To help industry and academia develop an advanced Industry 4.0 manufacturing workforce, the American Society of Mechanical Engineers (ASME) and Autodesk conducted a research study to identify the future workflows and skills needed for mechanical engineering, manufacturing engineering, and CNC machinist roles over the next decade.

Below are key findings from the *Future of Manufacturing* report.

Essential Changes to Three Roles in Industry 4.0

Mechanical Engineers

- Mechanical engineers will continue to improve upon engineering designs and become more involved in manufacturing implementations and processing production data results to improve designs for manufacturability.
- 60% of industry believe interdisciplinary engineering knowledge will increase for mechanical engineers over the next five to 10 years. This was consistent across small, medium, and large manufacturers.
- Continued emphasis on "soft" skills like problem solving and communication skills to complement their growing focus in software tool functionality, data analytics, programming, and "smart" and sustainable design techniques.

Manufacturing Engineers

- The manufacturing engineer position will become even more interdisciplinary as it blends skills with both mechanical engineers and CNC machinists.
- Within industry, 72% of respondents believe human-robotic interaction will increase and 74% believe automation will increase for this role.
- Like mechanical engineers, future manufacturing engineers will continue to need enhanced communication skills and will be expected to incorporate additive manufacturing and utilize artificial intelligence/machine learning (AI/ML), digital twin, and data analytics to improve throughput and efficiencies.

CNC Machinists

- Computer numerical control (CNC) machinists' roles will evolve dramatically, from a CNC operator to an engineering technician who programs CNC machines, and over time, they will take on other manufacturing engineering functions.
- The factory environments in which future CNC machinists will work will become more complex through the use of collaborative robotics or "cobotics," 3D printers, AI/ML and multi axis machines, and will require greater mental dexterity (such as programming) and productive collaboration with engineering teams.
- According to industry professionals, becoming increasingly fluent in computer-aided design and manufacturing (CAD/CAM) software and programming will enable machinists to increase their use of technologies, including five-axis machines (65%), additive/hybrid manufacturing (66%), and robotics/cobotics interaction (65%).

Across all three roles, 90% of all survey respondents stated that teaching deeper Design for Manufacturing knowledge was the most impactful way for academia to develop the future manufacturing workforce.

Additional Findings

- **Communication is paramount. –** The research suggests an increased focus on exchanging data between groups of people through cloud collaboration. Digital transformation of roles will shape communication across roles as workflows change.
  - 86% of total respondents strongly or somewhat agreed that there is a need for a collaborative design process between all three disciplines.

- **Certifications show specialization. –** Academia expects to promote supplementing degrees with certifications. Degrees will likely serve as the foundation, while certifications will showcase specialized skills.
  - 86% of academics embrace less reliance on degrees and welcome more specialized certifications developed in partnership with industry.
  - 84% of all survey respondents believe employers and academia should partner on new types of certification programs based on employer needs.

- **Academia embraces emerging tech. –** Academia embraces new technologies including generative design (GD), AI/ML, augmented reality/virtual reality (AR/VR).
  - For mechanical engineers in the next five to 10 years, 80% of academics believe GD application will be an important skillset and 67% believe AI or ML will be an important product design skill.

- **CNC machining is changing rapidly. –** CNC machinist role will change the most over the next decade.
  - For CNC machinists over the next five to 10 years, 65% of industry believe use of robotics will increase and 62% believe use of programming skills to program smart products will increase.

- **Mechanical engineers need interdisciplinary skill sets. –** No more "throwing it over the wall." Mechanical engineers need to have applied knowledge throughout the manufacturing process.
  - For mechanical engineers over the next five to 10 years, 79% of industry believe electrical and software engineering will increase and 77% believe system engineering skills will increase

About the study

For the *Future of Manufacturing* report, Autodesk and ASME conducted research in three phases, including a literature review, in-depth phone interviews with 30 thought leaders, and a survey with 324 respondents from the U.S., Canada, and UK. Respondents were chosen from industry based on their involvement in manufacturing physical, discrete, or mechanical products and from academia based on their instruction of mechanical or manufacturing engineering or CNC machining.

Additional resources

For Industry 4.0 to succeed, manufacturing education must transform
Future of Work campaign landing page

Media Contacts:

Drew Esposito, drew.esposito@autodesk.com

Monica Shovlin (for ASME), monica@mcshovlin.com