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Industry Perspectives: Creating Smart and Sustainable Cities

Two Generations of Industry Leaders Discuss the Challenges and Opportunities for Turning Today's Cities Into Sustainable and Livable Economic Powerhouses for the 21st Century

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Executive Summary

Investment in infrastructure provides a vital economic benefit to cities that seek to lead the way on high-tech innovation and robust job creation. A recent increase in severe weather events, coupled with rapid urban population growth, have made resiliency the cornerstone of urban planning and design. At present, however, the urgency to create more resilient and sustainable infrastructure exceeds our capacity to produce it.

Autodesk, the McGraw Hill Financial Global Institute and McGraw Hill Construction recently hosted two Roundtable discussions on the challenges and opportunities surrounding the need for enhanced infrastructure to support tomorrow's cities. The participants of our first Roundtable were senior executives who had served for many years in the AEC (architecture, engineering and construction) industry, while our second group came from the next generation of industry leaders. Each group discussed strategies to improve how buildings and infrastructure could be planned, designed, built and maintained to create cities that are centers of innovation and economic growth. Each group spoke with equal passion, engaging in an open discussion on how to best create tomorrow's thriving cities.

The Goal: Meeting the Needs of Future Generations

Today, the majority of the U.S. population lives in or near urban areas, and that number is expected to rise. Robert Prieto, senior vice president of Fluor, said, "Cities have been growing for the last 5,000 years because they are a good economic model, and infrastructure's role in that model is extensive." Infrastructure provides energy, water, transportation, waste management and access to food and manufactured goods; it is vital to a community's well-being. Infrastructure also supports more than basic needs; it encourages the ability to interact, communicate with ease and share ideas – the fundamental basics of innovation and future economic growth.

By all accounts, we are not making the grade with our current level of infrastructure investment; the American Society of Civil Engineers (ASCE) recently gave the United States a grade of D+ in assessing the condition and performance of the nation's infrastructure. Moreover, the gap between demand for new and rehabilitated infrastructure and projected spend over the next 20

years is significant. A recent report from CG/LA Infrastructure, “Building the Global Economy by 2030,” estimates \$36-\$40 trillion is needed worldwide but forecasts actual investment at only \$24-30 trillion. When we consider the potential economic impact caused by “super storms” and other climate change effects, the cost can only grow. By continuing to prioritize “building back” after natural disasters, rather than “building better,” we only exacerbate the spending gap.

“In 50 years, the decisions we make [for our cities] today will be evaluated by the people who are using them then,” observed Bill Bertera, executive director for the Institute for Sustainable Infrastructure (ISI), during the panel discussion.

While it may seem obvious, his statement prompts deeper conversation as to what is driving those decisions. What are the determining factors in our choices to plan, design, build and maintain the infrastructure needed to support thriving cities of the future? How dollars are prioritized for infrastructure investment is a reflection of a community’s social, economic and environmental values. By developing with sustainability as a primary goal, says Bertera, we can ensure that we will preserve essential resources for future generations.

Despite the economic impact of the recent recession on many cities, including Detroit’s bankruptcy filing, the prognosis for cities in the U.S. and around the world is excellent. A number of trends, such as re-localization (bringing manufacturing back to the U.S.), urban farming, and transit oriented development – where mixed-use residential and commercial areas are designed to maximize access to public transportation -- are providing the means for cities to compete for economic vitality.

Quality of Life

The Roundtable participants said cities are an ideal living environment. Christopher Mojica, a transportation engineer with Stantec, articulated a common opinion that “community will be the foundation” of a thriving city in the future. Architecture trends will bring greenery to buildings themselves, with greater support for rooftop gardens and vertical farming. More mixed-use zoning will provide office space ideal for collaboration. Connectivity will be ubiquitous, supporting a rise in entrepreneurship and self-employment; the air will be cleaner.

