PEARL

Peer Experience and Reflective Learning

COMPENDIUM OF GLOBAL GOOD PRACTICES

ICT in Urban Services


PUBLIC SERVICE AND GOVERNANCE
URBAN ADMINISTRATION
URBAN INFRASTRUCTURE PLANNING
ENVIRONMENT AND ENERGY
PUBLIC HEALTH AND SAFETY

PEARL

Peer Experience and Reflective Learning

an initiative of

National Institute of Urban Affairs

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National Institute of Urban Affairs

PREFACE

The National Institute of Urban Affairs is the National Coordinator for the PEARL Initiative (Peer Experience and Reflective Learning). The PEARL program ensures capacity building through cross learning and effective sharing of knowledgerelated to planning, implementation, governance and sustainability of urban reforms and infrastructure projects – amongst cities that were supported under the JNNURM scheme.

The PEARL initiative provides a platform for deliberation and knowledge exchange for Indian cities and towns as well as professionals working in the urban domain. Sharing of good practices is one of the most important means of knowledge exchange and numerous innovative projects are available for reference on the PEARL website. "Knowledge Support for PEARL" is a program supported by Cities Alliance that aims to qualitatively further this initiative. One of its key components is to carry out a thematic and detailed documentation of good practices in various thematic areas related to planning, governance and service delivery.

In an effort to fill the critical knowledge gaps for efficient service delivery in Indian cities, a number of good practices from across the globe have been compiled to address specific issues in the areas of water supply, sanitation, solid waste management, urban mobility, and the incorporation of information & communication technology in service delivery processes. Each volume examines case specific processes, activities and results to garner ways of improving operational efficiency – integrated water management, increasing customer base, corporatization of supply, reducing NRW etc. for efficient ***water supply;*** waste water treatment programs, pro-poor sanitation policy formulation, reclamation & reuse initiatives and public private partnerships for better ***sanitation***; comprehensive waste management strategies, at source reduction and segregation, municipal capacity building, recycling, reuse and resource recovery for effective ***solid waste management;*** integrated land transport systems, travel demand management, pedestrianisation for EcoMobility and integration of informal systems for enhanced ***urban mobility;*** and finally e-Government development models; GIS mapping for municipal functions and intelligent service delivery systems using ***ICT.***

The compilations assemble good practices from countries like Burkina Faso, Senegal, Ireland, Japan, Cambodia, Bolivia, Brazil, Kenya, Netherlands and Mongolia (Water Supply); South Africa, Denmark, Singapore, Thailand, Indonesia, Pakistan, Uganda, Mauritius, Philippines (Sanitation); Australia, USA, Brazil, Bangladesh, Egypt (Solid Waste Management); Nigeria, Mexico, UK, South Korea, Colombia (Urban Mobility); Germany, China, Peru, UAE (ICT). Cases are examined from the perspective of increasing operational efficiency, enhancing systemic capacity, creating efficient public private partnerships and building long-term sustainability into urban management activities. Priority has been given to cases from developing countries in order to increase adaptability and replicability of key concepts and practices.

Jagan Shah
January 2015

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The compendium of global good practices focusing on "ICT in Urban Services'' is an outcome of a collective contribution of several individuals. NIUA acknowledges their contribution and thanks them for their support.

Firstly, we wish to sincerely thank the Cities Alliance and World Bank whose grant support and knowledge partnership for PEARL has made the documentation possible at a time when urban infrastructure development is one of the main agendas of the Government of India.

We would like to thank Deeksha Matta, Apurva Bajpai, Shoma Mathew and Shilpi Madnawat of the PEARL team, who have contributed in putting the compendium together; and Deep Pahwa and Kavita Rawat for designing and formatting the compendium.

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Special thanks are due to Ajay Suri, Regional Adviser-Asia, Cities Alliance and Prof. Jagan Shah, Director NIUA for their support, guidance and inputs. NIUA has been enriched by the experiences gained in this process and sincerely hope that the report will contribute towards strengthening ICT services in India in cities.

