

INNOVATION IN STRUCTURAL ENGINEERING (ISE) GRANT TEAM UPDATE

Brian Petruzzi
Andrew Sundal

- 
- **ENABLE RESEARCH TO ADVANCE TECHNICAL & CODE-RELATED DEVELOPMENT**
 - **CREATE OPPORTUNITIES FOR YOUNG PROFESSIONALS**
 - **PROVIDE GRANTS TO SEAs**
 - **GROW AWARENESS OF THE PROFESSION**
 - **ENHANCE DIVERSITY, EQUITY, AND INCLUSION**

NCSEA Foundation

**ADVANCES THE SCIENCE AND PRACTICE OF
STRUCTURAL ENGINEERING BY SUPPORTING
NCSEA, THE STATE SEAs, AND PRACTICING
STRUCTURAL ENGINEERS.**

NCSEA Foundation | Core Pillars

Guiding the adoption of technology and services that advance the profession.

Innovation



Ensuring the future profession is supportive, inclusive, and diverse.

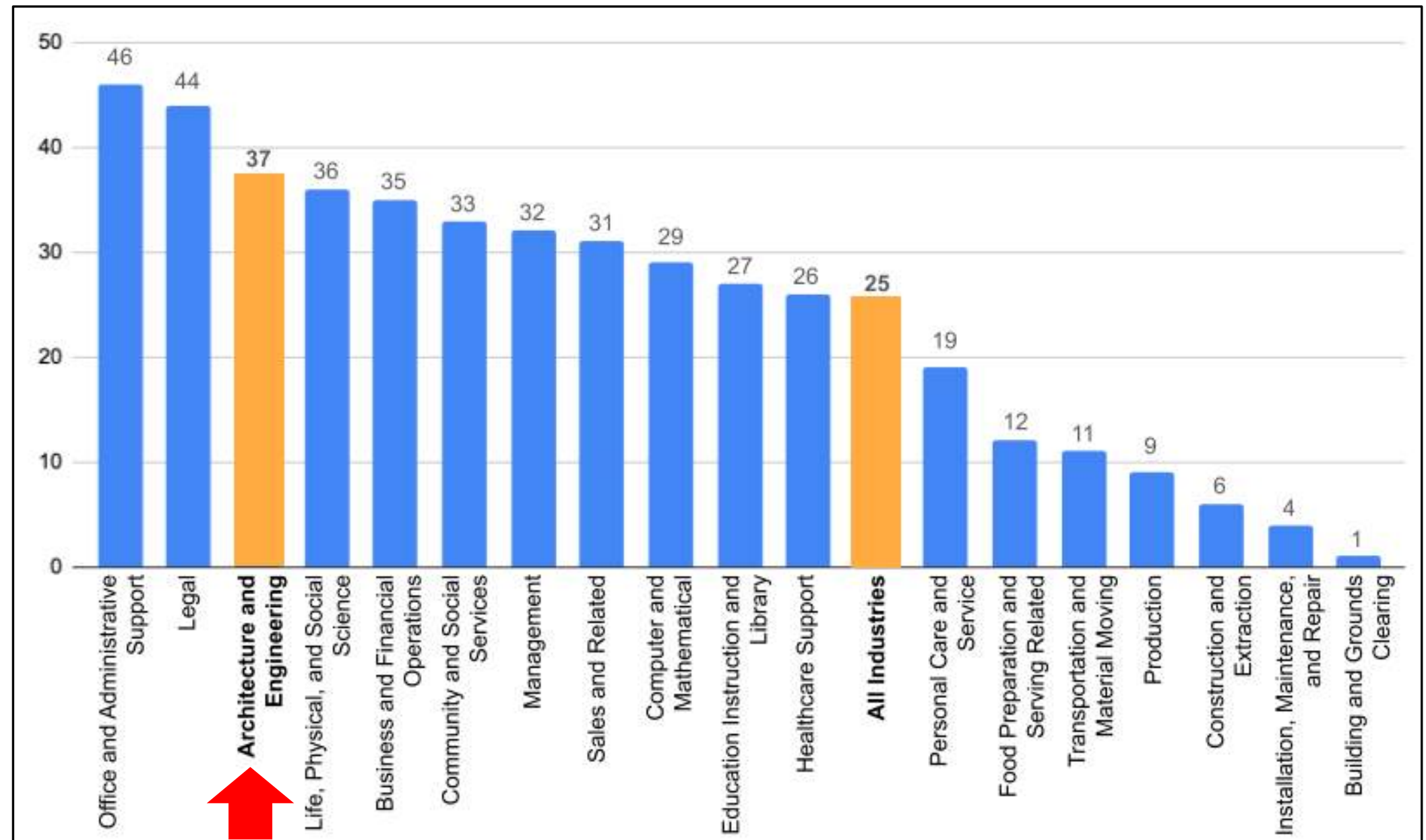
People

Advocacy

Growing awareness of the profession and its contributions to society while supporting SEAs in enhancing their local communities.

Potential to be Transformed

- Business Model
- Monetary Gain
- Codified Nature of the Profession



The share of industry employment exposed to automation by AI in the U.S. Data courtesy Goldman Sachs, 2023.

Challenges Facing the Industry

1. A Lack of **[Vision]**
2. Slow **[Adoption]**
3. **[Accuracy]** in Current AI Tools
4. Uncertainty in How Our **[Data]** Should Be Used
5. A Lack of Clarity around **[Privacy & Ethics]**



ISE Grant | Team Structure

AI Grant Team

- Responsible for Project Goals and Deliverables.
- Deliver an Industry-Shaping Roadmap.
- Roadmap will Inform Impacts and Opportunities

AI Advisory Board

- Thought Leaders in the field of AI.
- Provides Industry Knowledge and Experience.
- Quarterly Steering Meetings

2024 ISE Team Members

ISE Project Manager



John-Michael Wong

KPFF
San Francisco



Aditya Kaushik

Walter P Moore
Denver



Andrew Sundal

HGA Architects & Engineers -
Minneapolis



Ayush Singhania

Simpson Gumpertz & Heger
(SGH)
San Francisco

2024 ISE Team Members



Dave Martin

Degenkolb Engineers
Oakland



Emre Toprak

Arup
Washington D.C.



