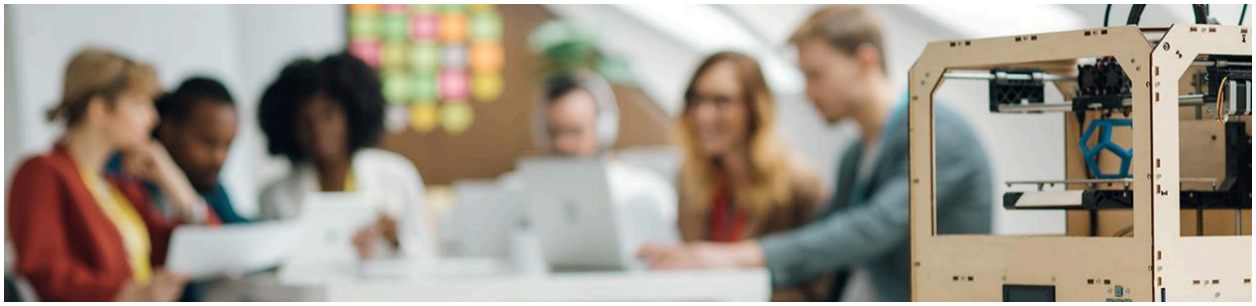

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

Infusing Advanced Manufacturing in Engineering Education

Virtual Workshop on February 24 & 25, 2022

Presented by the National Academy of Engineering (NAE) and the National Material and Manufacturing Board (NMMB)

Study Co-Chairs: **Maxine L. Savitz** and **Robert F. Sproull**

Learn more about our work and sign up for updates at

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Innovations in advanced manufacturing play a critical role in supporting the U.S. economy and national security, and it is important to prepare future engineers to exploit advanced manufacturing technologies in manufacturing. Please join the National Academies for a virtual workshop on **February 24-25, 2022** to discuss advanced manufacturing techniques for the defense industry and to explore how undergraduate engineering curricula can better develop advanced manufacturing capabilities in the workforce.

During the workshop, invited speakers from academia, industry, and federal agencies will discuss the treatment of advanced manufacturing technologies in undergraduate engineering education, educational innovations, and new ideas to prepare students to enter the workforce with knowledge and skills ready to apply in the field.

More information about this study is available at:
https://www.nationalacademies.org/our-work/strengthening-the-talent-for-national-defense-infusing-advanced-manufacturing-in-engineering-education-through-capstone-design-courses

Register to attend at https://manufacturing-education.eventbrite.com

Click here for Zoom Connection information

Day 1 February 24, 2022		
11:00 am ET **8:00 am PT**	**Welcome & Introduction to the workshop:** **John L. Anderson**, President, National Academy of Engineering	10 min
11:10 am ET **8:10 am PT**	**Remarks from Sponsor:** **A. Adele Ratcliff**, Director, Industrial Base Analysis and Sustainment (IBAS) Program at U.S. Department of Defense	15 min
11:25 am ET **8:25 am PT**	**Keynote:** **Kyle Squires**, Dean of the Ira A. Fulton Schools of Engineering**,** Arizona State University	30 min
Session 1: Government/Industry/Academia Collaborations		
11:55 am ET **8:55 am PT**	Moderators: Thomas R. Kurfess and Maxine Savitz	5 min
12:00 am ET **9:00 am PT**	**Jennifer Pilat**, MxD	10 min
12:10 pm ET **9:10 am PT**	**John A. Hopkins**, IACMI	10 min
12:20 pm ET **9:20 am PT**	**Pravina Raghavan**, National Institute of Standards and Technology	10 min
12:30 pm ET **9:30 am PT**	**Jose Zayas-Castro**, National Science Foundation	10 min
12:40 pm ET **9:40 am PT**	**Session 1 Discussion**	40 min
1:20 pm ET **10:20 am PT**	BREAK	25 min
Session 2: Growing Advanced Manufacturing in Industry		
1:45 pm ET **10:45 am PT**	Moderators: Don Kinard and Keith Hargrove	5 min
1:50 pm ET **10:50 am PT**	**Michael Sarpu**, Lockheed Martin	10 min
2:00 pm ET **11:00 am PT**	**Michael Packer**, Manufacturing Leadership Council	10 min
2:10 pm ET **11:10 am PT**	**William E. Bigot**, Ascent Aerospace	10 min
2:20 pm ET **11:20 am PT**	**Tracee Gilbert**, System Innovation	10 min
2:30 pm ET **11:30 am PT**	**Session 2 Discussion**	40 min

3:10 pm ET **12:10 pm PT**	**Day 1 Concluding Remarks and Day 2 Agenda** Study Co-Chairs: Maxine L. Savitz and Robert F. Sproull	10 min
3:30 pm ET **12:30 pm PT**	**Workshop Day 1 Adjourn**	10 min

Day 2 **February 25, 2022**		
11:00 am ET **8:00 am PT**	Welcome, Introduction, and Recap to the workshop Study Co-Chairs: Maxine L. Savitz and Robert F. Sproull	10 min
Session 3: Undergraduate Education in Manufacturing		
11:10 am ET **8:10 am PT**	Moderators: Sundar Krishnamurty, Chi Okwudire, and David Parekh	5 min
11:15 am ET **8:15 am PT**	**Amy Fleischer**, California Polytechnic State University	10 min
11:25 pm ET **8:25 am PT**	**Guillermo Aguilar**, Texas A&M University	10 min
11:35 pm ET **8:35 am PT**	**Susannah Howe**, Smith College	10 min
11:45 pm ET **8:45 am PT**	**Christopher Saldana**, Georgia Tech	10 min
11:55 pm ET **8:55 am PT**	**Session 3 Discussion**	40 min
12:35 pm ET **9:35 am PT**	BREAK	35 min
Session 4: Coalition, Innovation, and Steps Forward		
1:10 pm ET **10:10 am PT**	Moderators: Kathryn Jablokow, Chi Okwudire, and Bob Sproull	5 min
1:15 pm ET **10:15 am PT**	**Topic 1: Academic Innovations**	30 min
1:45 pm ET **10:45 am PT**	**Topic 2: Employer Innovations**	30 min
2:15 pm ET **11:15 am PT**	**Topic 3: Practicums of all sorts**	30 min
2:45 pm ET **11:45 am PT**	**Topic 4: Future Directions**	30 min
3:15 pm ET **12:15 am PT**	**Workshop Concluding Remarks** Alton D. Romig, Jr., Executive Officer, National Academy of Engineering	15 min

