Urban Infrastructure

A Holistic, Technologically Oriented Approach

THE IDEA OF INFRASTRUCTURE.

Character towns have strong, well-funded infrastructure systems. Potable water supply, wastewater disposal, solid waste collection and disposal, electricity, natural gas, stormwater management, roads and bridges, transit, sidewalks, parks, schools, hospitals, and the myriad of other systems that support our lives and life styles go mostly unnoticed, until they break.

Most of the systems we use and enjoy today were provided by previous generations who invested in the future by installing pipes and pavements and public systems of all sorts that make a city function. Today, infrastructure gets a lot of talk and press, but not so much money. The trends are:

- **Renewal & Replacement [R&R] Funds:** Our existing systems are showing the effects of neglected and raided renewal and replacement funds. Rather than paying smaller amounts on a more regular basis, we are now faced with a big bill for major upgrades and replacements.
- **Public-Private Partnerships [P3s]:** Public-private partnerships are popular and offer relief when used properly. Long-term, "sweet-heart" deals can leave cities without revenues for years, like the City of Chicago's privatization of their parking system. It may be a good deal; but it has to be done carefully.
- **"Smart" systems** are proliferating. The costs and benefits need to be carefully weighed. Like privatization, it is a big commitment that may be a great benefit, or not. It's one more thing we must consider.

The New York Times

By STEVE LOHR

Published: April 29, 2009

"In the mid-1990s, the Internet took off because its technological time had come. Years of steady progress in developing more powerful and less expensive computers, Web software and faster communications links finally came together.

"A similar pattern is emerging today, experts say, for what is being called smart infrastructure — more efficient and environmentally friendlier systems for managing, among other things, commuter traffic, food distribution, electric grids and waterways. This time, the crucial technological ingredients include low-cost sensors and clever software for analytics and visualization, as well as computing firepower.

"Wireless sensors can now collect and transmit information from almost any object — for instance, roads, food crates, utility lines and water pipes. And the improved software helps interpret the huge flow of information, so raw data becomes useful knowledge to monitor and optimize transport and other complex systems. The efficiency payoff, experts say, should translate into big reductions in energy used, greenhouse gases emitted and natural resources consumed.

"Smart infrastructure is a new horizon for computer technology. Computers have proven themselves powerful tools for calculation and communication. The next step, experts say, is for computers to become intelligent instruments of control, linking them to data-generating sensors throughout the planet's infrastructure. "We are entering a new phase of computing, in which computers will be interacting with the physical world as never before," said Edward Lazowska, a professor of computer science at the University of Washington."

Source: The New York Times

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- **Sustainable systems** are important and the life cycle costs for investments in conservation programs can be reasonable, but the initial investments are sometimes huge. Careful consideration is critical.

THE FISCAL CHALLENGE.

A city's infrastructure, by definition, supports the city's physical, economic and social systems. It provides capital improvements and public services that move people and goods throughout the city.

Demands for new and improved infrastructure systems comes from several primary sources:

- As cities grow, more facilities are required.
- As cities age, facilities need to be renewed or replaced.
- As technology evolves, obsolescent appears at an increasingly rapid rate.
- As the public demands new public goods and services such as computers in libraries, recycling, green civic buildings, high speed rail, and inter-active televised council meetings, the cost per unit of service, especially in the short run, increases.
- As cities become bigger, older, technologically more sophisticated and more expansive in their service offering, the system's upgrading, renewal and replacement grows exponentially.

Adequate public facility ordinances using adopted levels of service ease the evaluation of development proposals by establishing private infrastructure commitments at the outset.

More thought, investment and energy is required just to maintain the current level of service to existing residents and businesses. The challenge of providing for new and expanded facilities and services for growth while back-filling and replenishing existing systems becomes a serious management challenge.

The International City and County Managers Association [ICMA], the National League of Cities and all levels of government are focusing on this issue. The ASCE weighs in every four years with their assessment of the situation, see the table below. Every facet of our urban infrastructure is distressed.

