NAC **Executive Insights**

Evolving Artificial Intelligence (AI) Challenges and Risks in Construction

Key Points

- The roll out of artificial intelligence (AI) will bring many challenges, risks, and opportunities to the architecture, design, engineering, and construction industries.
- The Executive Order by President Biden on AI means that the U.S. government is committed to adopting AI technologies.
- The adoption rate of generative AI is unlike any other technology adoption rate ever seen.
- The architecture, design, engineering, and construction industries need to begin putting into place the various industry frameworks required to address the emerging capabilities, challenges, and risks associated with AI.

Introduction

AI is not just a defining theme across all sectors of society. It likely represents a major inflection point in how the architecture, design, engineering, and construction industries work and the nature of the work they do. This inflection point, a societal paradigm shift, already suggests impacts more profound than the smart phone or even those of the Industrial Revolution. And its potential is at the earliest stages.

President Joe Biden on Oct. 30, 2023, signed an expansive, 111-page Executive Order (EO) on the safe, secure, and trustworthy development and use of artificial intelligence in response to growing concerns over the potential risks of AI technologies. While the EO focuses in large part on AI systems of a certain caliber that pose the highest risk, for example foundation models like ChatGPT, it will also have broad impacts on developers and deployers of AI technologies. It is important because this EO means that the U.S. government is committed to adopting AI technologies. Many of the provisions encourage federal agencies to use AI safely and securely and foster the domestic development of advanced AI tools and related industries.

The EO directs agencies to take internal or external action to redefine AI governance, regulation, and leadership. To incentivize and require safety and security in the development and use of AI in government and the private sector, the EO covers where AI is involved with critical infrastructure, cybersecurity, labeling, immigration, competition, workforce, intellectual property, privacy, chip development, criminal justice, and civil rights. The EO also addresses national security and defense aspects of AI, although they are largely kept separate from other applications of the technology.

Agencies have between 45 and 365 days to complete most directives, and stakeholder engagement will be critical to most actions.

Like any broad-based societal change or new technology roll out, AI is bringing challenges and risks. These challenges must be kept front of mind, not to dissuade or discourage, but to ensure all Americans move forward on strong foundations.

The recognition of potential risks and opportunities has been discussed in various Executive Insights. Domestically and globally, governments are increasingly attuned to these risks, primarily from a national security perspective. Within the architecture, design, engineering, and construction industries, these challenges and risks require broader awareness and likely collective action. Is there a leadership role by the National Academy of Construction that should emerge as it relates to this collective action?

In this Member Viewpoint, some of the many AI challenges and risks that must be addressed are summarized and the AI challenges that potentially impact construction are highlighted.

What Has Changed?

The rate of change in AI capabilities and societal penetration is unlike any other technology adoption rate ever seen. The launch on November 30, 2022, of OpenAI's ChatGPT acquired one million users in five days and 57 million after one month, the fastest adoption rate of any technology. At the end of August 2023, the ChatGPT website received an estimated 1.6 billion monthly website visitors (an increase of around 1.0 billion from January 2023), with an estimated 100 million active users.

Importantly, AI is rapidly moving beyond simple chat bots and using and creating text to images, video, avatars, and automating research. And the AI "S-curve" is spawning new "S-curves" as it intersects with Blockchain, robotics, 3D printing, and more broadly, Big Data. Domain specific applications are already beginning to emerge in health and law. AI effects will be disruptive. Benefits will accrue in those domains, such as engineering and construction, that are able to aggregate and leverage broad based industry data. On this last point, the architecture, design, engineering, and construction industries lack a "data commons" (a platform to accelerate new information, research, and data through a cloud-based platform where industry participants can store, share, access, and interact with digital objects, data, and software generated from architecture, design, engineering and construction research) for effective knowledge leverage by AI.

Challenges and Risks

The AI challenges and risks in construction have expanded since NAC published its initial set of Executive Insights on the subject (see For Further Reading on page 5). Little has advanced, however, in addressing those previously identified.

