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GIS for Smart Cities

Cover Story
GIS for Smart Cities

Global View
Geospatial Technology and the Future of the City

Case Study
Singapore's Sustainable Development of Jurong Lake District

Build Smart Cities with Esri CityEngine

Create High-Quality 3D Content

Design urban layouts in 3D for analysis and review

Model 3D environments for entertainment and simulation

Quickly create 3D models using real-world 2D GIS data

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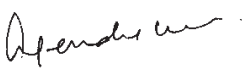
The pace of urbanization is speeding up in India with an expectation of better facilities and living conditions. Last year Ministry of Urban Development (MoUD) initiated the much laudable national programme for urban India – 'Smart Cities', to match the pace of urbanization and further drive economic development. The focus is on building green field cities as well rebuilding or retrofitting existing cities to be smart, future ready and sustainable. The government is already in the process of defining detailed guidelines and approach for the selection of cities and execution plans from operational perspective.

Weather it is a green-field smart city or an upgrade of an existing city into a smart city, we are all aware of the relevance of Geographic Information System (GIS) and its role right from the planning stage. Location is a common denominator in every aspect of a smart city and hence a location platform i.e. a GIS based technology platform has to form its backbone from the very beginning including for ICT planning and deployment. A centralized information system based on GIS provides an IT framework which integrates every aspect of a smart city – starting from conceptualization, planning and development to maintenance.

Smart planning, transparency in governance, smart energy, smart infrastructure, smart buildings, smart security, public safety, smart traffic management, smart waste disposal and smart service delivery mechanisms are some of the key components of any smart city. GIS integrates all aspects of city planning and management providing a common operating picture to all. As smart city involves multiple stakeholders, the integration, coordination and synergistic functioning of different participants of the smart city ecosystem is the key for the project to be successful.

In this issue, we explore the role of GIS in the smart city ecosystem. We present to you a collection of articles, global references and case studies which we think would be useful for everyone including city administrators, planners, utilities and IT solution providers in exploring the new approach of GIS based urban planning through Geodesign.



Agendra Kumar

Content

03 PRESIDENT'S DESK

05 NEWS
- Rajendra S Pawar, Chairman, NIIT Group gets lifetime achievement award for promoting GIS in India
- Esri India launches 'Geodesign' tool for planning smart cities
- Esri launches ArcGIS Open Data website
- Why Singapore is moving to 3D maps for urban planning
- ArcGIS 10.3 now certified OGC compliant
- ARC Advisory Group report highlights Esri as leader in global GIS market

09 PRODUCT REVIEW
- Three things about ArcGIS 10.3 that will change how you use GIS
- Esri CityEngine
- GeoEvent Processor

13 COVER STORY
- GIS for Smart Cities

16 GLOBAL VIEW
- Geospatial technology and the Future of the City
- What does it take to build a smart community

20 INDIA VIEW
- Smart Cities as envisioned by MoUD
- Planners vision for Smart Cities in India

24 CASE STUDY
- 3D Modeling shows off Elevated Rail System Landscape
- Singapore's sustainable development of Jurong Lake District

30 TECHNICAL ARTICLE
- Semantically enriched vision of Smart City
- 'Sensors' for Smart 'Cities'

36 EVENT COVERAGE
- Esri India User Conference focuses on 'Geo-Enabling Digital India'

39 TIPS & TRICKS
- Rethinking GIS for Local Government

40 GIS TRIVIA
- CityEngine FAQ

↑ Mr. Rajendra S Pawar, Chairman, NIIT Group being awarded the Lifetime Achievement Award by Mr. R S Sharma, Secretary, DeitY

Mr. Rajendra S Pawar, Chairman, NIIT Group gets lifetime achievement award for promoting GIS in India

Mr Rajendra S Pawar, Chairman & Co-Founder, NIIT Group, has been honoured with Lifetime Achievement Award by Geospatial Media, for his decades of service and leadership in helping GIS and associated technologies grow in India since the late 80s.

Mr Rajendra S Pawar on receiving the award said, "I am humbled and honoured to receive this award. It gives me great pleasure to see our efforts of driving GIS proliferation in India over the last 28 years receive leading industry recognition. Servicing the largest number of users, NIIT has seen GIS evolve into an all-pervasive technology that is helping organizations make informed decisions. Being a part of this journey, has indeed, been a very enjoyable experience."

"I am confident that the momentum and the capability created by us will be fundamental in meeting the Government's vision of Digital India and in creating Smart Cities," added Mr Pawar.

Mr Pawar has played a pioneering role in building GIS-focused products and services in partnership with the leading global player Esri Inc, USA. NIIT has developed an extensive range of offerings for the industry. These now constitute the core of several mission critical projects in disaster management, infrastructure, power, telecom, natural resources, and urbanization. Going forward, GIS is expected to play a key role in laying the foundation for Smart Cities in India.

Congratulating Mr Pawar on receiving the Lifetime Achievement Award, Mr Jack Dangermond, Founder and President of Esri said, "We have been extremely fortunate to have a very strategic partner - NIIT Technologies in India led by Mr Rajendra S Pawar. GIS industry in India has grown multi-fold in the last 3 decades; I strongly believe, it is Mr Pawar's vision, commitment and focus that have played an instrumental role in shaping the GIS Industry. Congratulations to Mr Pawar on being conferred with the Life Time Achievement Award by Geospatial Media. I am happy for this apt recognition and acknowledgement of his service to the industry. With his vision, I am sure GIS industry would leap to newer heights in the years to come".

Esri India launches Geodesign tool for planning smart cities

Esri India has introduced Geodesign, a key framework for conceptualizing and planning for Smart Cities and associated tools.

Geodesign provides a design framework and supporting technology for professionals to leverage geographic information, resulting in designs that more closely follow natural systems. These tools include GeoPlanner, CityEngine, and GeoEvent Processor. GeoPlanner, a specialized application for land based planning, allows to design and plan in a collaborative online environment that integrates data and powerful spatial analysis tools. GeoPlanner brings the power of ArcGIS Online and a Geodesign workflow to land-based planning activities with a JavaScript-based web application. It allows users to create, analyze, and report on alternative planning scenarios in support of better, more informed decision making. CityEngine is a 3D design tool with visualization technology to improve urban planning, architecture, and design. It is used to visualise the relationships of projects, assess their feasibility, and plan their implementation. GeoEvent Processor captures feeds from multiple sources for real time processing and transform GIS application into frontline decision application.

Arvind Thakur, Chairman, Esri India said, "Location is a common denominator in every aspect of Smart City development thus creating a strong need for integrating GIS in its planning. An integrated approach will result in sustainability and increased benefits for citizens residing in Smart Cities".

In India, GIFT City and Lavasa are using Esri tools for urban planning, infrastructure planning, construction monitoring and management. Esri software has been in use in India by various parts of a city system like utilities – Electric, Water and Gas; city planning departments; land management; roads & highways; security & safety. Esri India has vast experience in implementing GIS for various city operations like Municipal Corporation of Greater Mumbai, Orange City Water, Nagpur and Commissionerate of Municipal Administration, Chennai.

Esri launches ArcGIS Open Data website

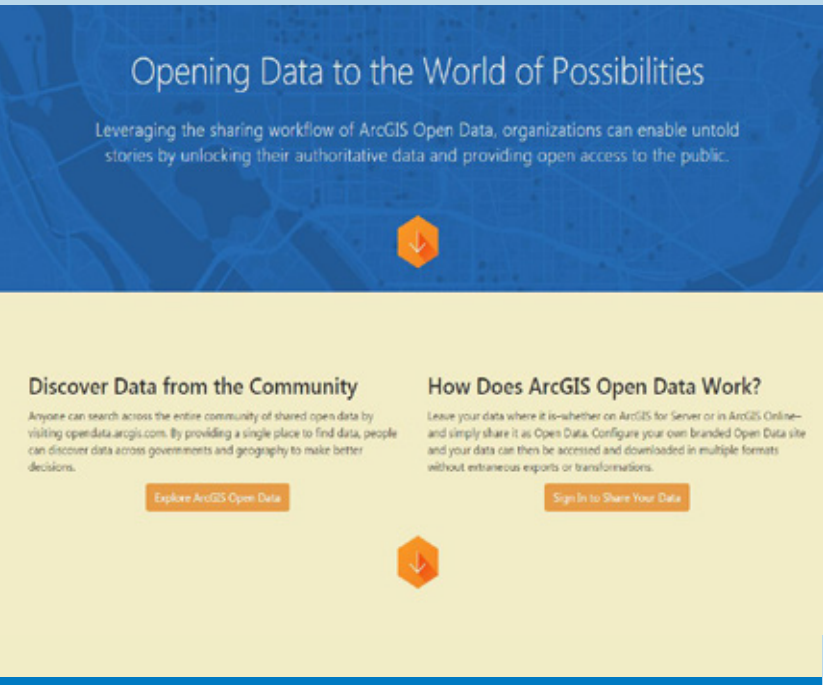
Esri announced the launch of a new site aimed to help citizens discover organizations sharing open data around the world and provide direct access to thousands of open government datasets. Citizens can search, download, filter, and visualize this data through their web browser or mobile device.

Andrew Turner, CTO of Esri's DC R&D Center said "We are excited about the large number of organizations currently sharing open data and believe we have a great opportunity to boost global support for open data and open knowledge. As more of the 380,000 organizations we work with across the globe begin to contribute open data, we will be able to help foster innovation by connecting the millions of datasets created by government agencies and shared through ArcGIS Open Data."

Since July 2014, more than 1,200 organizations from all levels of government, including the National Geospatial-Intelligence Agency (NGA), and the cities of Raleigh, North Carolina; Tampa, Florida; Charlotte, North Carolina; and Muroran, Japan, have used Esri's ArcGIS Open Data to configure custom open data sites to serve local citizens and businesses. Now the public can search across all these sites to find authoritative data by location and topic.

Any organization can make its data available through ArcGIS Open Data, and people can now discover this data by visiting opendata.arcgis.com.

↑ Shadow Analysis: Visulation of building casting shadow on it surrounding



↑ ArcGIS Open Data Website

Why Singapore is moving to 3D maps for urban planning

Singapore has limited land, but its skyline is constantly changing. The city's urban planning agency has found that 2D maps and physical models are not able to keep up with such a complex environment, its Chief Information Officer, Peter Quek said.

The Urban Redevelopment Authority (URA) is now using 3D mapping to get a more realistic view of the city and simulate future scenarios, so agencies can plan their services better.

Planners can run new types of analyses in 3D, Quek said. For example, a planner can see how a building casts shadows on its surroundings. This can be used to decide where best to plant trees to mitigate heat in the area.

Planners can also run 3D simulations to understand how a future development may impact its surroundings and create scenarios to optimise this. For instance, Singapore runs micro-climatic studies to understand how a development can improve wind flows around buildings and reduce heat for pedestrians, Quek said.

URA is working with GIS company, Esri, to use 3D techniques to plan its newest regional centre, Jurong Lake District. In addition, it uses 3D to generate scenarios for long-term planning - 50 years or more in the future - using economic and social parameters, he said.

URA is working with other agencies and the industry for real estate developers to submit 3D models so that URA can integrate these with its own platform and ensure that they meet design guidelines and urban plans, Quek added.

There are challenges that the agency is dealing with in using such a detailed system. Image gathering is one issue. Although advanced techniques like satellite imagery and remote sensing with laser are useful for gathering data on terrain, more intensive modelling techniques have to be used for creating high quality models of the buildings. "For planning we want a very realistic view. For that kind of an experience, we need to do a lot of ground survey and take photographs, so we need to have a team of highly trained people to do that," Quek said.

Another challenge is the software and sufficient computing power required to quickly crunch through all the images for real time analysis. The system needs high quality images of the city and it needs to instantaneously respond to planners making changes in the system, he said.

However, the benefits of using 3D mapping are "tremendous", Quek believes. In the past, it was not possible to generate many scenarios for future planning, he said. "Using physical models, you generate two to three scenarios and stop there," he said. "But with a [3D] model in place, you can generate many times the possibilities and optimise the plan."

The data that is gathered is not just used once, he added. "You can use it subsequently and can even share with other agencies so they benefit from the whole system."

The authority plans to complete detailed 3D models of 50 per cent of Singapore's urban areas by end of 2015, and complete the entire model in two to three years, said Quek.

While governments have been using digital 2D maps to plan services for a number of years now, perhaps it is time to consider if an investment in 3D maps could bring higher returns.

ArcGIS 10.3 Now Certified OGC Compliant

As part of Esri's ongoing support of GIS interoperability, the latest ArcGIS 10.3 release is now certified as Open Geospatial Consortium, Inc. (OGC), compliant.

This certification from OGC reaffirms Esri's continued commitment to standards-based interoperability. Through its support for OGC specifications, ArcGIS users can access data and services from many different sources, regardless of the technology used by those sources. In addition, users can share their content with others, including non-Esri users, thus contributing to the larger goals of the open data movement.

"Our goal is to help our users be successful, and Esri sees technical interoperability as a key driver to successful implementations," said Dr. Satish Sankaran, Esri product manager for interoperability and member of the OGC Architecture Board.

The OGC leads the development of geospatial interoperability standards. Esri is a long-standing, active OGC participant, helping GIS users to seamlessly work together.

Esri's first OGC compliancy certificates were granted in 1999, and many more Esri ArcGIS platform products have met OGC compliancy since then.

ARC Advisory Group Report Highlights Esri as Leader in Global GIS Market

ARC Advisory Group reports that Esri has a 43 percent share in the geographic information system (GIS) market, compared to just an 11 percent share from the second-largest supplier. ARC Advisory Group published its findings in an October market study and forecast through 2018.

"Esri is, without a doubt, the dominant player in the GIS market," the Geographic Information System Global Market Research Study authors stated.

The Esri business model relies on a constantly improving core GIS on which more than 2,000 partners develop Esri industry-specific solutions. In electricity transportation and distribution, Esri's partner-driven solution model, which combines Esri and Schneider Electric software, amounts to a total market share of 29 percent.

