

What It Takes to Be a Smart Community

An Esri® White Paper
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What It Takes to Be a Smart Community

Changes, Challenges, and Opportunities

Change is a constant. Demographic shifts and fiscal fluctuations impact communities around the globe, prompting community leaders to adapt by changing the way they think and operate.

In part, these changes are driven by the rapid increase in urban population. The United Nations Department of Economic and Social Affairs, Population Division, predicts that by 2050, an additional 2.5 billion people will be living in cities. Today, more than half the earth's population lives in cities. By 2050, that number will climb to two-thirds.

Population growth is not solely the domain of megacities. Even smaller cities must plan for high population growth rates. Commerce City, Colorado's population grew from 20,991 to 45,913 between 2000 and 2010—that's a rate of 118 percent. The city is expected to grow another 31 percent by 2019, according to Esri's demographic projections.

With the expected increases in population, cities need to adjust to accommodate the new citizens who will soon be at their doorstep. Those citizens will require energy resources, transportation, public safety, and housing. New residents will want safe, livable communities that provide satisfying work experiences. Unlike in past eras, communities planning for growth now must factor in potential impacts from climate change and more dramatic weather conditions. How will existing city infrastructure and systems address the added demands? How can new systems be most efficient and effective?

Population demographics are changing too. In many communities, the population is aging. Other communities are seeing an influx of immigrants. Shifts in demographics bring about a need for new and different services. For an aging population, more health and transportation services might be required. Immigrants are likely to need specialized education to help with language barriers. In the workforce, new demographics impact the skill sets, needs, and expectations of workers. How can local governments adjust services to support the changing needs of their population?

As governments work to provide services, citizens—especially Millennials—are demanding more transparency. Citizens want to see what's going on inside their local government. How can government provide more transparency and be more inclusive without slowing down the delivery of services? Better yet, how can government work together with young, tech-savvy citizens to address community needs in more innovative ways?

Not only do citizens expect transparency, they also expect higher levels of customer service, on a par with what they get from businesses. Now is the age of the consumer. To remain competitive and attract highly skilled citizens and valuable businesses, communities need to evolve quickly to improve services and appeal. Local governments also need to create and foster a vibrant, inviting culture—a place where bright, young innovators will want to live and work. Small and mid-size cities are challenged to provide

a desirable lifestyle and environment for economic development so they do not risk losing people to larger cities that already have so many amenities.

As if those challenges were not enough, most local governments have been through a period of reduced budgets. Insufficient funds means aging infrastructure is not updated or replaced. How can communities stay competitive, meet the needs of growing and changing populations, and accomplish more with the resources they have when it's already a struggle to maintain existing infrastructure and levels of service? As local government budgets rebound from the economic downturn, where will the wisest investments be made?

Reasons to Be Hopeful

Fortunately, new advancements in technology and data collection can help communities successfully tackle challenges by working smarter instead of harder. We live in a time in which just about anything can be tracked and monitored using sensors. Smartphones, with apps galore, are all but ubiquitous; cloud computing keeps getting better; and we can share data online and visualize plans in 3D. With the right technology, every community can become a smart community—a place that is more livable, sustainable, and economically vibrant. The technology that will help our communities make the transition is spatial. Smart communities will require geographic information system (GIS) technology.

Smart technology, together with smart people, will propel communities even further. We will be able to engage citizens, nongovernmental organizations (NGO), businesses, and the academic community in the problem-solving process. Imagine the potential for something amazing—a community that is greater than the sum of its parts; a city that is a true hub of innovation and economic growth; a place that is livable, sustainable, and resilient.

There are steep challenges ahead, but there are tools and a pathway to successfully address those challenges. Leaders in local government probably already have the tools they need. They just have to start using them in a different way.

Get a Clear View

Leaders must seek first to understand: *What* and *where* are the community's needs? What is the status of available resources? Smart communities are already getting a comprehensive view of needs and resources by using GIS and even incorporating real-time sensor data and 3D visualization. Citizens and businesses are using open data and increased governmental transparency to collaborate and drive innovation. When you can see the entire, community-wide landscape, it is much easier to identify gaps in service or areas that need to become more livable, sustainable, and resilient. That clear view can be seen from a GIS platform—a way to view, map, share, analyze, and act on information about the community.