Quality of life, according to the panel, is likely to be even more important in years to come, and factors like sustainability, resiliency, energy-efficiency, quality housing and schools, safety and even happiness will be requirements. Cities will be adaptive, collaborative, walkable, and everyone will have access to public services and public transportation. Needless to say, getting everyone involved and on board with the changes and investments required to create these kinds of cities will be critical to building and rebuilding the infrastructure needed to support urban population growth in a healthy, sustainable way.

Economic Competitiveness

Today people move to cities for many reasons, including access to jobs, schools, services and culture. Because of their compactness and walkability, many cities today offer features that support a sustainable lifestyle. Yaye Mah Boye, a project manager with AECOM, projects a future where sustainability might be the main attraction for prospective urbanites, while Robert Preito, senior vice president at Fluor, speaks to the importance of economic vitality. “In cities that represent solid economic models you’ll see growth in personal income ahead of the CPI (consumer price index) ... and that’s the creation of wealth.”

The question for city planners is how to foster economic activity in a way that maximizes benefits to the community. It is important that cities attract investment through policies that encourage growth for the businesses operating within their limits. It is these businesses – and the tax payers benefitting from their success – that will ultimately provide the financial investments in systems and services essential to a sustainable, community-oriented lifestyle.

It is, however, people who make a city; business and political leadership by itself is not enough. An informed public will be critical to any approvals for proposed new or rehabilitation projects to improve a city’s economic competitiveness. Whether planning for small improvement projects or large scale corridors, all decisions are local.

Mobility

"A thriving city has a lot of movement and adaptable transportation," said Matt Emma of Turner Construction. "While some rapidly expanding cities around the world are experiencing traffic issues, New York City thrives because you can move the 'components' or people of a city from one point to another quickly and with minimal energy."

As long as jobs are available and people are safe, it is unlikely that the trend toward urbanization will be reversed. As Jessica Vogel, senior project manager for Luthin Associates, Inc., an energy consultancy, noted, "The millennial generation is not about the suburbs," even as advances in telecommunications make the ability to work remotely increasingly common. Connectivity and digital mobility are as critical to the next generation as automation and automobiles were to those that came earlier.

What could drive people back to the suburbs is a lack of affordable housing. This constraint makes access to transportation critical and not just within the urban center. "We need to consider satellite hubs as we develop outside city limits," said Stantec's Mojica.

Whether more people move to the cities to walk to work or telecommute to remote offices, or flee to the suburbs by choice or by circumstance, adaptable strategies will be called for. As Prieto noted, "The future might not be about building more roads and highways. The future of infrastructure could be more bandwidth and bicycle paths."

Resiliency

The economic cost of super storm Sandy is estimated to have exceeded \$70 billion, with about \$250 million going to the repair of New York's metropolitan transportation systems alone. As the senior panel group noted, "We had an infrastructure problem before we had a resiliency problem." Nationwide, estimates are that it will take about \$2.2 trillion to upgrade current infrastructure to satisfactory levels.

This, argued Mojica, is a reason for hub and spoke city planning models. Mojica said that smaller, dispersed economies outside city limits will help improve resiliency by acting as back-up systems when major urban centers are impacted by natural (or manmade) disasters. Given that

insured losses as a result of Sandy total over \$25 billion, with businesses accounting for nearly half of that amount, this strategy might have appeal from a business continuity point of view. While current initiatives to rebuild damaged homes and infrastructure would meet federal insurance guidelines by building back “in kind,” federal policy could be used most effectively to build back “better.”

Making future resiliency loads part of the codes is a first step, but resiliency is about long term planning. Among all of the industry professionals we gathered, there is a keen awareness of the difficulty of getting infrastructure projects approved. If there is still no universal acceptance as to the causes and potential impacts of climate change, what will prompt policy-makers and industry to invest in more sustainable strategies?

