

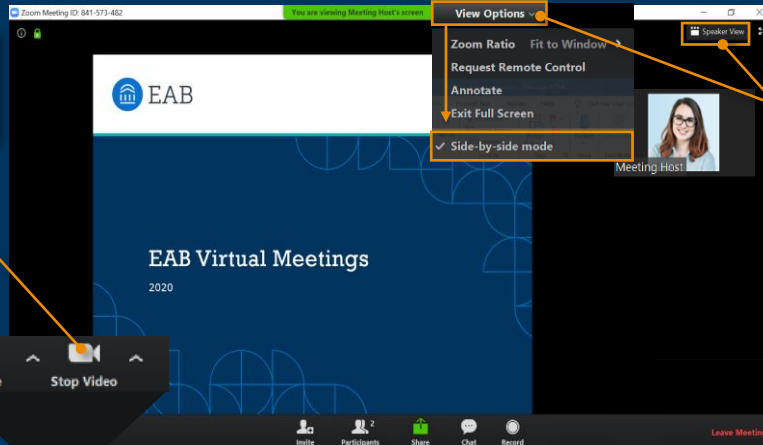


Industry Futures 2021: Technological Advancements of Smart Manufacturing

How Advancements in AI and Automation Are Changing Industry Skills Demand and the Future of Academic Programming

Zoom Features & Settings

We would love to see you on camera! It's not required but it helps facilitate discussion.



We recommend using Side-by-side Mode and Speaker View.

Please mute yourself if you're not speaking.

Click the arrow to select different speakers if you have audio trouble.

Three Truths, No Lies

The truth is out there...



PBS

US Manufacturing Activity Jumps to Three-Year High
(March 2021)



Manufacturing Needs Highly Skilled Workers for the Digital Revolution
(September 2020)

Forbes

Artificial Intelligence To Create 58 Million New Jobs By 2022
(September 2018)

...But don't just take our word for it.

12.4M Workers currently employed at US manufacturing companies

826K Open jobs at US manufacturing companies as of summer 2021

126% Growth in demand for manufacturing professionals with emerging tech skills from 2018-2021¹

58% Percent of manufacturing job postings that require an emerging tech skill in 2021

2.7M Number of industrial robots operating world-wide as of summer 2021

4M+ Expected number of open manufacturing jobs across the next 10 years

1) Emerging technical skills refer to those associated with digital revolution technology like AI, automation, robotics.

The Evolution of the Smart Factory

Autonomous Robots Make Decisions Using AI Machine Learning Technology



Robots plugged into...

- Co-bots work alongside humans
- Semi-autonomous robots work in enclosed barrier
- Data collected by sensors throughout factory floor

AI systems with...

- AI-connected robots analyze data from every point in production cycle
- Machines can make decisions based on market data and demand, and can identify inefficiencies in production line

machine learning ability

- Machines connected to each other through IoT, embedded intelligence tech
- AI systems “learn” from data, make more sophisticated decisions
- Identify, rectify issues with machines before they occur
- Make adjustments autonomously without human intervention

Smart Manufacturing in Action: Schneider Electric Smart Factory

Lexington, KY

Updated tech applications impact entire operations cycle from supplier to customer, including remote monitoring and predictive maintenance.



Goal

Increase agility and resiliency of operations

Outcomes

↑ 20%

Customer satisfaction

↓ 26%

Energy costs

↑ 20%

Demand forecast accuracy

↓ 78%

CO2 emissions

ETA to Industry 5.0 Not the Same for All



Manufacturing Companies Vary in Response to Digital Transformation



Lighthouse Factories¹

Smaller percentage pushing industry forward



- Cutting edge innovation
- Eager to invest in latest technology
- Access to large applicant pool and resources
- Expand reach and increase agility



Mom and Pop Shops²

Comprise about 75% of manufacturing sector



- Wait and see what others do
- Stick with what we know in niche market
- Lack competitive applicant pool and resources
- Unsure where to invest first

1) [The World Economic Forum](#) defines lighthouse factories as those that have integrated automation at a large scale.