AMERICA'S INFRASTRUCTURE

Every four years the American Society of Civil Engineers releases a report card of America's Infrastructure that depicts the condition and performance of the nation's infrastructure.

Aviation	D
Bridges	C+
Dams	D
Hazardous Waste	D
Energy	D+
Drinking Water	D
Inland Waterways	D-
Levees	D-
Ports	C
Public Parks and Recreation	C-
Rail	C+
Roads	D
Schools	D
Solid Waste	B-
Transit	D
Wastewater	D

Source: 2013 Report Card of America's Infrastructure, ASCE.

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INVESTMENT OPPORTUNITIES.

The entrepreneurs in the crowd should be amply impressed by the demands being placed on our existing management and infrastructure systems. Most public services and facilities are not discretionary. Cities and other governmental agencies will be spending vast sums of money over the next decades to replace or renew everything. The large technology companies are already in the game. Public infrastructure investors need to join.

URBAN INFRASTRUCTURE ELEMENTS.

Public infrastructure, by its nature, consists of ten essential systems:

- **Drainage:** The stormwater management system associated with streets and highways along with building, development and environmental protection.
- **Education:** The education system of public and private primary and secondary schools with colleges, universities and skill training centers, as well as, libraries, museums and galleries.
- **Garbage and HazMat**: Many solid and hazardous waste collection and disposal system are enacting "green" approaches to reducing, reusing and recycling.
- **Health Care:** Hospitals, clinics, indigent care, wellness programs and disaster relief.
- **Police/Fire/EMS:** The public safety system of fire, police and emergency management services. Many cities spend over half of their ad valorem tax receipts on these services.
- **Power:** The power grid system that generates and distributes electric, gas, and hydrogen, sets rates and spurs innovations.
- **Telcom:** The telecommunication systems include phone, cable and information system facilities, cell towers, wifi networks along with public television and radio.
- **Transportation Systems:** Urban mobility systems consist of the street and road network, the transit and rail systems, the bicycle and pedestrian systems along with water ports and airports.
- **Urban Open Spaces:** The urban open space system with urban plazas, parks, wetlands, stormwater areas and trails.
- **Utilities:** The utility system includes potable water treatment and distribution, wastewater collection and disposal, and reclaimed water distribution.

Cities provide all these services and more. Many are capital intensive and require long-term financing due to the extreme cost of facilities and equipment. Some cities privatize essential public services – one manager recently saying,

> *"It is easier to manage contracts than people". Whatever the delivery vehicle, essential services are essential! Criteria for level of service expectations, performance evaluation systems and public feedback loops make the systems work better.*

In all cases, it's about the money. Skills in public finance, private-public partnerships, grant writing and other innovations are valuable.

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NATIONAL ACADEMY OF ENGINEERING
OF THE NATIONAL ACADEMIES

In 2005, the American Society of Civil Engineers issued a report card, grading various categories of U.S. infrastructure. The average grade was D (Updated to D+ in 2013).

What is infrastructure?

Infrastructure is the combination of fundamental systems that support a community, region, or country. It includes everything from water and sewer systems to road and rail networks to the national power and natural gas grids. Perhaps there will be a hydrogen grid in the future as well.

INFRASTRUCTURE AS AN ECONOMIC DEVELOPMENT TOOL.

Businesses and institutions choose to remain in cities or move to new ones based on many factors. One of the fundamental business locational factors is the quality and cost of infrastructure.

Dependable power, waste disposal, fire protection, continuing education institutions and mobility systems ensure the continual and cost-effective operation of their business, the reasonableness that employees have a safe and timely trip to and from work, that training programs are available and that the costs of doing business are competitive with other locations.

Jobs, family income and municipal tax and fee receipts rise or fall based on efficient and effective systems.

URBAN INFRASTRUCTURE FOR THE SUSTAINABLE CITY.

The sustainable city is the amalgam of places and systems. The two systems, open space and infrastructure, hold everything together, literally, fiscally and emotionally.

