



The Partnership for Achieving Construction Excellence

The 29th Annual PACE Roundtable

Building Together



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November 10-11, 2020

Department of Architectural Engineering
The Pennsylvania State University

Dear Friends of PACE,

We welcome you to the 2020-2021 PACE Roundtable. The fact that we are holding our first virtual Roundtable speaks to the current environment and context of our discussions. The Research Roundtable is structured to include two break-out sessions in which critical industry issues will be discussed, intermingled with a panel discussion and an presentations session for engaging directly between students and industry.

Keynote Speaker: Dr. Rebecca Napolitano will present her research into digital twins and the opportunities for using them in novel contexts to understand building performance.

Break-Out 1 & 2: Attendees will break into groups that examine specific topics in:
1) Integration, 2) Applied Technology, 3) Workforce, and
4) Data & Digitalization.

Research Topics: Attendees will break into small groups, coupling industry members with students to allow the students to explore the ways they can capture at least one research topic for consideration.

Panel Discussion: Student panel discussing how Covid-19 look inside and outside the classroom

The main discussion topics, identified through The PACE Roundtable, are:

	A. Integration	B. Applied Technology	C. Workforce	D. Data and Digitalization
Round 1	Session 1A: Changing approaches to collaboration and integrated design	Session 1B: Human-Robot Collaboration at Construction site	Session 1C: Women in construction leadership	Session 1D: Digital Twin, a revolution or path to digitalization?
Round 2	Session 2A: Field adoption of lean methods	Session 2B: VR/AR simulations for training workforce	Session 2C: COVID 19 and Labor Challenges in Construction	Session 2D: How can technology help with pandemic-driven changes to design and construction

After the Roundtable, students will conduct research on the topics raised during the discussion and present their results at our PACE Research Seminar and Awards Banquet. Please plan on attending this important event!

Sincerely,

A handwritten signature in blue ink, reading "Robert M. Leicht". The signature is fluid and cursive, with the first name "Robert" and last name "Leicht" clearly legible.

Robert Leicht
Associate Professor of Architectural Engineering
Director, the Partnership for Achieving Construction Excellence

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Agenda

Wednesday, November 11, 2020

Link: https://gather.town/app/1iJv7zdsBn2kpxV4/PACE_Roundtable

- 8:30 AM Welcome and State of the AE Department
Zoom link: <https://psu.zoom.us/j/97650570830>
- 8:45 AM Speaker: Rebecca Napolitano,
Assistant Professor, Penn State Architectural Engineering
Digital Twins for Structural Health Monitoring
- 9:45 AM Session 1:
- 1A: Changing approaches to collaboration and integrated design
Zoom link: <https://psu.zoom.us/j/93932429625>
 - 1-B: Human-Robot Collaboration on Construction Sites
Zoom link: <https://psu.zoom.us/j/95177279895>
 - 1-C: Women in Construction Leadership
Zoom: <https://psu.zoom.us/j/94147594815>
 - 1-D: Digital Twin – is it a revolution or just another step toward digitalization?
Zoom: <https://psu.zoom.us/j/92045037706>
- 10:45 AM Break: https://gather.town/app/1iJv7zdsBn2kpxV4/PACE_Roundtable
- 11:15 AM Panel: The “student experience” during Covid-19
Zoom: <https://psu.zoom.us/j/97650570830>
- Facilitator:** Robert Leicht
Panelists: Jacob Maines, Molly Sizemore, Nicole Slavic, Nicholas Adams
- Noon Lunch: https://gather.town/app/1iJv7zdsBn2kpxV4/PACE_Roundtable
- 1:00 PM Session 2:
- 1A: Field adoption of lean methods
Zoom link: <https://psu.zoom.us/j/93932429625>
 - 1-B: The use of Augmented and Virtual Reality for workforce training
Zoom link: <https://psu.zoom.us/j/95177279895>
 - 1-C: COVID-19 and Labor Challenges in Construction
Zoom: <https://psu.zoom.us/j/94147594815>

1-D: How can technology help with pandemic driven changes to design and construction