AECOM’s Boye suggested that resiliency planning isn’t only about preparing for the impact of super storms; it is about mitigating their causes in the first place. “We need lower carbon emissions,” she said. “Even if we planned to build sea walls all around lower Manhattan to combat sea-level rise, we wouldn’t get the approvals or funding [to complete the work].” Instead, she and the other millennials at the Roundtable envisioned a future city where green roof tops would be productive (as opposed to simply ornamental) by providing a food source and building systems are upgraded to become more energy efficient.

Vogel agreed. “Think about the Earth’s resources being used by 9.7 billion people. We have to upgrade systems to give shelter, water and safety to support this population.” Buildings constructed decades ago will still be standing because they are made of steel, but the building systems will need to change. Simple fixes might be all that is needed for existing structures, as evidenced by the recently completed retrofit of the Empire State Building. The group proposed several strategies to reduce operating costs and utilize renewable energy sources – from how elevators are run and lights controlled to sending power back to the grid.

Obstacles to Growth

When it comes to creating and maintaining infrastructure, we will need to support future cities. The nation's near-failing grade from the ASCE suggests there are many daunting obstacles. Lack of political will, combined with the current global economic situation, are the most obvious root causes of our current low levels of public investment. Nevertheless, we asked the Roundtable groups to consider industry's role in delivering our infrastructure needs.

Cost

Cost is one of the most important issues in securing the nation's infrastructure, and there is considerable attention being paid to innovations that can close the funding gap. Methods that use private sector financing, such as public-private partnerships (PPPs), are gaining popularity as a solution but will not solve the problem on their own. Jonathan Greenspun, managing director at Mercury Public Affairs, a consultancy, told the group that the reason the U.S. has been slow to adopt the public-private model is because the "perception is that you are giving away the assets." While the general public might fear that our most iconic buildings and bridges will be foreign-owned with unpredictable rates and performance, the opposite is true, asserted Greenspun. The private investor is there for the long term but has strong incentives to maintain and improve the asset, as public approvals can only improve the return on investment.

It is unlikely that investment (public or private) will ever meet the full demand for infrastructure projects. We have to reduce costs. According to Prieto, another type of PPP is just as critical when considering the cost of infrastructure – People-Planet-Profit, the now familiar environmental adage for businesses. Prieto says that "time is the number one driver" of infrastructure project costs, and firms are, quite simply, in business to make a profit. Environmental requirements also factor into the high cost of infrastructure projects and potential risk to contractors and investors. Finally, businesses need a social license to operate, and governments must maintain the public trust. People can drive up costs of projects when public stakeholders delay project approvals or demand costly redesigns.

Approvals

Seventy percent of infrastructure projects fail, according to Prieto. “The number one cause of failure on large infrastructure projects is that the objectives were never clearly defined or communicated.” A lack of understanding of full lifecycle costs compounds the problem. Most projects are funded for initial construction costs, with no set-asides for maintenance. Capital expenditures are engineered to reduce first costs and taxpayer burden, without consideration of operating and maintenance implications or “what if” contingencies in case of disaster.

One of the challenges, according to Turner Construction’s Emma, is convincing the people who are providing the capital (whether private investors or taxpayers) to take the risk and support higher upfront costs for long-term benefits. Emma said the industry needs to demonstrate that the project is sustainable and will run more efficiently over the lifecycle to be a worthwhile investment.

An environmental impact assessment process can take 30 years to move forward; projects are stopped because of public perception, and the cost of these delays is rarely included in the initial estimates.

There needs to be a better informed and more engaged public, and yet the way projects are proposed and presented has not fundamentally changed in decades. Despite the advance of immersive, realistic visualization technology and social engagement platforms, it is more likely that there will be a set of 2D CAD drawings, supported by a hand-drawn artistic rendering of a new highway interchange, at a public meeting.

Encouraging Innovation

That some industries thrive on the status quo was a point on which most panel participants agreed. Since 1995, engineering construction productivity has dropped by half. At the 2012 CG/LA Global Infrastructure Leadership Forum, presenters from McKinsey and Company singled out poor productivity in the construction industry as an important factor in eroding returns and making infrastructure less attractive for private investment. McKinsey suggested an increased focus on productivity to make the economic model more attractive to investors.