Dr. Debjani Ghosh
Project Coordinator

CONTENTS

INTRODUCTION

ICT IN URBAN SERVICES

Technological advancements have changed the way we think of urban and spatial planning. The inclusion of conventional elements with modern technologies is allowing this field to advance at a rapid pace. The use of Information and Communication Technology (ICT) in urban and spatial planning has been under constant expansion over the last few decades. Today, planners utilize technology around the world in a variety of applications to address their day-to-day work needs while fostering the ability to effectively predict and respond to chronic urban issues. The global best practices in this section illustrate how technology is being used worldwide as a tool to help urban administrators and planners reach their goals of creating liveable communities and improving the overall quality of life while protecting the environment and promoting planned development. Some concepts that have evolved, as a result, are:

A city where investments in human and social capital, and traditional (transport) and modern (ICT) communication infrastructure fuel sustainable economic development and a high quality of life, with a wise management of natural resources, through participatory action and engagement.

A multi-layer territorial system of innovations that brings together knowledge-intensive activities, institutions for cooperation in learning and innovation, and digital spaces for communication and interaction in order to maximize the problem-solving capability of the city.

A connected city that combines broadband communications infrastructure; flexible, service-oriented computing infrastructure based on open industry standards; and innovative services to meet the needs of governments and their employees, citizens and businesses.

A city that uses technology to transform its urban management systems, urban governance and infrastructure for making better use of infrastructure, energy and urban resources.

Information and communications technologies (ICT) can be deployed to create innovative and intelligent ways of making our urban centres more resource efficient, citizen friendly and sustainable. Amalgamating information with city systems means that it can be used real-time, by city leaders, allowing them to make decisions about the most effective use of city resources– and, ultimately, feed those decisions back to the components of the city: municipalities, transport providers, energy companies, building owners. Information can be provided to the city's end users, and through awareness the behaviour change necessary to achieve resource efficiency can be achieved.

Publishing information via the internet, communication via e-mail and websites of the municipalities, and using interactive, virtual reality to show the results of a planning process are the planners' new tools towards achieving **Transparency, Accountability** and **Efficiency** in urban systems. The ICT-enabled city describes a step-change in both intensity and extent of connection, in that almost all aspects of infrastructure – from transit networks to energy, waste and water; from housing to street trees – can wirelessly communicate information about their activities via sensors and networks.

Residents can send data to and receive data from the government. Handheld devices, machine-to-machine systems and interconnected devices help facilitate these interactions. Built around informatics and instrumentation, new smart reporting systems improve information transparency and, in turn, create better informed citizens and more efficient cities.

The impact of open information

A city's operations and planning can be based on on-going monitoring, insightful visualisations and constant feedback loops that create more efficient systems and better informed decision making for leaders and citizens. Cities become real-time systems and create the opportunity to manage them in a real-time manner with the following impacts:

- Inducing efficiency in city's operations
- Facilitating transparency in governance
- Improving infrastructure management and service delivery
- Increasing efficiency of resource use
- Mitigating climate change risks

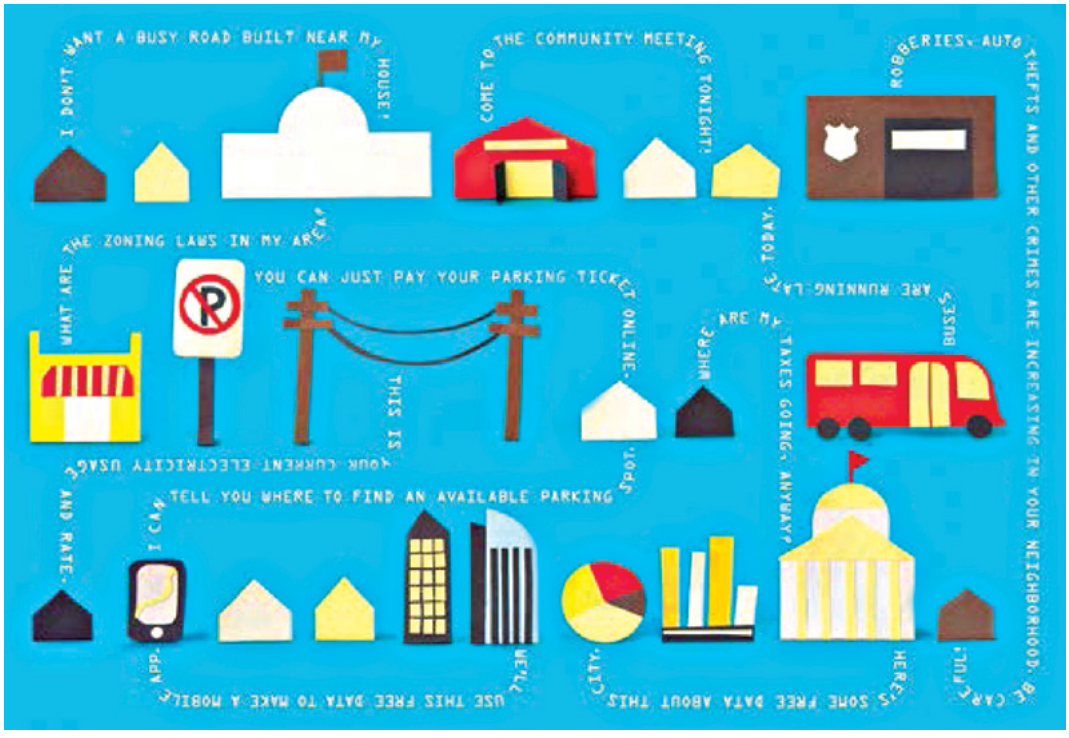
ICT is fast becoming part of the tool kit for urban leaders to create 21st century cities and regions better equipped in dealing with rapid urbanization, demographic change, population growth, urban resource demand and climate change.

