Fueling Urban Innovation with
Smart City Technologies:
Why an Open Approach is Key

Today's cities face an expanding array of economic, environmental and demographic challenges. In a rapidly urbanizing world, more and more people choose to move to urban centers each year. The U.N. projects that 68% of the world's population will live in cities by mid-century, up from 55% today. Such growth will place additional demands on urban infrastructures while necessitating that city governments deliver services at an ever-greater scale.

Cities currently assume the responsibility for the majority of the world's energy consumption and greenhouse gas emissions, but they also stand to bear the brunt of many of climate change's effects. Already, some urban areas see increased risks of catastrophic weather events and flooding, while others face water shortages and wildfire risks.

The events of the last two years, including the COVID-19 pandemic and subsequent economic aftershocks, have increased the urgency of these issues. Revenue streams experienced a significant negative impact from the pandemic, straining budgets and hindering cities' ability to provide their citizens with services. In many urban areas, economic and geographic digital divides widened during the pandemic.

WHAT, EXACTLY, *IS* A SMART CITY?

While exact definitions of "smart city technologies" differ, a commonly-held view considers smart cities as those that "use data, connectivity and forward-looking technology to solve citizens' problems," according to Brandon Campbell, Smart Mobility Manager for the city of Tampa, Florida. Or, as the city of Denver's CIO David Edinger explains, a smart city "uses edge technology and data, especially real-time data, to improve the urban experience and quality of life for its residents."

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The results exposed the need for efficiency, and that need has never been greater. Cities must provide convenient, easy-to-use services for their citizens to meet their needs in equitable and accessible ways. To achieve this cost-effectively and at the required scale, they'll need to leverage technology to streamline operations and use data purposefully to deliver a better quality of life to residents.

Smart city technologies promise to make it easier for municipal governments to do just that. When successful, smart city initiatives will enable cities to reach environmental and sustainability goals, improve government service delivery and use funds more effectively.

However, achieving success with smart city initiatives isn't always easy, especially for municipalities with less experience implementing and managing these types of projects. One recent survey found that 49% of smart city projects remained incomplete four years after the project's commencement.

In general, we can describe a city's internal expertise and track record of managing smart city initiatives in terms of a maturity model. This continuum considers the least mature cities those that adopt smart city technologies on an ad-hoc, department-by-department basis. At the other end of the spectrum, the most mature cities maintain a holistic strategy, comprehensive roadmap and resident-centric perspective on smart city technology adoption. The more advanced a city's smart city maturity, the more likely it is to see success when implementing smart city projects and the more likely it is to realize long-term value from such initiatives.

This playbook will discuss how adopting an open approach (including open source technologies, open standards and open data) enables cities to advance their smart city maturity. In turn, this shift helps cities become more likely to experience success in and realize value from their smart city initiatives.
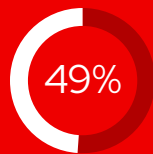
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HOW SMART CITY INITIATIVES ARE IMPROVING GOVERNMENT SERVICE DELIVERY: A FEW EXAMPLES

Smart emergency response systems that optimize call center and field operations for first responders in conjunction with traffic-signal control systems to give emergency vehicles a clear and safe path to the incident.

Intelligent integration of water/utility maintenance and road maintenance operations so that scheduling the repaving roads can take place after sensors or lifecycle data indicate that a water or sewer main needs repair.

Use of mobile apps to streamline the experience of using and paying for public transportation.

Water consumption tracking to identify leakage from waste systems and pipes and encourage conservation.

Smart lighting solutions that can not only turn on at dusk and off at daybreak but that can also adjust illumination levels based on how much activity is taking place around them. These solutions can automatically transmit information about their own maintenance, and their telemetry data could help with police resource allocation, since there's less need to patrol blocks with no activity.

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How an Open Approach Enhances Smart City Maturity

City governments share many similarities with other public and private sector entities tasked with collecting, analyzing and communicating data to generate revenue, improve efficiencies and make better decisions. But they also have unique needs and requirements that make open approaches a particularly good fit for use in smart city projects.

WHAT IS OPEN SOURCE?

Originally, the term "open source" referred to a software development methodology. Created for visibility, accessibility and availability to the public, open source code allowed anyone who wanted to see, modify or distribute the code in any way they saw fit. In this sense, proponents of the open source approach have been transforming software into a public good or utility.

Open source has since become a movement, philosophy and way of working that extends far beyond software production. The open source movement values transparency, decentralized problem-solving and public collaboration — all as a means of value creation.

Open source isn't just "free software." Even though open source projects have zero acquisition costs, open source products include support and lifecycle management expenditures. The open source approach has multiple benefits that make it cost-effective and well-suited to serve as a long-term foundation for tomorrow's smart city initiatives.

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> **HEIDI NORMAN,** Director of the Department of Innovation and Performance and CIO for the City of Pittsburgh

OPEN SOURCE, OPEN DATA AND INTEROPERABILITY

Today's cities exist in a state of constant and rapid change. Citizens' expectations evolve in tandem with consumer-oriented technologies, and cities' ways of delivering services and meeting their residents' needs must advance accordingly. Leveraging open source software, implementing open standards, and using an open data strategy will give municipalities the flexibility they need to build future-ready technology infrastructures.