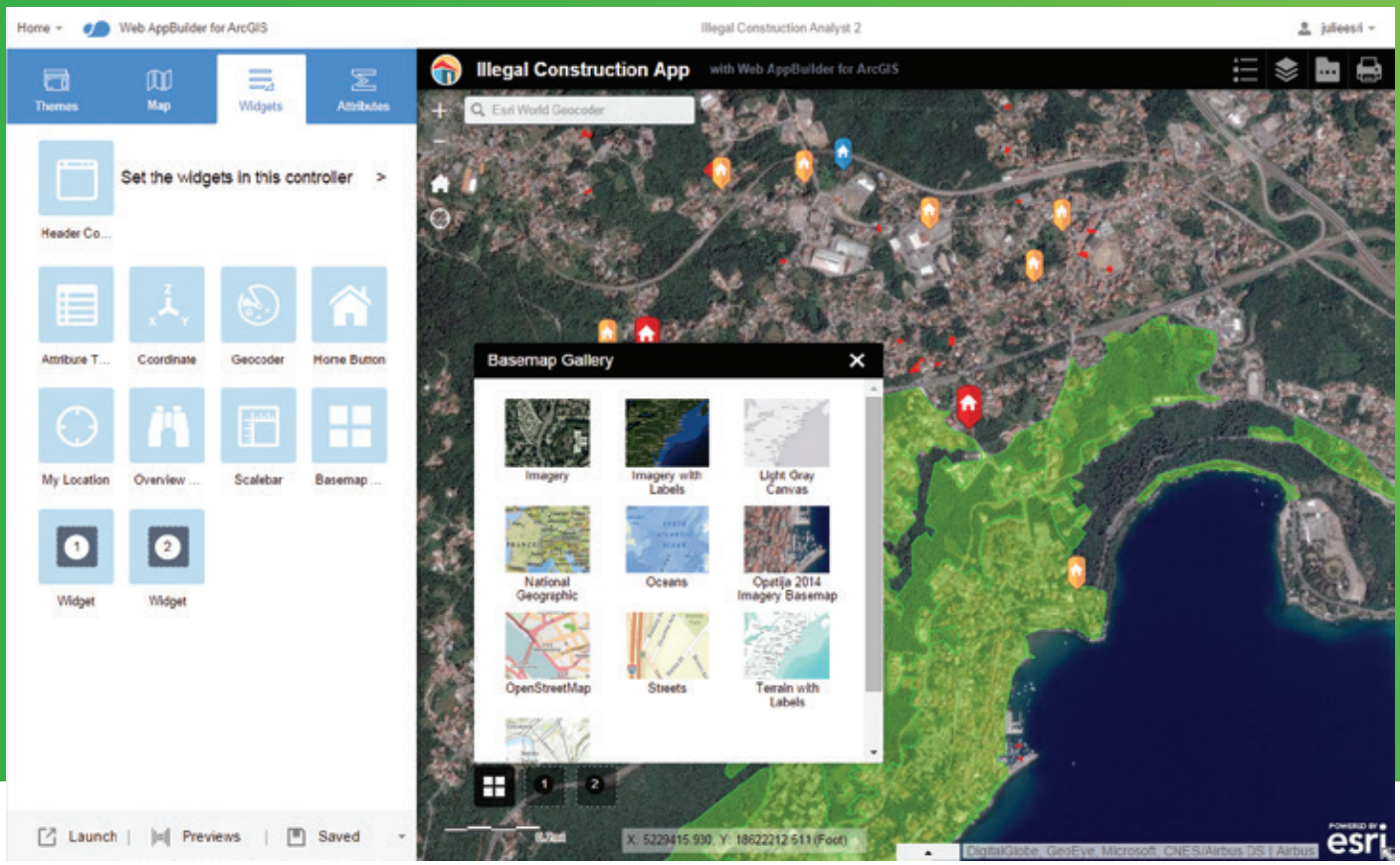
"Our success in the utility sector stems from Esri's platform technology, which makes it easy for companies to share, communicate, and collaborate on location information throughout their businesses," Esri utilities solutions manager Bill Meehan said. "Partner solutions, such as those Schneider Electric provide, add additional capability to an already powerful platform."

Esri's core GIS is used by more than two-thirds of Fortune 500 companies. The company's technology helps businesses save money and make stronger decisions by adding a location strategy to operations. Esri's ArcGIS platform has grown during the past 45 years to include cloud, mobile, server, dashboard, and firewall components in addition to its powerful desktop applications.

Partner solutions, such as Schneider Electric's ArcFM, target utility-specific issues (e.g., regulatory compliance, critical-infrastructure management). Key partners include Apple, Microsoft, Intel, Oracle, Dell, HP, Citrix, and Lenovo.

Esri-with its partners-plays a leading role in more than 10 industries: electric power transmission and distribution (with partner Schneider Electric), engineering and business services, government, public health and safety, health care, natural resources, oil and gas refining, retail, telecommunications, transportation and logistics, and water/wastewater.

Three things about ArcGIS 10.3 that will change how you use GIS



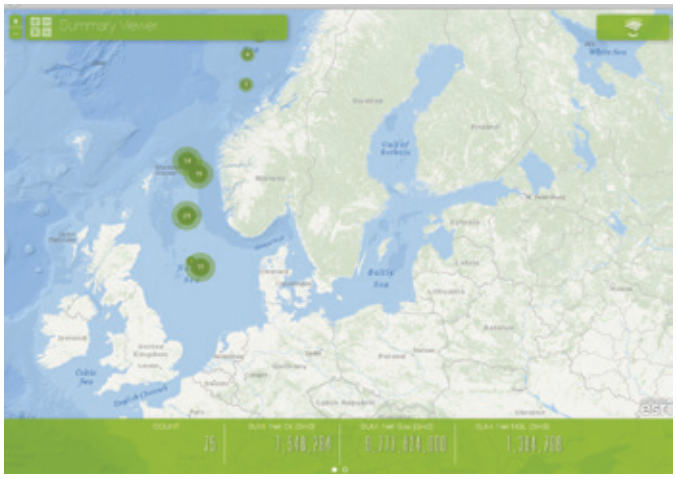
↑ Web AppBuilder gives you a way to create web applications in ArcGIS from scratch without writing a single line of code

ArcGIS Pro, Portal for ArcGIS and Easy Web Apps come together in ArcGIS 10.3 to transform the way your organization uses GIS to do its work.

ArcGIS Pro

This brand-new app is included with ArcGIS for Desktop. It enhances desktop GIS and makes GIS easy for new users. With its 64-bit architecture and new display engine, this multithreaded app provides much faster geoprocessing than ArcMap. You can design and edit in 2D and 3D. You can work with multiple displays and multiple layouts. With ArcGIS Pro you can easily make your maps accessible across the entire platform by publishing them to ArcGIS Online or Portal for ArcGIS.

↓ One of the out-of-the-box configurable web apps, Summary Viewer, is a dashboard that summarizes the numeric attributes of features in a specific operational layer of the map extent



Portal for ArcGIS

↓ Portal for ArcGIS is a front end to ArcGIS for Server that expands the use of maps and GIS throughout your organization

Portal for ArcGIS is a front end to ArcGIS for Server that expands the use of maps and GIS throughout your organization. People can find, use, create, and share maps and GIS apps built on top of ArcGIS for Server. This makes mapping and spatial analysis more accessible even for people who may not be very familiar with GIS.

Portal for ArcGIS includes a powerful suite of mobile and desktop apps, such as Collector for ArcGIS, Operations Dashboard for ArcGIS (both the desktop version and the cool new web version), Esri Maps for Office, and Explorer for ArcGIS. These apps provide you with a great way to boost productivity.

Portal for ArcGIS works with ArcGIS Pro, allowing you to publish and manage the maps you create with ArcGIS Pro. From an enterprise perspective, Portal for ArcGIS provides organizations with a well-defined process and the tools to manage maps and perform spatial analysis. Portal for ArcGIS allows organizations to effectively create, store, secure, and manage information products and access geographic tools in a central location. At ArcGIS 10.3, customers with ArcGIS for Server Standard and Advanced licenses get Portal for ArcGIS at no additional cost.

Easy Web Apps

ArcGIS 10.3 gives two easy ways to create web apps. You get out-of-the-box configurable web apps that use templates, and you get Web AppBuilder for ArcGIS. ArcGIS 10.3 includes an incredibly powerful collection of tools for creating web mapping applications. The Web Application Templates include the Summary Viewer, a dashboard that summarizes the numeric attributes of features in a specific operational layer of the map extent, and Local Perspective, which highlights features from a web map based on a location or address you select. Web Application Templates deliver great experiences for users performing everyday tasks. These templates can be easily configured so you can create web apps quickly using just these out-of-the-box tools.

Web AppBuilder is yet another way to create web applications in ArcGIS. Using Web AppBuilder, you can configure applications that include both out- of-the-box and custom widgets and themes. You control which tools are added to your app without writing a single line of code. Web AppBuilder includes advanced tools for geoprocessing so you can take advantage of the most advanced spatial analysis capabilities in ArcGIS for Server. Your apps will not only work on desktop browsers but also in browsers running on tablets and smartphones so you can easily share your work with the rest of the ArcGIS community.

Developers can take advantage of the Web AppBuilder extensibile framework by downloading and installing Web AppBuilder (Developer Edition) on a local machine. Organizations with web development skills can use the Developer Edition to further refine capabilities and the look and feel of their web applications.

A New Foundation for Your Work

Used together, ArcGIS Pro, Portal for ArcGIS, and Web AppBuilder create a new foundation for the ArcGIS platform that allows you to extend the reach of Web GIS throughout your organization whether you are running it on your own infrastructure, online hosted by Esri, or some combination of the two.

Esri CityEngine

Esri CityEngine is a stand-alone software product that provides professional users in architecture, urban planning, entertainment, simulation, GIS, and general 3D content production with a unique conceptual design and modeling solution for the efficient creation of 3D cities and buildings.

The Esri CityEngine is based on the procedural runtime, which is the underlying engine that supports two geoprocessing tools in ArcGIS 10.x and drives procedural symbology in the release of ArcGIS Professional. The CityEngine SDK allows a 3rd party to develop any required additional changes in import and export formats to extend CityEngine. Moreover, you can integrate the procedural runtime in your own client applications taking full advantage of the procedural core without running CityEngine or ArcGIS.

The software can be used either in isolation or as part of existing workflows, and it is an essential tool for anyone working with 3D urban environments, both real and imagined.

CityEngine allows you to efficiently create 3D urban landscapes using your existing GIS data, as well as do conceptual Geodesign in 3D. CityEngine relies on three ingredients: feature geometry, feature attributes, and procedural rules. The detail information about geometry, attributes and procedural rules helps in the generation of 3D content. CityEngine supports many GIS tasks, including mapping, data compilation, analysis, geodatabase management, and geographic information sharing.

The followings are the important features of CityEngine:

Transform 2D GIS Data into Smart 3D City Models

Esri CityEngine improves urban planning, architecture, and design. One can use its 3D visualization power to see the relationships of projects, assess their feasibility, and plan their implementation. CityEngine can help you make quality decisions that benefit your community for decades.

Build Flexible Scenarios Faster

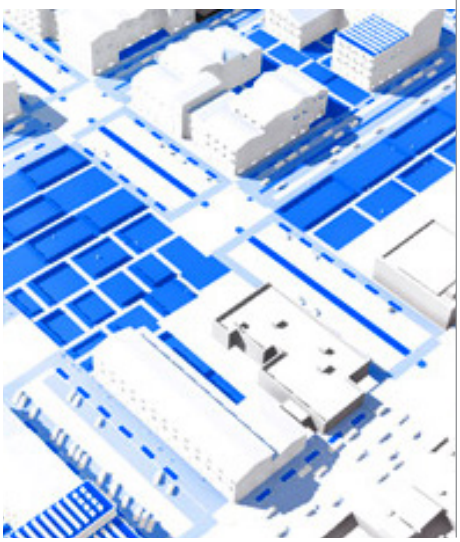
This feature compares and analyze building proposals from every angle and helps one to see how they fit into your city's overall vision for the future. It saves you time and money.

Create Realistic Context

This feature is used to visualize where a proposed building blocks the view, casts shadows, and reflects heat. By making the virtual 3D visualization as real as possible in the design phase, one can avoid costly mistakes in the building phase.

Share Your Urban Plan

This feature can help in publishing 3D model online. Others can interact with it, understand the urban plan, and participate in improving their community.



GeoEvent Processor

GeoEvent Processor is a new ArcGIS Server extension. It gives users the ability to connect to real-time data streams from a wide variety of sensors, perform continuous processing and analysis of those data streams, and send relevant information to users or other systems.

Making Real-Time Information Available

GeoEvent Processor for Server delivers the flexibility to incorporate virtually any source of real-time data into a GIS. It contains ready-to-use input connectors for the most common data stream sources, including built-in GPS connectors for Sierra Wireless and Trimble, and specific data streams for air traffic control, vessel positions, and others. GeoEvent Processor also provides an extensibility framework for creating custom connectors. Connectors can be configured to work over common transport protocols, such as UDP, TCP, and XMPP, and tap into vehicle telematics used by CompassCom, networkfleet, and many others.

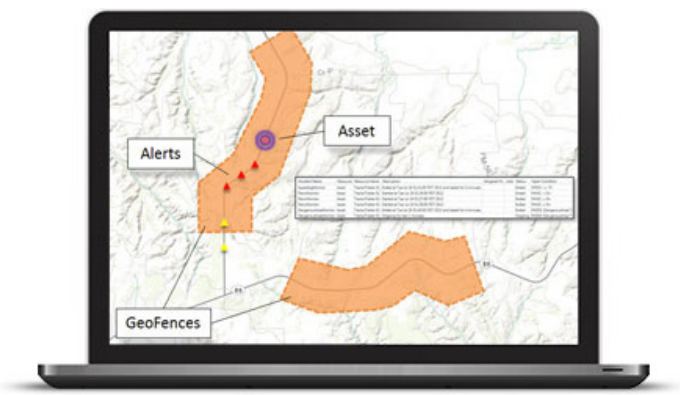
GeoEvent Processor is designed to process and filter events in real time. This means that it can be set up to receive large amounts of data and extract from it just the information that is relevant to users. For example, GeoEvent Processor can be configured to receive real-time weather and pollution measurements from a network of sensors and trigger alarms when specific pollution or wind thresholds are met. Or it can be used to detect and highlight vehicles that are speeding, stopped for a long period of time, or moving away from a predefined route. GeoEvent Processor provides a simple visual environment for configuring and processing data streams. It allows users to easily remove noise and filter the data into the most important and actionable information.

GeoEvent Processor provides the capability to share real-time information with users and other systems. Examples include sending an e-mail or instant message to a person when a particular alarm is triggered and writing incidents to a log file or sending messages to an enterprise messaging system.

A New Paradigm for Geofencing

A geofence is a virtual perimeter for a real-world geographic area. In the case of GeoEvent Processor, the GIS server is detecting and using geofences to alert the user or an authority when the device approaches, enters, and leaves the geofenced area. GeoEvent Processor provides the ability to use any map feature as a geofence. This means that geofences can be defined using jurisdictional areas, such as a city boundary, or an area defined through analysis, such as a high-crime area, an area determined by specified drive time, or a hand-drawn polygon. For example, an operations center may want to monitor vehicle assets as they approach, pass through, and leave hazardous areas defined by spatial conditions, such as flooding or suspicious behavior. These GIS-based geofences will help end users deliver more accurate, real-time assessments of live events.

