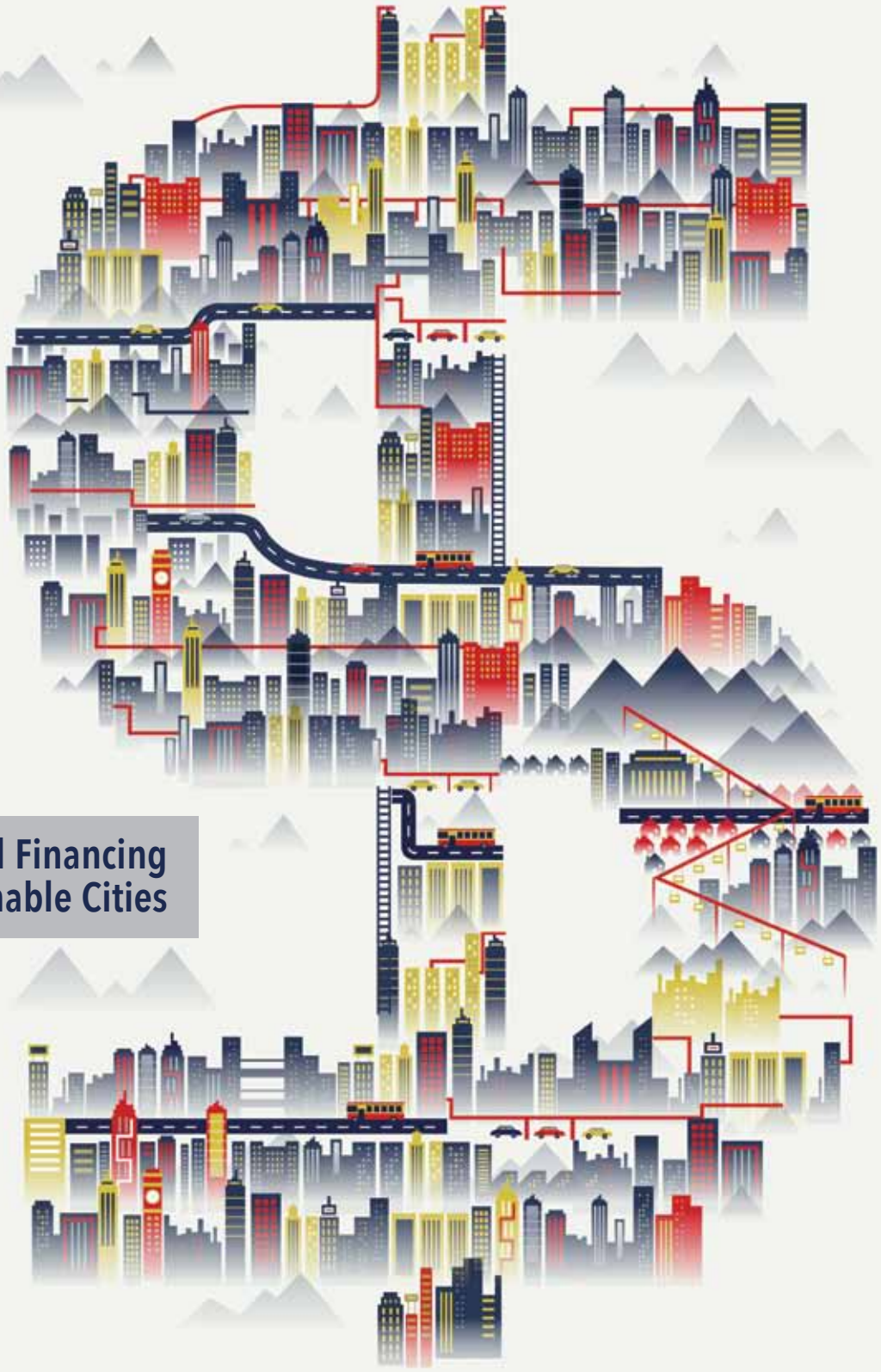
Planning and Financing Smart Sustainable Cities



