

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

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Preparing Technicians for the
FUTURE OF WORK
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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?

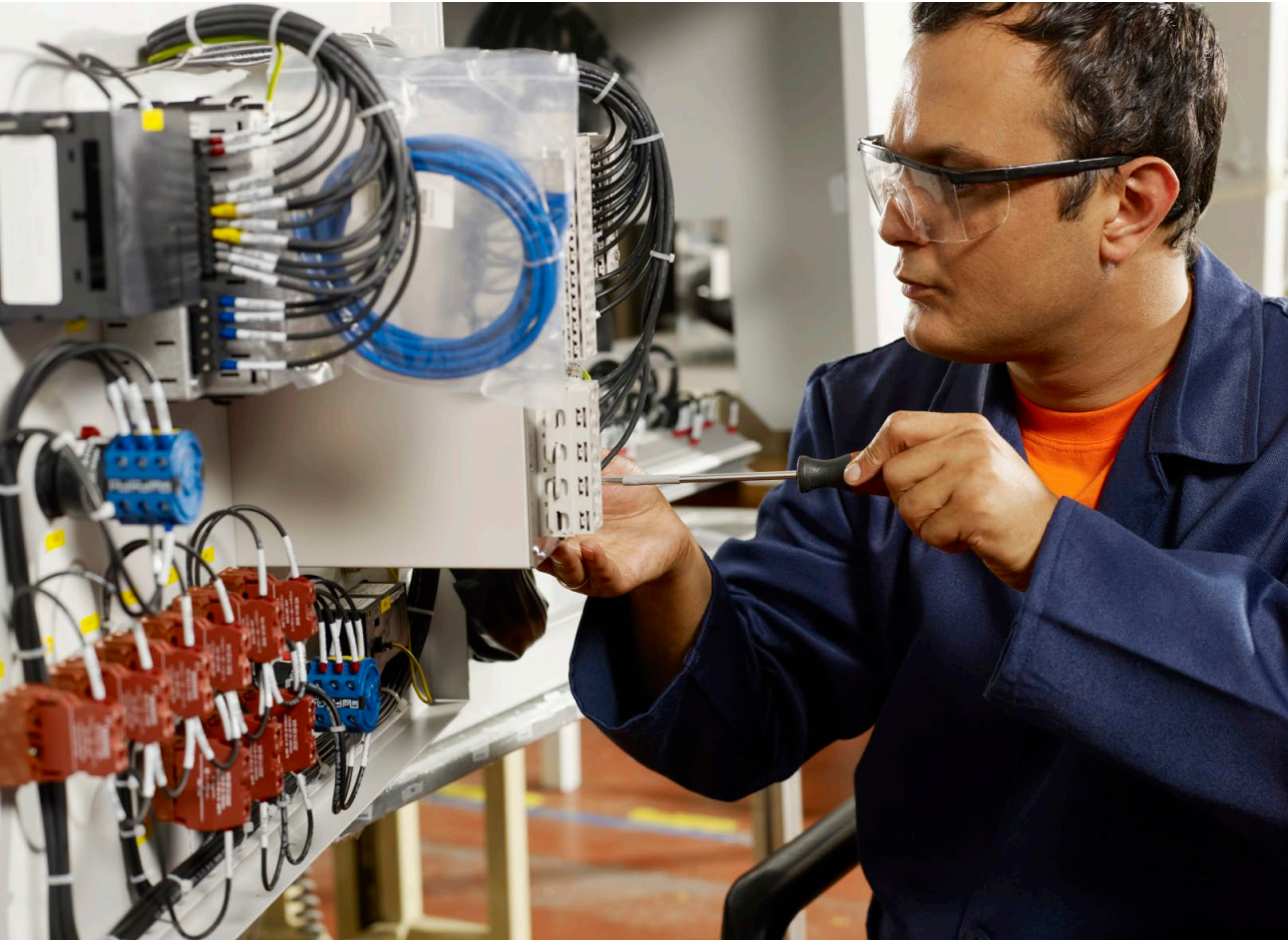
- Nature of work changing at unprecedented speeds
- Technology advancements in machine learning, AI, IoT, and robotics eliminating some jobs, creating others
- Technicians sit at the center of much of this disruption
- Education must keep up
- Our students' career paths will evolve

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Future-proofing STEM Technicians



The Cross-Disciplinary STEM Core:

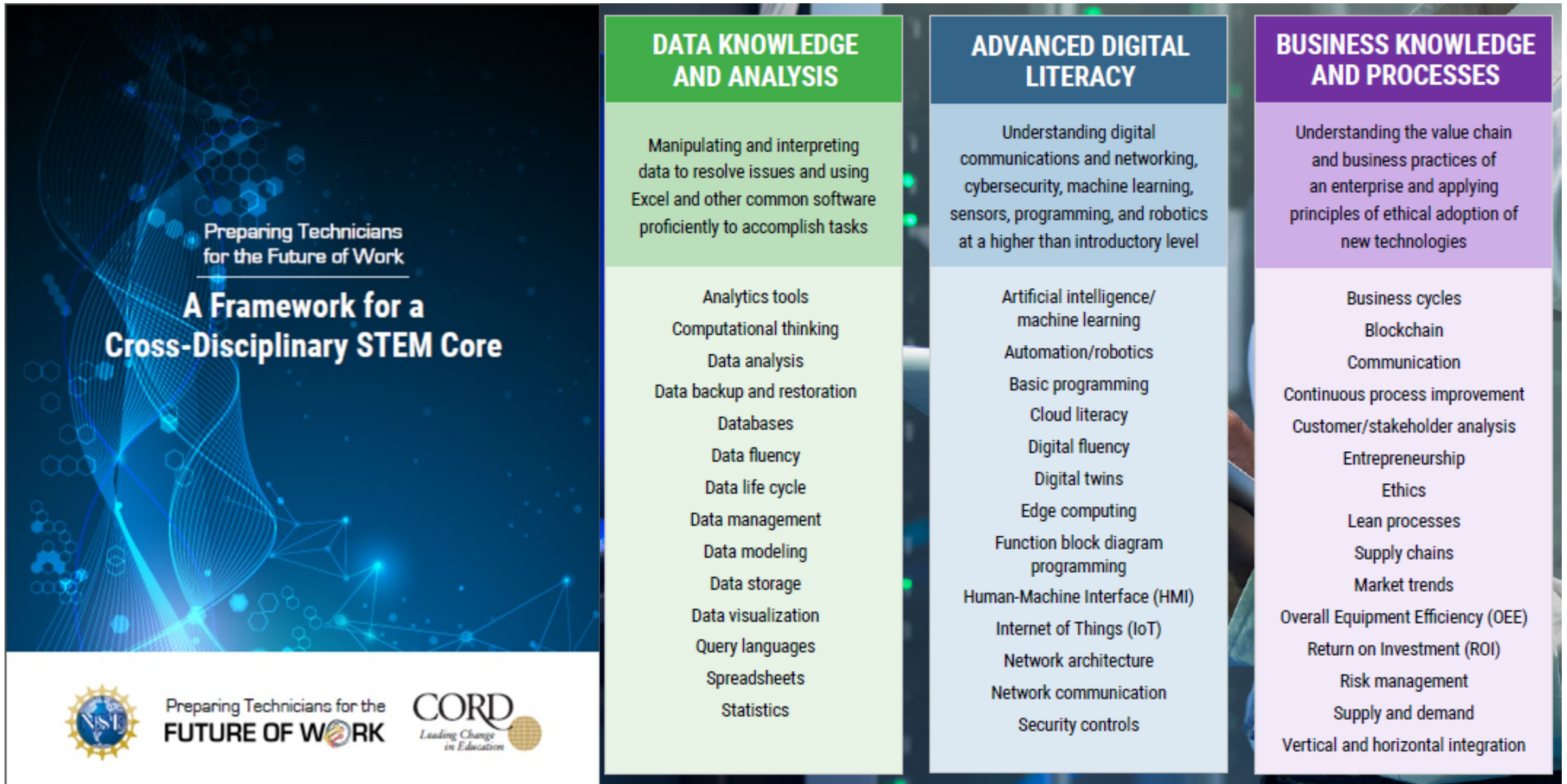
Skill Area 1: Data Knowledge and Analysis

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



Mason Lefler and Scott Danielson
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Preparing Technicians for the
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Introduction to Manufacturing Analytics from the Perspective of Data Analysts and Industrial Controls Technicians & Engineers

ATE #2202090: “Distance-Enabled Industry-Led
Data Analytics Technician Pathway”

ATE #2100322: “Teaching Technician
Troubleshooting with Mini Industry 4.0 Factories”