GeoEvent Processor is sure to be a game changer in many industries, including fleet and asset management, telematics, defense and intelligence operations, public works, public health, forestry, mining, water and petroleum management, public safety and emergency management, transportation, and utilities.



GIS for Smart Cities

As urban areas are getting more crowded and falling increasingly short on future development potential, development of new self-sustaining cities are emerging as an alternate solution to these problems. Technology is at the heart of these new self-sustaining cities enabling automation and real-time integrated city monitoring and management through a network of sensors, cameras, wireless devices and data centers. Also referred to as smart cities, these new self-sustaining cities are a developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas like economy, environment, energy efficiency, mobility, governance, people and living conditions.

Smart cities, on one hand present a substantial growth opportunity in the coming years while on the other offers various challenges as well. Smart city projects are rather complex with residential and commercial spaces supported by an infrastructure backbone for power, roads, water, drainage and sewage i.e. a virtual living and breathing city. A critical success factor is a need for a common technology platform to enable integration, coordination and synergistic functioning of different participants of the smart city ecosystem.

A centralized information system based on GIS (Geographical Information System) provides an IT framework which integrates not only every stakeholder but also every aspect of smart cityprocesses – starting from conceptualization, planning, and development to maintenance.

↑ 3D visualization by space classification

GIS – A platform for Smart Cities

A centralized information system based on GIS provides an IT framework for maintaining and deploying data and applications throughout every aspect of the city development life cycle.

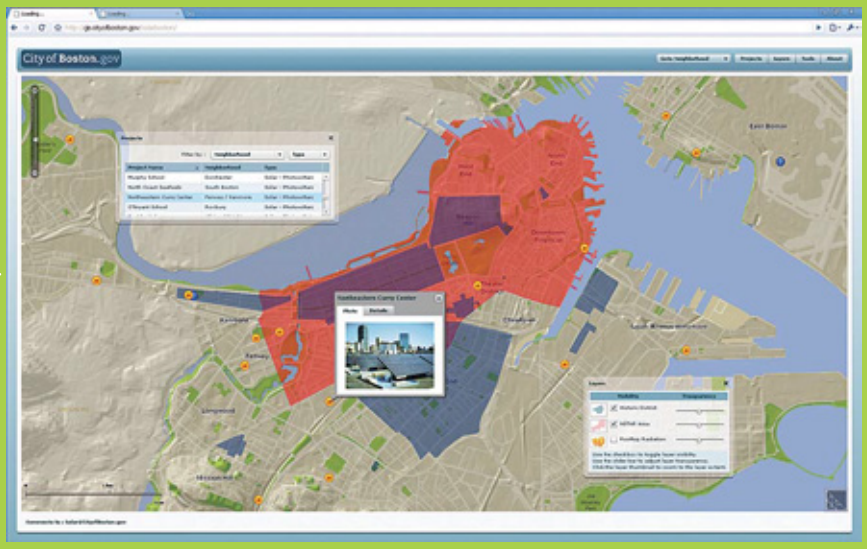
Acquire: Find the right sites for city development, view legal boundaries, arrive at right valuation of your existing / new sites

Planning & Design: Identify deficiencies and determine optimal solutions. Integrate GIS with most design tools, including Computer Aided Design (CAD), Building Information Modeling (BIM) bringing greater analytics and cost-estimation capabilities to your infrastructure design process

Construct: Integrate project and financial management software with GIS to better manage projects. GIS can provide a single point of entry for all construction-related documents and files

Sell: Understand where and how to market city developments, attract buyers and tenants, and improve retention rates. Analyze demographics and market conditions to provide a more accurate picture of a property's suitability to needs

Maintain: Easily manage disparate assets. Integrate your asset inventory with inspection history and work order management to maintain your critical investments in a cost-effective manner.



↑ Calculate the solar energy potential of building rooftops

GIS Applications for Smart Cities

Site Selection & Land Acquisition: GIS can combine and integrate different types of information to help making better decisions and also provides high quality visualization tools that can improve the understanding and enhance decision making capability w.r.t to site identification, valuation and finally selection. By analyzing location data – proximity to road network, fertility of soil, land use, soil bearing capacity, ground water depth, and vulnerability to disasters such as floods, earthquakes - the real estate organizations can arrive at the right property valuation. By analyzing, mapping, and modeling the merits of one site or location over another can be evaluated. In addition, this can also be used for arriving at appropriate market linked compensation to owners based on valuation parameters and in rehabilitation and resettlement planning

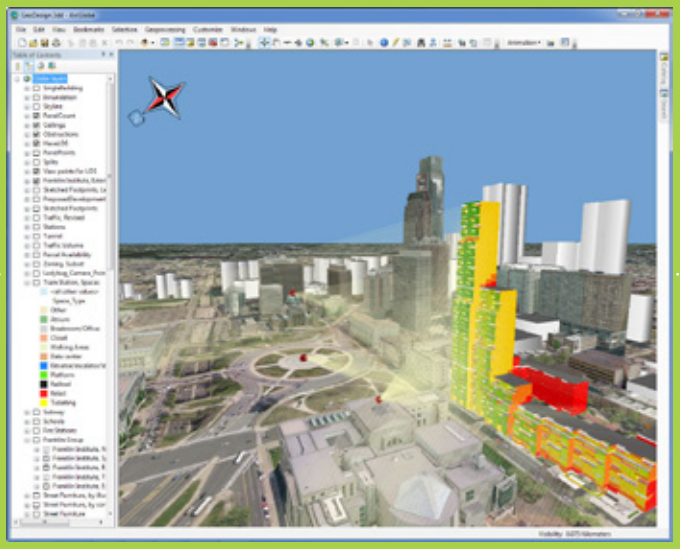
Environmental / Legal Compliance: GIS makes meeting regulatory requirements less time consuming and easier to accomplish by providing a common platform for communication with regulators and public. The existing data can be directly connected to a compliance workflow ensuring adherence. Also, GIS-based graphical outputs can help in quickly generate reports that clearly demonstrate how compliance requirements and building bye-laws are being met.

Planning, Design & Visualization: Geodesign will be the key framework for conceptualizing and planning for smart cities; it will assist at every stage from project conceptualising to site-analysis, design specifications, stakeholder participation and collaboration, design creation, simulation and evaluation. GIS enables planners to integrate a variety of data from multiple sources like road, sewerage and drinking water and to perform spatial analyses and planning. Utilities can manage and map the location of millions of miles of overhead and underground circuits.

By integrating imagery, elevation, and environmental information with the CAD / BIM environment, engineers can continue working with familiar software while gaining access to important GIS data. Design files can be brought into a GIS and linked to financial software for better labor and materials and total project cost estimation. With these types of capabilities, GIS is an essential componentof the engineering information systems of the future.

A 3D geographic information system can be used to create a realistic simulation of a project, environment, or critical situation.

GIS can help increase a facility's sustainability by reducing energy and water use, finding better waste disposal, and decreasing a building's carbon footprint. By managing information both inside and outside buildings down to the asset level, GIS can help in for example differentiating the environmental impact



↑ GIS-Based Line of Sight (LOS) / Shadow Analysis to determine desirability of a proposed design

of development, planning and evaluating neighborhood patterns and design, estimate the "walkability" for LEED-ND projects based data on streets, pedestrian routes, bicycle routes, transit accessibility, building entrances, and a variety of other factors.

Construction & Project Management: GIS, integrated with project management and financial softwareprovides a comprehensive view of projects and their current status and helps in tracking performance. GIS helps organize all relevant project information, from soil data, and geotechnical studies to planning, environmental studies, engineering drawings, project maps, inventory and asset control.

Sales & Marketing: With GIS, city developers can win over prospective businesses by creating informative sales tools and marketing reports that highlight the economic potential of a new location or future development. For residents, GIS helps in presenting a visual representation of all the information affecting the desirability and value of a property giving them a far more accurate picture of a property's suitability to their needs.

Facility Management (FM): A GIS-based information system provides a powerful foundation for better facility management by generating integrated information that helps make better allocation decisions. GIS can integrate with and extend the current facilities management system. By importing and aggregating into a GIS the geometries and tabular data of the multiple BIM and/or CAD files required to accurately represent the built environment, the efficiencies and power of BIM can be leveraged, extended, and connected in geographic space to other relevant site, neighborhood, municipal, and regional data.

Operations & Reporting: GIS can track and analyze assets over space and time and provide insight through visualization of information via maps and easy-to-understand reports. It supports creating an operations view that include maps, lists, charts, gauges, and more based on live geographic data defined in a web map or web service. Multiple operation views can be defined to meet the needs of stakeholders focusing on different aspects of the operation. With this ability to integrate disparate information sources into a common operational picture of all facilities, GIS provides greater power to control township operations and positively impact bottom line.

Conclusion

GIS can be used throughout the life cycle of a smart city – from site selection, design and construction to use and maintenance. GIS is an ideal technology that has the ability to scale across any expanse, from the individual asset within a building to a virtually global context tying all aspects of a Smart City planning and development.

Geospatial Technology and the Future of the City

Over the past four decades, GIS technology has systematically impacted local government by improving basic record keeping and data management as well as automating a wide variety of geospatially-related workflows including mapping. Most of these improvements have been in departmental systems focused on specific mission areas.

We are now entering a period in which geospatial (and other) data about cities is growing enormously. This data is increasingly being directed to address the growing challenges facing cities today. Managers and policy people are searching for approaches that better leverage this digital data to improve decision making and government management. Finally, there is strong interest in making government data openly available to the public and businesses in the belief that this can stimulate innovation and provide more government transparency. As a result, GIS is being more widely recognized as a powerful platform for local governments to achieve these goals. Its ability to manage, integrates, analyze, and visualize very large and complex data is making it an essential platform for creating the sustainable cities of the future.

GIS systems have traditionally been based on database-centric approaches that generate information products, such as maps, reports, or views, from centralized DBMSs (Geodatabase). While there are some exceptions such as Geneva, Switzerland, these GISs have been largely implemented as departmental systems.

Over the last decade, due largely to the emergence of faster computing and networks, the vision of distributed enterprise systems created by integrating departmental systems began emerging. This vision leveraged services-oriented architecture for dynamically combining data from multiple distributed databases.

As a result, we have seen the development of applications that can access, join, overlay, and view distributed data as if it was supplied by a single DBMS or geodatabase. This capability has eliminated the need to normalize and physically integrate data into a single centralized system. This distributed, federated architecture has dramatically accelerated with the maturing and acceptance of web standards as a backbone for enterprise architecture.

A New Web GIS Pattern

Today patterns of distributed data mashups (both tabular and map) are increasingly being implemented in cities. This is helping unify and integrate information from many sources across the enterprise and beyond. This new work pattern is facilitated by the web and web services. While not replacing the need for good traditional database design, it creates a much more agile framework for developing and deploying GIS apps. It is actually helping realize the data integration vision of enterprise GIS.

To make this type of dynamic database integration work in a tabular database world requires common keys among and between distributed datasets so that data can be easily integrated. Common to most local government data and services is some form of georeferencing or location. This georeferenced data can be x,y coordinates, an address, a place name, or geographic area such as ZIP Code or administrative area. GIS provides the tools that interrelate this data via spatial joins. This capability is increasingly being recognized as

Jack Dangermond
Esri President

playing a major role in integrating of all types of data across the enterprise.

The other key building block enabling this new architecture is the exposing of data as services using protocols such as REST. These services are increasingly used to support a whole new world of GIS application development that supports operational workflows, analytics, decision support, and citizen engagement.

More real-time data about cities is becoming available. Massive networks of stationary and mobile devices that measure and track everything that moves or changes are being created. This includes traffic, utility usage, environment, and smart building data, which are exposed as services. Over time crowd sourcing will also be integrated as an information source enabling citizens as well as city employees to report their observations and interpretations. Finally, service-enabling operational data (data maintained in enterprise systems) will mean that data can be easily connected and dynamically integrated.

Serverizing all local government data will transform GIS and make it more easily deployed to make cities smarter. This framework allows GIS professionals to easily mash up data and create apps that traditionally required far more resources. As a result, processes that involve tasking and resource allocation-such as dispatching repair crews, responding to emergencies, and deploying law enforcement-will become more rational and reliable.

GIS already provides many tools to do this and will increasingly be used to turn local government data into actionable information that cities can use to improve services and the quality of life for their citizens.

The Future City

Future cities will be much smarter. Everything will be measured in real time and in fine detail through the deployment of sophisticated arrays of sensors. GIS will play a major part in integrating mountains of real-time data so it can be understood and acted on. It will improve applications that range from managing environmental quality and the built environment to land-use and transportation planning. The result will be better decisions, more efficiency, and improved communication.

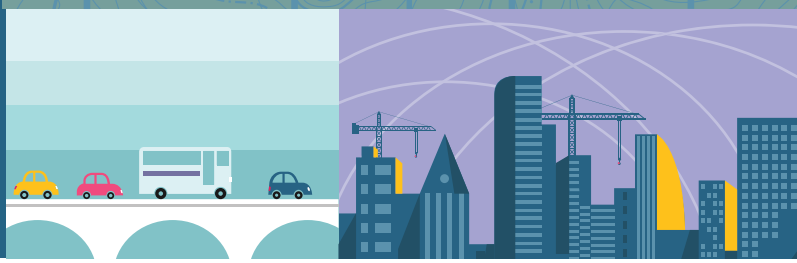
Cities will increasingly make their information available as open geospatial services (maps). These maps will help tell stories about the state of those cities and the policies they have taken. All transactions and changes will be illustrated virtually, resulting in citizens who are both more informed and engaged. They will visit city hall more frequently-virtually instead of physically-and most local government transactions will be done on the web.

Longer Term

As cities enable their information, people everywhere will be able to openly compare cities. Technically, this is already possible. It is being done by the Urban Observatory, which is an early prototype of what will come. We are also seeing exciting work done by organizations such as The Trust for Public Lands, which is providing new scoring measures that compare cities based on differences in the amount of open space and parks. This type of GIS-based scoring system will evolve into a framework for scoring everything in cities. My vision and hope is that GIS professionals will facilitate this process and provide an integrated, transparent, and comprehensive science-based framework that will help evolve our urban settlements into smarter and more sustainable cities of the future.

What Does It Take to Build a Smart Community?