Zoom: <https://psu.zoom.us/j/92045037706>

2:00 PM Break: https://gather.town/app/1iJv7zdsBn2kpxV4/PACE_Roundtable

2:30 PM Student / Industry Research Discussions
Zoom: <https://psu.zoom.us/j/97650570830>

3:30 PM Closing remarks and adjourn

4:00 PM Adjourn

Keynote Presenter



**REBECCA NAPOLITANO, PhD
ASSISTANT PROFESSOR;
PENN STATE ARCHITECTURAL
ENGINEERING**

Rebecca Napolitano, Assistant Professor in the Architectural Engineering Department at Penn State, will be providing the Keynote presentation at the Fall PACE Roundtable. Rebecca's research focus is at the intersection of civil engineering, computer science, and historic preservation as it pertains to diagnostics of existing infrastructure. She studies how neural networks, machine learning, physics-based modeling, and cyber physical systems can be used to adapt existing structures in a world moving more and more towards green infrastructure and smart cities. Her current research initiatives include the use of unmanned aerial vehicles for infrastructure

inspection, nondestructive evaluation, finite-distinct element modeling for simulating system interactions, and augmented reality. She has received a variety of awards for her research, teaching, and mentoring including Female Innovator of the Year, Woman of Innovation, the School of Engineering and Applied Science at Princeton Award for Excellence, and the Graduate School of Princeton University Teaching award. We are very excited that she joined our department and will be sharing her research on Digital Twins!

Session 1-A: Changing approaches to collaboration and integrated design

Zoom Link: <https://psu.zoom.us/j/93932429625>

Track: *Integration*

Facilitator: *Nathan Brown and Robert Leicht*

Probing Questions:

- What changes have you seen in how people are collaborating since the pandemic?
- What benefits does this offer?
- How has this made some collaborations more difficult?
- What has improved the effectiveness of collaborations when working remotely?
- How does the timing of remote versus in-person collaboration affect the development of collaborative relationships?
- How do you see this affecting future collaborations?

Notes:

Session 1-B: Human-Robot Collaboration at the Construction site

Zoom Link: <https://psu.zoom.us/j/95177279895>

Track: *Applied Technology*

Facilitator: *Houtan Jebelli*

Probing Questions:

- What are the most prominent areas in which robots can be helpful the most? What types of robot are poised for those areas/tasks?
- What are the primary challenges for construction industry to adopt robots at the job sites? (from societal, economical, legal, technological, and educational perspectives)
- What are the safety concerns for worker-robot collaboration in construction industry?
- What are the promising and practical communication techniques for enhancing collaboration between workers and robots?
- How can the presence and supervision of human workers facilitate the implementation of construction robots in the field?
- How robotic technology can help with the pandemic management and mitigation at construction job sites?
- How do you envision the future of construction in the next 10-15 years?

Notes:

Session 1-C: Women in construction leadership

Zoom Link: <https://psu.zoom.us/j/94147594815>

Track: *Technology*

Facilitator: *Somayeh Asadi, Elnaz Asadian*

Probing Questions:

- How can we create more successful woman leaders in the construction industry?
- What Issues and challenges do women face in the construction industry? What about the opportunities provided for them?
- What role do women play in the construction teams? (Also ask about the impact of having women leaders)
- How we can better use diversity to improve our construction project teams?
- What influences professional women's career advancement in construction?
- What barriers prevent women's engagement in the construction job sites? (barriers for career development of women)
- What changes seem necessary to better support women engagement in the construction industry?
- How we can create gender equality in the construction industry? (professional associations, labor unions, and universities)
- What factors might lead to the most job satisfaction for women? How they can be provided for them?

Notes:

Session 1-D: Digital Twin, a revolution or path to digitalization?

Zoom Link: <https://psu.zoom.us/j/92045037706>

Track: *Data & Digitalization*

Facilitator: *Rebecca Napolitano*

Probing Questions:

- What are you currently seeing on projects or in client requests related to digital twin?
- What benefits from digital twin have you seen?
- What are most company's sentiments about digital twin?
- Where can a digital twin have the biggest impact on a project?
- How has the presence of monitoring, simulation, BIM, and digital twins changed in the past 5 years?
 - What do you predict will happen in the next 5 to 10 years?
- What is the biggest challenge holding digital twins back in construction right now?
- What is one piece of practical advice you would give to someone starting out in construction regarding digital twins and the technical advancements yet to come?
- Students—if we had more classes in this topic, what would encourage you to take them as electives?