BY VINCENT REITANO

The United Nations projects that 66 percent of the world's population will live in urban areas by 2060.[1] In response to this trend, policymakers are applying evidence-based insight to city design. For example, city infrastructure is being outfitted with sensors to reduce energy usage, expenses, and pollution. Video cameras are being installed on highways and major intersections to monitor and manage traffic, a cheaper alternative to building new highway lanes. These and other initiatives lie at the intersection of urbanization, sustainability, and digitization, which together form the framework of smart sustainable cities (SSCs).[2] Many definitions and variants of SSCs exist, but generally speaking, they all converge on the idea that city decisions should be real-time, evidence-based, and involve all community stakeholders in order to meet the current and future demands of citizens. This article reviews case studies demonstrating the ability of SSC design planning and financing principles to improve greater efficiency and effectiveness in government — in addition to long-term economic development.

THE CONCEPT

The concept of SSCs has its origins in an ongoing effort to use evidence-based research (EBR) in government. Traditionally, EBR relied on researchers to study policy data and then test its efficacy with statistical procedures, in support of evidence-based decision making (EDM). The process of EBR is often time consuming, costly, and can be subject to human error and even political influence.[3] In some cases, however, EBR is being replaced with data science algorithms that effectively automate EDM as part of a smart sustainable city. While automated algorithms will never completely replace traditional EBR, they can work well for some defined use cases. For example, sensors, cameras, and other monitoring devices can instantly collect data on infrastructure to be analyzed by an algorithm, which can automatically send public works crews to address an issue.

A common example is the use of sensors in buildings to monitor internal and external temperature, emissions, and in some cases, even movement throughout the building. For example, Stanford University continuously monitors and adjusts the temperature in campus buildings, which is projected to save $420 million in 35 years.[4] Further, the One Albert Quay building in Cork, Ireland, can do everything from managing building temperature to collecting rainwater and reusing it in sustainable ways.[5] In fact, One Albert Quay and other SSC projects have been such attention-getters that they attract foreign investments for economic development with private firms such as AT&T.[6] These achievements have motivated local government officials throughout Ireland to make cities smarter and more sustainable:

> *"All over the world, rapid urbanization is putting enormous stress on resources and infrastructure which cannot be solved in a traditional way. However, cities can remedy these challenges by adopting a new approach and embracing innovative solutions and smart technologies to not just manage problems, but to enhance sustainability and competitiveness."*[7]

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A variety of use cases, which go beyond innovations in buildings, are directly relevant to public goods. Street corners and traffic signals can also be retrofitted with different types of sensors to collect data on and manage both pedestrian and automobile traffic. For example, the Tennessee Department of Transportation has an Intelligent Transportation System that measures traffic flow patterns, better detects accidents and traffic jams to provide quicker emergency responses, and communicates findings to the public via digital signs on roadways. Metrics are reported quarterly, providing an accountability measure. Additionally, the platform could be expanded as more devices are added to provide broader coverage than the major roadways currently being monitored in Tennessee.

In cities such as London, England, closed-circuit television (CCTV) video cameras on streets monitor real-time events and ensure that traffic flows smoothly. Monitoring can be automated with video analytics or even monitored with individuals who are trained to detect irregularities. The contractor on the project is only paid if 98.5 percent of systems are operational, a performance metric that yields immediate accountability for public money.[8]

THE INTERNET OF THINGS

Sensors, video cameras, and other technologies become even more powerful when they're interconnected. If they are integrated in a "machine-to-machine" setup, they become part of a broader "internet of things" (IoT), where input devices instantly collect data to be analyzed and used for automated decision making. A fully integrated SSC can use data feeds from thousands of devices in a decision ecosystem to effectively monitor aspects of a city. The most effective and advanced SSCs automate the process across all devices with a central predictive data analytics platform. Then, algorithms can detect patterns in the data and provide feedback to the sensors to mitigate a problem.

One of the clearest examples of IoT as part of the SSC is from Sweden. The country has set ambitious goals to greatly increase the use of public transportation to reduce pollution and traffic. One of many approaches Sweden has implemented is putting sensors on traffic lights and buses that can interact. For example, if a bus is running late, its sensors can communicate with the sensors on traffic lights, and the traffic lights can automatically prioritize buses to get them back on schedule.[9] This is just one approach to make public transportation more accessible and viable than driving in a private car.