The table below is intended to raise the AI challenges/risks visibility. It also highlights why these challenges/risks should be of concern to the construction industry. Some risks may fit into more than one category. The six categories are:

1. AI General – affects more than the construction industry.
2. Ethics – a multi-dimensional challenge.
3. Industry/Corporate – real risks to both industry and individual companies, but more broadly to the construction industry. This is an area where increased leadership by industry organizations such as the National Academy of Construction is required.
4. Regulation and Legal – includes some risks that derive from the White House Executive Order of October 30, 2023.
5. Data.
6. AI Models and Algorithms.

These last two areas pose special challenges for engineering and construction, but also represent significant opportunities if they can be systemically addressed in the industry.

AI Challenges and Risks in Construction	
AI General	**Data**
Emergent behavior in large language models	Quality and limits of training data
Sentience of AI models	Validation and verification
Application of multimodality	Access to sufficient data, including relevant dark data
	Data integrity
Ethics	Use of "data exhaust" from daily activities
	Human feedback in training process
Completeness of AI ethical considerations	
Hidden Biases	**AI Models and Algorithms**
Thoroughness and quality of due diligence and impact assessment of AI ethical issues	
Privacy erosion	Confirmation of appropriateness of use for selected AI
Data manipulation	Diagnosis vs Design
AI agent misuse by people	Safety of AI algorithms
	Veracity and quality of results
Industry/Corporate	Lack of verifiability
	Diagnosis of errors
Access to required AI skills	Adequacy of interoperability
Disruption to the construction industry	Assumption tracking and linkage to AI use cases
Job automation labor issues	Constraint awareness and tracking as it relates to the AI deployed

AI Challenges and Risks in Construction	
Convergence with Blockchain, 3D printing, robotics, Big Data	Insight into AI optimization parameters
Need for actionable certifications and standards	Non-determinism is a validation &verification (V&V) issue
Cost and efficiency (short term)	"Hallucination"
New skill requirements	Deep fakes
Cybersecurity	Adequacy of red-teaming qualifications and process
Scope 3 emissions associated with training	Asking the right questions
Disclosures related to AI risk	Task specific alignment
	Trust and safety of models
Regulation and Legal	Phrasing of inputs
	Adequacy of red-teaming qualifications and process
Accountability for AI impacts	
User data rights	
Emerging legal and liability issues	
Hidden biases	
Uncertainty around compliance with existing regulations developed pre-AI	
Copyright	
National security	
Government regulation	
Intellectual property	
Sharing of safety test results with government (notification; red team safety tests)	
Compliance with NIST developed standards for testing and safety	
Content authentication and watermarking	

Impacts Ahead

The paradigm shift marked by the startling growth in generative AI over the last year likely marks the beginning of Industry 5.0. The architecture, design, engineering, and construction industries have lagged other sectors in response to Industry 4.0. As a minimum, however, these industries need to begin putting in place the various industry frameworks required to address the emerging AI capabilities, challenges, and risks. Only then will these industries be able to capitalize on the plethora of innovation "S-curves" that will emerge at the intersection of generative AI and the Industry 4.0 technologies of Blockchain, robotics, Big Data, and 3D printing, to name a few. Industry leadership is required. NAC with its partnerships may be well positioned to contribute to that leadership.

For Further Reading – Executive Insights

- Artificial Intelligence Enabled Supply Chain
- Impacts of Artificial Intelligence on Management of Large Complex Projects
- Artificial Intelligence Ethics in Project Management and Civil Engineering Domains
- Proper Reliance on Artificial Intelligence in Project Management
- Verification and Validation of Project Management Artificial Intelligence
- Cybersecurity in Engineering and Construction

About the Author

Bob Prieto was elected to the National Academy of Construction in 2011. He is a senior executive who is effective in shaping and executing business strategy and a recognized leader within the infrastructure, engineering, and construction industries.

> *Although the author and NAC have made every effort to ensure accuracy and completeness of the advice or information presented within, NAC and the author assume no responsibility for any errors, inaccuracies, omissions or inconsistencies it may contain, or for any results obtained from the use of this information. The information is provided on an "as is" basis with no guarantees of completeness, accuracy, usefulness or timeliness, and without any warranties of any kind whatsoever, express or implied. Reliance on any information provided by NAC or the author is solely at your own risk.*