Notes:

Session 2-A Field adoption of lean methods

Zoom Link: <https://psu.zoom.us/j/93932429625>

Track: *Integration*

Facilitators: *Robert Leicht*

Probing Questions:

- What lean methods are you most familiar with?
- What methods are common in the field right now?
- Which methods would be valuable to support field efforts?
- What are the barriers to lean method adoption in the field?
- What is most needed to improve and support greater use of lean methods?
- How should project management enable or support greater use of lean?
- How does this topic parallel challenges seen with the Pandemic?
- How could the pandemic serve as an opportunity to increase the emphasis of lean in field operations?

Notes:

Session 2-B: VR/AR simulations for training workforce

Zoom Link: <https://psu.zoom.us/j/95177279895>

Track: *Applied Technology*

Facilitator: *Houtan Jebelli, Mahmoud Habibnezhad*

Probing Questions:

- What are the areas of construction safety training that require advance visualization, simulation, and interaction? (I.e., hazards recognition and identification, safety training and education, safety instruction and inspection)
- What are the barriers to adopting VR/AR technologies for safety practices at construction sites?
- What is the most convenient method to obtain training under immersive platforms? (e.g., mobile VR/AR, wireless headsets on sites, web-VR, etc.)
- How should we evaluate trainee's performance within immersive training platforms? (e.g., questionnaires, exams, interviews, etc.)
- What are the potentials of augmented reality for evaluating and augmenting in-situ worker performance?
- How can we establish a unified training platform across the industry with the capacity to provide both immersive and regular training programs for the workers and managers?

Notes:

Session 2-C: COVID 19 and Labor Challenges in Construction

Zoom Link: <https://psu.zoom.us/j/94147594815>

Track: *Workforce*

Facilitator: *Somayeh Asadi*

Probing Questions:

- What changes you have seen in construction labor since the start of the pandemic?
- What workforce shortages have you faced?
- Were there any specific challenges by trade or discipline?
- How can construction companies deal with labor instability?
- How have you addressed safety measures in projects during COVID?
- What types of supply chain challenges did you encounter?
- How have you managed your supply chain and deliveries?
- What strategies have you found that have helped?
- What strategies or tactics have you found to be ineffective?

Notes:

Session 2-D: How can technology help with pandemic-driven changes to design and construction

Zoom Link: <https://psu.zoom.us/j/92045037706>

Track: *Data & Digitalization*

Facilitator: *Yuqing Hu, Nathan Brown*

Probing Questions:

- What changes are you seeing from the pandemic on your work processes?
- What impacts does this have on your work and your projects?
- How has technology influenced this change?
- What technologies are proving extremely helpful or beneficial?
- How has this changed the adoption of technology within your firms and projects?
- How do you picture the use of technology changing as the pandemic subsides?
- Which of these technology changes do you see being sustained?
- What about those changes or technologies makes them more sustainable?
- What can we learn from this for future technology changes?

Notes:

AE Faculty

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Post-Doctoral Scholars & Research Fellow

<u>Researcher</u>	<u>Role & Faculty Advisor</u>	<u>Research Area</u>
Mahmoud Habibnezhad	Post Doc –Jebelli	Immersive Visualization and Construction Robotics

Graduate Students

<u>Student</u>	<u>Faculty Advisor (Co-Advisor)</u>	<u>Research Topic</u>
Baraa Alkhatatbeh	Somayeh Asadi	Improving daylighting and energy efficiency
Elnaz Asadian	Robert Leicht	Growing trade partner use of lean construction methods
Sagata Bhawani	John Messner & Robert Leicht	Development of Lean Construction Ontology to support Lean Construction Principles in AEC Projects
Stephanie Bunt	Nathan Brown	Supporting collaborative teams in integrated design
Zhouqian Jiang	John Messner	Evaluating the Use of Photogrammetry-Based 3D Reality Modeling for Construction Progress Monitoring
Ali Karji	John Messner	Smart Model-Centric Life Cycle Approach to Collaborative Execution of Capital Projects
Yumna Kurdi	Somayeh Asadi & Houtan Jebelli	A co-simulation and optimization of PV system design, building geometry and layout at the urban scale
Yizhi Liu	Houtan Jebelli	Human-robot collaboration for construction