Another example is when cities use sensor data in an IoT ecosystem to inform real-time public transportation apps and ticketing systems. These data allow a visitor or resident of the city to download an app that tells them how long it will take to use public transportation between two locations. Additionally, an integrated IoT can link the app to digital payment systems on buses and trains, so customers aren't required to use cash or even buy a ticket at a station. Essentially, this unified approach to public transportation can improve public transportation ease of use, along with associated revenues. It can also have longer-term effects such as an easier and more fluid management of user fees from public transportation, while potentially smoothing out projections for transportation revenues.

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WHY HAVE SMART SUSTAINABLE CITIES?

SSCs depend on context. IoT technology is increasingly accessible and affordable, but before deploying it, a city should first reflect on the best way to use it in trying to become an SSC.[10] Such questions require input from all stakeholders, from the public to elected officials and administrators. The first question should be why a city should invest in becoming smart and sustainable.

A body of research is starting to indicate that SSCs, when carefully thought out and supported over time, can lead to many positive benefits. At a minimum, the technological side of SSCs, particularly IoT devices, can automate aspects of government to make it more efficient and effective. This does not mean that fewer people will be needed for government work. Instead, data from IoT devices that are analyzed with automated, real-time data analytics helps public employees deal with issues that cannot be automated, such as citizen engagement.

Government will always need a range of individuals to help run the IoT. Having sensors are in place doesn't magically create analytics. Specific algorithms need to be implemented, and performance metrics created, based on the context of the government. Thus, IoT may help automate government, but it does not take the "thinking" out of governance.

Economic development is another clear reason to become an SSC. Private businesses and citizens will be attracted to and want to locate and invest in cities that are smart and sustainable. This can lead to increased tax revenues for cities, while making them more competitive. One example of this phenomenon is the ongoing development of the Johnson Controls Hall of Fame Village in Canton, Ohio, which is a multiuse sports and entertainment complex with smart city design principles "driven by advanced data, analytics and connectivity…efficiency through infrastructure integration that advances the human experience." The project reflects an $800 million investment as part of a strategic partnership. It is expected to have more than $15.3 billion in economic impact over 25 years.[11]

A further result from SSCs — which may be the most important and the most difficult to quantify — is making cities more livable. Many of the above examples not only reduce pollution, decrease infrastructure costs, and accelerate economic development — they also go beyond these measurable performance metrics and make city life better and more sustainable in the long-run. Reducing traffic times is one of many outcomes that IoT can achieve to make cities more popular and healthier to live in. Given a global world and increasing urbanization, cities are going to want to offer such features to attract new citizens and entrepreneurs who actually want to live in a city rather than just work in it.

> Evidence-based research is often time consuming, costly, and can be subject to human error and even political influence, but it is being replaced with data science algorithms that effectively automate evidence-based decision making as part of a smart sustainable city.

Of course, SSCs are imperfect and require extensive planning. One concern is the security around IoT devices, given the ongoing hacking of major corporate and even government databases. This article does not cover the scope of IoT and SSC security, but it should not be taken lightly.

HOW TO BECOME A SMART, SUSTAINABLE CITY

After determining the why, the next question is how to make a city smart and sustainable. A guidebook would be helpful, but an SSC is not something that can be implemented overnight, using experiences from other governments. Instead, it has to be carefully planned out and supported over time, depending on the specific context of the government.

In fact, becoming an SSC is an ongoing process that should be continuously evaluated, rather than being viewed as a one-time goal. Below, major aspects of the "how" question are addressed, including planning and citizen engagement, implementation and financing, and performance.

Planning and Engagement. Planning for smart cities should be conducted across government departments and with as many stakeholders as possible. Consider the case of the City of Kalamazoo, Michigan, which recently released its Imagine Kalamazoo 2025 master plan. The plan is intent on creating a "more prosperous and equitable city," and this realization was the work of everyone in the community. The city made sure people at all types of events, from open houses to picnics, were integrated into their planning process, which also included online survey responses. Values, strategic goals, objectives, actions, and metrics were developed to ensure the plan would follow an orderly and unified process over time, with the intent of translating goals to actions that can be measured over time as Kalamazoo becomes a smarter and more sustainable city. In the spirit of democracy, this process ultimately reflects the interests of the community.