GIS Provides a Comprehensive View and Understanding

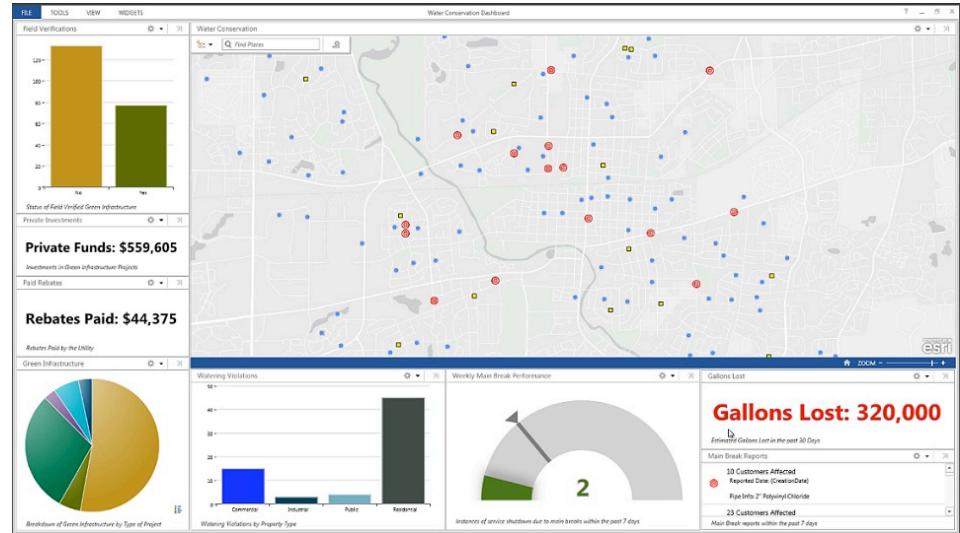
GIS pulls it all together. Every feature and resource in the community has a location. You can use that location within your GIS to look at data from various sources, systems, or departments. You can analyze community assets in relation to other assets or features of the community to gain valuable context and greater understanding. In this way, location is the common thread needed to create a complete view of what is happening.

When you look at a map, you inherently start turning that map into information by finding patterns and assessing trends that otherwise would not have been uncovered. This

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is *spatial analysis*. When you see information about your community on a map, you understand where resources are located and where they will need to be in the future.

Community leaders use maps to actually see where historic changes have occurred and how future plans will impact the community. This makes the decision-making process more focused, better researched, and more in line with smart community goals.



A complete picture: In this dashboard view, GIS brings together multiple sources of information on a map for greater context and smarter decisions.

Go Deeper with Spatial Analysis

When you see data on a map, you gain insight. But GIS can help you do much more by providing you with spatial analysis capabilities. You can answer important questions: Where is the best location for a new building or a community service offering? Is there a relationship between disease and environmental features in our community? What are the most efficient alternate routes a bridge is closed for repair? Through your GIS, you can also use spatial information to make predictions by asking questions such as Where are water contaminants most likely to flow? and Where will a fire most likely spread?

By using spatial analysis to answer questions and make predictions you give your community smarter use of its resources plus better services and increased safety for its citizens. The possibilities for spatial analysis are practically endless, limited only by the imagination and available data. Fortunately, new sources of data continue to emerge.

Sensors Provide a Valuable Source of Data

Communities have access to a new source of detailed, real-time spatial data, thanks to the expanding use of sensors for tracking, monitoring, and connecting many daily operations. Sensors can broadcast when a parking space is open, a city trash bin is getting full, or an energy turbine requires maintenance. When sensor data is combined with GIS, communities can see what is happening where and react more rapidly to events.

Using GIS and sensor data, many communities are tracking the real-time location of snowplows, police vehicles, city buses, and trucks. School buses in Dubai are tracked and drivers and operators are notified if buses veer from their planned routes. Parents can

track their child's progress to and from school and are notified a few minutes before it is time to pick up and drop off their children.