- The open space and infrastructure systems are, when done well, fully integrated, mutually supportive and assets to the city – visually, financially and socially.
- Successful open space and infrastructure systems are foundational to neighborhoods, city centers and development corridors.
- Open space and infrastructure systems can also serve as testing grounds and subsequent sources for innovation in the City. They can be "green" all at once or through pilot programs. They can use grants to test new ideas and approaches. They can be the subject of professional articles exploring new ways of solving old problems.

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SEIMANS SAYS: "Transforming cities for the better through sustainable technology. The megatrends of urbanization, climate change, globalization and demographic change will shape the future of cities. With the need to improve the quality of life and economic competitiveness, cities have to become more resource-efficient and environmentally friendly. Technologies are major levers and [the] base for further sustainable city development.

An effective infrastructure contributes to economic prosperity and improving quality of life. Urban residents need clean air, potable water as well as security. They need efficient buildings, a reliable power grid and capable mobility solutions. The complexity involved requires a holistic view and sustainable solutions for cities. Siemens provides know-how, and consulting expertise to make cities more livable, competitive, and sustainable."

SIEMENS

BUILDING CITIES, BUILDING FUTURES SPONSORED BY SIEMENS

In 2011, the National League of Cities, with support from Siemens, co-hosted day-long leadership forums with four U.S. cities – Charlotte, Chicago, Houston and Los Angeles – to look at the pressing infrastructure issues in these cities and their regions. Building Cities, Building Futures brought together elected officials and business and civic leaders to:

Highlight the individual infrastructure issues in each region

- Explore sustainable approaches and solutions
- Create linkages to economic competitiveness
- Benchmark with other cities and regions
- Identify common threads among the four cities

The City of Houston [July 14, 2011], the Houston-Galveston Area Council, and the Center for Houston's Future were NLC's local partners in developing the content for Houston's program. Some of the key issues that were addressed were green water infrastructure development, livability, and collaborative partnerships.

In Los Angeles, the Southern California Association of Governments (SCAG) was integral in developing a program with NLC that focused on transportation issues in the area ranging from a regional vision for transportation, to freight movement, to financing. Summary report of the Houston and Los Angeles events

Charlotte, September 15, 2011

A variety of water infrastructure topics were on the agenda at Building Cities, Building Futures Charlotte. The City of Charlotte and the Centralina Council of Governments mapped out an agenda which included the impacts of climate change, water policy and regulation, jurisdictional water issues and state regulation and smart grid technology. Summary report of the Charlotte event

Chicago, September 20, 2011

The final stop on the tour was Chicago where participants explored a variety of financing issues for both water and transportation infrastructure. The Chicago Metropolitan Agency for Planning, the Metropolitan Planning Council, and the University of Illinois at Chicago helped develop a robust agenda featuring regional experts. Summary report of the Chicago event

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URBAN INFRASTRUCTURE AS A KEY ELEMENT IN THE CITY'S FINANCIAL MODEL.

The city's infrastructure system should generate enough revenue to support itself and the city's open space system. Whether the city uses an "enterprise fund" system or operates these activities through the General Fund, the objectives are the same.

- Operate the open space and infrastructure systems as efficiently and as effectively as possible given the level of service standards acceptable to the community.
- Enact a fee structure for the fee-generating services that generate revenues sufficient to cover costs and reserves for both systems.
- Identify and program all revenue sources even though most revenue comes from the utilities and waste disposal activities. For example, use revenues from stormwater fees, selected park user fees [pavilions, boat ramps, e.g.], impact and connection fees.
- A Comprehensive Long Range Finance Plan for the city provides the framework for identifying and analyzing traditional revenue sources and uses while exploring non-traditional and non-recurring sources.

THE INDUSTRIAL USURPATION OF INFRASTRUCTURE INNOVATION.

IBM, along with other large technology firms, has launched a sophisticated program of "smart" services for cities and urban areas that have extensive infrastructure systems. IBM has branded its efforts "a smarter planet".