Sheng Zheng

Martin/Martin
Lakewood, CO

2024 ISE Advisory Board

ISE Project Manager



KP Reddy

Founder & CEO
Shadow Ventures



Robert Otani

Senior Principle & CTO
Thornton Tomasetti



Zak Kostura

Associate Principle
Advanced Digital Engineering
Arup



Kimon Onuma

Founder and President
Onuma, Inc

2024 ISE Advisory Board



Roark Redwood

Senior Vice President
Technical and Government Solutions
NIBS



KiSeok Jeon

VP of Digital Advisory
STV



Farahnaz Soleimani

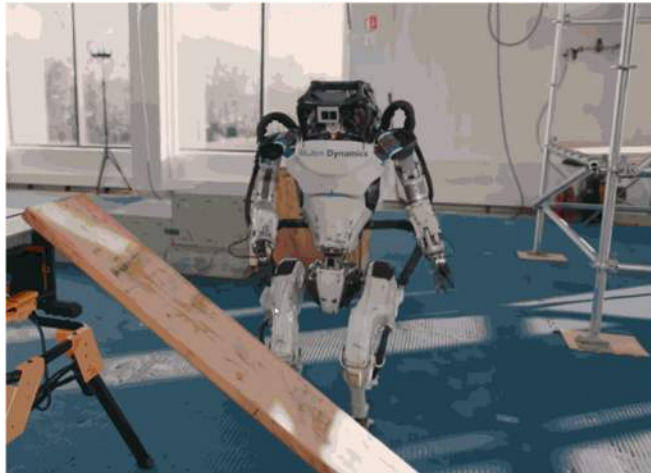
Associate Professor
Oregon State University



Strategic Planning Session Participants

AI is here now

Boston Dynamics Atlas



https://youtu.be/-e1_QhJ1EhQ?si=_xwxBvKec-q-YhyH

Canvas Drywall Robot



Building Codes (ICC, Upcodes, GPT)

NC How many drinking fountains are required if I only have an occupant load of 10?

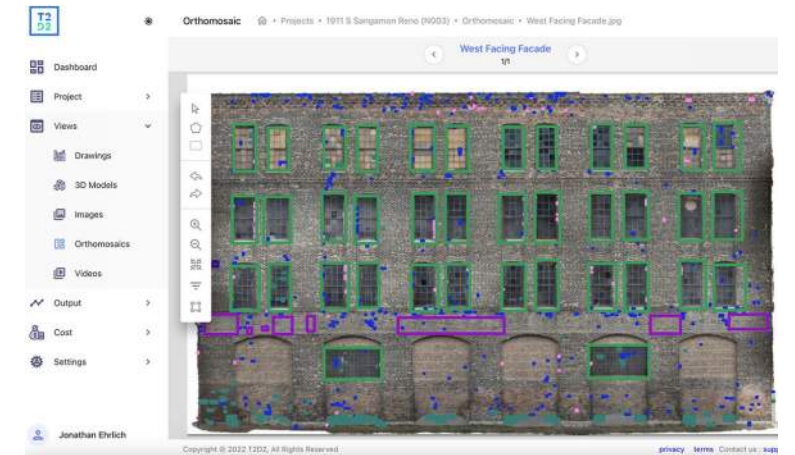
No drinking fountains are required if you have an occupant load of 10, as drinking fountains are not required for occupant loads of 15 or fewer.

PC 410.2 Small occupancies ('10) BC 2902.6 Small Occupa...

NY PC 410.2 Small Occupancies ('10)

Drinking fountains shall not be required for an occupant load of 15 or fewer.

Condition Assessment (T2D2, Aren)