Real-time Information enables better decisions

City systems driven by integrated hardware, software, and network technologies have access to real-time information and data of the real world and advanced analytics for engagement and management. Reporting should be in real-time, as efficient operations require immediate feedback, and will be built upon a platform of software services and wireless networks distributed across the city's man-made and natural infrastructure. With better information, leaders, city administrators, urban professionals and citizens make efficient decisions and actions leading to improved quality of life.

Initiatives in India

Indian cities have also started to introduce technology-based interventions in urban management. Under the Jawaharlal Nehru



National Urban Renewal Mission (JNNURM), the massive city-modernisation scheme launched by the Government of India under Ministry of Urban Development in 2007, "e-governance" was one of the mandatory reforms to be achieved at the ULB level.

Several Indian cities have already begun deploying a few smart technologies to efficiently provide civic services. Cities such as Hyderabad, Surat, Coimbatore, Bengaluru, Mangalore, Jamshedpur, Kanpur, Delhi, Mumbai and Chennai have launched initiatives related to the deployment of advanced communications systems, metro rail systems, traffic management systems, smart meters, GPRS for solid waste management, GIS to manage property tax, online water quality monitoring, online building plan approval schemes, etc.

At the same time, several new smart cities – Kochi Smart City and Gujarat International Finance Tec-City – are already being developed as model cities through private sector participation. In addition, seven smart cities are under development by states as part of the Delhi-Mumbai Industrial Corridor (DMIC). To develop ICT-enabled cities in India, it is imperative to address the challenges relating to political alignment, financing and stakeholder management. A conducive policy and investment environment can act as an enabler for the success of such initiatives. It will also have to be ensured that all stakeholders have been included in the decision-making process.

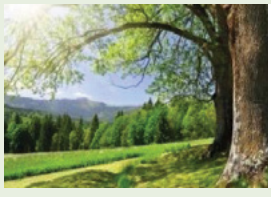
Key Application Areas

Governments across the world are using information technology as a tool for solving urban problems and creating an efficient governance mechanism. The best practices discussed in this section are based on experiences of various initiatives undertaken globally. The case studies illustrate the application of a multitude of newly developed hardware and software technology advancements in urban and spatial planning. The key applications of ICT have been discussed under the following thematic areas:

THEME 1: PUBLIC SERVICE AND GOVERNANCE
e-Governance: Case Study of Seoul, Korea
M-Government: Case Study of Dongcheng-Beijing, China
People's Participation: Case Study of London, UK
Electronic Graft Management: Case Study of Kenya

THEME 2: URBAN ADMINISTRATION
Municipal Administration: Case Study of Bahrain
Knowledge Management: Case Study of Callao, Peru

THEME 3: URBAN INFRASTRUCTURE PLANNING
Transit Planning: Case Study of Singapore
Waste Management
Water Management: Case Study of Bangkok, Thailand



THEME 4: ENVIRONMENT AND ENERGY
ICT for Renewable Energy: Case Study of Germany
ICT for Sustainable Development Planning: Case Study of Masdar, UAE
People's Participation in Emmissions Reduction: Case Study of San Francisco, USA

THEME 5: PUBLIC HEALTH AND SAFETY
Public Health: Case Study of Sub-Saharan Africa
Disaster Risk Management: Case Study of Armenia, Colombia