GIS is also used to overlay the path of storms with sensor data to narrow down which electric utility equipment could be impacted by severe weather, reducing outage time and accelerating restoration of service. The increasing reliance on spatiotemporal data means that GIS will become essential as communities begin to adopt more advanced technologies.

Community Engagement Adds to Your Data

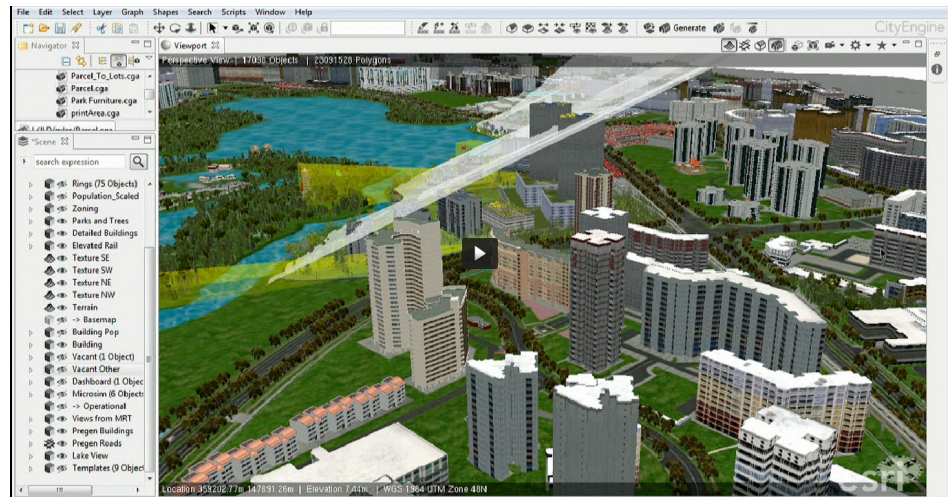
Community engagement means that you can communicate directly with citizens and staff, and they can communicate immediately with you—reporting problems, locating services, and supporting local initiatives. Citizens can use their cell phones to voluntarily collect information about their surroundings and share that data with the community. You can use GIS to aggregate this and other data on a map to identify hot spots such as water conservation concerns, property damage, mobile health clinics, or areas in need of graffiti removal.

3D Modeling and Visualization Improve Planning

Sensor data and community engagement within GIS give a clearer view of your community. You can make that view even more holistic by adding 3D visualization and analysis. Compare, for example, construction proposals of a new structure by viewing and analyzing them from every angle to see how each proposal fits into the landscape. You can make a more informed decision before any construction occurs. Urban planners and the public can see the potential impact of any proposed building in terms of issues such as where it will cast shadows, block views, or reflect heat. And it's not just decisions about buildings that will benefit from a 3D view. When you see 3D representations of mass transit proposals, you get a more realistic view of the impact on communities and existing structures, so you can more accurately discuss the merits and concerns of proposed routes. The immersive nature of 3D visualization makes it an unparalleled tool for communicating community impact of a project design.

As populations grow and become more urban, leaders are under more pressure to design healthy, desirable communities with consideration for the way a built environment impacts residents' health, the economy, nature, and quality of life. GIS enables 3D modeling of large cityscapes, so planners can change a design and immediately see how it would affect livability, sustainability, and economic development for the *entire* community. In this way, the overall impacts of different development proposals can be calculated quickly and presented to stakeholders, helping them make better decisions.