AI is different -

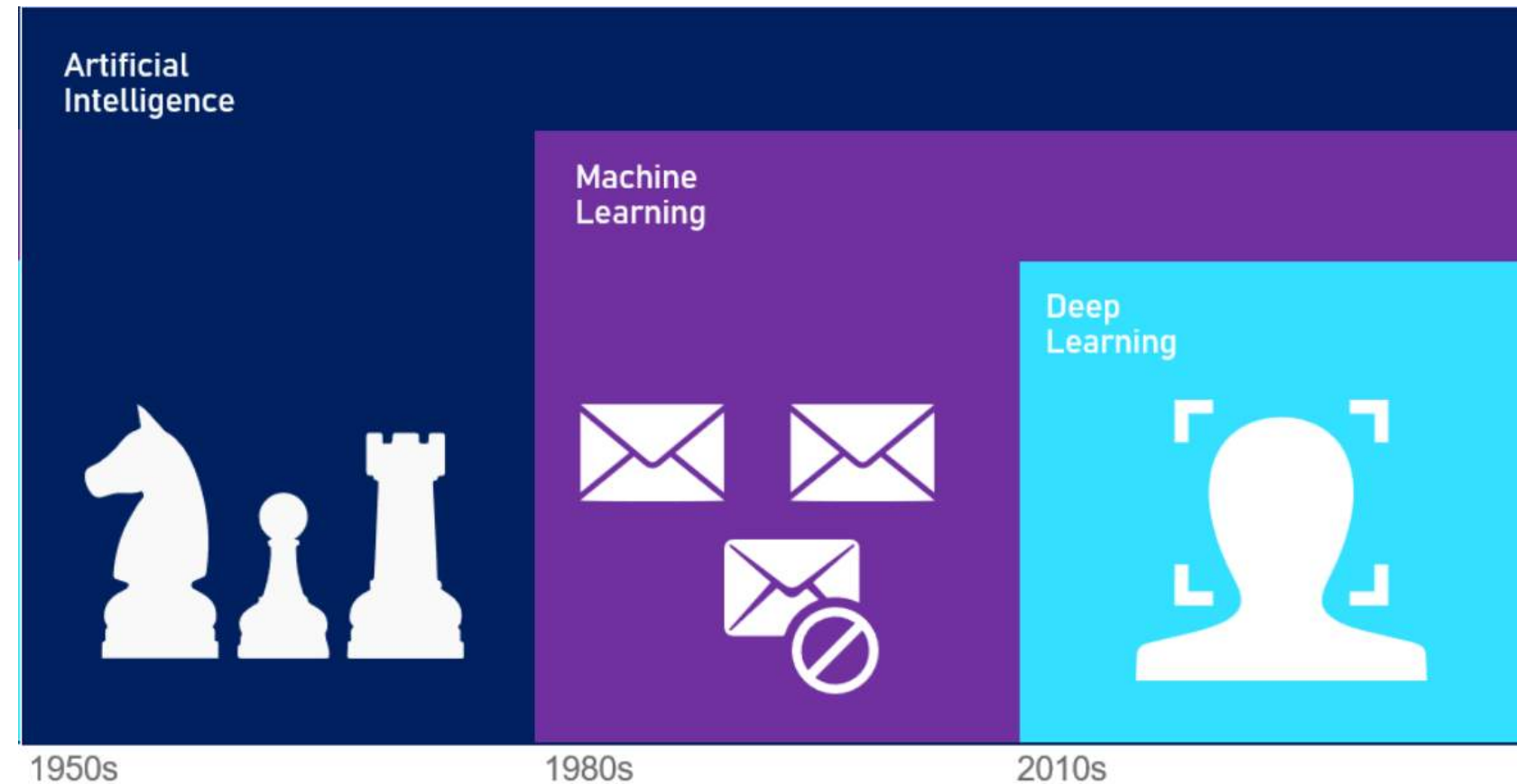
- *Not just another computer program*

Oxford English Dictionary

The theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages.

AI Uses a Lot of Data

- Training
- Context
- History
- Rules
- Access to data
- Processing time
- Model selection



More like asking people with different experience levels or background

AI will change us

“We should **stop** training radiologists now.

It's just completely obvious that within five years, **deep learning** is going to do better than radiologists.”

Geoffrey Hinton, 2016

AI Pioneer

Radiologists:

“Will AI replace radiologists?”, is the wrong question.

The right answer is:

Radiologists who use AI will **replace** radiologists who **don't.**”

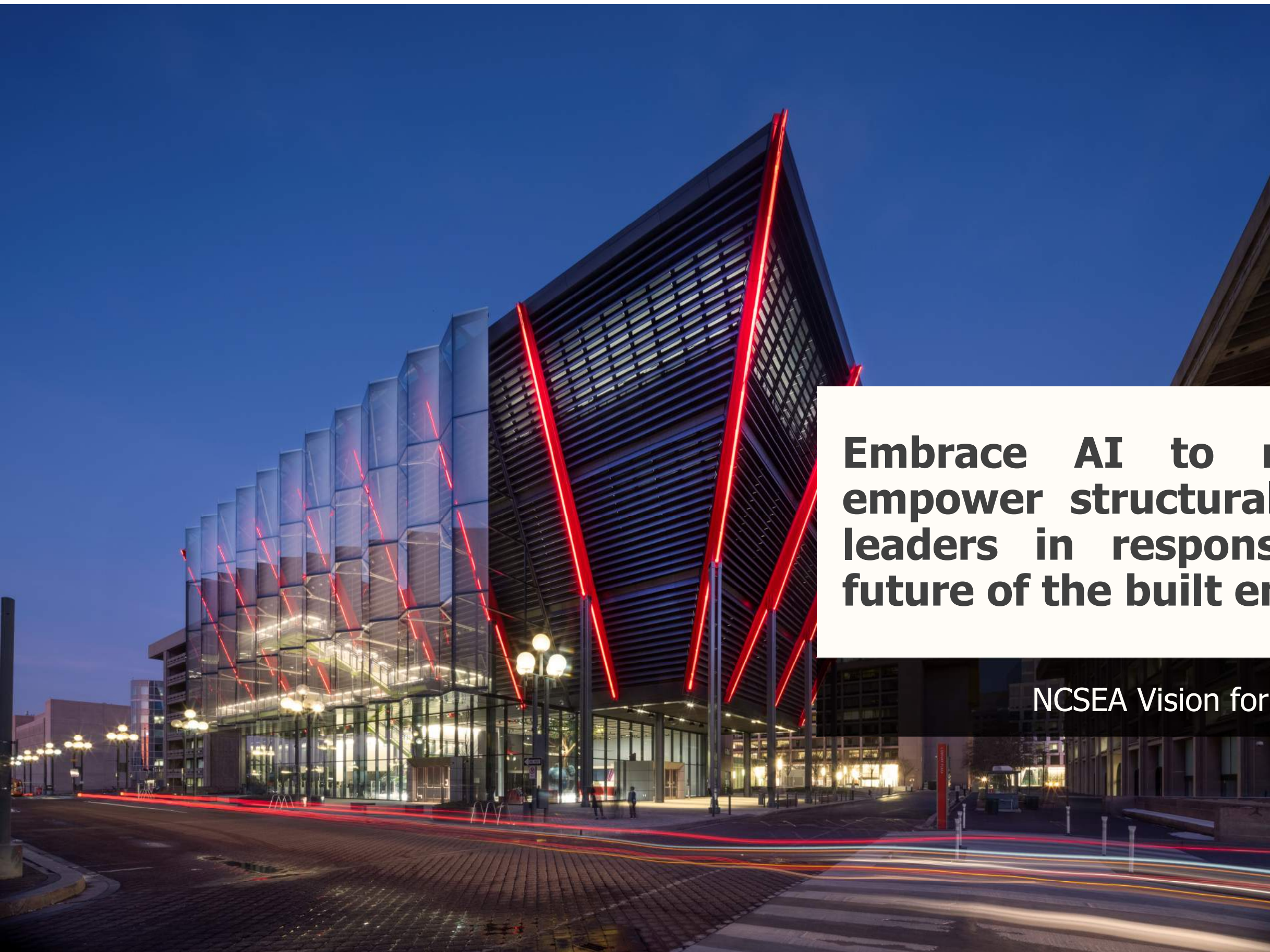
Curtis Langlotz, 2019
Professor of Radiology
Stanford University

Structural Engineers:

“Will AI replace **Structural Engineers**?”, is the wrong question.