BEST PRACTICE MATRIX

INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)							
Location	**Policy and Regulatory Instruments**	**Service Delivery**	**Real Time Information/ Monitoring**	**Transparency**	**Citizens' Participation**	**Web Services/ Internet**	**Mapping using GIS, etc**
Seoul, S Korea	■	■		■	■	■	
Dongcheng, China		■	■				■
London, UK		■			■	■	
Kenya				■	■	■	
King. of Bahrain		■		■		■	■
Callao, Peru				■	■		■
Singapore	■	■	■		■	■	
Bangkok		■	■				
Germany							■
Mazdar, UAE		■	■				■
San Francisco, USA					■	■	
Kenya, Zambia, Rwanda		■					■
Armenia, Colombia							■

THEME 1

PUBLIC SERVICE AND GOVERNANCE

Internationally most countries in Europe, USA, Australia and Singapore have developed sophisticated ICT-enabled infrastructure for service delivery and governance. In the past two decades, various initiatives have also been undertaken by developing countries in this direction. In developing countries, however, adopting information systems for governance requires careful treatment since technology costs can be far greater than labour costs. Therefore, the best practices can be followed by governments in both resource-rich and resource-poor environments, as long as the technologies are adapted to the environment. Some such practices are discussed below. The four basic models with regards to ICT-enabled governance can be summarised as follows:

- **G2G (government-to-government):** Government services aimed at serving other governments using information and internet technologies.
- **G2C (government-to-citizen):** Government provision of its services to citizens through the internet.
- **G2B (government-to-business):** Government services to businesses that can be obtained via the internet i.e. Online Business Registration, Online Tax Payments etc.
- **G2E (government-to-employees):** Government coordinating operations with its employees using information technologies.

Initiatives in India

Use of ICT in governance has steadily evolved in India from the computerization of Government Departments to initiatives that encapsulate the finer points of Governance, such as citizen centricity, service orientation and transparency. The National e-Governance Plan (NeGP)has been formulated by the Department of Electronics and Information Technology (DEITY) and Department of Administrative Reforms and Public Grievances (DARPG). The Union Government approved the NeGP in 2006, comprising of 27 Mission Mode Projects (MMPs) and 10 components. NeGP takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision, a shared cause. Around this idea, countrywide infrastructure is evolving, and large-scale digitization of records is taking place to enable easy, reliable access over the internet. The NeGP aims at improving delivery of Government services to citizens and businesses.

ICT-ENABLED APPLICATIONS
Policy coordination and implementation, regulatory framework
Delivery of services online
Land information system, Digitized mapping SDI, Geo-portal, GIS-based property records, plans and transactions
Online building plan approval
Broadband development
Citizen participation, citizen feedback program
Digital communication, automated messaging/mass short message service
Electronic billing

SEOUL E-GOVERNMENT DEVELOPMENT MODEL

Location	Seoul, Korea
Region	Asia
Year	1999
Agency	Seoul Metropolitan Government (SMG)
Recognition	No.1 ranking in UN's Municipal e-Governance International Survey for five consecutive times from 2003-2011

Project Aim

To become a mobile city, communicate with the citizens, provide citizens with customized public services, create jobs, build new engines of growth and share with the world.

Project Description

SMG is making constant efforts to make use of smart technologies under the new paradigm of citizen-centric administration based on communication, transparency, sharing, and collaboration. SMG Seoul e-Government pursues drastic improvements in administrative efficiency and quality through the incorporation of advanced information and communications technologies into its public services for citizens. Thus it has realised open government, enabling citizens to have fast and easy communication with it about a range of issues.

Project Implementation

SMG has appointed a Chief Information Officer (CIO) since 1999. The CIO has taken the lead in the city's efforts to establish sophisticated information systems and a network infrastructure. The Seoul e-Government currently focuses on the promotion of across-the-board mobile administrative services and the so-called big data-based municipal administration to realize a new data-centric, scientific, innovative information culture in the city.

