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Smart Construction: Increasing Opportunities for Small Businesses in Infrastructure

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Introduction

Chairman Golden, Ranking Member Stauber, and members of the Subcommittee, thank you for inviting me today for this important discussion on smart construction and the future of the construction industry. My name is Lennart Andersson, and I am an engineer and licensed architect. For the past 20 years I have applied virtual design and construction methodologies on a wide variety of projects from large scale projects such as bridges, tunnels, and municipal buildings all the way down to small scale projects.

At Pratt Institute in Manhattan, New York, I teach a collaborative course on Virtual Design, Construction & Operation (VDCO) methodologies alongside designers, construction managers, and facilities management graduate students. I also serve as director of Virtual Design, Construction & Operations at the LiRo group and I am the founder of FormD, a next generation architecture, engineering, construction, and owner/operator (AECO) startup which works to accelerate the digitization of the built environment.

I received the Digital Edge 50 award in 2018 and the CIO 100 award in 2019. I am a member of the International Facility Management Association's (IFMA) Environmental Stewardship (ESUS) committee, have been a member of the Center of Architecture's professional practice committee—developing the next generation of connected documentation, and am currently developing webinars for ASCE on the digital transformation of civil engineering.

Today, I am appearing on behalf of the more than 150,000 members of the American Society of Civil Engineers (ASCE). Founded in 1852, ASCE is the nation's oldest national engineering society representing the civil engineering professionals who serve as stewards of infrastructure here in the U.S. and around the globe.

I also represent ASCE's Construction Institute (CI), whose mission is to advance the construction industry. Construction engineering is a professional discipline that combines design skills with planning, supervision, and management of construction projects. CI members are made up of everyone from owners and facility managers, architects and engineers, contractors and subcontractors, project managers, to consultants, governmental agencies, lawyers, and many other support services. As a part of ASCE, the Construction Institute has been a leader in providing vision, leadership, problem-solving skills, and unique continuing education for the past 20 years.

ASCE appreciates the opportunity to discuss smart construction and increasing opportunities for small businesses. We also thank the U.S. House Committee on Small Business for examining this important and ever evolving area. ASCE is eager to work with Congress to find ways to improve the project delivery at all stages including planning, funding, design, construction, operation, maintenance, and decommissioning of projects.

All phases of construction are poised to change and evolve in the coming years, incorporating traditional tools of the trade and new technologies that could transform the way projects are completed. The industry has much to gain with these new and innovative technologies so that we can build better ,more cost effective buildings, infrastructure, and communities.

Current construction design can be slow to adopt new technology, therefore slowing project delivery. In 2017, the McKinsey Global Institute released a report that stated that the efficiency of

Architecture, Engineering, and Construction (AEC) sector dropped by 26% since 1991, while the performance of average non-AEC industry increased by 48% during the same time period. The tools and processes used in infrastructure construction are still largely analog and manual. If properly implemented, the very latest technology will enable fewer people to do more and achieve a higher quality.

Examples of innovation can be seen in the following areas:

- Construction artificial intelligence (AI) systems, which may recommend to a builder what materials, specific design languages, and costs are needed to create the home based on available data—all within seconds.
- Incorporating smart robotics to save time and money.
- Using virtual and augmented reality simulators, which can serve as training tools to improve operating proficiency or design efficiency on projects.
- Commercial drone technology has come a long way and extends beyond capturing project images and video. Systems are now using thermal imaging and sensor technology to deliver quantifiable data about materials, processes and personnel on site.
- 3D printing has the potential for use in both component manufacturing and building applications.

Virtual design and construction not only helps to create 3D and 4D models of a project, but as a part of the construction process, it helps to create budgets and schedules as projects go through funding approval and access a single repository for all project scope and design documentation. It also simplifies owner/engineer collaboration through interactive processes and manages iterations of the project's budget, schedule, and design models; creates detailed estimates and schedules by managing documents, changes and forecasts, and drives field productivity from anywhere with mobile solutions. Virtual design and construction also enable access to a single searchable repository for as-designed and as-built information to facilitate construction, maintenance, and operations activities.

For East Side Access, only four people were needed to model and code what is considered the largest (Building Information Modeling) BIM project in the world. By applying automated reality capture and digitization of documentation, processes, and common-sense standards, it is possible to realize the digital twin of infrastructure before construction. This model is used for planning and augmenting the design for all stakeholders through interactive interfaces. Prior to actual construction, BIM is used for accurate cost estimates, schedules, finding requests for information (RFIs) prior to construction, and then automatically connects progress tracking and reporting. The digital copy is also used for traffic simulations, virtual mockups, staging planning, construction phasing, site safety analysis, as well as community outreach—which all help to accelerate decision-making and optimize execution.