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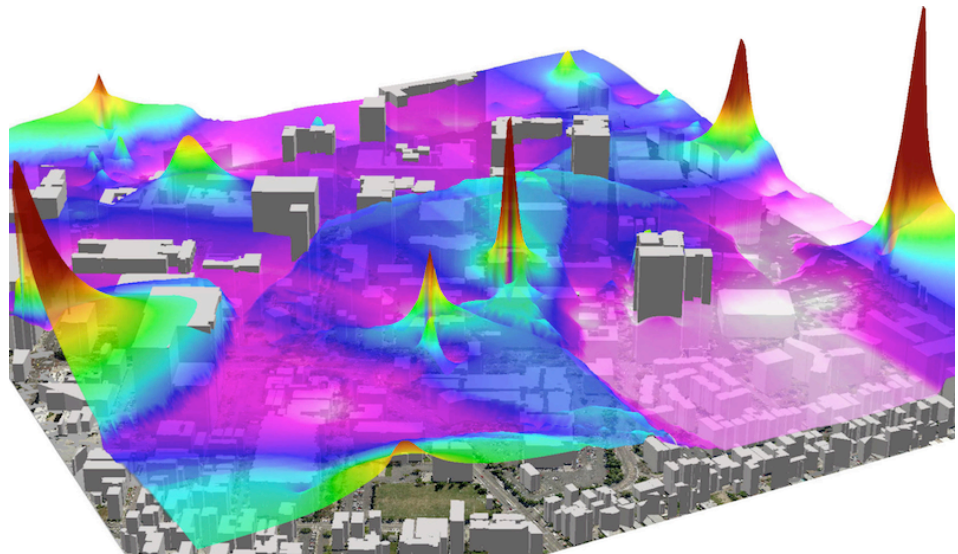


Case Study: Singapore uses 3D modeling to carefully plan growth on the already densely populated island. Singapore's Urban Redevelopment Agency takes into account local planning guidelines for land parcels and applies local building templates to iterate feasible designs quickly. Lines of sight and changes to traffic patterns are easily assessed and viewed in the context of a 3D environment.

The Intersection of New Smart Technologies

3D visualization is an excellent tool for quickly understanding patterns in sensor data collected across the city and at different elevations. For example, you can collect noise pollution data at different locations and building elevations throughout the city and render that data in 3D. Likewise, you can look at the severity of air pollution measured by sensors in 3D to show areas where pollution needs to be mitigated.

3D visualization is not limited to viewing the exteriors of buildings—data within buildings can also be visualized for analysis. GIS within buildings can be used for maximizing the efficient use of space, keeping track of the location of costly equipment, mapping floor plans and escape routes to help emergency services workers, and determining the best routes within buildings for getting somewhere. Data captured from sensors within buildings can be used to map the flow of people, measure indoor climate conditions, and help determine when and where maintenance is needed.



Case Study: Esri partner, Valarm, used a GIS-based app to collect air quality data such as volatile organic compounds (VOC) around the University of Southern California (USC) campus in downtown Los Angeles, California. The sensor data was combined with GIS for 3D visualization.

Geodesign for More Sustainable and Healthy Communities

Given the global concerns of climate change and growing population, it is more important than ever to evaluate planning and design decisions related to the built environment within the context of the natural environment. Communities need access to geology, biology, ecology, hydrology, meteorology, and other scientific data during the design process. Geodesign is a formalized process for taking into account all the geographic information and stakeholder input available when deciding where and how to build.

Geodesign principles are gaining wider adoption because GIS technology (including 3D visualization) makes them achievable. Geodesign uses GIS to automate the calculations of hazards, risk, sensitivity, capacity, proximity, accessibility, vulnerability, and other factors to inform design decisions. This allows planners and the community to compare and evaluate different plans more quickly. By incorporating geodesign principles into the planning process, communities have another means of increasing the sustainability and livability of an area while decreasing the overall time used for design projects.

Build on a Solid GIS Foundation

While there are new data sources and analysis techniques, GIS is not new to most communities. GIS capabilities have been used within government departments for decades in order to make the delivery of community services more efficient and effective. Governments have shown significant return on investment (ROI) when they use GIS technology to solve problems. King County, Washington, staff use GIS applications to improve operations in more than 42 county agencies. Dr. Richard Zerbe, an economist at the University of Washington, conducted a study measuring the ROI of the King County GIS program during the 18-year period between 1992 and 2010 and found that the county accrued net benefits between \$776 million and \$1.7 billion during that time.