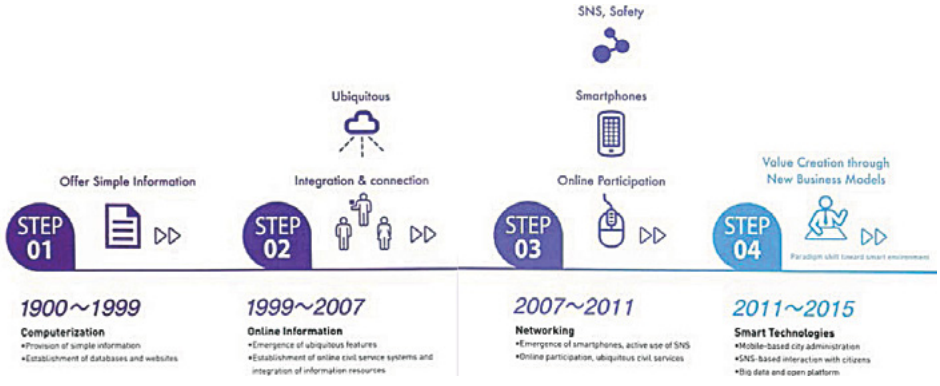
E-GOVERNANCE

E-governance is the application of information and communication technology (ICT) for delivering government services, exchange of information communication transactions, integration of various stand-alone systems and services between the government, citizens, businesses and the civil society as well as office processesand interactions within the entire government framework. Through e-governance, government services are made available to citizens in a convenient, efficient, cost effective and transparent manner. The driving force can also be public demand for online services and information that increase democratic participation and accountability, and the quality and speed of services.

Key Results and Impacts

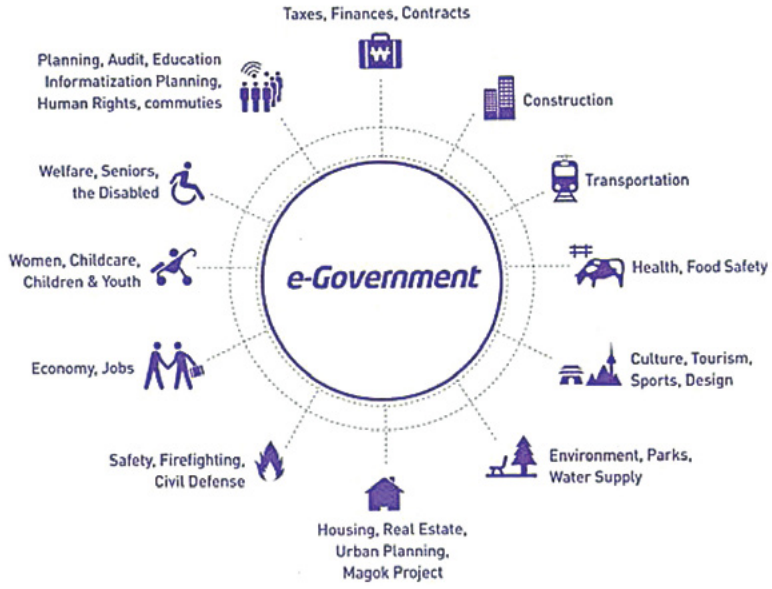
- **Open Administration based on Transparency and Communication:** SMG website has been renewed in collaboration with citizens; using 'Mobile Seoul', public services are offered on smartphones; using 'M-voting', citizens' opinions are gathered to facilitate participatory democracy; using 'Information Open Plaza', all administrative information is disclosed to citizens.
- **Smart Administration based on Sharing and Collaboration:** Big Data is utilizedfor settlement of administrative issues and for evaluate the locations of public facilities; 'Seoul-type Map tacking' offers map based administrative services for the convenience of citizens.
- **Sharing benefits with All:** Free Wi-Fi networks and Free Mobile Recharging services have been built in key locations
- **Participatory governance based on sophisticated IT service infrastructure:** Citizens are the recipients of various public