They say as an example…"Smarter water management creates a holistic view of water and wastewater across departments, silos and systems by aggregating, integrating and visualizing key data such as consumption, quality, flow and pressure. Visit the Smarter Water Management site and explore water solutions for cities."

Not to be outdone, Siemens offerings include:

- Total integrated power solutions for safe, reliable and efficient power distribution,
- Smart grid technologies that balance supply and demand, prevent power outages and integrate renewable power cost-effectively,
- Integrated mobility solutions that move people and goods faster, safer and with fewer resources, and
- Smart building technologies that drive energy efficiency, reduce costs, and protect and secure all assets.

THE CHALLENGE FOR CITY MANAGEMENT.

The cost of creating, maintaining and upgrading infrastructure is high and rising. Big business is at the public trough with ideas, information, challenges and a high quality sales force. The challenge for city management is to match the vendors' expertise with in-house knowledge sufficient to discern the good aspects of technology from those aspects that are ineffective, inappropriate or unnecessary. The ICMA, the National League of Cities and ASCE provide resources to help evaluate the pros and cons of this surging wave of technology.

The National League of Cities
An Example of Infrastructure Focus

Infrastructure Week 2014
May 12-16, 2014 is Infrastructure Week, with activities across the U.S. that explore emerging solutions, innovative approaches and best practices being developed nationwide to modernize aging infrastructure. Sign up for NLC's May 13 webinar: "Local Solutions to Pay for Your Transportation Projects: Infrastructure Funding & Financing"

- Connecting People and Places for a Livable Community
  Watch how Salt Lake City, Utah Mayor Ralph Becker planned a balanced and sustainable transportation system with "complete streets" that supports cars, light rail and other public transit, bicycles and pedestrians. See more "Big Ideas For Cities."
- Transportation
  City leaders can drive the creation of efficient transportation systems that provide for its community's needs in ways that influence patterns of growth and economic activity.
- Technology and Communications
  Broadband access promotes economic development, improves environmental sustainability, enhances public health and safety, and increases educational opportunities for millions of Americans and serves as a powerful tool that can effectively empower local leaders to efficiently govern, deliver services and engage with their constituents.
- Water
  Visit NLC's Sustainable Cities Institute for resources on how cities can manage their municipal water systems.

Knowledge Network .....About the Knowledge Network

VISION STATEMENT
Committed to fostering excellence and innovation in local government, the Knowledge Network is an online community for local government professionals built on the following ideals:

RICH CONTENT
Breadth and depth of content in all facets of local government operations and management.

SOCIAL NETWORKING AND KNOWLEDGE EXCHANGE
Within an open environment, ability to network and exchange ideas with a worldwide community of experts in local government and topics related to local government.

PARTNERING
A partnership of ICMA, the Alliance for Innovation and the School of Public Affairs at Arizona State University, the Knowledge Network is designed as a shared resource.

GLOBAL SCOPE
The free flowing exchange of concepts, ideas and best practices occurs without boundaries. City leaders in developing nations are able to access the functionality of the Knowledge Network to seek answers to their unique challenges and spur resource sharing and knowledge exchange throughout their countries.

http://icma.org/en/icma/knowledge_network/Page/100049

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ORGANIZATIONAL FERVOR.

1. **Stay ahead of the vendors;** work with them, not for them.
2. **The Florida Benchmarking Consortium [www.flbenchmark.org].**
   The Consortium was formed with the support of the University of Central Florida to assist infrastructure managers with their systems. Levels of service funding and cost data and operational details are shared by many city managers and public works directors in Florida. North Carolina and other states have similar organizations. The FBC Service Areas are: Animal Services, Building Development and Review, Code Enforcement, Environmental Management, Fire Rescue, Fleet Management, Human Resources, Information Technology, Parks and Recreation, Police, Purchasing, Risk Management, Road Repair, Solid Waste – Collection, Solid Waste – Disposal, Stormwater and Drainage Maintenance, Traffic Engineering, Water and Wastewater.
3. **The Cisco Internet Business Solutions Group** published, in 2012, *Smart City Framework, A Systematic Process for Enabling Smart + Connected Communities.*
4. **The Smart City Council** has partners including: Cisco, Microsoft, S&C Electric, IBM, nationalgrid, Alstom, Enel, Qualcomm, MasterCard, EDF, Bechtel, GE, and Itron.
5. **GE Cities** offers Sustainable Information for City Planners.
6. **Green Sigma™ Coalition.** IBM has created a collaborative network of some ten high tech firms with related interests and capacities.