Traditional ways of working are insufficient to meet the unrelenting need for new and rehabilitated infrastructure amid today's economic realities. The methods by which projects are delivered and assets are managed must undergo a fundamental change in order to meet today's critical objectives. Improved productivity and better communication will help close the gap between soaring investment demand and limited access to capital.

And yet, innovation is rare. "You take the spec book and you apply it," remarked Emma. Given the financial stakes, owners and service providers are understandably risk adverse, preferring to go with traditional methods that have been proven over time. Even if the track record demonstrates no meaningful improvement in efficiency, waste, cost nor safety, the alternative – to try to be cutting edge and fail – is untenable.

"What we have been doing isn't in itself sustainable," commented ISI executive director Bertera. It's not just about the physical resources, but the thought processes that tie planning and design to the community as well. Lawrence Pesesky, senior vice president of The Louis Berger Group, Inc., agrees, and suggests that data are what give people permission to take risks. Today's technology supports big data; cities and commercial firms can use data to create and present proposals for new designs shown within their existing surroundings or conduct analyses for population growth, weather impact and many other factors. Allowing people to plug in to the data can help facilitate communications and smooth the approvals process. It has been used successfully by many leading edge firms, such as Parsons Brinkerhoff. Jay Mezher, director of virtual design & construction at the firm, understands this acutely. "It's the integration of information that brings people on board," he said.

Solutions for Success

Like commercial businesses that must react to market disruptions or competitive innovation, cities must also compete to gain their share of a thriving future. Well informed, long-term strategies to attract and support a vital population with strong economic growth prospects are vital to success. "New York City is a great example. We can't knock all the buildings down, but we should be upgrading them to be more energy-efficient now," suggests Megan Messmann, project manager at CDM Smith.

All of our participants agreed that thinking and behaving differently was not only necessary for policy makers at every level, but could be driven by industry -- by those responsible for the planning, design, construction and maintenance of the cities' buildings and infrastructure.

Better Planning

The planning process is meant to define community desires and determine what systems are needed. The underlying premise of planning, however, has evolved from community building to an exercise that requires balancing varying interests and priorities. Every community should have roads, utilities, water and wastewater systems, parks, schools and other public facilities in order to thrive economically, environmentally and socially. During decision-making, projects that maximize economic activity are often given priority but consideration of additional alternatives that incorporate social and environmental objectives might maximize the benefit to a larger number of people and result in a different distribution of investment. To make the best decisions, the public needs to understand all of the alternatives, as well as the pros and cons.

The biggest challenge is defining what we want our future to be; only with clear objectives can we achieve our goals. Metrics matter because when it comes time to rationalize spending finite resources, we need to be able to do this on social and environmental – as well as economic – factors. Planning should be the fundamental best practice for achieving results that support these objectives. Frameworks are valuable guides to coordinate infrastructure systems, public facilities and land use to maximize benefit to the community.

During the panel, Bill Bertera, of ISI, advocated for the ENVISION™ Sustainable Infrastructure Rating System as a tool for public administration because it is a community planning tool that introduces elements of sustainability into the thinking of planners, engineers, builders and policy makers at every stage in the lifecycle of a project. “The tool is actually being used as an aid to help us decide what needs to get done, rather than a measure of what has already been completed,” Bertera said.

While the field of sustainable community indicators and performance metrics is steadily gaining traction, that activity is largely occurring outside the planning profession. However, there are more instances where improved criteria for measuring and comparing sustainability considerations are being incorporated into current planning practices, and that must accelerate.

New standards and design criteria are emerging and are expected to be embedded within comprehensive planning approaches from the beginning. A key success factor is how is this information shared amongst stakeholders.