The right answer is:

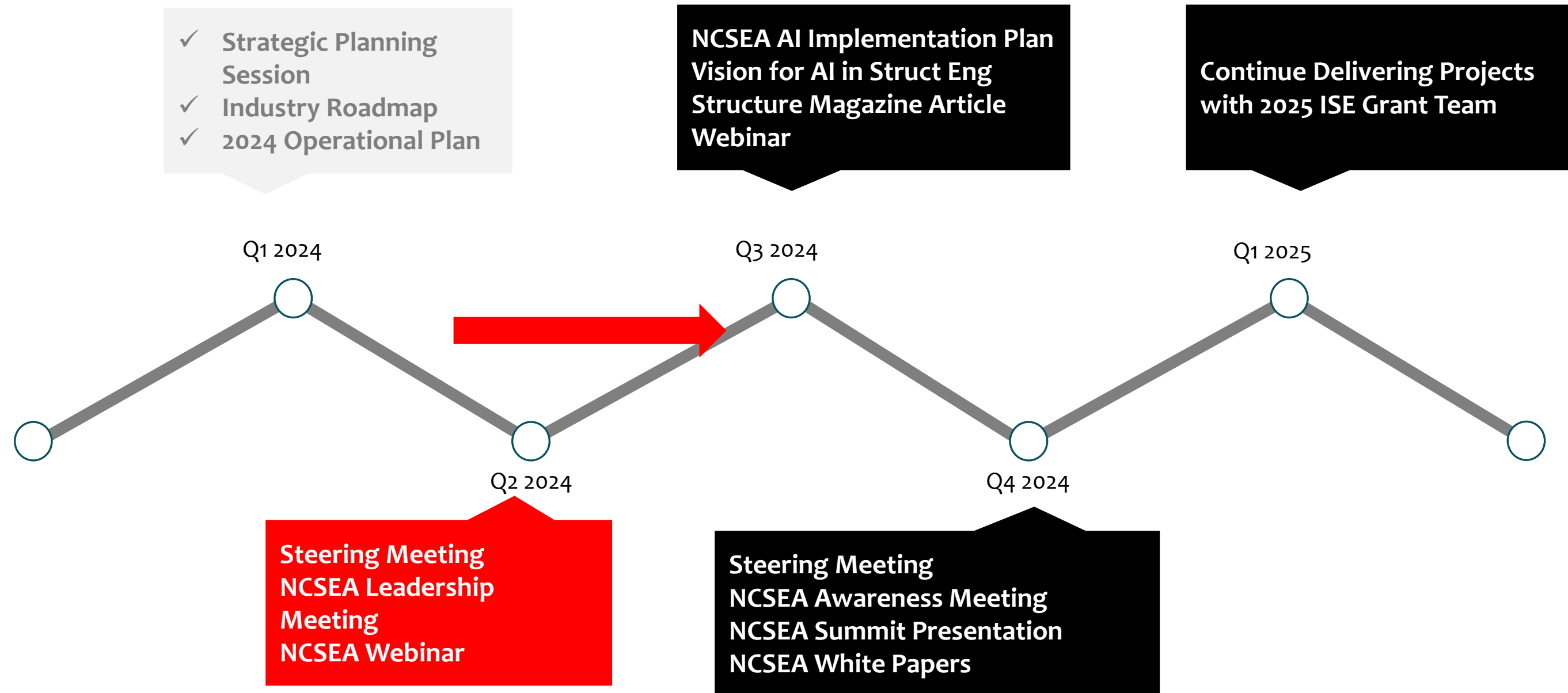
Structural Engineers who use AI will replace **Structural Engineers** who don't.”



Embrace AI to revolutionize and empower structural engineers to be leaders in responsibly shaping the future of the built environment.

NCSEA Vision for AI in Structural Engineering

NCSEA Foundation can help with AI



April STRUCTURE Magazine Article



CREATING A FOUNDATION FOR AI IN THE STRUCTURAL ENGINEERING PROFESSION

The NCSEA Foundation selected Artificial Intelligence as the topic for its inaugural Innovation in Structural Engineering (ISE) Grant.

By Brian Petrucci, PE, Emily Guglielmo, SE, PE, Christopher Carino, PE

Artificial Intelligence (AI) has the potential to revolutionize the structural engineering profession. However, several obstacles must be addressed before AI can be fully integrated into practice. These challenges include a lack of vision or roadmap for AI's impact on the industry; slow adoption of new technology; concerns about accuracy, risk, data privacy, and ethics; and the need for education and innovation. The National Council of Structural Engineers Associations (NCSEA) Foundation launched an Innovation in Structural Engineering (ISE) grant to lead the profession in embracing AI to revolutionize and empower structural engineers to be leaders in responsibly shaping the future of the built environment.

What Is Artificial Intelligence?