Primarily, the Digital Twin is an integral component for proper life-cycle management through data connectivity to computerized asset management systems and geographic information systems (GIS). Coupled with the emergence of robotics, machine learning, and automated progress tracking, it is possible to revolutionize infrastructure productivity while working towards a sustainable future. The gradual recording of underground utilities enables connectivity to Smart City concepts, which is needed to effectively manage cities in the 21st century.

BIM increases transparency and fosters an environment of participation for all stakeholders. This method of virtual building sets the stage for more collaborative forms of project delivery methods (in contrast to the traditional design-bid-build) such as design-build, integrated project delivery, and at-risk construction management methods. BIM also coincides with lean construction and public-private partnership projects, where timely coordination and accurate information is paramount. As multiple alternatives can easily be studied and shared, it provides optimized understanding of value engineering.

We have an opportunity to use small businesses as changemakers of infrastructure. Innovation is often more difficult to implement in larger organizations, while small businesses are inherently forced to innovate in order to be competitive.

Congress must support and foster these new processes and technologies by:

- Drafting and passing legislation and policies that encourage development of innovative technologies and processes;
- Encouraging research to accelerate the development of existing technology and develop new technology in the fields of design, materials, construction, maintenance, rehabilitation, and operation of the infrastructure, while understanding the need for reduction of life-cycle costs, and improved sustainability and resilience;
- Allocating appropriate funding for research at the federal level in conjunction with state/local agencies, universities, and the private sector;
- Supporting the identification and dissemination of information about federal, state, and local governments, academia, and private sector construction research and development activities;
- Encouraging implementation of innovative technology;
- Creating opportunities for academics and practicing engineers to conduct basic and applied research and development activities; and
- Developing and implementing new strategies and technologies to mitigate the impact of disasters on the nation's infrastructure.

In addition, Congress must continue and expand funding to ensure that that National Institute of Standards and Technology (NIST) can carry out its mission of promoting U.S. innovation and competitiveness by anticipating and meeting the needs of the U.S. building and fire safety industries for measurement science, standards, and technology. Congress must also expand the research efforts at NIST in man-made and natural hazards, their effects on structures and building equipment, and the mitigation of their impacts—including new metrics to enable proper assessment of infrastructure resilience and life-cycle performance. Such new metrics are needed to properly assess life-cycle performance of buildings and other structures.

Tackling our Nation’s Infrastructure Challenge

Every four years, ASCE publishes the Infrastructure Report Card, which grades 16 major infrastructure categories using a simple “A” to “F” school report card format. Through this format, ASCE educates the public on the current state of our nation’s infrastructure system.

ASCE's 2017 *Infrastructure Report Card* graded the nation's infrastructure at a D+. Gaps between identified needs, investments needed to rehabilitate our public infrastructure, and public commitments to meet those needs widen every year. If expansion of the infrastructure to accommodate sustainable performance, resilience and growth is also considered, the gaps are even wider. The most cost-effective method to close these gaps and raise the grades is to enhance innovation throughout the construction industry, thus improving the efficiency of available resources.

Examples of innovative practices, technologies, and procurement policies might include: the use of performance instead of prescriptive criteria in procurement policies; emphasis on life-cycle costs during procurement; emphasis on innovation as a selection factor for procurement; reduced liability connected with innovation; and maximization of commercial rights to innovative intellectual property developed during construction projects.

Incorporating and embracing new approaches, materials, and technologies will help to ensure our infrastructure is more resilient – to more quickly recover from significant weather and other hazard events – and sustainable – improving the "triple bottom line" with clear economic, social, and environmental benefits. Specifically, we must:

- Develop active community resilience programs for severe weather, seismic events, and other hazards to establish communications systems and recovery plans to reduce impacts on the local economy, quality of life, and environment.
- Consider emerging technologies and shifting social and economic trends – such as autonomous vehicles, distributed power generation and storage, and larger ships – when building new infrastructure, to assure long-term utility.
- Improve land use planning at the local level to consider the function of existing and new infrastructure, the balance between the built and natural environments, and population trends in communities of all sizes, now and into the future.
- Support research and development into innovative new materials, technologies, and processes to modernize and extend the life of infrastructure, expedite repairs or replacement, and promote cost savings.