By Chris Thomas, Esri Government Industry Manager



The term smart city has been gaining quite a bit of attention lately. Known by many names - livable communities, sustainable cities, resilient cities, and even smart nation or subsets like safe cities, healthy communities, and coastal resilience - the objectives are fairly similar, that is, to build a government that is more responsive, productive, efficient, transparent, and more engaging with its citizens.

At Esri, we have opted to embrace two terms: smart communities and resilient communities. Building smart communities reflects national, state, regional, and local governments' desire to improve quality of life. Building resilient communities relates to assisting governments in preparing for and recovering from man-made and natural disasters such as hurricanes, floods, earthquakes, economic collapse, or climate change.

There are a lot of "smart approaches" out there claiming to meet the needs of building a next-generation smart community. However, most approaches seek to only support large metropolitan areas or are focused on a single problem. After years of working in partnership with thousands of governments around the world and asking how we can really help, a clear path has emerged.

This approach will support governments regardless of size or geography. It delivers solutions that cover more disciplines across a government as a means of strengthening the entire government operations. Think of government as a platform. At its core, building smart communities involves working side by side with governments and professional trade associations to truly understand government needs.

There are four steps in creating a successful strategy to support smart communities:

1 Start with a world-class GIS platform

The primary reason governments the world over have embraced GIS is that location is the most common denominator looked at when addressing a problem. The solution needs to serve GIS professionals, the professional that simply uses GIS, field-workers, decision makers, and citizens. It also needs to support the five major government workflows: collecting data, analyzing and performing what-if scenarios against the information, improving operational awareness, improving field operations, and enabling civic engagement.

2 Develop a location strategy that allows governments to prioritize the GIS applications they need.

Chris Thomas is the global manager for government activities at Esri. He has worked in and with government agencies worldwide for over 22 years. He is viewed as a pioneer and thought leader in the adaptation of technology by government and citizens alike.

This needs assessment indicates a government's readiness to incorporate new solutions and at what rate. The government can begin with analyzing the entire organization's issues department by department or it can tackle a single department, such as law enforcement or health, to meet goals of more limited scope such as smart infrastructure, smart buildings, healthy communities, or safe cities.

3 Deliver real solutions that serve government priorities.

Governments know that their biggest challenges are often improving infrastructure, efficiency and productivity, and local economic conditions as well delivering green solutions. They hear regularly from or are polling businesses and citizens on what their priorities are. They do not always have the quickest answer as to how to solve these issues.

We have found that working side by side with governments and asking What apps do you wish technology companies would build? results in the development and delivery of apps that successfully meet their needs. These apps are honed by working directly with governments on design and testing. Once completed and tested, the solutions are extended back to governments at no charge. These apps can be deployed immediately and tailored over time.

4 Develop strong relationships with business partners.

Partners can deliver sophisticated solutions for permitting, crime analysis, asset management, and climate analysis, for example, that are built on top of a strong GIS platform. They can extend customized solutions that scale with a state, municipal, or regional government over time.

Smart Cities as Envisioned by MoUD

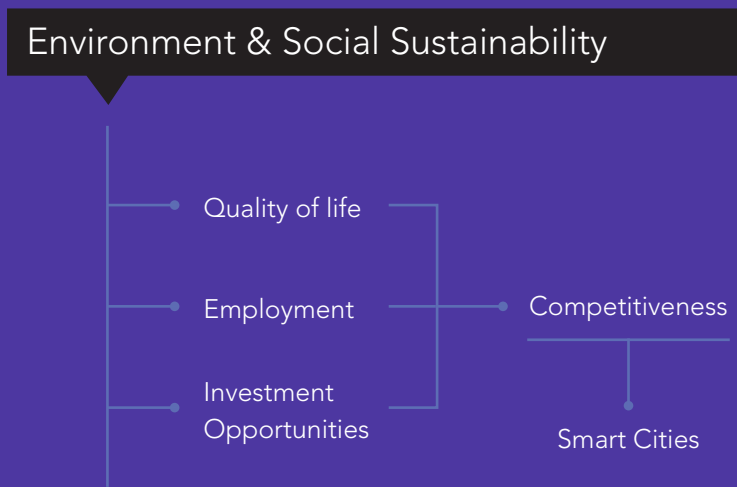
(Excerpts from the Concept Note on Smart City Scheme, December 2014)

Ministry of Urban Development (MoUD) in order to meet the requirement of growing urban space prepared a 'Draft Concept Note on Smart City Scheme" last year. According to the document Smart Cities are those which have smart (intelligent) physical, social, institutional and economic infrastructure. It is expected that such a Smart City will generate options for a common man to pursue his/her livelihood and interests meaningfully. In this context :

Competitiveness refers to a city's ability to create employment opportunities, attract investments and people. The ease of being able to do business and the quality of life it offers determines its competitiveness.

Sustainability includes social sustainability, environmental sustainability and financial sustainability.

Quality of Life includes safety and security, inclusiveness, entertainment, ease of seeking and obtaining public services, cost efficient healthcare, quality education, and opportunities for participation in governance.



Pillars of a Smart City

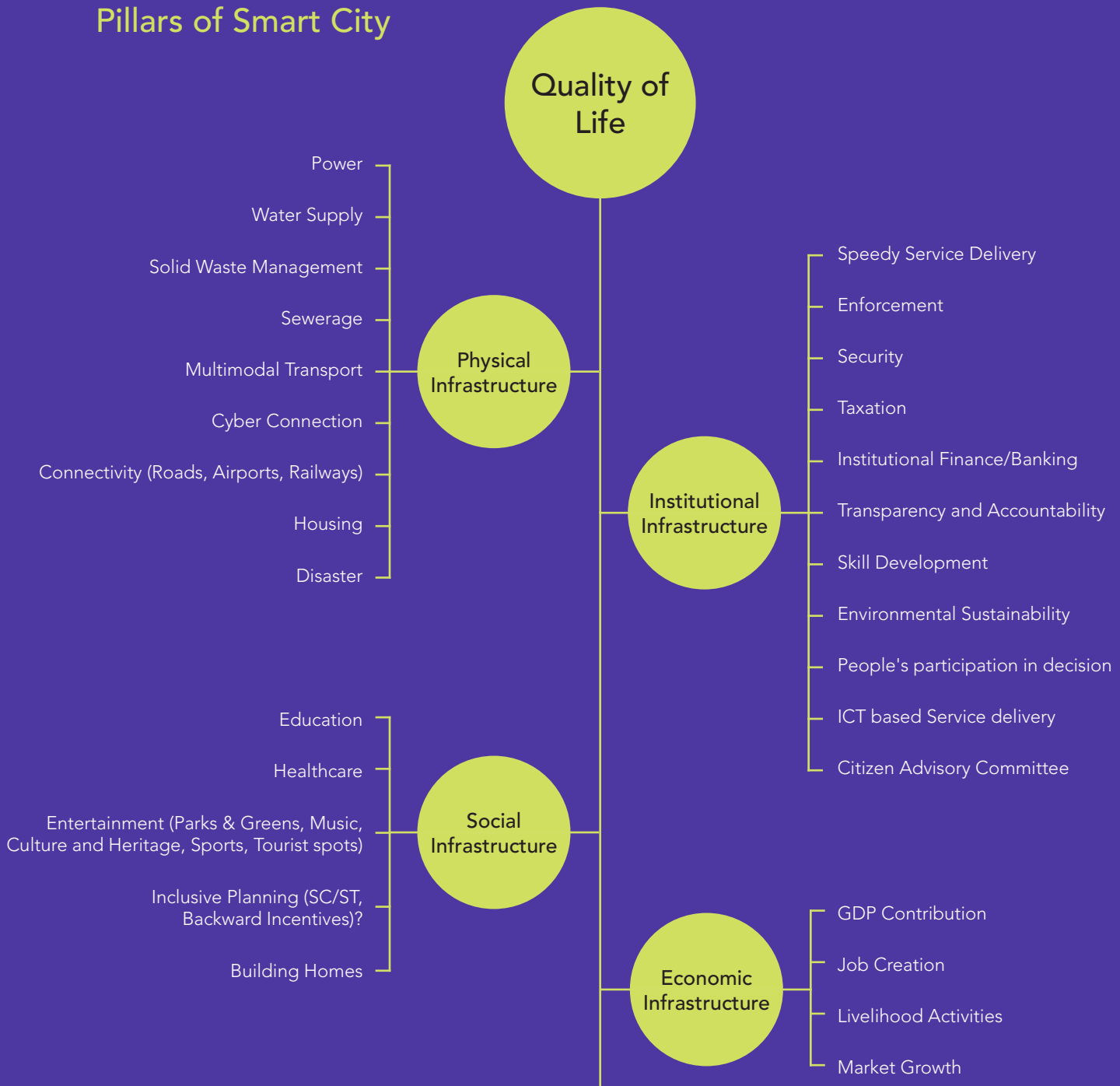
Smart city is envisaged to have four pillars, its Social Infrastructure, Physical Infrastructure, Institutional Infrastructure (including Governance) and Economic Infrastructure. The centre of attention for each of these pillars is the citizen. In other words a Smart City works towards ensuring the best for its entire people, regardless of social status, age, income levels, gender, etc.

Social Infrastructure relate to those that work towards developing the human and social capital, such as the educational, healthcare, entertainment, etc systems.

Physical Infrastructure refers to its stock of physical infrastructure such as the urban mobility system, the housing stock, the energy system, the water supply system, sewerage system, sanitation facilities, solid waste management system, drainage system, etc. which are all integrated through the use of technology.

Institutional Infrastructure refers to the activities that relate to the planning and management systems in a city. Cities needs high quality governance, with a strong local say in decision making, is critical for Smart Cities. Typically, the principle to be followed is "Governance by Incentives rather than Governance by Enforcement".

Pillars of Smart City



Source: Concept Note on Smart City Scheme

Economic Infrastructure : For a smart city is to attract investments and to create the appropriate economic infrastructure for employment opportunities, it has to first identify its core competence, comparative advantages and analyse its potential for generating economic activities. Once that is done, the gaps in required economic infrastructure can be determined. This would generally comprise of incubation centres, skill development centres, industrial parks and export processing zones, IT / BT parks, trade centers, service centres, financial centers and services, logistics hubs, warehousing and freight terminals, mentoring and counseling services.

Instruments facilitating development of a Smart City

Use of Clean Technologies: There is a need to promote the use of clean technologies that harness renewable materials and energy sources and have a lower smaller environmental footprint. In smart cities buildings, transport and infrastructure should be energy efficient and environmentally favorable.

Use of ICT: The extensive use of ICT is a must and only this can ensure information exchange and quick communication. Most services will need to be ICT enabled. An extensive use of ICT enabled services will need a sound communications backbone.

Participation of the Private Sector: Public-private partnership (PPP) allows Government to tap on to the private sector's capacity to innovate. Greater involvement of the private sector in the delivery of services is another instrument as it enables higher levels of efficiency (this should be the prime motive for using the private sector rather than just tapping financial resources). It is proposed to take advantage of this capability in a structured manner.

Citizen participation: Citizen Consultation and a transparent system by which citizens can rate different services is yet another instrument for improving performance. Making these ratings openly available for public scrutiny creates a powerful incentive for improved performance and a disincentive for poor performance.

Smart Governance: Urban Local Bodies (ULBs) would need to make effective use of ICTs in public administration to connect and coordinate between various departments. This combined with organizational change and new skills would improve public services and strengthen support to public. This will mean the ability to seek and obtain services in real time through online systems and with rigorous service level agreements with the service providers.

Financial Architecture for Smart Cities

It is suggested that cities which desire to participate in the smart city programme have to prepare a financing plan along with their smart city development plan and detailed project reports. Strategies for enhancing the resource pool available to cities include the following:

- User charges for utilities to reflect O&M and capital investment costs
- Land value based taxation:
    - Sale or leveraging the land available with the ULBs / parastatal
    - Betterment levy/ Higher Floor Space Index (FSI) or Floor Area Ratio (FAR) to take advantage of the increase in property prices on land serviced by new infrastructure such as roads, water etc. by imposing a surcharge on stamp duty on sales transaction, FSI, FAR, property taxes etc.
    - More accounting transparency (double entry, accrual based accounting, balance sheets) to capture unencumbered cash resources.

Government would assist all identified smart cities to develop City Development Plans based on ICT, GIS and spatial mapping. The selected cities will have to strive towards attaining specified benchmarks in a range of services such as transport, spatial planning, water supply, sewerage sanitation, solid waste management, storm water drainage, electricity, telephone connections, Wi-Fi connectivity, health care facilities, education and fire fighting. The draft document highlights the need to have digitized spatial and GIS maps of property and all services such as power, water supply and sewerage.

Reference: *www.goo.gl/J9uSvy*

Planners Vision for Smart Cities in India

R. Srinivas
Town and Country Planning Organisation, India

The vision of the Ministry of Urban Development (MoUD) is "to facilitate creation of economically vibrant, inclusive, efficient and sustainable urban habitats". Its mission is to "promote cities as engines of economic growth through improvement in the quality of urban life by facilitating creation of quality urban infrastructure, with assured service levels and efficient governance".

The Town and Country Planning Organisation (TCPO) is the technical wing of the MoUD. It plays an important role in formulating policies, programmes and strategies for urban development in the country. TCPO also monitors specific plan schemes of MoUD in growing community productively and managing the growth.

The Town Planners are responsibly working on the Town's future. The effective and creative planning of major projects will benefit residents by providing them environmental protection along with economic development.

The planner has a role in evaluating issues in achieving responsible for regulating the subdivision of land through the use of local subdivision regulations, effective decision making using tools such as GIS.

MoUD has announced development programmes for pilgrimage centres and heritage cities. This development program is for 500 cities under 'Amrit', basically Urban Infrastructure strengthening program beside 100 cities to be developed as smart cities. It will ensure the India's first systematic attempt for urban renewal to create financially robust and sustainable local bodies. The Government of India programme will encourage all states in developing 18 critical functions of the urban local bodies under the constitutional amendment.

A smart city demands an understanding of public purposes and public interests to define a better and planned city which supports creation of livelihoods, and enhancement of economic growth. The India's economic growth also depends on harnessing renewable natural resources. The central, state and local level government officials should work with infrastructure developers in public and private space along with the thought leaders in framing the policy, regulatory incentives, and effective compliance mechanisms to make changes in Indian infrastructure market.

The town planner plays a role in formulating a plan and they should appraise from time to time the progress of the plan. They should proactively make recommendation on policy and measures to balance the utilization of the country's resources. The priorities define the stages in which the propose of the plan should come out for allocating resources for the completion of project which indicate the factors for economic development, and determine the conditions of the current social and political situation.