The concept of artificial intelligence was first described in 1955 by computer scientist John McCarthy as the theory and development of computer systems able to perform tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. In the 1980s, AI began growing into a field of study that combined computer science and robust data sets to enable problem solving. AI took off in the 2010s with the development of highly efficient computer graphic card processors and access to large data sets. However, it wasn't until the release of ChatGPT 3.5 in 2023 that AI was accessible, user-friendly, accurate, and efficient. As Stephanie Slocum wrote in her January *STRUCTURE* magazine article, "ChatGPT in Structural Engineering," "ChatGPT is the fastest-adopted tool in the Internet age," passing over 100 million users in just two months. Its impact on the field of AI has been profound, and it continues to inspire innovation and to drive advancements, including in the structural engineering profession.

[Embrace] AI to revolutionize and empower structural engineers to be leaders in responsibly shaping the future of the built environment.

Challenges Facing the Structural Engineering Profession

At a recent conference focused on the future of corporate real estate, Kay Sargent, Senior Principal at HOK, likened the current real estate environment as our industry's Kodak moment. While we all know the story of Kodak being the first to invent digital photography, she emphasized Kodak's challenges in monetizing the new technology. It wasn't in their business plan, as they incorrectly identified their product

as paper and film—not memories. While AI is already being used in many structural engineering applications, there is no vision or roadmap that articulates the potential disruptions, impacts, and opportunities that AI will have on the profession. Consequently, very few structural engineering firms understand or embrace the AI movement. According to Goldman Sachs, architecture and engineering is in the top three industries with the greatest potential for transformation. This is due to AI, given the potential monetary gain and relative ease of training AI models given the codified nature of the profession. How will structural engineers continue to provide value to building owners after AI is widely adopted in the industry? Does our profession's product change with this new technology? Developing a vision for our industry is difficult when we don't fully understand the technology but is necessary to define our future.

To address these challenges, the NCSEA Foundation has selected AI as the topic for its inaugural Innovation in Structural Engineering (ISE) Grant. The 2023-2024 ISE grant program aims to:

- Provide Education:** Provide structural engineers with information on the latest developments in AI as it relates to the profession and outline future areas of study surrounding this topic.
- Foster Innovation:** Encourage structural engineers to explore, develop, and implement innovative AI solutions that enhance the efficiency, accuracy, and longevity of structural engineering practices.
- Promote Collaboration:** Foster collaboration between structural engineers, AI experts, and other industry partners by encouraging the exchange of ideas and expertise to drive progress in the field.
- Address Industry Challenges:** Address key challenges faced by the structural engineering industry through the application of AI technologies, including ethical and legal areas.

Roadmap Development

To kick-off roadmapping efforts, members of the NCSEA Foundation Board of Directors, the AI Grant Team, and AI Advisory Board traveled to San Francisco in February for a two-day roadmapping session facilitated by .orgSource, an organization dedicated to supporting growth and innovation for industry associations and nonprofit organizations. The team spent this time thinking big and challenging the status quo. While discussions took place on current trends, challenges, and opportunities, much of the time was spent focusing on a desired future state of the profession and how advancements in technology will help us achieve



| 2024 Today | Near-Term | Longer-Term | Future →



- Learn about technology
- Establish strategy to evaluate technology
- Set goals about future client needs



- Leverage AI for working solutions (technical + project management)
- Launch pilot projects and build small successes
- Continuous learning with more experience