HISTORY OF SEOUL'S E-GOVERNMENT

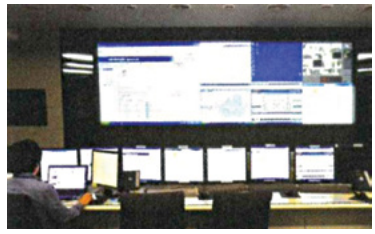


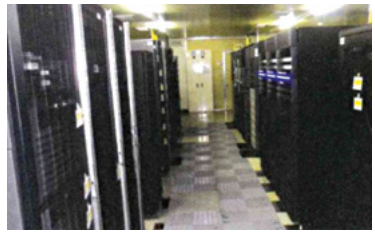
SEOUL E-GOVERNMENT SYSTEM

E-GOVERNMENT INFRASTRUCTURE



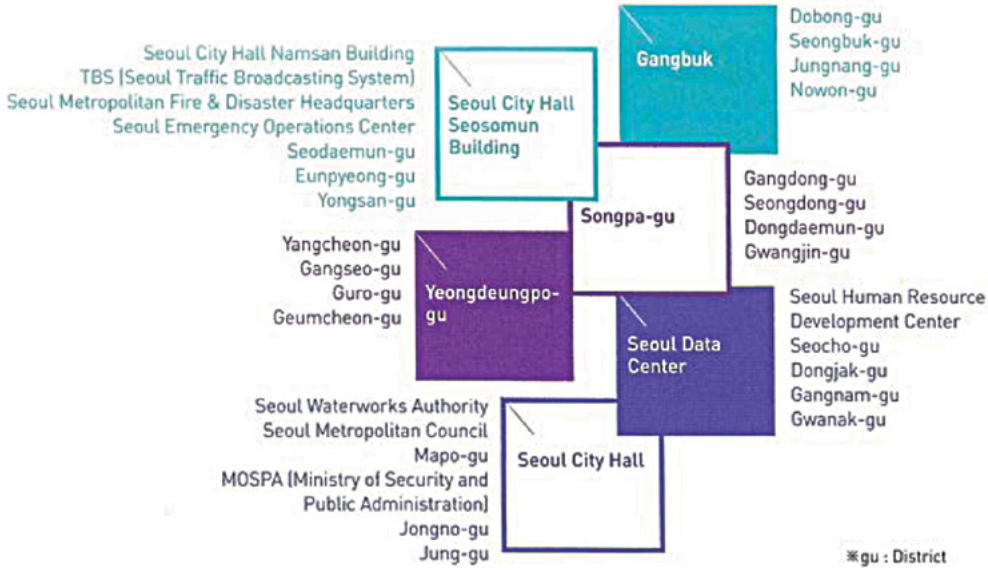
Seoul Data Center





For IT-based efficient administration, the SMG has established 477 types of information systems covering the city government's public services (urban planning, culture, tourism, transportation, housing), built its own telecom network connecting 16 affiliated organization, and set up an extensive e-government promotion group headed by the chief information officer (CIO).
Seoul Data Center performs integrated control of the systems through its 973 servers, 272 pieces of telecom equipment, and 89 information protection systems.

INFORMATION TECHNOLOGY INFRASTRUCTURE

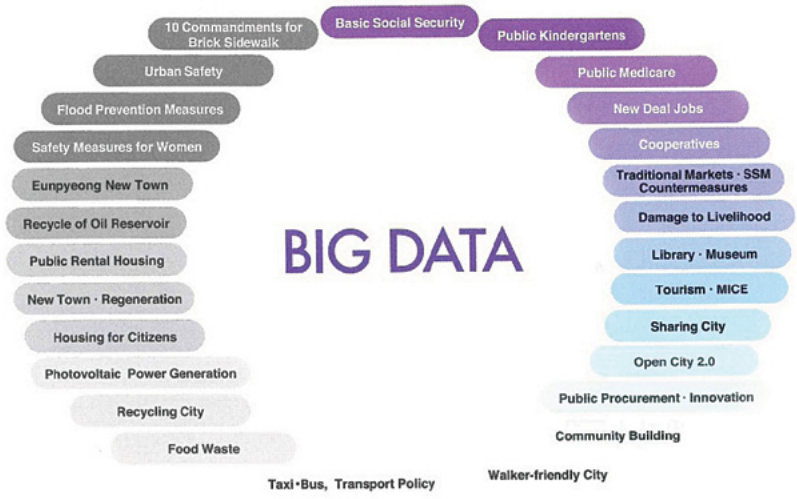


In 2003, for the first time in the world, Seoul set up e-Seoul Net connecting its 36 agencies via fibre-optic cables along Seoul's subway tunnels. e-Seoul Net, a high-speed telecom network that provides citizens with audio, video, and internet services so that they can access any of the city's smart public services anytime, anywhere including mass transit information.