"Our GIS service is an example of a high-performing IT service that is providing a large amount of customer efficiency for the investment. The GIS service is a model that we

want all our services within King County IT to aspire to."—King County Chief Information Officer Bill Kehoe

Take the Next Step: GIS as a Platform

Using GIS in individual departments is an important step for improving those departments. By taking the next step—making GIS data accessible and reusable *across* all departments—your community can reach higher levels of productivity and innovation. A good place to start is to transform existing GIS investments into a GIS platform that supports all departments with maps, analysis, and applications. Right away, you will reduce or even eliminate costs incurred by silos and redundant data collection. You will also more easily solve problems that span the purview of multiple departments.

Part of creating a modern GIS platform involves transforming GIS information into web services that can be shared across the platform and assembled in useful ways. Imagine having a comprehensive view of real-time road closures by pulling data from the multiple government departments in charge of transportation, utilities, emergency services, and public events. Similarly, imagine having real-time data from multiple departments in an executive dashboard that provides government leaders with the latest view of community-wide performance.

Better Planning and Resiliency

Up-to-date access to cross-departmental data is important for managing planned events, like road repairs, as well as for adjusting quickly to unexpected events, such as man-made or natural disasters. For this reason, a GIS platform is a powerful tool in creating resilient communities. Spatial analysis can be done in advance to improve disaster preparedness. You can, for example, identify the locations of your community's most vulnerable populations and infrastructure. During an emergency, you can use a common operating picture via your GIS platform to determine where recovery resources should be deployed to reach the most people. In the aftermath of a disaster, you can use GIS to plan and orchestrate recovery efforts.

Sharing Is Easier

Technology advancements over the last few years have paved the way for easier sharing. Traditionally, local governments have invested in centralizing GIS data behind the firewall on their own hardware. And they still can. However, the rise of cloud computing and storage has made the process of sharing and collaboration faster and easier. Data and map services can be easily shared online and consumed by those who have been granted access to the data. Individual government departments can still maintain the data locally while making sure the latest information is synced and published online. This ensures that the right people get up-to-date, authoritative data.

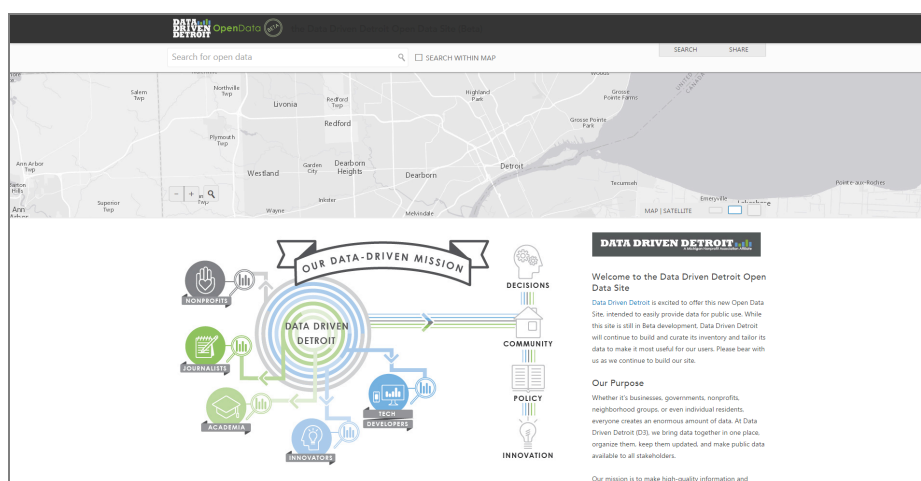
Sharing GIS data and map services across departments makes a government more efficient. By going even further and making data open to the community, you achieve citizen engagement, government transparency, and innovation.



In Los Angeles, California, mayor Eric Garcetti recently presented the first Civic Innovation Award to city Sanitation Department employees who used GIS web services to create a smartphone app for optimizing routes to pick up unwanted furniture. The task had previously been completed by using paper maps. The mobile application makes use of technology that people use in their daily lives.

Open Data for Transparency and Engagement

The same cloud infrastructure that enables the sharing of map data across internal departments can be used to share data with the public at large. This is an easy win for many communities. Making GIS data and maps available to the public leverages the existing GIS platform to inform and engage citizens. Creating an open data website not only provides a step toward greater transparency, it also empowers the public to unlock the value inside authoritative data. Open data can be used by everyone, from the entrepreneur building the next great app to the academic making a research breakthrough.