2) Mom and Pop shops are small to mid-size manufacturing companies that tend to produce one product and have a regional reach.

Talent Needs Vary Depending on ETA to 5.0



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The Right Skillsets to Meet Companies Where They Are

Lighthouse Factories

Managers with business acumen and basic understanding of advanced tech to oversee change management

Engineers with deep knowledge of newest, most advanced tech like artificial intelligence and integrated systems

Technicians with skills in automation, robotics, and data analytics

Staff Needs

Executives

Specialists

Frontline Staff

Mom and Pop Shops

Consultants with business understanding of new tech to create step-by-step digital transformation strategy, starting with 'sure-bet' investments

Engineers with technical understanding of advanced tech to test and implement new processes

Technicians with foundational production and engineering skills and a willingness to learn new tech

The (Human) Jobs in Today and Tomorrow's Factory

Each Manufacturing Worker Interacts with Emerging Tech in Unique Ways

Theo the Technician

Robotic Automation Technician



- Has his AAS in Manufacturing Tech and takes night courses for BS
- Troubleshoots and operates robotic machines
- Suggests process improvements
- Reports to engineers on data collection, recording, and analysis

The Remaining Gap...

Data analysis and uniquely human skills

Evelyn the Engineer

Artificial Intelligence Engineer



- Has her BS in Industrial Engineering
- Develops, tests, and iterates new processes virtually before testing on the factory floor
- Implements new tech and adjusts as needed
- Oversees a team of both robots and humans

The Remaining Gap...

Business, management, and emerging tech skills

Marion the Manager

Digital Transformation Director



- Has their Master of Business Administration
- Operates as a change agent to identify new tech to match business strategy
- Works with engineers to integrate new technology and oversee process adjustments
- Acts as a liaison between engineers and executives

The Remaining Gap...

Emerging tech applications and business strategy skills

Close the Skills Gap

Adjust or Create Programming to Match Skills Demand



Associate's Level

- Retain foundational manufacturing courses
- Add introduction to data analytics courses
- Incorporate advanced critical thinking and trouble shooting skills

Example Courses:

"Data Analytics for Quality Control and Manufacturing"
"Technical Problem Solving"



Bachelor's Level

- Create programs with meld of engineering, advanced tech, data analytics
- Embed basic business coursework or experiential, real-world projects

Example Courses:

"Industrial Internet of Things"
"Economics of Digital Manufacturing Systems"



Master's Level

- Retain foundational business courses
- Focus on change management and thought leadership strategies
- Integrate basic and broad understanding of emerging tech

Example Courses:

"Machine Learning & AI for Technology Leaders"
"Managerial Data Analysis"

Match Learning Outcomes to Emerging Tech Needs

- 1 Determine Balanced Offerings for a New Degree Program
- 2 Add Emerging Tech Content into Current Programming
- 3 Create Experiential Learning Opportunities for Human Skills Growth



Determine Balanced Offerings for a New Degree Program

Creating an Advanced Smart Manufacturing with the
Right Combination of Digital Revolution Skills

SECTION

1

How, Where, and When to Create a New Program

Leaders Must Weigh Strengths, Feasibility Against Growing Alternative Options

Key Considerations For New Program Launches



Unique value-add beyond current program offerings



Faculty expertise and willingness



Institutional funding and support



Realistic timeline to launch



State approval, if necessary



Flexibility to adjust content as tech changes



Inter-collegiate support for interdisciplinary programs



Industry partnerships



Options beyond new programs

Executive education unit can incubate advanced manufacturing content

- Badges
- Certificates
- Micro-credentials
- Micro-master's

Colleges can create intentional, clear advanced tech tracks into curricula

- Specialization tracks
- Minors or concentrations

Common Characteristics of Bachelor's Programs

Equip Engineers with Deep Knowledge of the Most Advanced Technology



Credits

120 - 138



Program Type

In-person, due to employer partnerships and co-op opportunities



Typical Student

Classic undergrad profile



Ownership

Engineering department



Other Considerations

Opportunities for degree completion in Executive Education unit



Popular Titles

- BAS in Manufacturing Technology Management
- BS Manufacturing Engineering
- BS Management and Engineering for Manufacturing
- BS in Digital Manufacturing Technology
- BEng in Automated Manufacturing Engineering Technology