The engineering community is also committed to improving innovation within the industry. The ASCE Grand Challenge is a commitment to rethink what's possible in our industry. The goal is to work towards reducing infrastructure life-cycle costs by 50% by 2025. This can be done by focusing on four main areas:

- **Resilience:** Civil engineering projects must account for long-term environmental factors that America's infrastructure must withstand. Designing and building for resilience is a key component of the Challenge because it allows the industry to plan for potential infrastructure emergencies rather than rely on large cash flows when there is a disaster.
- **Life-Cycle Cost Analysis (LCCA):** This methodology is used for determining the total cost of ownership of an asset – from acquiring, planning, permitting, engineering, procuring, constructing, owning, operating, maintaining, and disposing of an asset. The LCCA approach is essential for ensuring that a project is the most sustainable and cost-effective choice over its lifetime.

- **Innovation:** Building a culture of innovation will lead the way for investment in smarter materials and processes. It is important for engineers to embrace innovation at every level and at every project stage. To successfully "launch" innovative approaches across the board, we need to reduce barriers in thought leadership. Hypothesis, examination, testing, and refinements are essential to the successful implementation of new ideas.
- **Performance-Based Standards:** Migrating standards and practices from prescriptive- to performance-based requires the development of new solutions and approaches. Performance-Based Design encourages innovation across the civil engineering profession.

Research shows that LCCA can lead to significant cost and resource savings. To paint this picture, here's an example:

Michigan Department of Transportation (MDOT) implemented an improved efficiency and new technology-focused plan that saved the department time and money. MDOT estimates the agency has saved approximately $12 million annually due to better efficiency, along with six million pieces of paper — thanks to their new process initiatives. The agency also used new-to-market paperless technology on a recent $150 million infrastructure project, the reconstruction of I-96, to help manage 55 firms and almost 500 construction workers, completing work in about seven months and ahead of schedule. The productivity gains alone are estimated to have saved Michigan over $1 million.

<u>Codes and Standards</u>

ASCE supports, as an import cornerstone of construction innovation and resilience, the development, adoption, and enforcement of up-to-date building codes. The role of the federal government includes enacting and funding incentive programs encouraging state and local agencies to adopt building codes and support funding for research that is necessary for the development of model building codes.

Both responsible design and construction are essential to improve the quality of life, assure safety and durability, and reduce vulnerability of the nation's infrastructure. The purpose of a building code and the consensus-based standards is to establish minimum requirements necessary to protect and improve public health, safety and welfare in the built environment. Model building codes provide for protection from fire, structural collapse, general deterioration, and extreme loads related to man-made and natural hazards. They are also created to conserve natural resources, reduce owner costs, and preserve the environment by establishing minimum building standards. Safe and sustainable buildings are achieved through performance-based, code-based design and construction practices, in concert with a code administration program that ensures compliance.

<u>Research and Development</u>

A robust federal research and development program (R&D) can lead to new approaches, materials, and technologies to ensure more innovative, resilient, sustainable, and cost-effective built environment. It will also lead to more sustainable development by improving the "triple bottom line" with clear economic, social, and environmental benefits.

ASCE supports basic and applied R&D programs, coupled with demonstration and commercialization programs, structured to meet needs for:

- Revitalizing the nation's public works infrastructure to protect citizens by improving function and reducing life-cycle costs;
- Enhancing environmental quality and fostering sustainable development;
- Increasing the application of identifying, proving, and fielding emerging technologies, materials and processes to improve security, durability, disaster resilience, sustainability, and performance of engineered systems;
- Advancing the business performance of the practice of civil engineering and the industries supported by civil engineering services through Quality Based Selection (QBS) to improve the nation's competitiveness; and
- Enhancing the security, safety and resilience of critical infrastructure to protect the safety and economic vitality of the nation against natural and man-made hazards.

Conclusion

ASCE thanks the Committee for holding this hearing on a topic that affects the quality of life and livelihood of every American. Our world is constantly changing, and we must embrace these changes by ensuring we are using the most modern and technologically advanced construction materials—in addition to considering life-cycle costs—when making investments that will last for decades or longer.

Civil engineers are the stewards of infrastructure and have a leading role in planning, designing, constructing, operating, and maintaining the built environment. We understand the significant benefits to society of infrastructure renewal and construction innovation. Careful thinking about likely future realities is what civil engineers do every day when planning, designing, and implementing their projects.

We are designing our infrastructure systems to last for 50, 100 years or more. It is critical we think about solutions that will fit our future world. We can prepare now by utilizing new approaches, materials, and technologies to ensure our infrastructure is more resilient – to more quickly recover from significant weather and other hazard events – and sustainable – improving the “triple bottom line” with clear economic, social, and environmental benefits. We must commit today to make our vision of the future a reality – an American infrastructure system that is the source of our prosperity.

ASCE and its 150,000 members look forward to working with the House Committee on the Small Business to improve America’s built environment so that every family, community, and business can thrive.