Data Driven Detroit recently created an open-data site to bring together high-quality data and analysis for community stakeholders including businesses, governments, nonprofits, neighborhood groups, and citizens. The goal is to drive better-informed decision making through the use of data by grassroots movement leaders and public officials.

Add Useful Apps

With a GIS platform in place, it is easy to start adding focused applications that meet the

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needs of both government and the community. New residents often have several questions about the community: Where are the parks and libraries? When is trash pickup day for this neighborhood? Where is the polling place? Using websites and apps that provide information about local services is a cost-effective way to deliver basic information while reducing calls to local officials. GIS-based applications within government also make processes and services more efficient, reducing the burden on limited existing resources.

Go from Good to Great

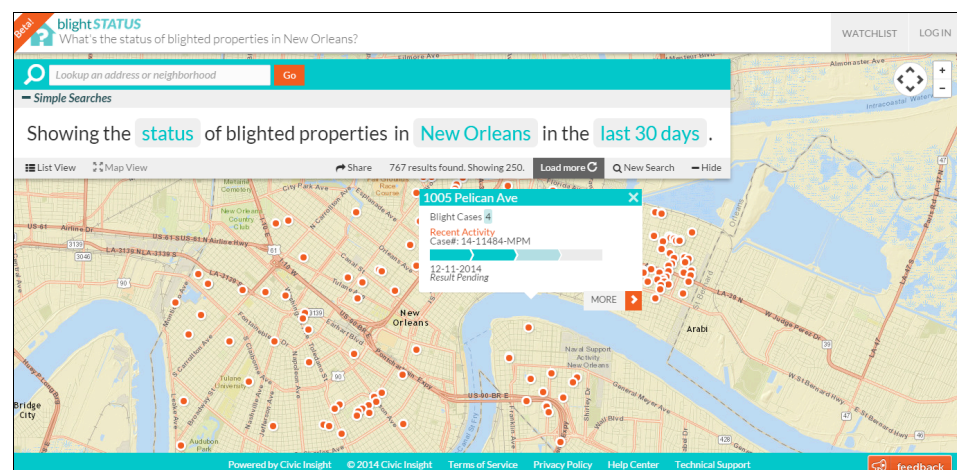
Become a Hub of Innovation

Putting in place a GIS platform and open data strategy creates the infrastructure for information sharing, solution creation, and innovation. The most solution-oriented, economically competitive communities will find ways to make their GIS platform and open data initiatives actionable by others in the community. These communities will actively work to become a hub of innovation by engaging with NGOs, start-ups, academia, businesses, and citizens.

Encourage Start-Ups

Data provided by the local government can find innovative uses when put in the hands of local start-ups. Entrepreneurial thinkers are often willing to put time, energy, and resources into creating new solutions. If those solutions meet a real need, a small business can bloom and grow within the community, creating attractive new job opportunities.

Government leaders increase the odds that a start-up will be successful by finding ways to create an ongoing dialog. Start-ups will be more successful in addressing a community problem if they understand the community's needs, comprehend all aspects of the problem, and have insight into how the local government functions. Is the local government likely to adopt and use a new app that addresses the problem? How should the new app feed into existing government information systems? By creating a dialog with local businesses, government leaders will accomplish better outcomes and find more useful solutions.



Civic Insight provided government data on blighted properties to the citizens of New Orleans in an easy-to-use tool called blightSTATUS.

***Partner with
Academia***

Academic institutions in the community may be an untapped source of skills and innovation. Universities have talented researchers who want to solve important, real-world problems. By engaging with students and researchers, local governments can activate potentially underutilized local resources, stimulate creative solutions, sharpen the skills of students, and introduce students to job opportunities so they don't leave the community after graduation.

Universities have their own incentives to be engaged community partners. They want to demonstrate that they are economic engines in the community and attract entrepreneurially minded students and professors. Some forward-thinking universities are creating programs for nurturing start-ups that begin on campus and helping them successfully transition into the local business community. Government leaders can leverage, encourage, and promote these programs. By sharing the problems that need to be addressed along with the authoritative data needed to address them, community leaders give researchers the projects and entrepreneurial opportunities they can really sink their teeth into.