SmartCitiesCouncil | LIVABILITY WORKABILITY SUSTAINABILITY

Our Vision, 04/17/2013
We envision a world where digital technology and intelligent design have been harnessed to create smart, sustainable cities with high-quality living and high-quality jobs. We promote cities that embody our three core values:

READ MORE ABOUT OUR VISION

Our Mission, 04/17/2013
The Smart Cities Council is an advisor and market accelerator. We promote the move to smart, sustainable cities. We contribute to our Partners' business success through advocacy and action.

READ MORE ABOUT OUR MISSION

Our Sector, 04/17/2013
A smart city gathers data from smart devices and sensors embedded in its roadways, power grids, buildings and other assets. It shares that data via a smart communications system that is typically a combination of wired and wireless. It then uses smart software to create valuable information and digitally enhanced services.

READ MORE ABOUT OUR SECTOR

http://smartcitiescouncil.com/article/our-vision

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CONCLUSIONS

1. A city's infrastructure, by definition, supports the city's physical, economic and social systems.
2. ASCE's report card evaluating America's infrastructure indicates major deficiencies and improvement needs.
3. Infrastructure is a significant economic development tool of every city.
4. New technologies can transform cities into more sustainable systems as investments are made in replacing aging infrastructure.
5. With the ubiquity of sensors, useful results can be obtained through the collection, organization and analysis of "big data".
6. A city utility system can generate revenue to support itself and other non-revenue generating activities, such as the city's parks and open space system. Parking can pay for transit.
7. Taking a holistic view of operations such as water and wastewater across department lines, eliminates the inefficiencies of silos by aggregating, integrating and visualizing key data such as consumption, quality, flow and pressure.
8. Advice and experiences of others are becoming plentiful. The ICMA, the National League of Cities and ASCE provide resources to help evaluate the pros and cons of the surging technological wave.
9. Private industry is aggressively innovating city applications for technology; stay ahead of the private vendors; work with them, not for them.
10. A big idea [read *Smart Machines*] is the notion of the city designed as a single an operating system…think about it.

READINGS.

1. **Next Generation Infrastructure: Principles of Post-Industrial Public Works,** Hillary Brown, D.C.: Island Press, 241 pages, 2014.
2. ***Operating Manual for Spaceship Earth,*** Fuller, Buckminster R. [1885-1983], Southern Illinois University Press, 1969. Pocket Book edition published November, 1970; 7th printing, October, 1974.
3. ***Playing to Win, How Strategy Really Works,*** Lafley, A. G. and Martin, Roger L., Harvard Business School Press, Boston, Mass., 2013.
4. **Smaller Faster Lighter Denser Cheaper: How Innovation Keeps Proving the Catastrophists Wrong,** Robert Boyce, New York City: Public Affairs, 371 pages, 2014.
5. ***Smart Machines, IBM's Watson and the Era of Cognitive Computing,*** John E. Kelly III and Steve Hamm, Columbia University Press, New York, 2013.
6. ***The Knowledge: How to Rebuild Our World From Scratch,*** Lewis Dartnell, New York City: Penguin Press, 340 pages, 2014.
7. ***The Resilient City. How Modern Cities Recover from Disaster***, Vale, Lawrence J. and Thomas J. Campanella, Oxford University Press, 2005.
8. ***The Sanitary City: Environmental Services in Urban America from Colonial Times to the Present,*** Martin V. Melosi, [Abridged] [Paperback], The Pittsburgh Press, University of Pittsburgh, Pittsburgh PA, 2008.