First of all, cities remain obligated to operate within resource constraints. The ability to demonstrate the value that smart city initiatives provide for municipal governments and their constituencies is essential for stakeholders. To do so, they'll need access to data derived from applications, sensors and systems so that they can harness it for analytics. However, city governments tend to have siloed organizational structures, with each department potentially storing their data differently or using proprietary vendor-provided data structures.

"For us, being able to have access to the data that's generated by smart city technology systems that we're implementing is critical," said Heidi Norman, Director of the Department of Innovation and Performance and CIO for the City of Pittsburgh. "We need to be able to decide for ourselves which of the data we want to collect, analyze and report on. We've been frustrated with proprietary solution vendors who say that being able to download a CSV file once a month is adequate data access. It's not. Instead, we need standardized APIs, specifications on how open APIs need to be, and open data dictionaries so that everyone can understand what all the fields are."

An open approach makes this sort of data interoperability possible. When stakeholders from all departments across a city agree to adopt open standards — for data structures, formats and APIs — universally, they'll all be able to facilitate the free exchange of data amongst themselves, with multiple technology vendors, and with other government entities. They'll also be able to share their data with their constituencies and the general public.

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This approach also increases flexibility when purchasing commercial off-the-shelf (COTS) software and solutions. Rather than staying locked into a single vendor's ecosystem, a city that has adopted an open smart cities approach can choose the best components for its evolving needs. This encourages the vendor community to continuously deliver value and creates a robust ecosystem for vendor selection.

"By definition, smart cities are comprised of an array of disparate components," said David Egts, Chief Technologist and Senior Director, North America Public Sector, at Red Hat. "Even if you buy a solution from a single integrator, that integrator will likely be buying different parts from different vendors. As time passes, companies will come and go. An open source strategy enables you to futureproof your smart city initiatives because instead of buying a 'smart city in a box' from a single vendor that won't work without that vendor's components, you can plug in sensors or other system components from any vendor that uses the open standards and communication protocols. And it'll work."

"The idea behind the open source approach is that it's a meritocracy," explained John Senegal, Principal Customer Success Architect at IBM. "In the open source philosophy, all ideas are published, so they're all available for critique. That way, the best idea can win. If the goal is to be open and efficient, this process leads to the kind of cultural change that paves the path for interoperability."

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Nurturing Open Source Culture for Smart City Success

As mentioned, open source isn't just a way of building software or creating technology. Adopting the open source approach also requires changing mindsets and navigating a cultural shift. In the past, city governments have had a longstanding tendency to operate within departmental silos. Expertise typically stayed concentrated within jurisdictions. Commonly, people in one department remained unaware of a project implemented by another. For instance, the public works department might not know about a project carried out by the department of traffic and transportation until it goes public — even though both departments undertake projects related to the city's roads.

"Generally speaking, cities are very amenable to sharing their data," said Senegal. "But each department has its own needs and needs and responsibilities. Without purposeful effort, they won't necessarily take the time to build common standards so that they can all do their jobs better. Or there's simply a lack of knowledge about what data exists across the organization. Open source can bring all parties and stakeholders together to understand the technology and their shared objectives."

"Cities are a sort of breeding ground for the open source philosophy. Not only because they can share data and technology but also because they can share processes and approaches. The reality is that most cities have the same problems."

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Adopting an open approach encourages ongoing transparency and information-sharing. Rather than individual departments going it alone, stakeholders are incentivized to share ideas, proposals and learnings from implementing projects and overseeing smart city operations. This model fits well with cities' commitment to serving their citizens holistically and providing transparent access to information about how they use public funds to create value. It's a superior alternative to doing things on an agency-by-agency basis. It also complements the municipal government's goal of collaborating across departments or with other public sector entities to meet citizens' needs efficiently and effectively.

When multiple cities and local government entities adopt open approaches, everyone can collaborate on projects, share best practices and eliminate repeated efforts. Such transparency also encourages public trust in government.

Senegal continued, "Cities are a sort of breeding ground for the open source philosophy. Not only because they can share data and technology but also because they can share processes and approaches. The reality is that most cities have the same problems. So, if one city builds a smart trash can solution and another develops a smart traffic management system, they can each benefit from and improve upon the other's work. The other cities' trash and trash projects won't be identical, of course, but they'll share a common foundation that makes it much easier to build them out."

The need for collaboration with other public sector entities is particularly acute for city governments, which often share responsibilities with counties, regions or state and federal government entities. The city of Pittsburgh, for instance, has built a collaborative data-sharing agreement with the Allegheny County Council, whose physical jurisdiction overlaps with the city's.