Engage Citizens

Open data platforms and public-facing applications not only provide greater transparency but can also stimulate community involvement. When citizens don't have access to information, they tend to be more critical of government decisions. Providing information helps all parties operate from a common base of understanding grounded in fact and creates the transparency citizens are requesting.

Longtime residents might not realize how much their community has changed over time and thus form their policy opinions based on outdated information. Leaders can communicate a lot of information quickly and effectively by using maps to display data, trends, and analyses. Informing citizens is important, especially as communities generate plans for the future and seek participation from citizens in shaping and approving those plans.

Citizens can also use map-based web and mobile apps to provide data *back* to local governments. A person walking down the street can pull out a smartphone and report graffiti directly to the city or provide ideas for improving a park. A new trend is to ask citizens to volunteer to capture data voluntarily using their smartphones. In some cities, citizens' smartphones are being used as sensors to relay data about the environment. Capturing this citizen-generated data and feeding it back into the GIS platform can help local governments and business professionals determine how to change designs and better allocate resources.

***Boost the
Effectiveness of
NGOs***

NGOs play a role in creating smart, inclusive communities; influencing policy decisions; and providing resources where there is a gap the public sector cannot fill. NGOs would also benefit from government-collected data. In many cases, NGOs are surprised and impressed by the data that government agencies have available. When creating an open data platform and sharing location-based data about community needs, governments empower NGOs to operate more effectively.

Similarly, local government agencies can benefit from the data collected by NGOs about population needs and resource usage. For example, regional food bank organizations can relay how many citizens they are serving and give government another measure of data

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on poverty and citizen needs. By sharing information, local governments and NGOs can collaborate to find better solutions and build a smarter community.

Support the Business Community

Businesses within the community can benefit from the most up-to-date information on issues such as zoning rules, contract-bid opportunities, land-use plans, taxation, and other factors that might affect growth or operations. For example, changes in local infrastructure can greatly impact the business community. Greater access to development plans and maps will help inform business planning and open up opportunity for business leaders to provide constructive input into the planning process.

Create an Interconnected, Engaged Community

A GIS platform gives business stakeholders the latest authoritative information. Most business leaders need to see and understand opportunities and rules, often in terms of location. Maps provide a vehicle for that dialog.

Local governments can use the GIS platform, open data, and apps as vehicles to stimulate dialog with NGOs, citizens, academia, businesses, and start-ups. Those same tools can be used to bring multiple parties together in exciting combinations for even more synergy. An NGO might engage a group of business leaders in a community project, or leaders in academia might use government data and resources to find solutions for the business community. The different engagement combinations create a stronger community fabric.

Building Blocks for Success

Esri holds the rare position of having worked across the community spectrum for more than four decades with governments of all sizes as well as businesses, NGOs, start-ups, academic institutions, students, and citizens. Millions of people use Esri's mapping and spatial analysis capabilities every day. Through the experiences gained in these customer engagements, Esri has created a path for communities of all sizes to work toward becoming smart communities.

Step 1: Start with a World-Class GIS Platform

The first step is to adopt Esri's ArcGIS® platform. The ArcGIS platform provides a scalable solution that is designed to meet the needs of all stakeholders. GIS professionals who craft spatial analyses, maps, and apps have all the rich desktop, server, and online tools available for data creation, analysis, and sharing. This valuable content can be delivered across an organization to anyone, on any device, anywhere, anytime. Colleagues who consume maps and data can easily discover and use what they need, then add their own intelligence to the maps in a collaborative online environment. Interactive maps and data can be shared across the organization or externally, increasing the reach and impact of all contributors. Live map services enable online maps and apps to display real-time data, which is invaluable for smart community collaboration.

The Esri® ArcGIS platform includes tools for making map services and data open to the public—citizens, start-ups, businesses, academia, and NGOs. As a comprehensive platform, ArcGIS integrates with business systems, including IBM, SAP, and Microsoft.

The ArcGIS platform is suitable for organizations of any size. Small organizations can start focused and grow confidently, knowing the platform will be able to accommodate more complex or large-scale needs.