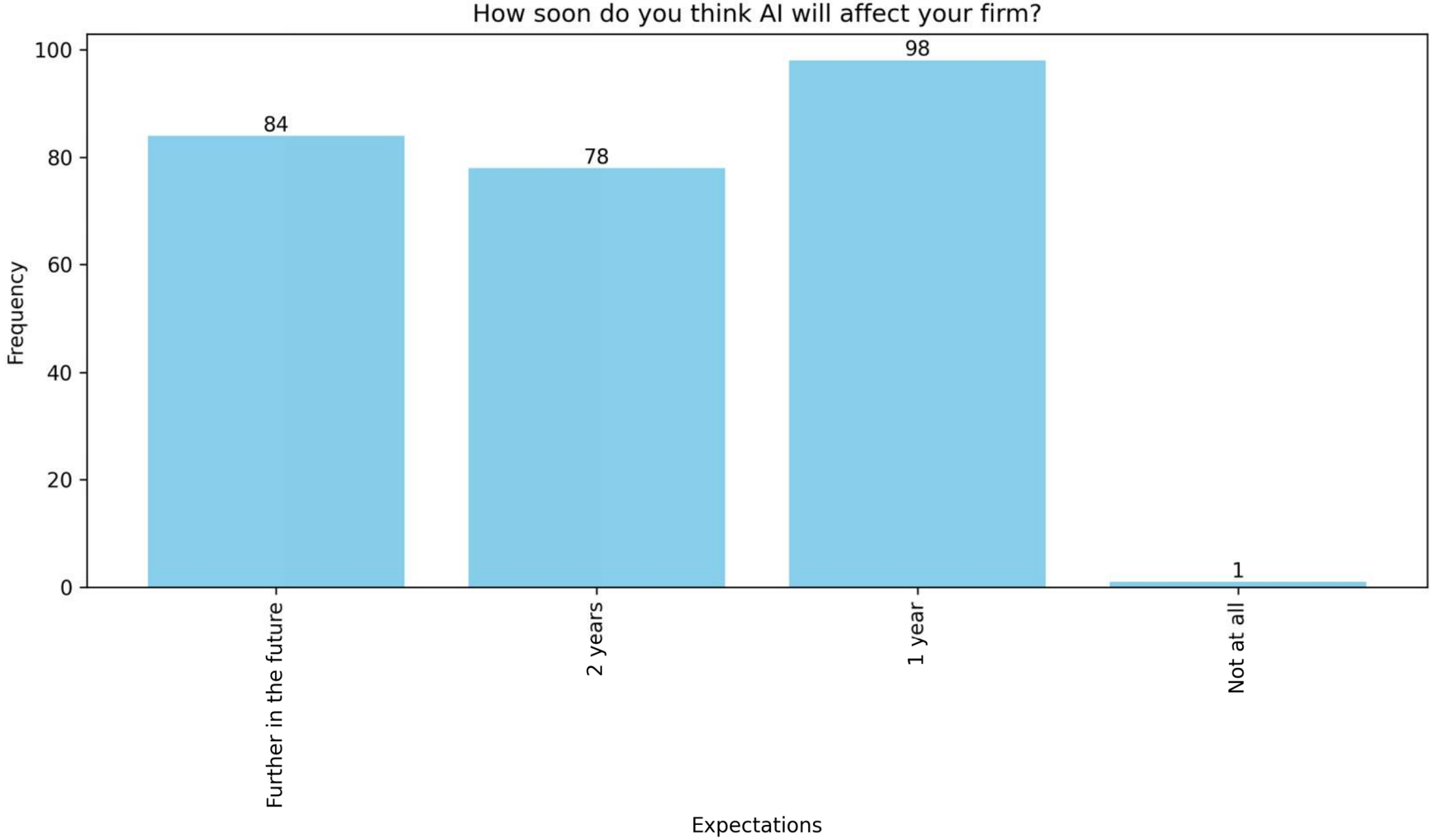


- Assess growth and success internally + externally
- Establish strategy as clients/partners also adopt AI
- Consider business strategies that best leverage AI



- Assess your value among startups/competition
- Innovate and perpetuate

NCSEA Webinar Survey Results



NCSEA Foundation's AI Initiatives support the SE Profession

ISE Team develops Roadmap for 3 Initiatives

AI Education

- Support SEs in advancing their understanding and use of AI

AI Tools & Innovation

- Provide information about AI tools, policies, and innovations that SEs can use in their work

AI Partnerships

- Pursue education and research partnerships advancing the use of AI in structural engineering

AI Education Initiative

Advisory Board recommended to start here

Policy & Guidance

- AI Policy examples
- Data security guidance
- Financial investment data
- Ethical guidance
- Legal framework

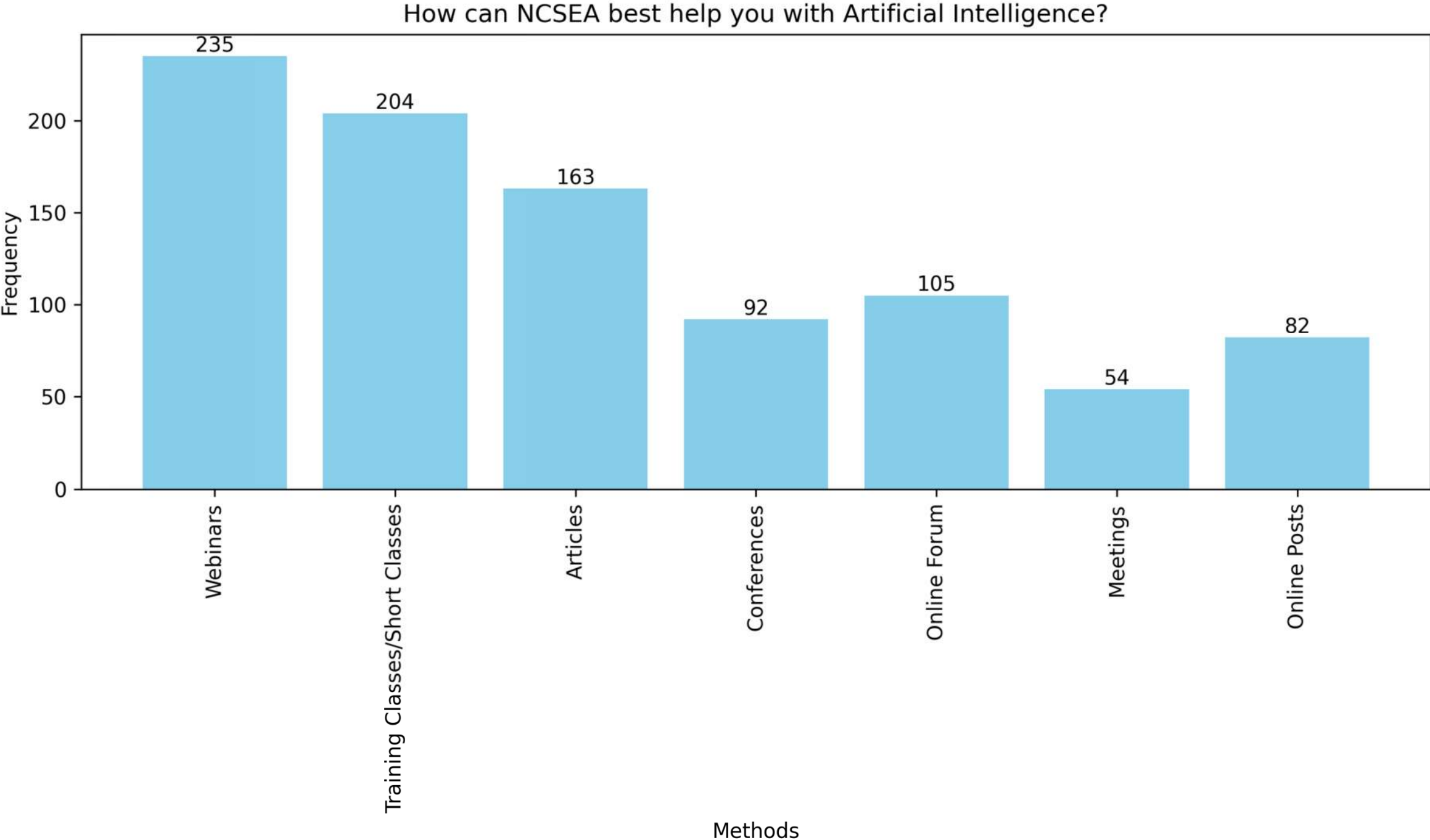
Instruction

- AI Strategy examples
- Research paper highlights
- Short courses on AI Platforms & tools