"Together with Allegheny County, we co-founded a data trust through which we make our data open," noted Chris Belasco, Manager of Data Services in the City of Pittsburgh's Department of Innovation and Performance. "We built this initiative together, in partnership with the University of Pittsburgh. We're using an open source data management tool that the Western Pennsylvania Regional Data Center helps manage to serve open data to the public. We've also made our code repositories publicly available. Anyone can see what's in the development efforts we've made to leverage cloud resources or build data pipelines. And the software we've built was created as a civic utility."

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Benefits of an Open Approach to Building Smart Cities

Tomorrow's cities will likely be more livable and sustainable while also becoming better able to listen to and meet the needs of their citizens. Cities that adopt an open source approach to smart city technology adoption will have a better ability to build holistic, interoperable systems that meet residents' needs (and whose value can be demonstrated through the use of analytics). But other advantages exist to adopting this approach as well.

COST ADVANTAGES.

While open source software isn't zero-cost, the bulk of expenditures shifts from licensing (an acquisition expense) to operations and maintenance. Given municipalities' limited budgets, not needing to pay to license intellectual property certainly offers an attractive proposition.

MODULARITY.

Open source software tends towards a modular architecture, meaning that code is built to be flexible, robust and re-usable. Open source software can serve in a variety of use cases, with the intent to avoid needing to reduplicate efforts. Rather than having each city re-invent the wheel, an open approach encourages participants to re-use innovations developed elsewhere, saving time and effort.

MANY EYEBALLS MAKE ALL BUGS SHALLOW.

Empirically, open source development practices tend to produce better quality software than proprietary development. Not only can open source projects tap into the expertise of the world's best developers but because many people will work on the same problem at once, bugs and edge cases will surface much more quickly. Since security is (and should be) top-of-mind for today's municipal leaders, and since adding large numbers of connected devices greatly increases a city's IT attack surface, this cost-effective security advantage can greatly benefit smart city projects.

ACCESS TO MODERN DEVELOPMENT PRACTICES.

Culturally speaking, open source software goes hand-in-hand with agile and DevSecOps methodologies. This alignment means that development cycles tend to be shorter, releases more frequent, and the quality and security of the software higher. Because today's citizens increasingly expect that digital government services will offer experiences on par with those they've grown accustomed to as consumers, the delivery speed and agility that open approaches make possible play a major part.

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MEET ETHICAL OBLIGATIONS TO GOVERN TRANSPARENTLY.

City governments are entrusted with the responsibility to perform public services using tax revenues. It's their duty to spend this money wisely. Many stakeholders would argue that the city remains obligated to share whatever they create with their constituencies — including code and data. An open data approach makes it possible for third-party developers to build tools leveraging the smart city data made publicly available through open APIs, supporting and encouraging public-private partnerships.

ATTRACT THE MOST TALENTED DEVELOPERS.

The best developers want to work on the most interesting unsolved problems. And the biggest names in technology contribute to open source communities. In fact, Google, Microsoft, and Red Hat, the three largest contributors, maintain open source repositories on GitHub. Plus, open approaches tend to lend themselves to novel ideas, such as the concept of citizen-as-sensor, in which members of the public voluntarily participate in an open initiative by, say, reporting potholes or adopting fire hydrants to shovel out after snowstorms. This inherently democratic approach encourages a spirit of generosity and ownership along with innovation. Today's smart city use cases need this sort of motivating force.

Smart City Maturity Prepares Cities for a Technology-Enabled Future

As digital transformation accelerates, it will only become more and more important for municipalities to take advantage of the rich benefits of adopting an open approach to smart city initiatives. Some of these appear technological in nature, but many go far beyond technology. After all, open organizational cultures — that prize transparency, inclusivity and adaptability — spur innovation and encourage bringing new ideas to life.

At Red Hat, we're more than just familiar with these ideas; they form our core values and make up our DNA as a company. Open source principles guide how we create software and how we work, and we have extensive experience building technology solutions supported by open source principles. This commitment makes us the perfect partner for state and local government agencies striving to meet citizens' needs while embracing emerging technologies. We believe that the future of government is digital, and we'll work alongside you to make your path to that future as smooth as possible.

Visit us at red.ht/state-local to learn more.

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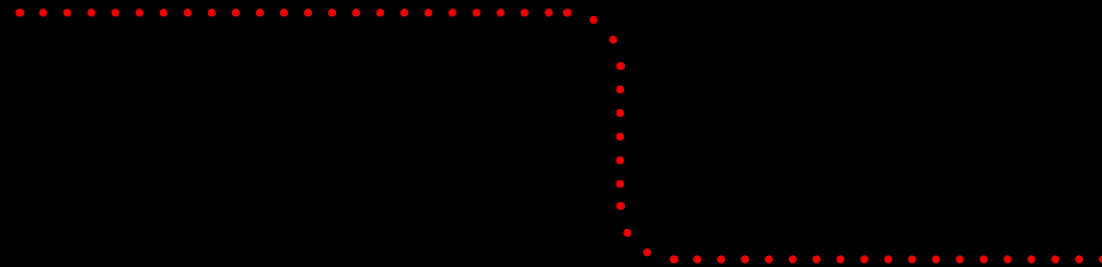
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