SEOUL E-GOVERNMENT STRATEGIES

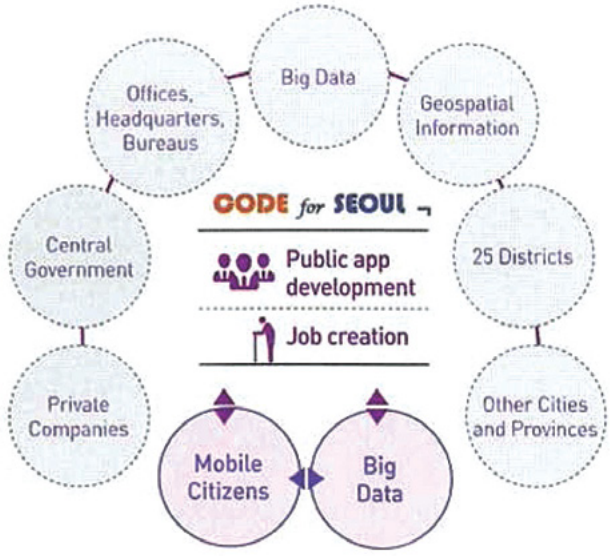
USING BIG DATA TO OFFER SCIENTIFIC AND INNOVATIVE, NEW ADMINISTRATIVE SERVICES

Under the slogan "Big data solves even the smallest grievances", the SMG integrates diverse data collected through its various e-government functions with those collected by the private sector to create new values and realize citizen-centric municipal administration.



PURSUE MOBILE-CENTERED INNOVATIONS IN CITY ADMINISTRATION

SMG is promoting mobile-oriented administrative services to provide citizens with real-time public services on their mobile devices. In 2003, Seoul announced the 'Mobile Master Plan' with the aim of building a mobile platform for sharing information and collaboration. The SMG plans to integrate 39 tasks in the range of its administrative services including welfare, health, safety, transportation, and environment.



EXPORT SEOUL-TYPE E-GOVERNMENT TO OVERSEAS CITIES

Seoul initiated WeGO (World e-Governments Organization of Cities and Local Governments), an international body for the development of e-Governments worldwide. In 2011, SMG signed anMoU with the World Bank for developing 'City e-Government Diagnostic and Solution Framework'. The 69 WeGO member cities can use the toolkit to establish their respective e-Government.

services and act as creators of diverse types of public information for fellow citizens utilizing a new type of participatory administrative platform.

Lessons learnt

- A well-equipped Data Center is crucial to the management of city's information systems to facilitate efficient e-government operations
- The overall control of city government's diverse ICT projects is ensured through pre-consulting procedures instead of individual department's sporadic initiatives.
- Digitization and incorporation of ICT into the city's public services can lead to efficiency and improvement in service delivery
- Sharing of data with the citizens based on the principle of 'Open Data' can ensured transparency.

Replicability

SMG has expanded its services to feasibility study for overseas cities like Buenos Aires, Dar es Salaam, Addis Ababa and some others. The toolkit developed by SMG in 2013, 'E-Government Self Diagnosis Toolkit', is instrumental in the building of e-governments by cities around the world for improving their public services to the people.

LOCAL GOVERNMENT GOES MOBILE IN DONGCHENG-BEIJING, CHINA

Location	Dongcheng, Beijing, China
Region	Asia
Year	2004
Agency	Dongcheng District Government

Project Aim

To 'reinvent' the municipal administration by deploying ICT, wireless and other mobile technology, for the efficient management of urban infrastructure and urban problem solving.

Context

In Beijing, city administrators and citizens alike were frustrated by the government's inability to resolve problems in a timely fashion. Among the concerns were street lighting, drainage, water supply facilities, underground pipelines, housing, gardens, environmental protection, etc. When municipal employees conducted field visits, they fulfilled only their assigned tasks. Other problems found during the visits went largely ignored. While an employee might note a problem in a report, the information was not used in a systematic fashion that facilitated corrective action. A lack of integration among the highly specialized departments further exacerbated the situation.

Project Description

Dongcheng District has implemented the pilot program using ICT, such as GIS and GPS technologies for the management of urban infrastructure. The district use **gridding technology** by dividing the area of 25.38 square kilometres into 1652 cells; each cell is assigned a 6 digit number code. A thorough survey about the public facilities (public conveniences, bus stop signs, public telephone booths, manhole covers, etc.) in the district was carried out to map the locations of each public facility in GIS system. Each public facility has been assigned an 8 digit number code and is placed in its relevant cell. The program also identified four levels of responsible entities in the relevant 1652 cells: the district government, 10 neighbourhood committees, 137 residents committees, and various public institutions throughout the district. Having these types of data available in GIS enables the city to quickly locate where the problems have occurred as well as determine which entity had the responsibility for resolving each one.