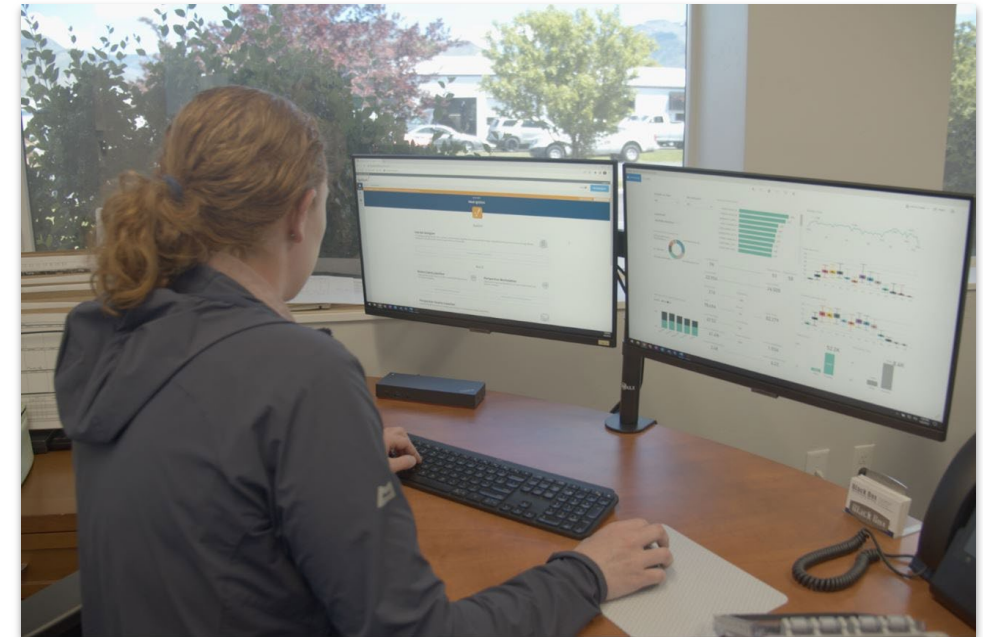
Data and Industry 4.0

- Rise of data in all sectors of manufacturing
 - Connects IT and Manufacturing
 - Mitigates manufacturing problems and risks
 - i.e., food processing, auto parts manufacturing, and aerospace manufacturing
- Data trends at local companies
 - Actionable insights
 - New software
 - Predictive / Preventative Maintenance
 - Upskilling current employees
 - Managers, line operators, controls technicians, data technicians, and automated manufacturing technicians



Advantages of Data in Industry 4.0

- **Improved Efficiency**
 - Streamlining operations
- **Enhanced Quality Control**
 - Manual > Digital > Connected > Intelligent
- **Increased Productivity**
 - Real-time insights help identify bottlenecks
- **Sustainability**
 - Eliminate paper trail
 - Reduced resource consumption
- **Informed Decision Making**
 - Data-driven decisions improve strategic planning
- **Competitive Advantage**
 - Over competitors not utilizing data strategies



Local Industry 4.0 Example

Blackbox Engineering

- Local Industrial Automation Firm

Gossner Foods

- Local Manufacturing Plant

Bridgerland Tech

- Local Technical College



Industry KSA and Curriculum Development

Automated Manufacturing KSA & Course Outline

- Challenge: obtain a trainer to simulate real-life manufacturing
- Advisory board co-designed industry 4.0 mini factory with BTECH
- Formal KSA will be implemented during Fall 2023 advisory meeting



Industry Mini Factory Trainer



National
Science
Foundation



Course Development



Bridgerland Courses by Department



Data Analytics Department

Course: Manufacturing Analytics

- Overview
 - Geared toward **data technicians**, managers and management at local companies utilizing automation
- Sample Objectives
 - Connect a Programmable Logic Controller (PLC)-driven manufacturing system to a database
 - Process PLC data as though in an active working environment applying data analysis techniques