3:30 pm ET **12:30 pm PT**	**Adjourn Workshop**	

To attend the workshop:

Register to attend at https://manufacturing-education.eventbrite.com

Webcast:

Sessions 1-3 will be streamed live (all day February 24 and 25). Closed captions will be available. A link to the live stream can be found on the NASEM website: https://www.nationalacademies.org/event/02-24-2022/workshop-infusing-advanced-manufacturing-in-engineering-education

In Sessions 1-3, you may pass questions to the session moderator using Slido:

- Use your browser to connect to Sli.do: https://www.sli.do/ with access code **#AMEE2022** to enter a question. A short video (https://youtu.be/qWwbuqNJaw8) explains how to enter questions.
- You may vote on the questions as well. Questions with more favorable votes may be given preference.
- If we do not have time to answer your question, you may send it to amee@nas.edu after the event.

To facilitate discussion, Session 4 will use a different format than sessions 1-3. If you wish to engage in discussion, you may join a Zoom session during the break between sessions 3 and 4 on February 25. A link will be provided at the end of session 3.

- When in the Zoom session, please mute your line unless you are speaking. If you are logged on from a phone, please note mute is *6; unmute by entering *6 again.
- If you wish to make a comment or ask a question, use the Zoom feature to "raise your hand." The "Reactions" menu located along the bottom of your screen includes this option. The moderator will indicate when it's your turn to talk; please try to be unmuted, ready to talk. After speaking, please lower your hand.
- If you are facing a low bandwidth/unstable internet, it is helpful to turn off your video so your audio can be clear.
- When using Zoom's chat feature, please note you can send messages to all zoom participants (default) or to each individual privately.

Program for Session 4:

After an introduction to the session, the session host will place you in a breakout room (selected at random) to discuss four topics. Each breakout room will change topics at 30-minute intervals as the topic moderators rotate through the rooms; the order of topics will be different for different rooms. Attendees will stay in their assigned room as moderators move from room to room. At the discretion of the room's moderator, you may raise questions or comments outside the assigned topic area. The questions below are intended to stimulate discussion, not to require answers.

Topic 1: Academic Innovations

- Which advanced manufacturing topics/technologies should be taught as part of undergraduate engineering education? (vs. on the job)
- How might we attract more undergraduates to manufacturing? Why aren't they attracted now?
- How might we change the perceptions of students (including high school) and faculty about manufacturing?
- How do students learn about advanced manufacturing opportunities? How might we leverage these opportunities to educate and draw them in?
- Many engineering programs are already crammed with required courses: How can new opportunities for advanced manufacturing be accommodated?
- What innovations would you like to bring into your manufacturing curriculum, but have not been able to realize? What are the hindrances?

Topic 2: Employer Innovations

- What are the most effective ways for employers (of all sizes) to engage with undergraduate engineering programs in advanced manufacturing? What are the hindrances?
- How might we incentivize the defense industrial base to engage meaningfully with undergraduate engineering programs and SMMs to strengthen manufacturing talent?
- Which is more important for advanced manufacturing: A broad (portable) education program or specialized training programs? How do we make training programs applicable across the industry?
- In what ways have you tried to attract the best students into careers in advanced manufacturing? What have you found to be most effective? What has not been successful?
- If you were given the opportunity to craft the ideal undergraduate engineering curriculum in advanced manufacturing, what features would you include (e.g., course in X, experience in Y)? Which topics would you want to upskill new hires in yourself?

Topic 3: Practicums of all sorts…

- What practical experience should a beginning engineer have? What is best for the engineer? For the employer? What balance between hands-on and "principles" instruction do employers seek?
- Capstone and project courses are often lauded as ways to erase the "silos" in conventional undergraduate engineering education and to nurture management talent. Is this true?
- How can capstone and project courses provide manufacturing experience?
- What form of industrial collaboration or sponsorship is best for university practicums?
- Is it essential for students to have experience with the latest manufacturing technologies and equipment? If so, what are good ways to share the cost and care of equipment?
- What "best practices" are emerging in preparing talent for the most advanced factories today?

Topic 4: Future Directions

- How will education and training need to change to serve new manufacturing needs?
- What "best practices" are emerging in preparing talent for the most advanced factories today?
- What are the implications of increasingly digital product specifications (e.g., to factory technicians; to "machine tool" developers)?
- What digital knowledge and skills will be needed for what roles?
- To what extent can training for factory machines and operations become remote? What are the roles of AI, virtual reality, simulation, etc., in education and training? What about table-top versions of factory machines?
- How will credentials change? What are the opportunities and implications for "stackable" or "portable" credentials?

If you have a question or comment that was not addressed in the session, please feel free to contact the study committee via email at amee@nas.edu

Technical Support: For technical support during the workshop, contact Moises Ramirez at mramirez@nas.edu or 202 528-5757 (Cell).

The full zoom information is listed below.

Breakout rooms will not open until 12:55 pm ET/9:55 am PT

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