The TCPO is responsible for framing its recommendations consultation with the Ministries of the Central and State Government to implement decisions rests with the Central and the State Governments.

The TCPO is suggesting to work on GIS based spatial planning which is one of the important pre requisites for smart city in Indian context and should consider the crucial aspects like preparation of comprehensive city spatial plans using 'State of Art' technologies such as GIS. It will envisage efficient allocation of land resources polycentric city plan with mixed land use integration of land use and transportation.

3D Modeling Shows Off Elevated Rail System Landscape

Honolulu Uses Geodesign to build case for Rail corridor

Highlights

- Three core models were needed for the rail corridor geodesign process-walkability, urban growth, and densification.
- Esri CityEngine was used to improve the model by creating 3D geometry and applying textures.
- Through imaging and 3D software, holograms provided unique views for stakeholders and the public.

↑ The City of Honolulu, shown here in CityEngine, shows the elevation levels of the downtown corridor, as well as the proposed transit-oriented development, giving citizens and planners a dynamic view of potential changes to the city

Being on island time conveys the aura that everything is as peaceful and slow traveling as an islander in paradise. In Honolulu, the islanders can boast they do travel slowly through their paradise, but maybe not so peacefully on their roadways, since Honolulu has claimed the top spot as the worst US city for traffic. Compounding the problem, citizens have moved to suburban areas in search of affordable housing, creating urban sprawl, which increases traffic demand when traveling to urban centers for work.

For Honolulu, the effects of urban sprawl go beyond increased traffic demand and have negative impacts, such as environmental pollution, natural habitat reduction, loss of agricultural land, and even decline in human health and well-being. In an effort to help alleviate some of the traffic pressure on its roadways, the City and County of Honolulu have approved and begun construction of an elevated rail system connecting East Kapolei to Ala Moana Center. Not only will the new railway change the way citizens and tourists will travel through Honolulu, but the planning and development surrounding the rail corridor will be redefined through what is known as transit-oriented development (TOD).

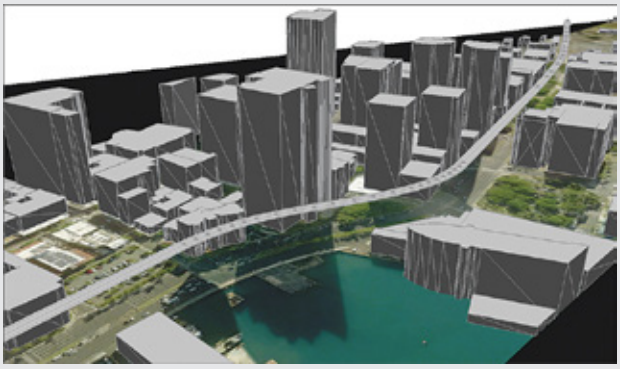
Planners look to TOD as a common solution to accommodate future population growth, control urban sprawl, and decrease traffic demands on communities through the use of dense, mixed-use housing placed near transit. This creates mass-transit and walkable access to retail and amenities. This paradigm shift to TOD planned communities with medium- to high-rise development and a new feature in the landscape, the elevated rail system, can and has been met with opposition by some community members. Part of the planners' role is to persuade the citizens of the benefits of TOD for their community through a collaborative planning process where they share information and ideas about the development. The planners must tell the story of the future of the community from both sides of the coin. To do so, planners and consultants are using more sophisticated visualization tools, which can be very effective at shifting the attitudes about new and different development in this island paradise.

To tell the story of TOD, the City and County of Honolulu turned to GIS as a primary tool within the process. The city GIS department embraced and applied the concept of geodesign-that is, incorporating geographic knowledge into design-to more effectively analyze, compare, and visualize different scenarios of TOD for the key communities affected by the new development. To build the case for TOD, the GIS team needed to support the planners' goals to share with the public who would have safe access to rail; how changes to the zoning would visually

redefine their community; and how the TOD would positively affect the community and region, preventing future urban sprawl.

The team identified three core models that would be needed for the TOD geodesign process: walkability, urban growth, and densification models. As with any new GIS project undertaking, the GIS department first determined data resources needed to support the analysis and whether these datasets were available or needed to be developed. Most of the core data, such as roads, zoning, and buildings, was available in the rich geodatabase that Honolulu has been developing for years. Since visualization is a key component of geodesign and a powerful tool for persuasive planning support, a 3D model of the physical environment would be needed for the transit corridor. Honolulu had a good start to the city model with 3D geometries for the downtown area, including key landmark buildings with textures.

However, the model was not complete and needed to be enhanced in areas, since more than 3,000 buildings were without textures and some were mere footprints. The team used Esri CityEngine to improve



← Preparing this model for hologram printing and display is as simple as adding textures, saving the project, and loading the model into ArcGIS for use with the Zebra Imaging plug-in

the model by creating 3D geometry and applying textures based on a custom set of rules. Honolulu wanted to simulate the true look and feel of the city and accomplished this by collecting photos of real facades that were used to create a custom set of textures. These textures were applied based on the rules, instantly painting the remaining buildings. Rules were further applied to create 3D geometries by converting simple building footprints into complex structures with textures. The last component was the addition of the proposed evaluated rail, which was added from the existing engineering drawings, completing the 3D urban model of Honolulu.

The next step in the geodesign process was to analyze the effectiveness of a TOD and create alternative scenarios used by the planners to convey the benefits of TOD for a given community and the region. Utilizing the ArcGIS 3D Analyst and ArcGIS Spatial Analyst extensions and ModelBuilder, the GIS team developed reusable walkability, urban growth, and densification models in which data was run against changing variables to create different scenarios. A key factor of TOD is to provide the acceptable and safe walking or biking distance to a transit stop. The walkability model used Spatial Analyst geoprocessing tools to determine the travel distance from residences or work to a transit station.

From this analysis, stakeholders or citizens could determine the viability of transit for their use. Since the acceptance of TOD in a community must be more convincing than just ridership, the planners must convince members of the public that TOD will benefit Honolulu's future whether they utilize the rail or not. The GIS team supported the planners by creating scenarios based on the projected future with TOD and without. The TOD plans for each station were run against the urban growth and densification models using Spatial Analyst and 3D Analyst to perform the analysis.

Using CityEngine, the rules for creating 3D geometries and texture were applied to the resultant analysis, and new models were generated representing proposed build-out of the future with TOD. The 3D model showed urban growth concentration around stations with low- to medium-density buildings and ample undeveloped land. The same models were run against the existing zoning with no TOD, resulting in a sea of houses, showing a stark comparison of Honolulu's landscape in the future as urban sprawl. An incentive of geodesign for planners is to equip them with analytic outcomes that could be used to persuade the stakeholders and public that TOD will have a positive impact on the community. Honolulu approached the community engagement with unique visualization technologies, which included 3D holograms and simple web views of TOD scenarios. The GIS team worked with Zebra Imaging, a leading 3D visualization company and Esri Partner (Austin, Texas), to create visually captivating, true 3D views of the analysis in 3D holographic images.

Through Zebra Imaging software, ArcGIS 3D Analyst, and Esri CityEngine, the holograms were sourced directly from the exports of 3D GIS data models representing TOD and rendered to capture thousands of unique 3D views. The 3D views of the GIS were used to create a holographic grating that is recorded on film with lasers. When illuminated with an appropriate light source, what looks to be a flat piece of plastic reveals a 3D, full-parallax, color image reflected above the film's surface.

Skyline of Singapore's business district

Singapore's Sustainable Development of Jurong Lake District

Highlights

- With ArcGIS, the development team models, visualizes, compares, and communicates the advantages of alternative scenarios
- ArcGIS helped organize and address the complex sustainability needs of a large-scale redevelopment project in Jurong Lake District.
- A GIS evaluation tool works at multiple scales to address cumulative impact.

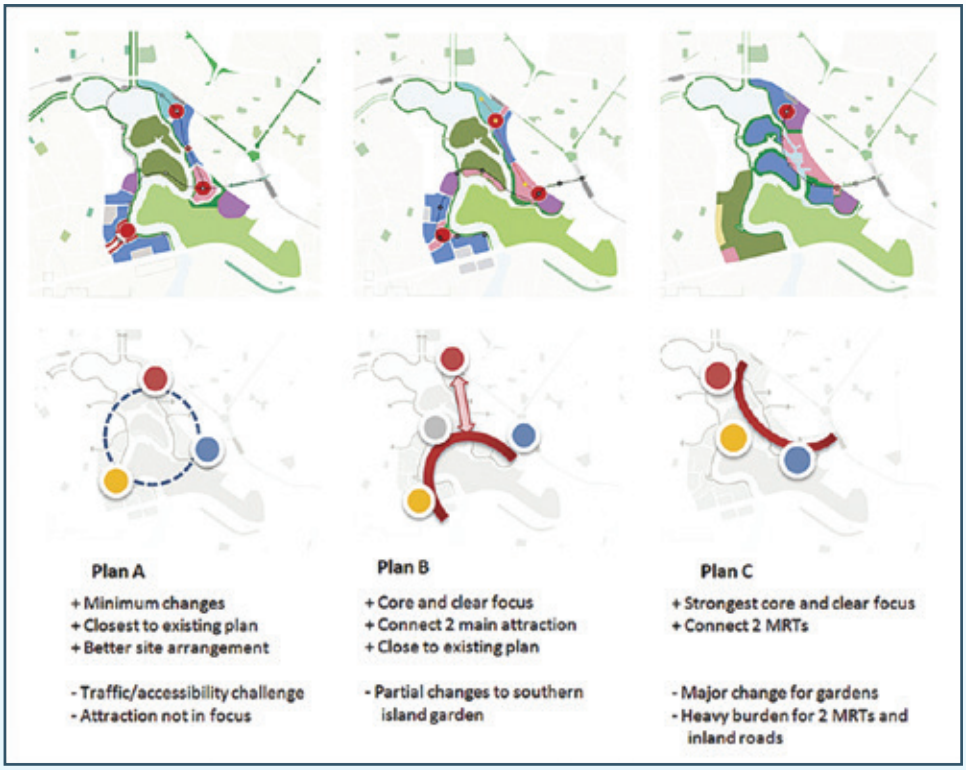
The Republic of Singapore is a city-state composed of 63 islands off the southern tip of the Malay Peninsula. It is highly urbanized, with approximately 5.1 million people (as of 2010) living in an area that covers approximately 270 square miles. By comparison, the City of San Diego has a population of 1.3 million people living in an area of 340 square miles. Singapore has finite space, limited water supplies, and no natural resources. Nearly everything in Singapore is imported, whether it is for personal consumption, manufacturing, or construction. The government of Singapore has made sustainable development, the use of renewable energy, and the efficient use of resources primary considerations in all future planning efforts.

Every 10 years, Singapore reevaluates its long-term land-use strategies to ensure there is sufficient land to meet anticipated population and economic growth needs without damaging the environment. Given the high population density and amount of existing urbanization, a strategy of developing and rejuvenating existing buildings is encouraged.

In the 2008 Draft Master Plan for Singapore, the Urban Redevelopment Authority (URA) heralded the Jurong Lake District (JLD) as an ideal place for such redevelopment, referring to it as "a unique lakeside destination for business and leisure." To help with this complex planning effort, URA would use GIS to model, visualize, and communicate the advantages of alternative scenarios.

JLD comprises two distinct but complementary precincts totaling 360 hectares: a commercial hub at Jurong Gateway and a vibrant world-class leisure destination at Lakeside. The 70-hectare Jurong Gateway is planned to be the largest commercial area outside the city center. As outlined in Singapore's Blueprint for Sustainable Development, unveiled by the Inter-Ministerial Committee on Sustainable Development, JLD will be developed as one of Singapore's new sustainable high-density districts. Overall, the aim is to formulate a holistic framework to guide the planning, design, and development of Jurong Lake District, one that considers the environment, the economy, and society concurrently during the decision-making process.

URA proactively included aspects of the sustainability blueprint in the JLD planning efforts, such as the incorporation of landscaped open space and pedestrian park connectors, to heighten the sense of greenery and closeness to nature and increase accessibility to



An example of the positive and negative effects of three alternative plans, the last focusing on Singapore's Mass Rapid Transit (MRT) →

existing transit, public facilities, and venues. Land sale requirements were also put in place to encourage developers to achieve higher Green Mark ratings (Platinum and GoldPlus) for new buildings.

Additional initiatives promote "sky rise" greenery—the addition of elevated parks, gardens, and green roofs on rooftops and skyways; the protection and enhancement of biodiversity; the reduction of resource use through building rehabilitation; and the increase of water catchment and treatment using natural systems whenever possible.

But how were these visionary goals going to be evaluated and translated into reality given the myriad of stakeholders, assortment of variables, and budgetary constraints?

To assist with this ambitious plan, URA enlisted the help of Esri Partner AECOM (headquartered in Los Angeles, California), which proposed the use of a geodesign framework using ArcGIS to help organize and address the complex sustainability needs for such a large-scale project as JLD.

The Sustainable Systems Integration Model

AECOM's Sustainable Systems Integration Model (SSIM) is a key component of the team's sustainability planning process, providing a platform for rationally evaluating, balancing, and costing a wide variety of sustainability strategies to determine the combination best suited to the economic, social, and business objectives of a given project. The model places ecological enhancement and service components side by side with energy, water, mobility, green building, and sociocultural strategies so that a truly integrated, balanced sustainability program can be measured and conceived. The result is a whole-system economic and GIS evaluation tool developed to work at multiple scales.

The model consists of many steps and techniques that allow users to select the themes and variables most befitting a given project's needs. The framework tracks a set of indicators including total energy use, water demand, waste produced, vehicle miles traveled, and total greenhouse gas (GHG) emissions that can be modeled to show the impact of a single building, block of buildings, or entire community. Various energy or water conservation strategies can be recombined and modeled to show the immediate carbon or water footprint, as well as initial development costs or ongoing maintenance and management costs of a given scheme for any point in the future.

Stage I—Urban Form and Master Planning

Urban form—the physical layout and design of a city, including land use and circulation patterns—has the largest impact on a city's energy use and GHG emissions. Stage I of developing a master plan seeks to identify the best mix of urban form, land-use density, and transportation network to achieve the highest trip capture and reduction in carbon emissions at the lowest cost.

The process started out with a visioning workshop at which all stakeholders and subject experts were brought together to help define and prioritize issues, metrics, and target goals. In this case, the stakeholders were the Building Construction Authority, Land Transport Authority, National Parks Board, National Water Agency, and URA, among others. Participants were encouraged to address problems beyond their field of expertise. The end result of this dynamic interaction and the sharing of views and perspectives across disciplines was an increased understanding among stakeholders of the complexity of key issues, enabling them to reach agreement on priorities.