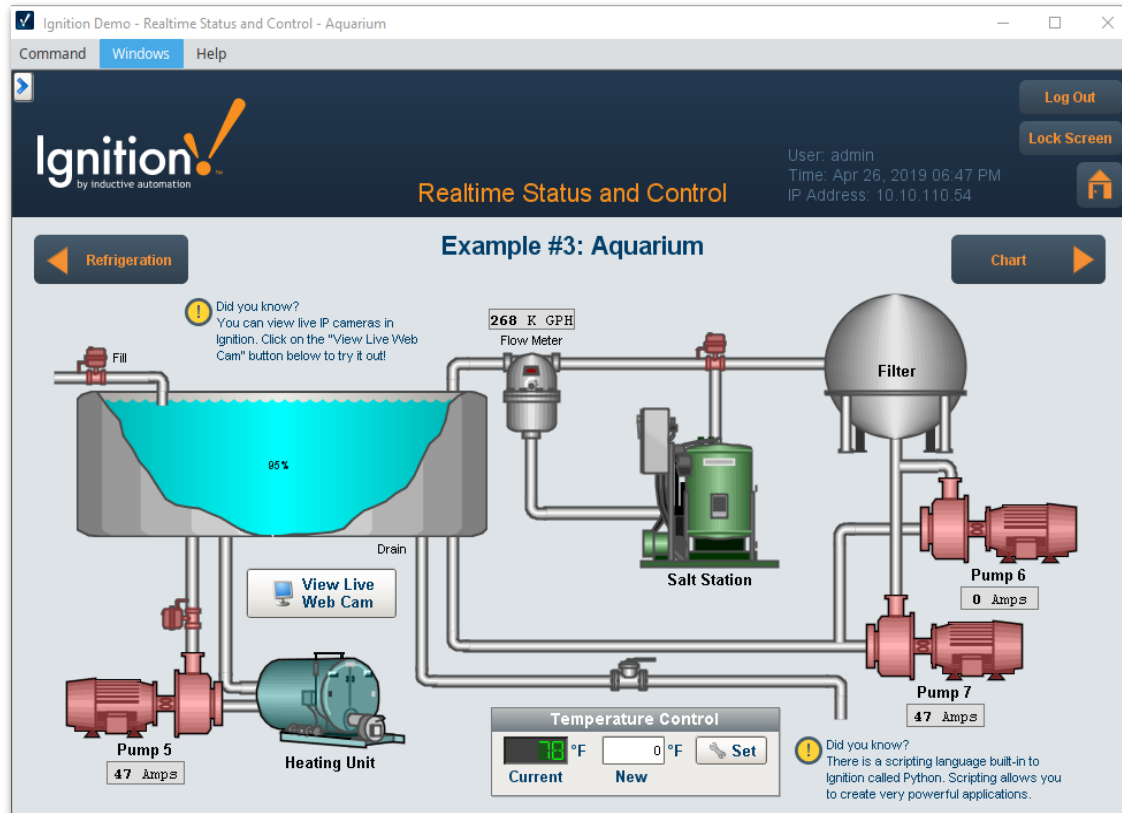
Automation Department

Course: Data and Manufacturing Analytics

- About
 - Focused on helping **automated manufacturing technicians/controls engineers** support and utilize data generated on manufacturing lines
- Sample Objectives
 - Setup data transfer from a Programmable Logic Controller (PLC)-driven manufacturing system to a database using Kepware
 - Analyze data in a manufacturing optimization scenario
 - Analyze data in a manufacturing predictive maintenance scenario