The Bachelor's of Science in Advanced Engineering

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Innovative Bachelor's programs offer courses in the latest manufacturing technology, data analytics, and leaderships and business. Industry partners provide input on curricula and assist in hands-on, real-world learning opportunities.



BS in Smart Manufacturing Industrial Informatics

- Curriculum created in partnership with industry leaders, including Microsoft, General Mills, CAT
- New curriculum based on the latest technology like AI, IoT, Robotics
- Interdisciplinary program with science, engineering, info systems, and computing in manufacturing
- Physical and virtual labs represent the most advanced factories equipped with newest machinery and applications



BS in Digital Manufacturing Technology

- Interdisciplinary degree combining liberal arts and technical training
- 13 credits in programming and design-thinking, 72 credits in application of new technology
- Co-curricular opportunities with industry partners for hands-on experiences, including capstones, entrepreneurship and leadership programs

Common Characteristics of Master's Programs

Create Successful Change Management Leaders in Manufacturing



Credits

30-33



Program Type

About half of programs offer hybrid or online options



Typical Student

Has experience in industry and a STEM background, returns to school for promotion



Ownership

Engineering department, engineering and business schools, School of Professional Studies



Other Considerations

Opportunities to partner with employers to create cohort-based model for employee enrollments



Popular Titles

- MS in Integrated Manufacturing Systems Engineering
- MBA + MS in Manufacturing Engineering
- MEng in Advanced Manufacturing
- MEng in Robotics and Intelligent Autonomous Systems

The Master's of Science in Manufacturing Leadership

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Innovative Master's programs focus on the implementation of technology, leadership, and business management strategies. They are often interdisciplinary and flexible, offering part-time and online options.



Master of Engineering Management and Leadership

- For technical professionals within industry experience or STEM backgrounds
- Offered both online and in-person, full or part-time
- Courses in engineering management leadership, specializations like data science or financial engineering



ARIZONA STATE UNIVERSITY

Online MBA/MS in Industrial Engineering

- For professionals who want to enhance business acumen, management and leadership skills
- Four specialization tracks, including management systems and quality and reliability engineering
- Culminates in MBA capstone and MS exam



Modeling and Data Analytics for Operations Graduate Certificate gives students computer modeling and data analytics knowledge to conduct manufacturing and service systems operations. It is 12 credits and can be completed online.



