similar in your education and training space? A robot (or an automated system) for every student, in every learning situation?

Recordings of This Webinar Series



- 1. Preparing Technicians Using the Cross-Disciplinary STEM Core
- 2. Professional Development and Instructional Resources
- **3.** Future of Work: Integrating Emerging Technologies

https://www.preparingtechnicians.org/webinars/