Graduate Students

<u>Student</u>	<u>Faculty Advisor (Co-Advisor)</u>	<u>Research Topic</u>
Austin McClymonds	Somayeh Asadi	BIM to Robot information workflow
Milad Mohammadi	Somayeh Asadi & Houtan Jebelli	Smart Home Energy Management Based on Learning Occupants' Preferences
Morteza Nazari-Heris	Somayeh Asadi	A cyber-physical-based self-scheduling model for smart parking integrated with renewable energy
Shahrad Shakerian	Houtan Jebelli	Facilities Predictive Maintenance using Embedded Sensors and Machine Learning Algorithms
Shayan Shayesteh	Houtan Jebelli	Virtual and Augmented Reality for Construction Safety Training
Chenxi Shi	Robert Leicht (visiting PhD)	Organizing subcontractor designs using a transaction cost economics and resource-based framework
Shuyuan Wang	Yuqing Hu	Artificial Intelligence applications for smart buildings
Xiaohui Wang	John Messner	Impact of Virtual Reality Training for Electrical Workers on Energy Storage and Microgrid System
Qin Yin	Somayeh Asadi & Esther Obonyo	Behavior-based construction safety
Chen Xia	Yuqing Hu	Digital transformation in construction from socio-technical perspective

2020 – 2021 S:PACE Officers

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Upcoming Events

29TH PACE RESEARCH SEMINAR

Date - TBD

The research seminar combines presentations of research results and timely industry speakers for a diverse audience of building industry professionals. This event is held each spring. We will have a reception and dinner on April 20, followed by a full day of presentations and events on April 21st.

PACE ADVISORY BOARD MEETING

July 2021 – Virtual

Representatives from PACE Member companies meet to discuss key issues facing the building industry and establish a research agenda for the next year. The date will be defined soon.

SENIOR THESIS PRESENTATIONS

April 12-15, 2021 – (Virtual), University Park, PA

SENIOR THESIS FINAL COMPETITION

April 30, 2021 – (Virtual), University Park, PA

PACE Contributors

Leaders

James G. Davis Construction
Penn State Office of Physical Plant
Southland Industries

Partners

ARCO Design/Build
Balfour Beatty Construction
Barton Malow Company
Clark Construction Group
Warfel Construction

Associates

Alexander Building Company	Gilbane Building Company
Baker Concrete	Grunley Construction
Benchmark Construction Company	Holder Construction
Bozzuto Construction Company	JE Dunn Construction
Clayco	McClure Company
DPR Construction	Mortenson Construction
Fujita Americas	Rosendin Electric

Donors

Burns Mechanical	Langan Engineering &
C3M Power Systems, LLC	Environmental Services
Forrester Construction Company	LS Fiore
Harkins Builders	Massaro Corporation
HESS Construction	Reynolds Construction, LLC
	Trammel Crow Company

Thank you for your support!

Industry Participant Form

Please complete this form for the student(s) within the Students / Industry Research Discussion session.

Student Name: _____ Project Name: _____

Research Topics Discussed:

Project Topics Discussed:

Student Name: _____ Project Name: _____

Research Topics Discussed:

Project Topics Discussed:

Student Name: _____ Project Name: _____

Research Topics Discussed:

Project Topics Discussed:

Student Participant Form

Please complete this form for each of the two morning research sessions that you attend.

Student Name: _____

Session #1: Title: _____

Research Ideas:

1)

2)

3)

Session #2: Title: _____

Research Ideas:

1)

2)

3)

Student Participant Form

Please complete this form during the *Students / Industry Research Discussion* you attend.

Student Name: _____

Industry Contact Name: _____

Key Feedback:

Which research topic(s) are most relevant to industry? What scope recommendations did you receive?

Suggested Resources:

What industry contacts are beneficial? Where can you find additional information?