Examples of Potential Student Visualization Products

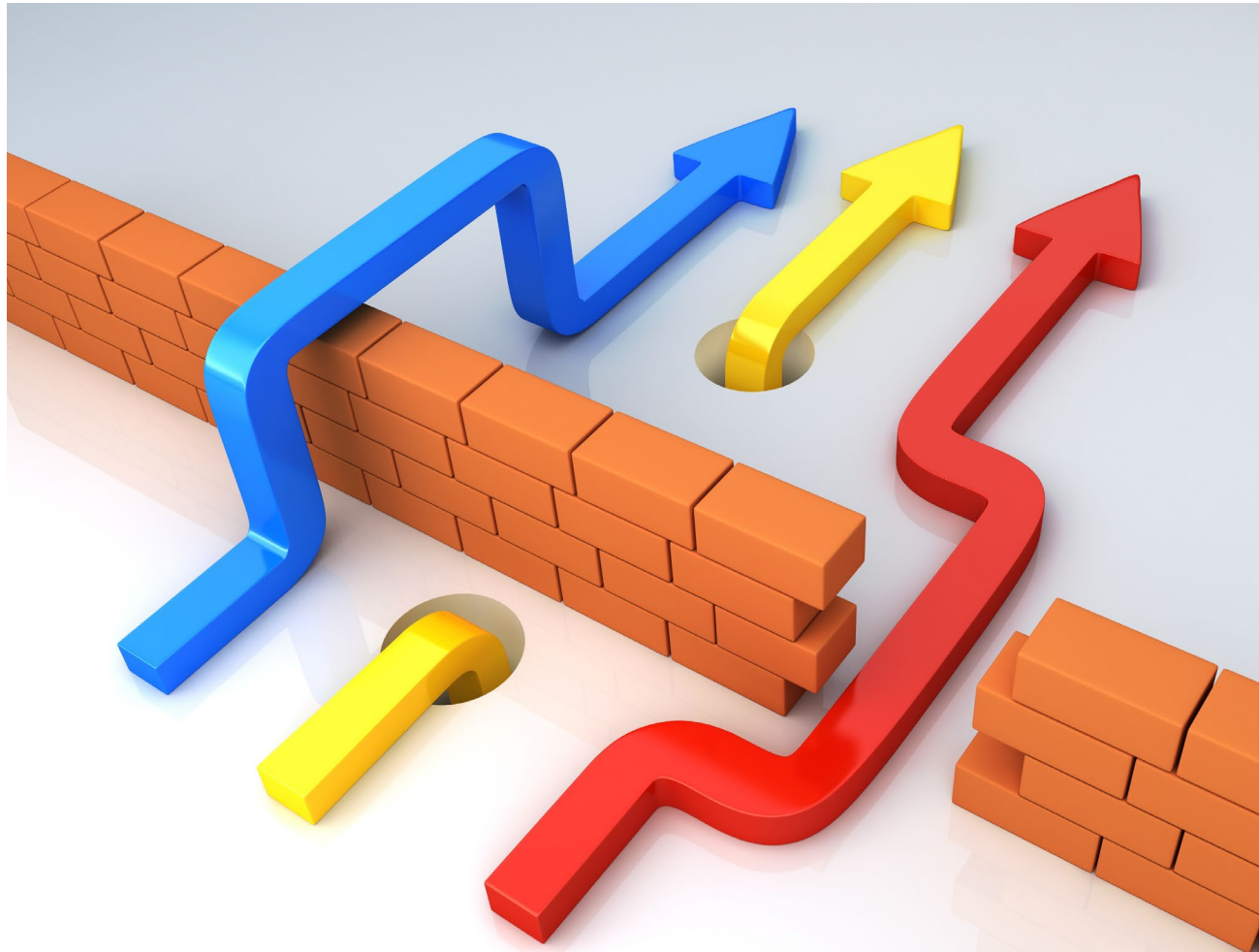


Material	Height		Polish	Camera		Weight
Plastic	Short	0.769	Polished	Failed	Failed	N/A
Plastic	Short	0.753	Polished	Passed	Passed	7
Plastic	Reject	0.772	Unpolished	Failed	Failed	N/A
Plastic	Tall	0.883	Polished	Failed	Failed	N/A
Metal	Reject	0.823	Unpolished	Failed	Failed	N/A
Plastic	Tall	0.884	Polished	Passed	Passed	10
Plastic	Tall	0.889	Polished	Passed	Passed	7
Metal	Tall	0.884	Polished	Failed	Failed	N/A
Plastic	Short	0.749	Polished	Passed	Passed	7
Metal	Reject	0.817	Unpolished	Failed	Failed	N/A

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Challenges





At the Project Website: Preparingtechnicians.org

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

DATA KNOWLEDGE AND ANALYSIS
Data Visualization

What is Data Visualization?
Data visualization represents information in the form of a chart, diagram, picture, or infographic so that the data can be quickly and easily understood. Technicians use data visualization software to create graphics that communicate complex and relational information to a variety of audiences.

Vocabulary

- **Dataset** - a collection of data, often organized in a spreadsheet or database
- **Chart** - a graphic representation of data, examples are charts, pie charts, histograms, line graphs for example
- **Scale** - marks on a visualization that indicate the range of data values presented. A scale on a graph reflects the magnitude of the data presented.

Common Types of Data Visualization

- A pie chart uses "pie slices" to show relative sizes of data.
- A histogram uses bars of different heights to group data into ranges.
- A scatter plot uses points plotted on an X-Y axis to show the relationship between two sets of data.

How will a technician use data visualization?
Evan Garcia is a technician for Green Mountain Power Company. He is responsible for tracking increased system outages over time across a metropolitan network, collects outage statistics, including system logs, environmental information, and helps to select details from network nodes and service centers in order to determine the cause. Evan shows the data in an Excel workbook, then imports data into SAS, Tableau, or MS Power BI visualization tools and creates a dashboard to present to management. The data dashboard provides an interactive geographical heat map showing outage details and other graphical representations of his data analysis of the event. The heat map allows management to make real time decisions and troubleshoot problems.