Add Emerging Technology Content into Current Programming

Enhancing Existing Offerings with Digital Revolution Curriculum

SECTION

2

Fixer Upper: Update Programs to Remain Relevant

Examine Current Programs to Determine Where Skills Gaps Live

Core Steps of Updating Existing Program Curriculum



Analyze

Examine labor market data and competitors



Audit

Review existing program curriculum and skill gaps



Convene

Gather faculty and industry to discuss trends



Decide

Determine institutional and faculty capacity



Launch

Establish new courses within existing programs

TEXAS STATE
UNIVERSITY

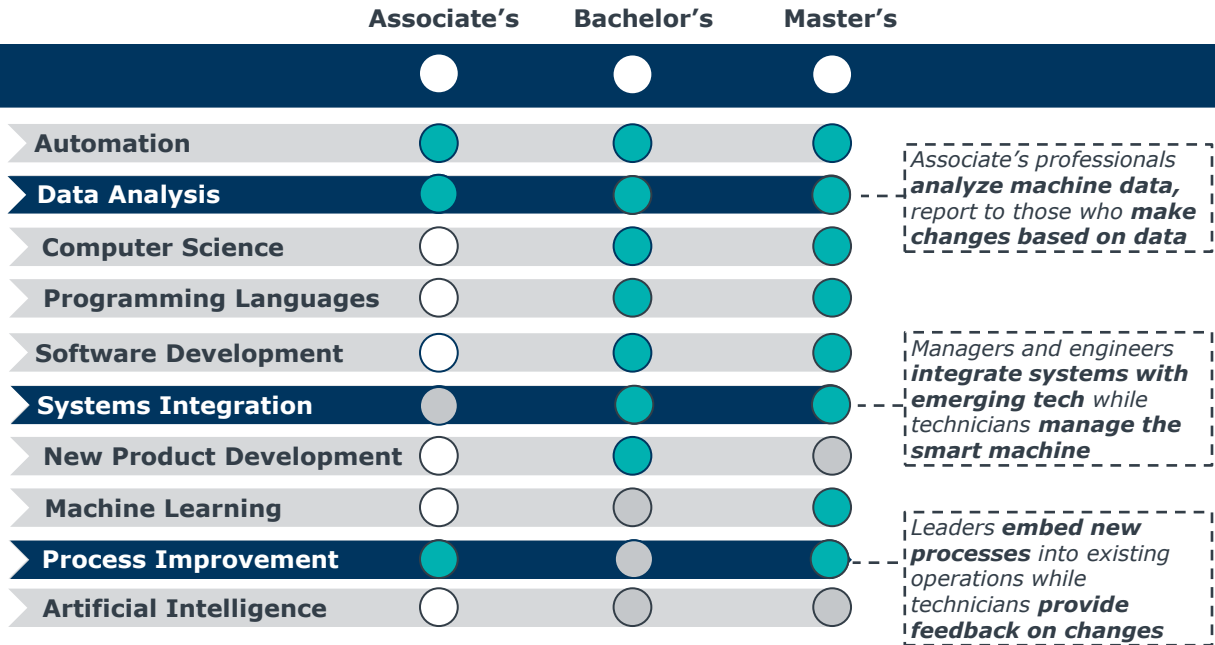
Texas State University Restructured Existing Degree to Meet Industry Needs

Texas State University worked with their Industry Advisory Board to ensure their engineering technology programs were up-to-date with emerging local trends. After auditing the existing curriculum and analyzing local trends, administrators:

- Updated MS in Technology Management to MS in Engineering Management to **meet employer demand**
- Eliminated broad tech courses to **focus on strengths in construction and manufacturing**
- **Added new emerging tech electives** in data mining, managerial data analysis, and new venture launch

Enhance Programs with Skills Relevant for Degree

Top Emerging Tech Skills for Employees in the Manufacturing Industry



Key ● High Demand ○ Moderate Demand ○ Low Demand

Bachelor's-Level Data and Strategic Business Acumen 20

Foundational Engineering and Advanced Emerging Tech Skills in Demand¹

September 2018-August 2021, National Data



+148%

Production Systems



+217%

Digital Transformation



+108%

Industrial Engineering



+164%

Artificial Intelligence

Integrate Foundational and Advanced Skills Throughout Traditional Program Curriculum

BYU *BS in Manufacturing Engineering*

Engineering

- "Lean Manufacturing & Systems Design"
- "Statics"

Industry 5.0

- "Industrial Automation"
- "Intro to Smart Manufacturing"

Data Analysis

- "Data Analysis"
- "Manufacturing Systems & Simulation"

Business

- "Innovation & Entrepreneurship"
- "Manufacturing Leadership"

1) 41% baseline increase in demand for bachelor's level manufacturing skills

Master's-Level Change Management

Manufacturing Managers Need Data-Integrated Management Strategies¹

September 2018-August 2021, National Data



+126%

Organizational Leadership



+111%

Strategic Decision-Making



+142%

Machine Learning Algorithms



+127%

Deep Learning

Embed Emerging Tech into Traditional Master's Programs to Prepare Students to Make Strategic Decisions with Data