Knowledge Sharing

- Local SEA forums
- Website articles
- Podcast
- Online forums

NCSEA Webinar Survey Results



AI Tools & Innovation Initiative

ASO

Datasets

- Awareness and examples of open-source data
- Synthetic data for AI development
- Examples for ML Training

LLM, Chat, RAG

- **Make NCSEA Chatbot – SE GPT**
- Structure Magazine
- Webinars
- + more

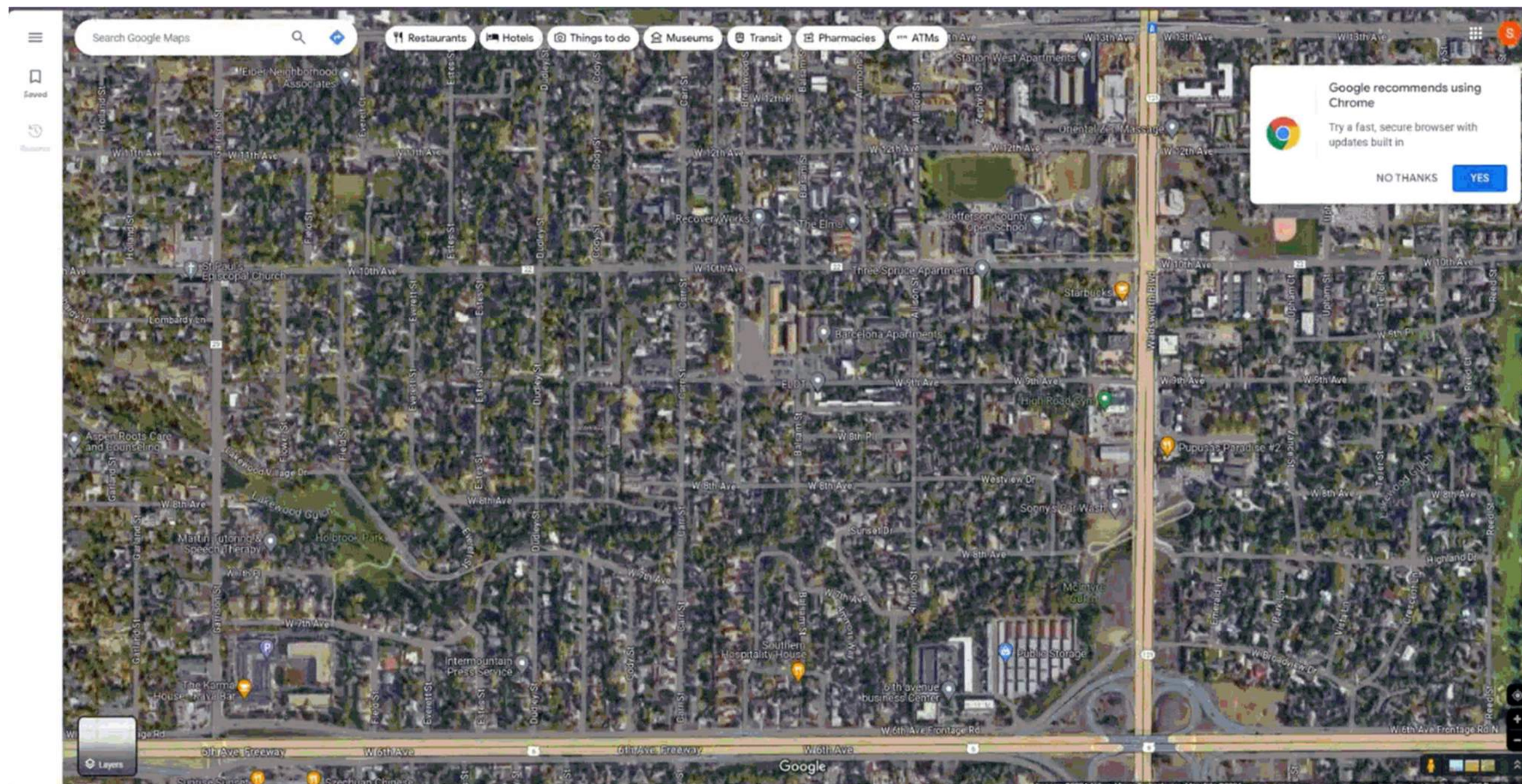
Tool Sharing

- AI/ML libraries relevant to SE workflow
- Case studies on available tools
- Example applications for SE tasks

Vendor Software

- Platform for awareness of helpful tools
- Real world examples

Sheng's Tool for Surface Roughness



Courtesy Sheng Zheng – Martin/Martin

AI Partnerships Initiative

Universities

- Student projects and research initiatives
- Platform for sharing latest research
- Industry advisor network for AI projects