Innovation

Public private partnership (PPP) financing models can help transfer investor risk and facilitate innovation. Greenspun proposed that private investors look for innovative ways to build, design and own projects to maximize return on investment. While it might make financial sense, PPPs won't comprise the majority of infrastructure projects in the U.S.

Innovation, then, will be driven by the owners. Emma cited the Whitney Museum as an example. When the basement of their new Hudson River location flooded during Sandy, the owner of the museum took additional measures to carry out their mission of preserving art for the future. The museum's capital goal was increased significantly so that flood mitigation strategies could be put in place. The resiliency investments made today by owners such as The Whitney Museum are, according to Emma, "a step in the right direction." Private enterprise can serve as a model when it comes to justifying additional upfront costs that would, over the long term, reduce risk and lower operating costs. .

Risk is the greatest inhibitor of innovation in the construction industry. Prescriptive standards are put in place to help protect each stakeholder from liability as a result of planning, design, construction or operating decisions, and no one wants to be first to test the boundaries of what's possible. Reversing the trend to "build to spec" would promote more collaborative, holistic designs that take advantage of what's possible.

Boye recalled a recent AECOM-sponsored future cities competition, which showcased innovative ideas from kids, including levitating cars, and then asked a more pragmatic question. "How do we create the infrastructure that makes this innovation possible?" A simple solution would be to incorporate innovation into planning and policy by moving from accepted standards to new performance-based standards that foster innovation.

Technology

Advanced technology for simulation and visualization is already in wide use today in the manufacturing sector and is growing rapidly in the infrastructure industry to better understand projects. These tools use intelligent 3D models, quickly evaluate multiple design options and help predict the physical and functional performance of the finished project under a variety of conditions. Known as BIM (building information modeling) by planners, engineers, architects, contractors and owners, the process is also valuable in helping achieve significant construction productivity improvements.

During the panel, Mercury Public Affairs' Greenspun said he believed that government will "eventually understand the benefits of the BIM process, even while engineers remain threatened by the technology." These modern software tools (that go beyond CAD) provide visualization, simulation and analysis capabilities that can improve understanding of design and investment options.

Today, the use of BIM during planning, design and construction is already showing benefits related to infrastructure projects that can help address the obstacles around cost and approvals. Overall project costs can be reduced by 15-20% as a result of less rework, improved communication, and shorter schedules. Mezher pointed out that there are more non-professional stakeholders involved in the planning and design of large infrastructure projects. He also said BIM helps feed information in to the design, and modeling and simulation help engineers and planners make better decisions.

The Next Generation

Susan Walter, a principal at Stantec Consulting, said during the panel, "The younger generation is where we need to focus." In 50 years, the generation known as millennials could still be wrestling with shrinking natural resources and crumbling infrastructure, and if that is the case, hopefully they will harness the influence of their well-connected peer group of digital natives to create thriving cities. Mojica noted that Stantec is a strong supporter of the ACE Mentor Program, which introduces more high school students to the principles of engineering.

Engaging the next generation may well be one of the most important things that industry can do today; they work, play and think much differently than older professionals. They were raised on technology, and some refuse to be constrained by traditional methods of doing things. However, this highlights the challenges of having this generation work in today's engineering business environment, where outmoded tools, processes and approaches are still the norm.

Conclusion

It is people, not technology, that make cities vital. But planning, design, and investment decisions, along with supportive policy-making, can be informed and expedited via new tools enabling infrastructure simulation, analysis, and visualization. With the rise of big data and the availability of advanced modeling technology, it is now possible to plan and prioritize infrastructure investment with greater foresight, better communicate the potential outcomes, and yield measurably better results. More importantly, this technology, along with social and mobile platforms, now provides a means to engage all stakeholders – from citizens to professionals – earlier and throughout the process in a way that is easily understood.

The opportunity for industry today is to begin to change the way we work and think. Exerting influence on policy makers, professional societies, and educational institutions to promote innovation and push industry forward is the yeoman's work of today that will lay a foundation for tomorrow's thriving cities.

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