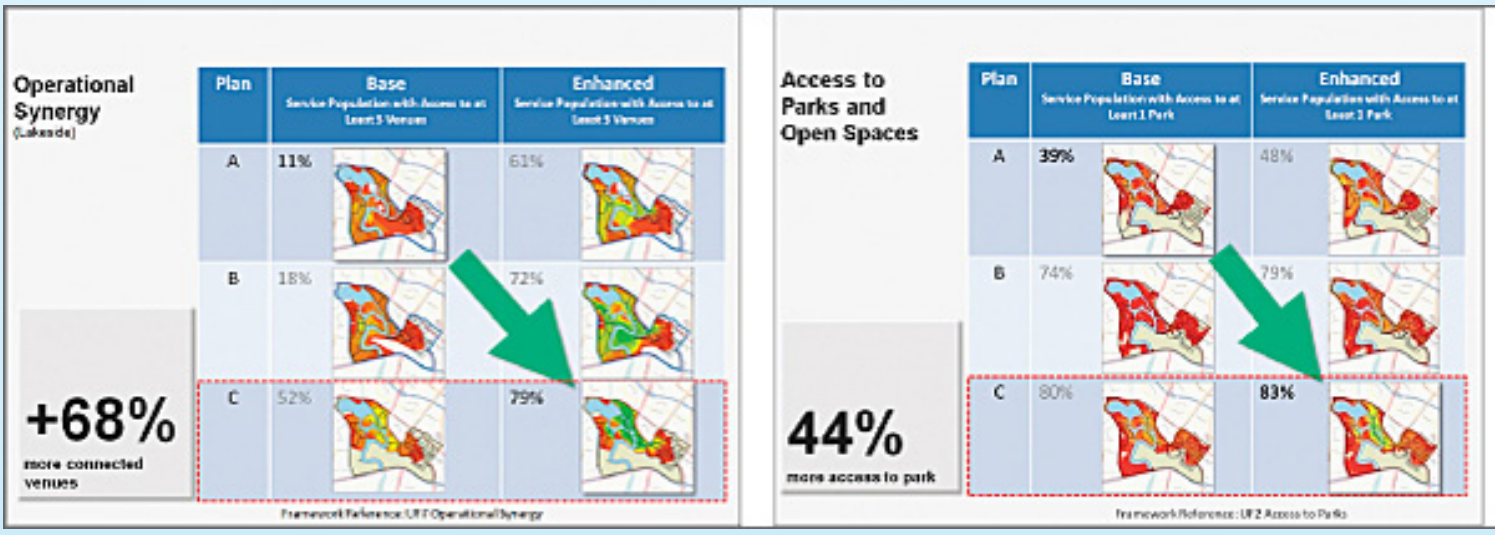
To create a relatively accurate frame of reference, the team established definitions for business as usual (BaU) and baseline, to which the aspirational targets and all future scenarios could be compared to help the team understand improvements in performance, as well as associated costs (evaluation models). For JLD, BaU was defined as the original master plan in place for Jurong Gateway and Lakeside assuming conventional construction practices. The baseline was defined as the original master plan, combined with the existing sustainable development initiatives already implemented by URA, such as Green Mark certification, the proposed pedestrian network, and the greenery replacement program.

Once the BaU and baseline models were created, alternative master plans (change models) were "sketched" by participants using customized templates or palettes of predetermined land uses, building types, transportation modes, community facilities, and other amenities to help facilitate this process. Sketching was enabled through the standard ArcGIS 10 editing template functionality.
The model's GIS mapping and geoprocessing tools, developed as an ArcGIS for Desktop add-in using ArcObjects, were used to model accessibility to certain plan features, including land-use spatial allocation, internal and external connectivity, and access to key services and transit. A unique addition to the JLD project was the creation of tools to measure the accessibility of vertical components, such as elevated parks, skyways, and trams. These evaluation models, characteristic of a geodesign process, quickly evaluated design decisions, allowing participants to see the impact just by running the tools.

Stage II - Infrastructure or Primary Systems Evaluation and Modeling

After a preferred master plan framework was selected, a more intensive evaluation of sustainability practices and measures took place, focusing more at a detailed infrastructure level of analysis. By tweaking certain measures—for example, selecting certain building materials or switching to low-flow faucets—additional improvements can be made in water consumption, energy consumption, or cost. This step seeks to answer three core questions for each theme: What energy reduction targets should be evaluated? Which combination of project design features are required to achieve each target? Which combination of project design features will achieve the reduction targets in the most cost-effective manner?

Just like in the evaluation of urban form in stage I, stage II requires the identification of a BaU and baseline for each system (the former being the minimum level of performance allowed by building and zoning codes, while the latter represents the level of performance required by URA in the existing plan). The primary difference between these two was in the amount of open



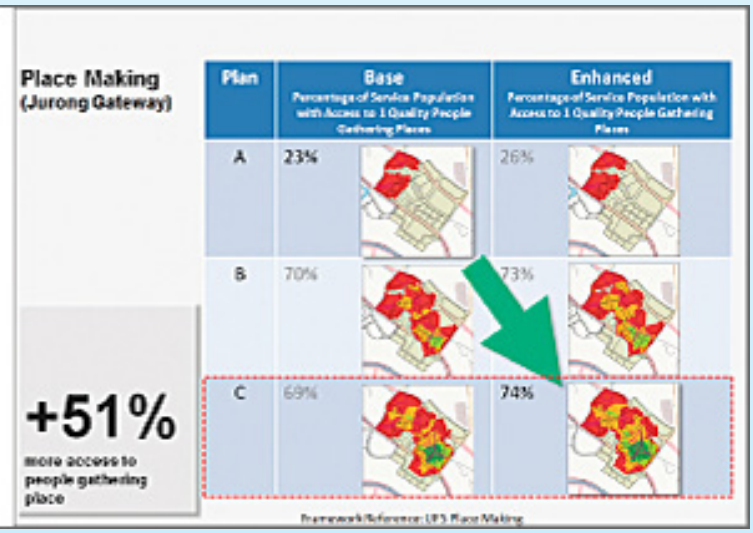
space and green building requirements in the Gateway district. Three additional levels of performance (termed good, better, best), which had been earlier identified in the Sustainability Framework Matrix, were the basis for assembling "packages" of measures that would theoretically achieve each of the respective targets for each system. These packages were then modeled to test whether they in fact achieved the targets.

After identification of the packages of measures to be utilized in closing the gap between the aspirational targets and the current BaU case, each package of strategies underwent a cost estimating step and a cost-benefit analysis.

Stage III - Master Program Optimization

The goal of SSIM stage III is to combine the effects of multiple systems and strategies to create integrated sustainability programs across the entire project site for each of the alternative master plan scenarios refined in stage I. The Gameboard tool of SSIM facilitates this goal by allowing the selection of a performance package for each major system and simultaneously reporting various performance and cost indicators resulting from the package selections.

Gameboard is used to optimize the overall master sustainability program. In this context, optimization is the process of selecting unique combinations of sustainability choices that result in achieving the aspirational targets set out in stage I using a set of predetermined cost thresholds. The optimization process is assisted by a logic engine that solves for the set of constraints stipulated by the thresholds.



Conclusion

In the end, Singapore defined and evaluated three to five master sustainability framework programs. The variation between the programs included multiple combinations of good/better/best scenarios on all the systems. SSIM allowed URA to examine the theoretical 10-year life cycle analysis comparing net present value for each model run.

The savings from energy and water efficiency are expected to offset the investments in other sectors, such as parks, open space, public transportation, potable water infrastructure, and even social programs.

The refined sustainability framework matrix serves as the master checklist for achieving a holistic sustainability program for JLD. It is a living document that will be amended as time goes on and as adjustments need to be made in targets, due to changes in either technology, demographics, costs, or priorities.

Semantically Enriched Vision of Smart City

Anuj Tiwari & Dr. Kamal Jain, IIT Roorkee
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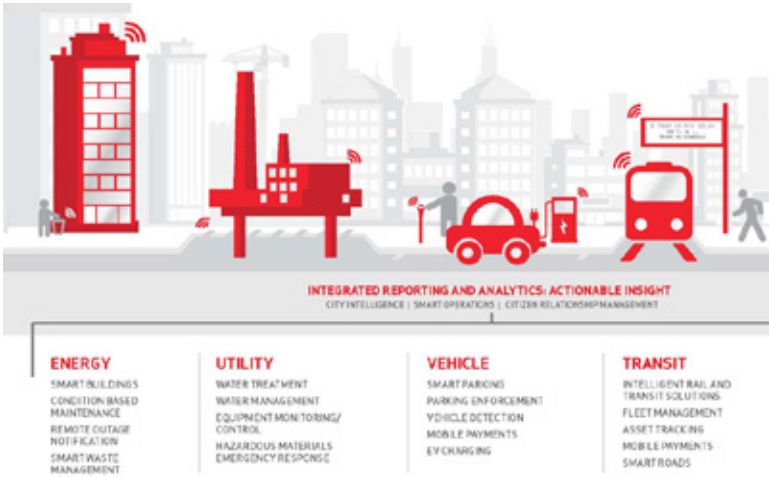
Debates to achieve a sustainable and harmonious tomorrow have been increasingly influenced by discussions of smart cities. Researchers argue collaborative information and communication technology with different level of social participation of residents is a fuel for quality of life that reduces the environmental impact of urbanization. In similar fashion, policymakers emphasize on high technological solutions to offer new ways of operating, learning, living, working and travelling, and apply smart, innovate and combined strategies to fuel economical development. Government's vision places the people at the heart of the smart city concept, and they focus on achieving a smart governance framework, connected by innovative technologies that enable citizens to experience all public services with ease and low cost, fuelling economic development to stimulate a high quality life for all.

India is drawing on the development of smart cities at the global level. Since the arrival of new government in India, a new technical term, a modern buzz word "Smart City" is increasingly used by public authorities and private developers to address the urbanization and sustainability solutions. Vision of 'Digital India', has a plan to build 100 smart cities across the country.

There is much debate on the ways to approach objectives of smart city but regardless the disparity of views, technology is the common denominator.

ICT or ubiquitous computing paradigm is the central nervous system of smart cities. Smart city solutions relies on the widely distributed smart devices to monitor the urban environment in real time, to react in time, to establish automated control, to collect information for intelligent decision making, and to facilitate various services and improve the quality of urban living. The distributed network of intelligent sensor nodes, as well as the data centers/clouds where the sensor data are stored and shared, constructs the main body of smart city infrastructure.

Wireless sensor networks develop the foundation for Smart Cities, adopting a spatially distributed network of autonomous intelligent sensors to measure a variety of physical or environmental parameters, such as pressure, noise, temperature, sound, ambient light levels, and toxic gas concentration, for efficient urban management. This monitoring capability can be effectively used in the emerging



initiatives of smart city. Every second, massive amounts of heterogeneous data are being produced by these sensors that bring the challenge to develop a common platform to share unambiguous meaning of collected data. This aim can be achieved by the concept of Semantic Sensor Network (SSN). SSN enables sharing and reusability of sensor data from various sensors in a meaningful way and endures system to process sensor data in heterogeneous environment.

In 1998 father of web, Berners-Lee coined back the term semantics to achieve the vision "Lead the Web to its full potential". He described semantics as a common framework technology to enhance visibility of knowledge and enable automated processing for machines and humans alike. Semantic Web extends the description of contents and services over web in a machine process able and understandable format and let humans and machines to work in an integrated environment through semantic interoperability of the knowledge. At the bottom level, for sensor and sensor network applications, there are no ubiquitous standards. The backbone of the sensor service infrastructure and the API to sensors is provided by OGC standards as part of its Sensor Web Enablement (SWE) program viz SensorML and Observation & Measurement (O&M). While the OGC SWE standards provide description and access to data and metadata for sensors, they do not provide facilities for abstraction, categorization, and reasoning offered by semantic technologies. World Wide Web consortium (W3C) is another authority responsible for Semantic Web standards for sensor networks. To facilitate this process, linguistic techniques, such as extensible markup language (XML), resource description framework (RDF) and web ontology language (OWL) have been developed as standard formats for the sharing and integration of data and knowledge as explicit metadata and logical reasoning. The availability of tools and reasoning systems has contributed to the increasingly widespread use of semantics, and this technology is growing and started applying in various application domains as biology, medicine, geography, geology, agriculture and defense. Applications of semantics are particularly prevalent in the life sciences where it has been used by the developers of several large biomedical ontologies, including the SNOMED, GO and BioPAX ontologies, the Foundational Model of Anatomy (FMA) and the National Cancer Institute thesaurus. These ontologies are the result of collaborative efforts across different community commonly aimed at facilitating online knowledge sharing and exchange.

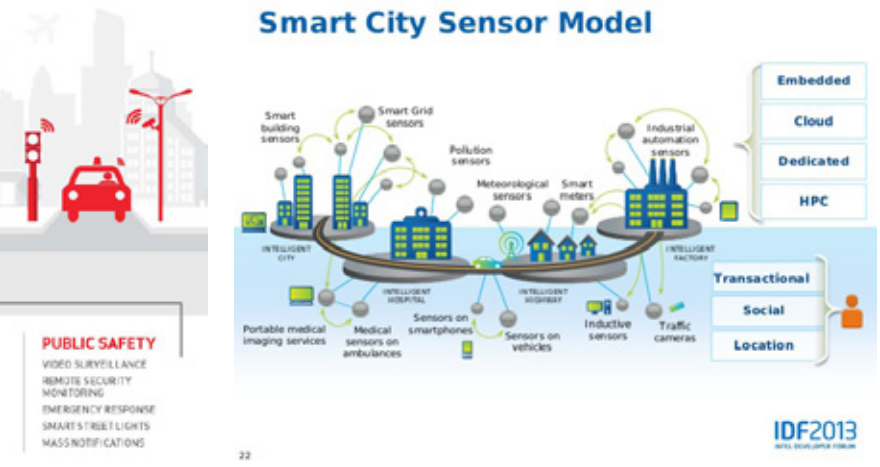
World Wide Web consortium initiated a dedicated Semantic Sensor Networks Incubator group (the SSN-XG), which ran from March 2009 to September 2010, worked on an OWL ontology to describe the capabilities and properties of sensors, the act of sensing and the resulting observations. The SSN ontology was developed by group consensus over a period of some eleven months. The SSN ontology, available at http://purl.oclc.org/NET/ssnx/ssn, describes sensors, the accuracy and capabilities of such sensors, observations and methods used for sensing.