AEC & SE Industry

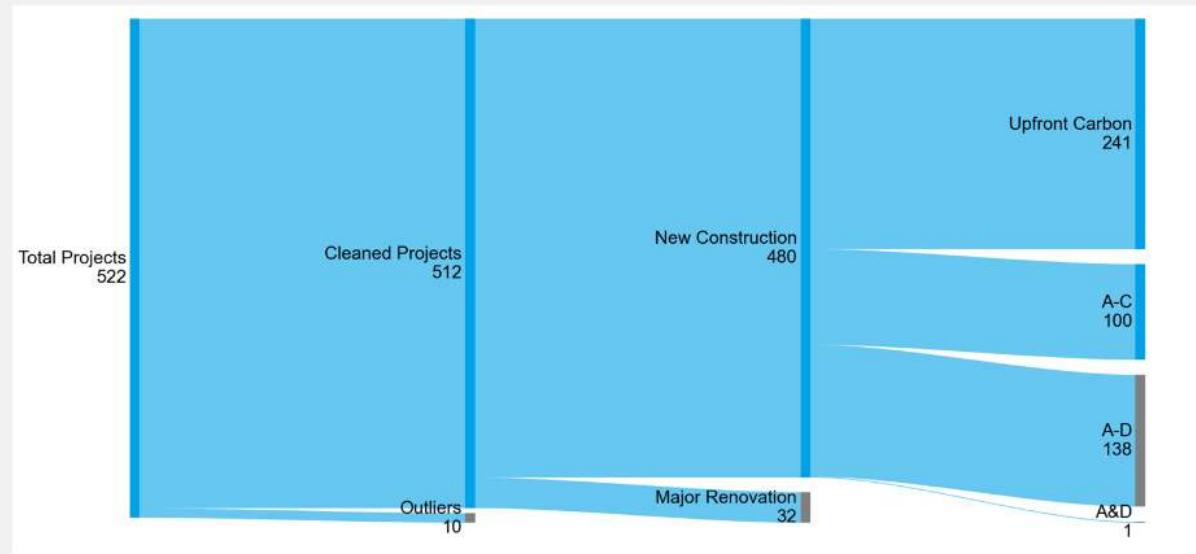
- Connect with SE 2050 data + other sustainability databases
- Platform for guest speakers on AI
- Local SEA collaboration

Events

- Hackathon
- Virtual Competitions
- Grand Challenges

Datasets

SE 2050 Database



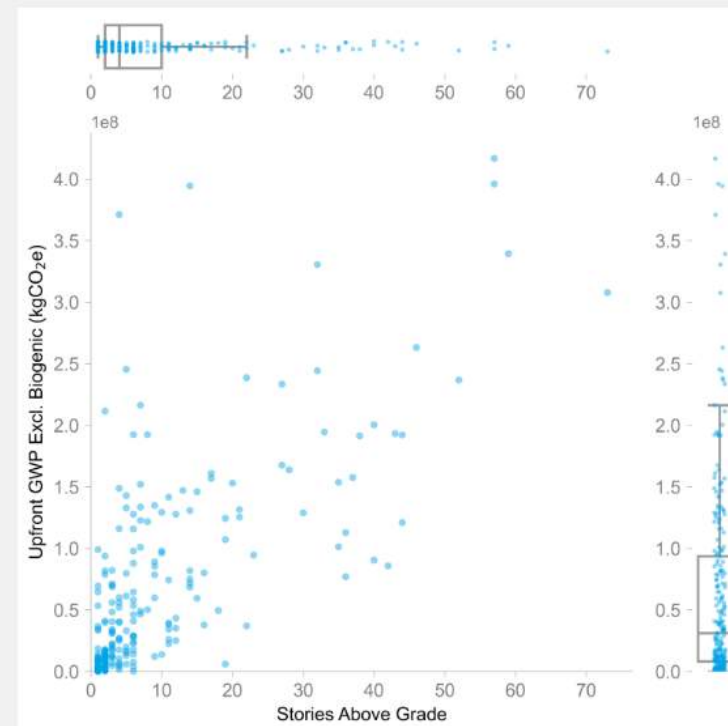
Outliers

- Projects with GWP Intensity excluding Biogenic Carbon less than 0 or greater than 5,000,000 kg CO₂e/m²
- Projects outside of North America

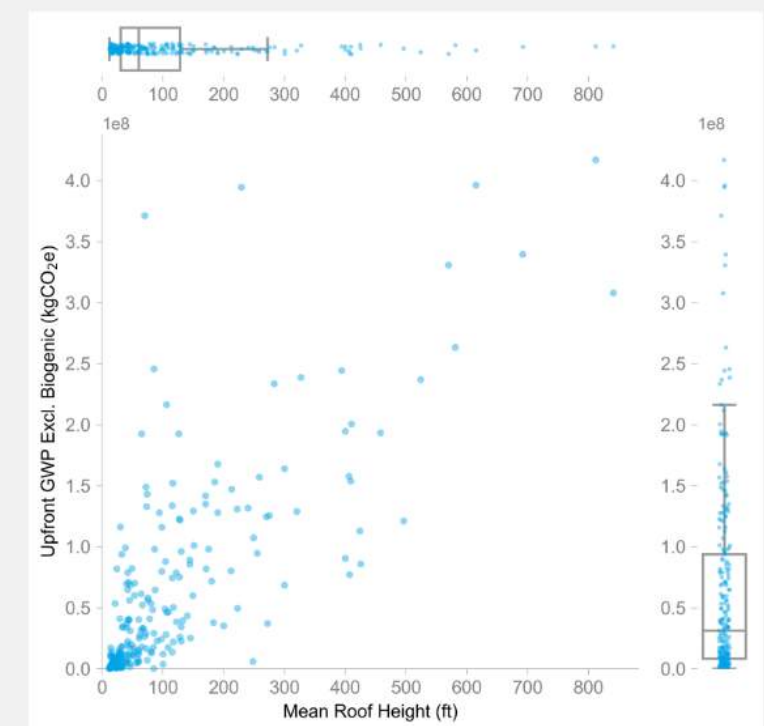
Life Cycle Stages

- Upfront Carbon (A1-A3 - in some cases includes A4 and A5)
- Life Cycle Stages A-C
- Life Cycle Stages A-C, including module D
- Life Cycle Stage A, including module D

GWP vs. Stories Above Grade



GWP vs. Mean Roof Height



Courtesy Lauren Wingo, ARUP & SE2050 Committee

What can firms do now?

Advisory Board identified Education as the top initiative this year



Awareness



Learning



Strategy



Data

What can firms do now?

Start thinking about Data!



Data



“It’s not a technical problem – it’s a cultural problem.”

- Large Firm Executive

- **Agility** – Small firms are more agile, and able to quickly adapt to new technology and integrate them into their workflows
- **Flexibility** – Small firms are more flexible in terms of the types of projects they take on and resources to devote to them, helping them experiment with AI technologies and applications.

Questions for NCSEA Committees