A heat map uses a scale to color code specific data values by color.



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

Advanced Digital Literacy
Network Communications - Internet of Things (IoT)

What is the Internet of Things (IoT) and how is it related to network communications?
The Internet of Things (IoT) consists of physical devices connected to the Internet. IoT devices are a combination of sensors, software, and electronics that connect to a central location usually in the cloud. They are often connected through a wireless network through which they communicate with one another and feed information to a user's mobile device or computer. Through the device, the user can monitor a condition or control a process through a control panel or dashboard. Known as the human Machine interface, Internet connected dashboard, thermostats, weather systems and wearable fitness trackers are everyday examples of IoT devices. In industry, a variety of sensors monitoring quality and machine operational parameters for preventative maintenance.

Vocabulary

- **Smart sensors** - devices that receive and process data before sending to a centralized source. Flow sensors used to measure water and natural gas usage - smart meters - are an example
- **Cloud computing** - delivery and storage of data over the Internet rather than on-site. Google's Gmail is an example
- **Information security** - processes used to protect information from unauthorized access, modification, or destruction. Requiring password entry to access devices and content is an example.

How will technicians use network communications and IoT technologies?
Network Communications Technicians familiar with IoT technologies will install, monitor and maintain the IoT devices and the network's communication software that connects them to ensure proper operation. This includes tasks such as installing software updates, developing procedures to detect and prevent system loading, testing the network for malware, and troubleshooting system malfunctions. Their job often requires creative problem solving, as in this example:

A company that manages large parking garages wanted to reduce the time its customers spent waiting for open parking spots. Some drivers spent several minutes searching up and down multiple floors to find an open parking spot. The desired system being for open parking spots are sent a message to other cars and pedestrians. A network technician is required to manage a solution after reviewing several options. The network technician decided to implement an IoT solution that includes sensors, cables, and a mobile app. IoT sensors were installed to monitor the status of each parking spot. The status of each parking spot was sent to a centralized computer. If a spot was available, signs throughout the garage would provide direction to the next location on the garage floor to the open parking spot. The status of each parking spot was also available on a mobile app for the app to show how long the garage has many spots were available and on what floor. The IoT solution reduced customer wait times, increased safety, and increased parking garage profits.



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

Business Knowledge & Processes
Student Resource
ENTREPRENEURSHIP

What is Entrepreneurship?
Entrepreneurship is the concept of developing and owning a new business for profit. It involves creating a company and driving the enterprise by asking "How can we improve this process?" It is an important. Entrepreneurship involves finding, creating, and solving problems using a market-driven approach that seeks potential new products, services or processes.

Vocabulary

- **Entrepreneur** - the individual who starts a new business venture. Typically, the individual who takes on most of the risk and develops the business concept.
- **Workforce** - business enterprise in which the expectation of gain is accompanied by the risk of loss or failure.
- **Capital** - the wealth or assets available to invest in a business.
- **Business Model** - a description of how a business will be able to create and deliver value and become profitable.
- **Market Research** - relevant data that helps demonstrate market potential for a business venture.
- **Intellectual Property** - rights or creations that are the result of creativity to which one has rights and can apply for a patent, copyright, or trademark.

How will an entrepreneurial mindset be used in the workplace?
An industry 4.0 technician of tomorrow needs creative entrepreneurial thinking as a new, essential skill. Evan Garcia is an automation technician at Advanced Auto Safety who and he has been experienced several customer complaints regarding repair times. Using an entrepreneurial mindset, Evan identified the problem and then researched possible solutions and their value propositions. He asked questions like: How much is a customer's satisfaction and loyalty worth? How much time and money can be saved through more accurate diagnosis and efficient repair? He then researched his supervisor about a potential solution he has researched that will provide better customer service, shorter wait times, and fewer errors by the technicians, resulting in higher profits for the business.

In another example, Casey Sanders is a robotics technician at Cooper Belding, an automated filling and packaging company. Over the last several days, a robot gripper has been dropping every cardboard box. The fault affected everything from the line, to the point at which several boxes dropped in a customer's warehouse. This is clearly not an acceptable business practice. Casey applied troubleshooting skills to



Instructional Activity Cards:

- **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

[Read More »](#)

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? PC13 and PC22	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/>