Sensors are nowadays part of our everyday life. In the vision of smart city, SSN is visualized as the key solution for heterogeneous sensors which enables semantic sensor information annotation for real time systematic measurement and handling of environmental dynamics to achieve essential solutions or services. Semantic Sensor Network technologies provide a mechanism for better communication among these sensors. Advantages of SSN are as follows:

- Semantic sensor information annotation enables smart decision making with real time heterogeneous sensor measurements.
- SSN can be used as a common platform for knowledge sharing across the boundaries of proprieties data format provide a sound foundation for innovative solutions.
- SSN fill the gap between human process able and machine understandable information which develop a strong platform for human and machines to achieve better tomorrow for mankind.

In smart cities data being produced by sensors is enormous and there is a strong need to time these data streams and build applications and services to take smart decision by performing analysis of these data streams in real-time.

Reference : www.goo.gl/OzPlyW



'Sensors' for Smart 'Cities'

The trend of urbanization is growing word wide. According to United Nations, Department of Economic and Social Affairs, Population Division (2014)*, more than 6.3B people, 60% of the population will be living in cities by 2050. With more population shifting to urban areas, cities across the globe are dealing with tight budgets and aging infrastructure.

The cities of the future needs to be safer, more sustainable, efficient, comfortable, Interactive and 'smart'.

In smart cities, a network of sensors, cameras, wireless devices, data centres form the key infrastructure, which allows civic authorities to provide essential services in a faster and more efficient manner. Smart cities are also far more environmentally friendly as they use sustainable materials for building facilities and reduce energy consumption. Efficient use of technology helps create an efficient transport management system, improve healthcare facilities and develop a robust communication network to connect all businesses, people and beyond the relationships between central and sub-national levels of governments.

There will be an urban environment that is permanently communicating with the citizens and capable of managing public services in real time to improve their quality of life through traffic management, garbage collection, waste disposal, irrigation systems, assisted parking, alerting the local authority when an incident occurs and allowing the government to stay in touch with the people.

What it takes to make a city 'SMART'?

A smart city capable of becoming both environmentally sustainable and attractive to citizens and businesses requires a new kind of intelligent infrastructure — an innovative and open platform based on smart sensor networks that can help forward-looking cities more predictably integrate a complex suite of services cost-effectively, at pace and at scale. While many smart city technologies including smart electricity grids, smart meters and real-time transportation information are already in pilot programmes. Some of the major components of the Smart city are as follows:

Use of Sensor Technology - A smart city can create an efficient and smart services delivery platform for public and municipal workers by installing sensors in the city and to create platforms that allow the share of information and give it for proper use to the public, city managers, businesses and professionals. The platform can have common data warehouse where different sensor system store their information.

One of the aspects of smart cities is the optimal use of available resources. Sensors can help make optimal use of resources with connectivity to tell us when and where to save. These sensors can control, detect and manage the unnecessary use and make certain adjustments as per the need.

Water Management

At present, the major cities waste up to 50% of water due to pipe leakages. With sensors fitted on each pipes, water leaks can be easily detected and corrected before any heavy loss. Besides this, the irrigation systems in public parks can automatically turn off whenever rain is detected to save water.

Energy Management

Sensors have also enabled the concept of "Advanced Metering Infrastructure (AMI)" underpinning energy management in cities. Cities are considering use of "Smart Meters" embedded with Phase Measurement Unit (PMU) sensors and communication module which facilitates a two-way communication between the consumer and the supplier. For utility service providers, it helps check meter status prior to sending a repair crew in response to a customer call. These checks prevent needless field

Remote control network - An integrated control network with common data transmission infrastructure monitors all the municipal and supply networks of the service companies involved in the project. The goal is to manage and find out about the ordinary consumption, incidents and eventualities in these networks, all of this independently from the municipal services. All the networks have alert devices and monitor consumptions, flows, intrusions, etc., making it possible to act in the event of leaks.

The service network should include supply network, drainage network, rainwater network, public lighting, pneumatic waste collection, climatology, electrical energy and internal home comfort.

The city (Project) should able to provide publicity subsidised homes in a short period of time.

Information & Communication Technology (ICT) - ICT improves the way cities function and communication flow increases the sustainability of cities as it gives people the appropriate information to make well informed decisions. ICT manages cities in a more participative way and facilitates active participation of individuals and local communities as well as provides efficient feedback system and improves internal and external interaction. It creates an urban commons for cities collaborations around the world.

Smart Mobility - It is important to ensure availability of open public data for its analysis and onward distribution to its users for the use by colleagues, friends and public at large for smooth mobility. Further, provisions of alternatives such as multimodal approach and professional working at a smarter place result in the comfortable and easy work environment. Sharing of available resources as well as parking solutions in the city ensures use of resources in a smarter way. This also results into overall improved quality of life. Car running on green gas adds to sustainability and eco-friendly environment which cities should ensure.

Global Initiatives

Rio de Janeiro, Brazil's second largest city and host to Summer Olympics 2016 is a tangible example of what a smart city in future would be like. During the Olympics, millions of tourist would visit this city from across the globe. The logistics of moving so many people around in a few short weeks, while still running the daily operations of a city of such size, would be daunting for any government.

Located in a building that looks like a glass cube, the Centro de Operacoes is a high-tech control room for the entire city, packed with computers, giant screens and hundreds of workers who can monitor everything from water levels in streets after a rainstorm to developing traffic jams.

The goal is to make decisions in real time as events or emergencies occur, mitigating their impact on the daily lives of Rio's residents while making sure the city's budget is used as effectively and efficiently as possible.

crew dispatch to customer sites. For consumers, it can provide the real-time energy usage detail in a way which a user can understand quite easily. Based upon this data, users can change the preferences and make more informed decisions about their usage without waiting for their energy bill at the end of month.

Smart Streetlights

In cities street lights remain ON even when there's no activity in the area (sometime in daylight too!). Additionally, it becomes very difficult for authorities to detect any fault and theft of street lights. With sensors, lights can go dim when they aren't needed and authorities can get a text message almost instantly whenever there is a fault or tampering in street lights.

Waste Management

With sensors fitted in the garbage bins, the municipal authorities can be notified when they are close to being full. The Netherlands became the first ever to produce "Intelligent Bins" that report to the officials via text messages whenever the bins are either full or if there is any damage.

World Urbanization Prospects: The 2014 Revision, Highlights (ST/ESA/SER.A/352)

Centro de Operacoes, Control Room, Janeiro

Transport Management (Smart Parking)

Traffic can be reduced with sensors that detect where the nearest available parking slot is. Motorists get timely information via text messages so they can locate a free parking slot quickly, saving time and fuel. A similar project is being carried out at San Francisco called SFPark - where parking spaces have been installed in 8200 on-street places. This concept would be replicated in several other states in coming days.

Santander, the Spanish city is embedded with more than 12,000 sensors that measure everything from the amount of trash in containers, to the number of parking spaces available, to the size of crowds. Besides helping the government operate as efficiently as possible, it's changing the way Europe thinks about cities.

Since 2010, 12,500 sensors have been placed in and around the city's downtown district. In addition, sensors on vehicles such as police cars and taxicabs measure air pollution levels and traffic conditions. The data from these sensors flows to banks of computers that analyze the real-time information and give city officials the kind of big picture that allows them to adjust the amount of energy they use, the number of trash pickups needed in a given week and how much water to sprinkle on the lawns of city parks.

At the same time, the city is opening up its data so that programmers can create apps that help citizens find bus arrival times or let tourists find out who is performing at concert halls simply by pointing their mobile phones at a bus stop or building.

Real-time Pollution Management

Sensors mounted on poles can monitor the Ambient Air Quality (AAQ) of cities. Citizens can monitor the pollution concentration in each street of the city or they can get automatic alarms when the pollution level rises beyond a certain level.

"ArcGIS 10.3 and ArcGIS Pro Modernize GIS for Organizations and Enterprises"

Map Like a Pro!

ArcGIS 10.3 is a major release that will help you discover, make, use, and share maps from any device, anywhere, at any time.

ArcGIS 10.3 includes new apps and enhancements that continue to revolutionize the science of geography and GIS and enable users to more readily share their work throughout their organizations. Here are some of the highlights:

ArcGIS Pro - Your New ArcGIS for Desktop App

ArcGIS Pro reinvents desktop GIS. This brand new 64-bit desktop app lets you render and process your data faster than ever. With ArcGIS Pro, you can design and edit in 2D and 3D, work with multiple displays and layouts, and publish maps directly to ArcGIS Online.

More Tools for ArcMap

At 10.3, ArcMap is better than ever with improvements like new analysis and automation tools, info graphics capabilities, and tools for managing your data more efficiently. You can even run any version of ArcMap side by side with ArcGIS Pro.

Get Your Work into the Hands of More People with Web GIS

Since the 10.2 release, ArcGIS for Desktop comes with an ArcGIS Online account that lets you share your work throughout your organization. Ready-to-use apps including Explorer for ArcGIS, Open Data, and Esri Maps for Office make your maps available to anyone on any device.

Want ArcGIS 10.3?

ArcGIS 10.3 is available to all customers current on maintenance. If you need to get back on maintenance or need to have a technical discussion to understand more about ArcGIS 10.3, contact Esri India at info@esriindia.com.

Esri India User Conference focuses on

The announcement of the 'Digital India' initiative by the Government is an important step in reforming governance through the use of information technology. The strategic plan aims to transform India into a digitally empowered society and knowledge economy. GIS, in fact, will play an important role in the roll-out of the Digital India vision. Various ministries and departments are being encouraged to use GIS technology in their programs for planning, implementing and monitoring the execution.

Recognizing this, the theme of the 15th edition of Esri India's User Conference was 'Geo-Enabling Digital India'. The conference held on December 9-11, 2014 in Delhi, focused on how GIS would play a significant role in full-service orientation and become a core component in the digital infrastructure, enabling the process of governance, planning, and nation building.

Various thought leaders, eminent speakers and technology experts from the GIS industry shared their knowledge and experiences with GIS and talked about how the technology could be leveraged for geo-enabling digital India.

The conference was kicked off by Mr Agendra Kumar, President, Esri India. He set the context for the conference by providing insights on how GIS could support the Digital India initiative.

Dr. Vandana Sharma, Advisor (Remote Sensing and GIS Division), National Informatics Centre (NIC) gave a talk on the 'GIS Platform for Digital India'. She spoke about NIC's efforts towards creating a platform for creating and integrating GIS applications. Dr. Aruna Srivastava, Consultant, National Institute of Malaria Research (NIMR) presented her view on 'GIS in Decision support of Vector Borne Disease control in India'. She provided real life

Mr Rajendra Pawar, Chairman, NIIT, presented a keynote on the theme. "The only place where information becomes real is on the ground and GIS is a technology where information touches the ground", he said. He gave the simple analogy of water tanks, pipes and taps to show how citizens would be impacted by Digital India.

Mr Lawrie Jordan, Director of Imagery, Esri Inc., shared insights on technology evolution and Esri's technology vision, stating how GIS is changing the way people think and act and how it would play a key role in shaping the future of our country.

Mr R. Chandrasekhar, President, NASSCOM, emphasizing on the mainstream adoption of GIS and Mobility said "We are standing at a particularly interesting juncture in the history of our country, more particularly in terms of the adoption of technology in our day-to-day lives. Mobile has enabled easy accessibility of geographically relevant information".

'Geo-Enabling Digital India'

examples of the application of GIS in the health sector and its use in the control of diseases like Malaria, Dengue and Chikungunya.

In addition, NASSCOM President, R Chandrasekhar presented Esri India's prestigious Special Achievement in GIS (SAG) awards and the Making a Difference award at the event. The SAG awards recognizes users who had applied geospatial technology innovatively to address the needs of their industries and communities and defined GIS best practices. The award was presented to Forest Survey of India (FSI), the Geographical Survey of India (GSI) and Central Ground Water Board (CGWB). The 'Making a Difference award' went to National Dairy Development Board (NDDB) acknowledging the efforts of NDDB in revolutionizing the dairy planning process across India that brought together all stakeholders up to village level.

As a part of Lightening Talks sessions, users presented their unique applications developed using Esri technology. Mr. Manoj Arora, VP-Flight Operations of Jet Airways talked about how GIS is helping the airline in flight height & path planning and operations. Mr. Sheshadri T., IT Head, Bruhat Bangalore Mahanagara Palike (BBMP), shared how the ArcGIS software based system had helped the company improve governance and service efficiency and how the

Mr. Agendra Kumar
President, Esri India

Experience Zone

Mr. Anand Singh Bahl
Economic Advisor, MoUD, GOI

Exhibition

Mr. Srinivas Garimella, Microsoft | Mr. NSN Murthy, PwC | Mr. Rakesh Raina, Esri India | Dr. Prashant Pradhan, IBM | Com. Avanish Dureha, SAP

automated workforce and GIS reporting with detailed dashboards had facilitated more informed decision making. Mr. M.L. Srivastav, Deputy Inspector General of Forests, Ministry of Environment and Forest (MoEF) provided glimpses of various GIS-based applications being used for the real time monitoring of forest fires, building a national forest inventory, etc.

One of the key highlights of the conference was a dedicated track on 'GIS and Smart Cities' hosted in collaboration with Institute of Town Planners, India. The key objective of the track was to reinforce the use of GIS in the end-to-end smart city planning and management. The track featured eminent speakers such as Dr. Najammuuddin, Secretary General, Institute of Town Planners, India (ITPI), Mr. Anand Singh Bahl, Economic Advisor, Ministry of Urban Development, Mr. Shishir Rai, Assistant VP, Planning, GIFT City, Mr. Kapil Chaudhery, Director, Spatial Decisions, Prof Chetan Vaidya and Dr. G S Rao including many others. The track concluded with a key message that GIS will provide a central IT framework which integrates every aspect of a smart city – from conceptualization, planning and development to maintenance.

The conference concluded with a panel discussion on the theme "Geo-Enabling Digital India", moderated by Mr. Rakesh Raina, Sr. Vice President– India Business, Esri India. The panelists included Mr. S K Sinha, Director, TNP & A&N GDC, Survey of India, Dr. (Mrs). Manosi Lahiri, M L Infomap, Dr. P. S. Acharya, CEO, National Spatial Data Infrastructure (NSDI), Mr. A K Gosain, Professor, Dept. of Civil Engineering, IIT Delhi. They discussed on "how to ensure that GIS becomes integral part of every government project, what are possible challenges, what will be industry participation in digital India."

The panelists acknowledged and highlighted that GIS would be an integral part and backbone of the Digital India initiative.

The conference also included a Developer Summit, Systems and Design Strategy seminar, technical expo and paper and poster presentations. There was a buzzing exhibition floor where Esri India and various other companies like HERE, HP, Trimble and Cybertech displayed their offerings. In addition, users from across India presented papers and posters and participated in the contests that were organized over the three days of the conference.