*Online Master's in
Manufacturing Leadership*

Traditional Manufacturing Foundations

"Manufacturing Supply Chain Operations"

Emerging Technology Applications

"Emerging Tech in Discrete Manufacturing"

Engineering Management Core

"Leadership & Organizational Change"

1) 56% baseline increase in demand for bachelor's level manufacturing skills



Create Experiential Learning Opportunities for Human Skills Growth

Providing Students with Explicit Opportunities to Hone Uniquely Human Skills

SECTION

3

That Special Something: Human Skills in a Digital Age ²³

Top Human Skills for Manufacturing Professionals



From Curricular to Extra-Curricular

Creating Opportunities for Students to Showcase Their Human Skills



Curricular



Co-Curricular



Extra-Curricular

Definition

Opportunities to enhance value-add for corporate partners and student experience

Allows students to unpack employer issues so project is connected to work experience

Empowers students to apply instruction and demonstrate problem solving skills

Opportunities

- Applied projects
- Cohort presentations
- Business simulations

- Capstone projects
- Practicums
- Co-Ops

- Internships
- Competitions
- Coaching programs

Skills Gained

- Analytical Thinking
- Teamwork
- Presentations

- Critical Thinking
- Teamwork
- Delivering on Results

- Problem Solving
- Influence
- Delivering Solutions

Demonstrating Competency

Students should have an exemplar output and have delivered a presentation

Students should have a completed business case problem and a team environment experience

Students should have applied human skills in a workplace and (ideally) a sponsor recommendation

Creating Your Own Walk of FAME

How to Work with Industry from the Start to Ensure Placement, Success

Hallmarks of FAME



Earn and Learn
Opportunities



Triangular
Partnerships



Regional-Need
Focused



Building a Workforce in Unlikely Places

While Colorado does not rank highly among manufacturing states, Pueblo Community College recognized the need for skilled workers in the region's growing energy and metal manufacturing communities.

FAME at Pueblo CC allows participants to work for (and get paid by) a sponsor while also completing coursework towards a STEM-focused Associate's degree.



Combining FAME with Other Programs

Northeast Indiana has a strong manufacturing industry but is always keen to attract new companies and grow in-demand talent to keep things moving.

FAME at Ivy Tech expands the opportunities for students pursuing STEM Associate's degrees by increasing the number of "learn and earn" companies in their partnership pipeline.

Making Manufacturing Accessible to All

DEI Considerations in Co- and Extra-Curricular Programming



Flex the Employer Challenge Projects

Focusing projects on real-world challenges instills critical skills, but can be limiting for students in unrelated or adjacent jobs while enrolled in programs



Ensure Mandatory Means Paid

Mandating co- and extra-curricular learning experiences enhances the curricular but if those opportunities require additional costs, they can deter financially burdened students



Safeguard Against Affinity Burden

Dedicated affinity groups can encourage professional growth within underrepresented communities, but too often they become responsible for all local development efforts



Good start, but what else?

While these considerations are good starting points, they alone cannot address the DEI gaps in the manufacturing industry. What other opportunities exist?

- **Recruitment:** How can institutions help remove the barriers (perceived and otherwise) to entering the manufacturing workforce?
- **Culture:** How can institutions help manufacturing companies develop more welcoming and inclusive workplaces?
- **Retention:** What further development opportunities can institutions offer to improve employee retention?

Further EAB Resources on Industry Futures



Register for a [FinTech Roundtable](#)

Learn how progressive institutions meet emerging fintech skills needs.



Explore the [Industry Futures Webpage](#)

Read the latest insight pieces and past reports.



Request a **subject matter expert call**

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Brief Post-Session Poll

*Thank you for your participation today.
We appreciate your feedback on this material.*