Step 2: Create a Location Strategy

It's important to know where to start and have a clear vision of how to tackle government and community goals. Creating a location strategy provides a road map for how the organization can best use the ArcGIS platform and lays out the steps to achieve desired goals.

One of the most powerful aspects of the ArcGIS platform is that it can provide a comprehensive view of government services and enable cross-departmental solutions to community-wide problems. However, some governments might find that it is necessary to prioritize the needs of individual departments in order to achieve more focused goals such as smart infrastructure, smart buildings, healthy communities, or safe cities. Once these departmental goals have been achieved, the organization can build on its initial success and expand data sharing and solutions across departments. Having a location strategy ensures that goals are clearly articulated.

Based on experience in working with organizations, Esri has created best practices guides for implementing the ArcGIS platform and formulating a location strategy. Esri Professional Services is available to help should organizations need more assistance.

Step 3: Provide Real Solutions That Add Value

Through its work with governments of all sizes, Esri developed more than 150 ready-to-use map and application templates for state and local governments. The maps and applications are part of the ArcGIS for Local Government and ArcGIS for State Government collections and are included in the ArcGIS platform.

These solutions are designed to help local governments meet important objectives: improve the operation of utility networks, analyze the value of land and associated improvements, maintain right-of-way assets, develop and share public safety response plans, promote sustainable communities, and conduct open elections.

ArcGIS for Local Government is free to ArcGIS users, easily configured, fully documented and supported, open source, and extensible. Governments that have the Esri ArcGIS platform can immediately deploy these apps and maps.

The applications and templates can be localized and customized to meet specific needs of the community. Organizations can customize the applications themselves, or they can get assistance from a valuable network of experts, including Esri partners and consultants, fellow Esri software users, and Esri Professional Services.

Case Study

The City of Fort Lauderdale, Florida, has implemented multiple application templates to help its citizens. The city used the My Government Services template to help established and prospective residents find services such as sanitation curbside pickup schedules, public school assignments, and the location of emergency facilities—complete with turn-by-turn directions. The city also implemented an application that allows citizens to locate city parks and recreation opportunities.

"Had we not used the ArcGIS for Local Government template, the development effort would have taken months."—Ian Wint, GIS Manager for the City of Fort Lauderdale

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***Step 4: Develop
Relationships within
the Esri Partner
Network***

Esri has the breadth and depth of GIS capabilities to meet the needs of many organizations. When a specialized solution is needed, Esri has a large partner community that provides applications to meet the diverse needs of many industries and workflows. Esri's partner community delivers sophisticated and focused solutions built on ArcGIS for permitting, crime analysis, asset management, climate analysis, and much more.

**Create a Smarter
Future**

A smart future begins today, with a smart response to changes in population, the economy, and the weather. It begins with the adoption of essential technologies including real-time sensor data, 3D analysis, and open data, all used and shared within GIS. It begins with more collaboration and transparency from government leaders. It begins with citizens, businesses, NGOs, and academia working together to make and implement innovative solutions.

A smart community is a place where people feel safe, healthy, happy, and motivated to improve. It's a place where kids grow up and then want to stay to build their own businesses and raise their own families. It's a place where people want to live, work, and play, a place that is resilient and sustainable because its citizens are not only informed but also involved. A smart community is your community—with the right technology and aspirations. Every community can be a smart community.

**Let Us Help You Get
Started**

Esri's smart community experts want to help you get started. Send an e-mail to smartcommunities@esri.com so we can help make your smart community vision a reality. You can also learn more at esri.com/smartcommunities.



Esri inspires and enables people to positively impact their future through a deeper, geographic understanding of the changing world around them.

Governments, industry leaders, academics, and nongovernmental organizations trust us to connect them with the analytic knowledge they need to make the critical decisions that shape the planet. For more than 40 years, Esri has cultivated collaborative relationships with partners who share our commitment to solving earth's most pressing challenges with geographic expertise and rational resolve. Today, we believe that geography is at the heart of a more resilient and sustainable future. Creating responsible products and solutions drives our passion for improving quality of life everywhere.



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