Delegates at Esri India User Conference 2014

Rethinking GIS for Local Government

For cities and countries, implementing GIS just got easier

Governments have demonstrated the power of GIS technology for many years, and now even more value has been added to help public-sector agencies extend their reach with ArcGIS® for Local Government. ArcGIS for Local Government consists of a set of tools, application templates, and resources that are helping government agencies rethink how they extend GIS. Part of a solution initiative at Esri, these maps, applications, workflows, and other resources are available today to be customized and used for numerous departmental functions. Local agencies can now implement applications that enhance their existing GIS immediately and more easily than ever. Many are seizing this opportunity to create more efficient government, improve workflows, increase citizen engagement, and generate productivity gains. More than 60 maps and applications are available, and more are on the way. There are customizable applications for service requests from citizens, public comment on land use, emergency management, property taxes, and numerous other local government activities. Configurable application templates are discipline specific for areas such as land records, public safety, water utilities, public works, elections, general government, and planning and development. Base maps—ready-to-use maps loaded with content give local governments a solid foundation on which they can build their own maps. Imagery and road data, demographics, topographic information, and other features, are also available and the list of tools continues to grow.

Ready to Go

ArcGIS for Local Government is a ready-to-go set of practices and resources that enable local governments to fully utilize GIS quickly and easily—potentially saving months of development work for cash-and time-strapped agencies. The maps and applications are organized as a set of modules that can be downloaded and configured individually. They can be localized and customized, and they come with ongoing support and development from Esri. And everything's built on the Local Government Information Model—GIS datasets, web services, and maps that work across numerous departments, making collaboration and sharing easy. ArcGIS for Local Government is focused on customer success, helping to provide better services to Esri customers and the public. It aligns perfectly with five key areas of government activity: data creation, planning and analysis, field mobility, operational awareness, and citizen engagement. The application templates, resources, and tools available also integrate with ArcGISSM Online, a popular mapping platform that enables the sharing of maps, applications, and geospatial data.

In addition to creating ArcGIS for Local Government, Esri offers several ways to implement these tools and resources. Organizations can customize the applications themselves, of course; or, they can also get assistance from a valuable network of experts, Esri partners and consultants, and Esri Professional Services.

However it's extended, ArcGIS for Local Government will make an immediate impact—and it couldn't be easier.

CityEngine FAQ

1 How to install City Engine quickly on system?

The installation of Esri City Engine is a multistep process:

- Install ArcGIS 10.2.2 License Manager (if it doesn't already exist for your use) to use the concurrent-use version. For more information, see about the license manager. If you intend to use Esri City Engine as a single use version only, you do not need to install and use ArcGIS License Manager.
- Install Esri City Engine 2014.1 using the Esri City Engine 2014.1 setup.
- Complete the City Engine Administrator wizard to specify your product type, assign a license manager (if using a concurrent-use license), or authorize your software (if using a single-use license).

Once installed, you can change your product level or switch between Concurrent Use and Single Use versions without uninstalling or performing any additional installation actions.

Esri City Engine 2014 and 2014.1 Concurrent Use require ArcGIS 10.2.2 License Manager be installed to support this product. The ArcGIS 10.2.2 License Manager setup package is designed to detect and upgrade an existing installation of the ArcGIS 10.1 (including SP1), 10.2 or 10.2.1 License Manager. Existing authorized licenses and configuration information (including Service.txt and ARCGIS.opt files, if applicable) are retained in the upgrade. For more information on installation upgrades, new installations, or installations over versions earlier than ArcGIS 10.1 License Manager, see the ArcGIS License Manager Reference guide. The License Manager Reference Guide is installed with ArcGIS 10.2.2 License Manager.

2. What is new in Esri City Engine 2014 & 2014.1?

Esri City Engine 2014.1 can be used on the same machine as Esri City Engine 2012/2013/2014. Existing Esri City Engine 2012/2013/2014 authorization numbers will work with Esri City Engine 2014.1.Esri City Engine 2014 and 2014.1 for Single Use: If Esri City Engine 2014 or 2014.1 will be installed on a different machine than where Esri City Engine 2012/2013 is currently installed, and you wish to use the existing Esri City Engine 2012/2013 authorization for Esri City Engine 2014 or 2014.1, the Esri City Engine 2012/2013 product must first be deauthorized before authorizing the Esri City Engine 2014 or 2014.1 installation.

3. How much RAM does City Engine typically need?

City Engine requires approximately 1 GB free memory for startup. Additionally, a small 3D scene with a few hundred low-resolution buildings requires 0.5 to 1 GB RAM (depending on the graphics card memory). In case your operating system uses another 1 GB RAM, you would therefore need at least 2 to 3 GB. Therefore, we recommend you use a 64-bit operating system with 6 GB RAM. With such a system, you can work with larger 3D scenes and have other applications running in the background without difficulty.

4. How can I fix the error my computer has OpenGL 1.x?

Make sure your graphics card is OpenGL 2.x minimum capable and that your drivers are up-to-date to run the OpenGL 2.x standard. If your graphics card is not OpenGL 2.x capable, you will need to buy a new graphics card to run City Engine.

5. Where can I download the latest OpenGL drivers?

OpenGL drivers are usually installed together with the rest of the graphics drivers and support software (such as DirectX), but may be out of date. It is highly recommended to download the latest drivers from NVIDIA, AMD/ATI, or Intel found on the manufacturer's home page.

6. Does City Engine run on virtual machines?
   No, since OpenGL rendering cannot be emulated, City Engine requires physical graphics card hardware.

7. Does City Engine run on Windows, Mac OS X, or Linux?
   City Engine runs on all three major operating systems. Native 64-bit and 32-bit versions are available for Windows (8/7/Vista/XP).A native 64-bit version is available for Linux and Mac OS X with Intel processors (no City Engine support for 32-bit or PowerPC Macs).

8. What are the requirements for my Linux distribution?
   City Engine runs on all major Linux distributions as long as the following requirements are fulfilled: >= glibc6 / version 2.6
   2.2.1 of the GTK+ widget toolkit and associated libraries (GLib, Pango)

9. What 3D model export capabilities are available at City Engine Basic license levels?
   In City Engine Basic, the 3D model export ability is limited to basic 3D file formats only. A model can be exported as AutoDesk 3DS, Wavefront OBJ, and E-On Software Vue formats only.

10. How much RAM does City Engine need for working with large scenes?
    We recommend at least 6 GB of RAM.

11. How do I calculate the average slope of a curved street or sidewalk shape?
    The CGA example below can help with calculating the average slope of a curved street or sidewalk shape. CGA stands for Computer Generated Architecture, a scripting language specific to Esri City Engine and used to generate 3D content. See the link to the 'Basics of Rule-based Modeling' in the Related Information section below.
    approxCurvedSlope = asin (scope.sy / geometry.du(0,unitSpace))
    Street -->
    alignScopeToAxes(y) print (approxCurvedSlope)

12. Can I calculate the approximate average slope of a (non-planar) shape?
    Yes, by using the following example. Please note that this is CGA sample code and may not apply in all situations. See the link to the 'Basics of Rule-based Modeling' in the Related Information section below.
    slopeFunction = atan (sqrt (scope.sy / scope.sz))
    Lot -->
    alignScopeToAxes(y)
    print (slopeFunction)

13. How do I place street furniture like lamp poles or trees?
    Elements can be placed on streets or sidewalks by using CGA code. See the link to the 'Basics of Rule-based Modeling' in the Related Information section below.The best strategy is to duplicate the start shape (street or sidewalk) for each type of object that is to be placed.
    Example code:
    Sidewalk -->
    SidewalkShape. # Original shape
    PutTrees # Duplicate of the shape for placing trees

The actual placement is then done in a new rule by splitting the shapes using the split(u or v) directions. The precise placement is usually done by first splitting strips of the shape (in the short dimension), then splitting those strips into small repetitive parts (in the long dimension), and finally replacing each of the resulting shapes with the actual assets, for example, trees.

The following code example shows how to place vertical poles along a sidewalk:

```
Sidewalk -->
SidewalkGeometry.
SidewalkObjects     # shape duplicated!
# idea : we cut off small strips of the original shape sideways and along the length of the sidewalk.
# on the remaining shape 'dots' (small rectangular shapes), we insert a post.
attr placementWidth = 0.05
attr streetDist = 0.2
attr objectDist = 5
attr objectSize = 0.1
attr objectHeigt = 2
SidewalkObjects -->
# split sideways the sidewalk shape
split(v,unitSpace,0) { streetDist : NIL | placementWidth : PlacementStrip | ~1 : NIL  }
PlacementStrip -->
# split along the sidewalk shape
split(u,unitSpace,0) {objectDist: NIL | placementWidth : PlacementPoint }*
PlacementPoint -->
alignScopeToGeometry(yUp, 0) # align the shape to the current point shape, thus the street direction!
#r(0,90,0) # toggle 90 degree rotation, e.g. for lamp poles
s(objectSize*2, objectHeigt, objectSize)
i("builtin:cube")
center(xz)
```

14. What is OSM data and how do I import it?

OSM data is free (vector) map data, provided by the Web site OpenStreetMap.org. It contains street maps and footprint shapes that can be used in Esri CityEngine. Depending on the region, some datasets are more complete than others. The data is provided in a browser window that lets the user choose a specific region on the globe to export. Data may be exported to an '.osm' file (OpenStreetMap XML Data). Additionally, the corresponding map image file can be exported, as well as embeddable HTML code.

On Mac OS, these files may need to be renamed from '.xml' to '.osm' after downloading.

Once the data is downloaded, the user can copy-paste the files to the project's data folder. From there, the files are ready to import into the scene.

OSM data is georeferenced, thus if imported into a new scene, the dataset may not directly be visible, because it was placed in its true position, far away from the Cartesian origin. In this case, pressing the 'f' key frames the scene contents in the camera view.

esri India

1 Senior Database Engineer/Database Analyst

Experience : 3-8 years
Qualification : Graduate / Post Graduate
Requirement : 1
Location : Gurgaon
Primary Skill : Good knowledge on Administration of Oracle Enterprise Server
Good knowledge on Administration of ArcGIS Server
Plus point if worked on ArcFM Server also
Should have experience in publishing and managing data nad data services
Good knowledge on Spatial data and formats of Esri
Good communication skills

2 Senior Tech Support Executive

Experience : 3-7 years
Qualification : Graduate / Post Graduate
Requirement : 1 (Against each location)
Location : Hyderabad / Gurgaon
Skill Set : Developer skill set with knowledge of ArcGIS Server and API on .Net and Python technologies
Should be willing to undertake training and minimum travel as required
Desired Skill : Additional : Should have development knowledge on ArcGIS Engine, development on Java / Windows
: Knowledge of GIS technologies

3 Team Lead - Photogrammetry

Experience : 6-10 years
Qualification : Graduate / Post-Graduate in GIS, Geology, Preferable BE/B.Tech/Misc. in GIS
Requirement : 1
Location : Gurgaon
Primary Skill : Must have a through understanding of Sociest Photogrammetry Software Ver. 5.3 onwards
Sound understanding and knowledge of AT, DTM and Orthophoto creation

4 Senior Business Executive Sales

Experience : 7-12 years
Qualification : Graduate / Post Graduate
Requirement : 1 (Against each location)
Location : Raipur, Ranchi, Chandigarh & Nagpur
Primary Skill : Must have exposure to "Government" sales (State Government)
Should be from IT - S/W, H/W, GIS Industry
Drive sales targets and should understand the entire sales cycle
Desired Skill : Selling of Autodesk / Bentley Software's
Exposure to GIS Industry

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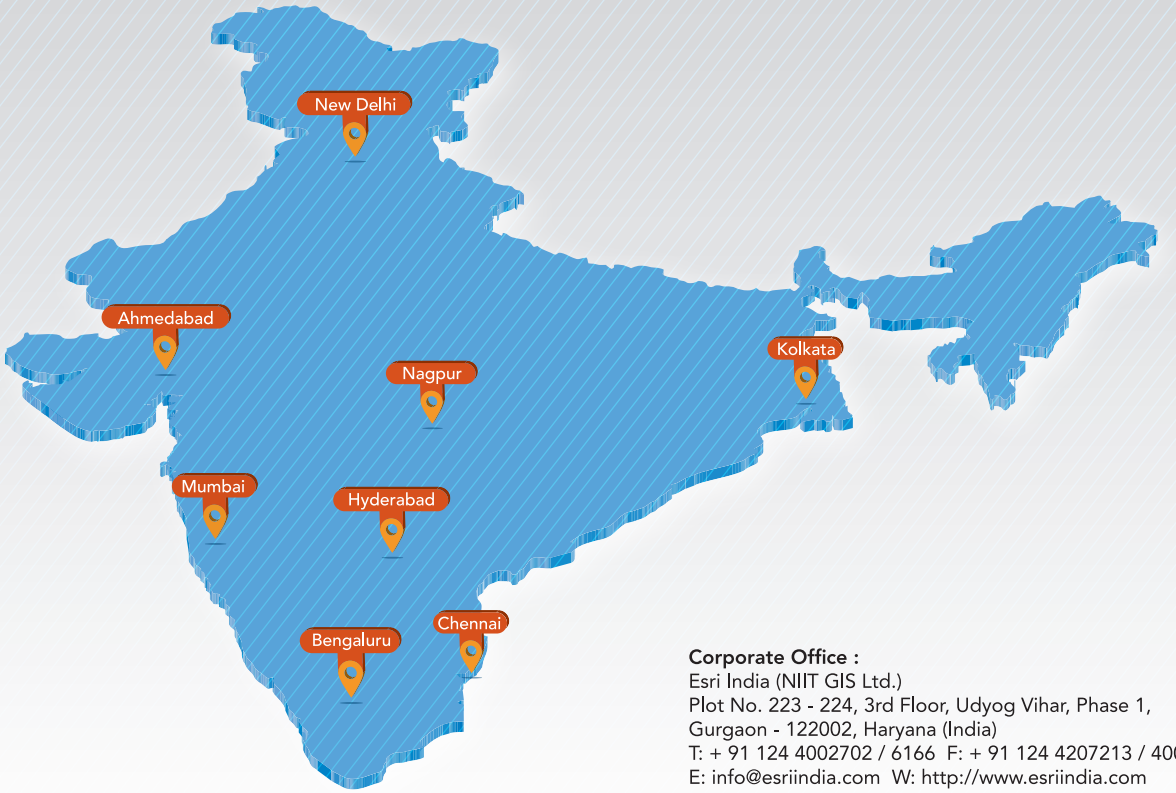
Esri India Locations



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