Implementation and Financing. Even if a government creates a comprehensive strategic plan, its success is not guaranteed. A unique aspect of the SSC is that it is forward looking and integrates the perspectives of many stakeholders, including private business and investors. In many cases, it takes the involvement of firms that assist with the development and implementation of IoT devices and analytics. The private sector often brings best practices and experience to the mix, and they can help with linking venture capital opportunities to subsidize the public investment.

In many cases, a community can put itself on the road to becoming an SSC by aligning its values (e.g., emphasizing sustainable economic development) with those of appropriate private businesses, which can foster public-private partnerships (P3s) and attract other large public infrastructure investments. Consider the case of Columbus, Ohio, which won the 2015 Department of Transportation $50 million Smart City Challenge grant. The money made it possible for the city to begin a variety of SSC projects, and to connect with local, regional, and national companies to work on these projects. In effect, Columbus is serving as an SSC laboratory, with the hope of serving as a model for other U.S. cities that want to learn how to finance strategic infrastructure and technological investments.[12]

When working with P3s, a key goal is to ensure that private companies fully understand the government's priorities and what they must do to meet the needs of the community. Governments should emphasize finding mutual benefits from a P3 arrangement. One example is the City of San Francisco's Startup in Residence (STIR) program. To help build a 21st-century government, the city fosters startups with civic tech. In some cases, this can lead to mentorship for startups and

the possibility of a first government contract for technology startups that are innovative and can help create a smarter city. Case studies indicate that STIR has produced technologies that help improve the foster parent process, data visualization for community services, community outreach, and homelessness services, among other critical areas that need innovative and cost-effective solutions.[13]

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Performance. There is always an interest in increasing the efficiency and effectiveness of government. The SSC IoT examples discussed throughout this article directly lend themselves to improved performance. In fact, SSCs will be able to respond in real time to emerging concerns in a community, ranging from immediate issues (e.g., traffic and public safety) to problems that need to be addressed into the future (e.g., pollution). Thus, SSC technologies represent an investment in government's ability to respond to citizens' needs while ensuring sustainable and technologically advanced governance.

LONG-TERM SUSTAINABILITY

There is also the broader question of how SSC interacts with long-term financial sustainability. Even with financing strategies such as P3s, finance officers may question whether IoT-type projects are financially sustainable. If they are fully thought out and well planned, however, there is no reason why these projects cannot be sustainable in the long term.

According to the Smart Cities Council, technologies such as IoT will create equity and economic prosperity. This occurs through a "triple bottom line" that includes savings and positive benefits from financial, social, and environmental perspectives.[14]

In terms of financial prosperity, cost savings are associated with many IoT projects. Over time, these savings can add up and be projected via return on investment calculations. If a project breaks even or even has a positive net return, then an IoT project that makes a city smart is indeed sustainable. Sensors that can reduce energy costs for a building or mitigate risks to electric and water utilities are examples of technology that will reduce costs and avoid community losses.

One of the less-recognized aspects of IoT is that it can be expanded over time. Indeed, no project is likely to implement an entire IoT ecosystem instantaneously. Like much of government infrastructure, it can be implemented and paid for over time with a variety of financing mechanisms, ranging from P3s to actually devoting a small portion of public revenues specifically to smart and sustainable projects. In some cases, such as the City of Atlanta, Georgia, the public data from sensors can be sold to companies that make apps. (The prospect of selling data may be challenging for a variety of reasons, but it will continue to occur as governments look for innovative financing solutions.)

CONCLUSIONS

SSCs are increasingly enabled by IoT. Cities across the United States, Europe, Asia, and other regions have made great strides in responding to rapid urbanization, and significant potential exists for innovation that goes beyond investment into technology and into making city life better for all citizens. SSCs continue to broaden government's scope of operations from day-to-day tasks to longer-term planning.

Notes

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