MOBILE GOVERNANCE (M-GOVERNANCE)

While e-governance is the model of governance in which services are made available to the citizens via electronic means such as internet connected computers and other devices, M-government goes one step further. It takes services to the citizens rather than the citizens visiting the municipal offices or websites to access services. M-governance is defined as the delivery of government services by the utilization of various kinds of wireless and mobile technology, services, applications and devices. It implies delivering services in the field – in the streets, in people's homes or other convenient locations. The rapid development of mobile technologies such as internet enabled mobile phones, PDA, Wi-Fi and wireless networks, has triggered the development of the m-governance model.

Project Implementation

To support the implementation of this new technology, the

District Government split the supervision function from the management function. Two Centres were established: the Supervision Centre and the Command Centre, both of which are independent of the municipal administration.

The **Supervision Centre** recruited 400 supervisors, each of whom is responsible for about twelve cells or an area of about 180,000 square meters. The supervisors patrol their assigned areas to look for and report problems, which are registered using a smart mobile phone that records the GPS location of the problem. Photos of the problem can also be sent to the centre if needed.

The Supervision Centre provides a report to the **Command Centre.** With the information about the nature and location of a problem, the Command Centre can assign a work crew to resolve it. The smart mobile phones allow the centre to monitor the location and working status of all supervisors through a radio service network. The mobile phones allow the Supervision Centre to contact supervisors in the field and instruct them to investigate the problems reported. Supervisors can send additional information back to the Supervision Centre with a recommendation for action. After the problem is solved, the supervisor visits the location and confirms resolution of the problem with another photo. A final report closes the issue in the system.

Key Results and Impacts

- The initiative has improved the relations between the municipal administration and citizens by bringing the organization and tracking to the delivery of government services.
- There has been a transformation in the work culture of the municipal staff. Consequently, the local government employees no longer stay in the office to process information but instead spend more time on field visits working to resolve problems.

Using smart mobile phones in the field, an employee reports problems back to the command

Replicability

The success of the pilot project in Dongcheng has attracted considerable attention from other municipalities throughout China. In Beijing, seven other urban districts have adopted similar systems.

Information about supervisors displayed from screen at the centre

FIX MY STREET, LONDON, UK

Location	London, United Kingdom
Region	Europe
Year	2007
Built by	mySociety, a not-for-profit company
Award	SustainITeWell-Being Award 2008

Project Aim

To enable citizens to participate in local governance and discuss issues in their neighbour from the comfort of their desk

Project Description

FixMyStreet is a web service to help people report, view, or discuss local problems with their local council by simply locating them on a map. Built by MySociety in conjunction with The Young Foundation, FixMyStreet smartly routes reports of things that are broken or dumped, or need fixing, cleaning or clearing, direct to the local council or related organisation in the UK. Users can report potholes, broken street lights and similar problems with streets and roads, and see what reports have already been made.

FixMyStreet app was developed in 2008 to enable iPhone users to report problems using their phones, and since then volunteers have written apps for Nokia and Android, as well as another app for the iPhone.

Replicability

FixMyStreet has inspired similar sites in other countries. The

PEOPLE'S PARTICIPATION/ E-PARTICIPATION

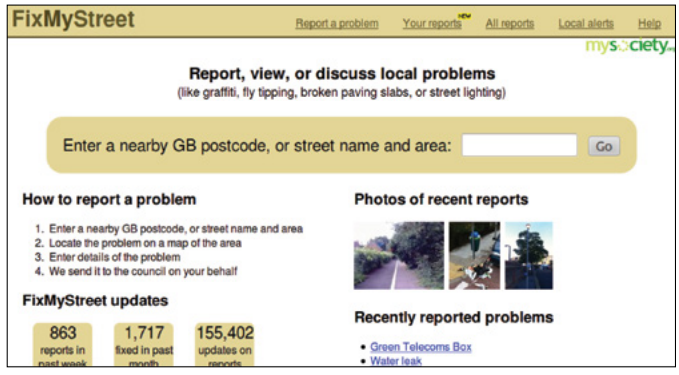
ICTs have the potential to open up and democratize societies. Government can use ICTs to influence people and people can use it to influence governments. With e-participation, the governments around the world are using ICTs to facilitate participation and citizen engagement in their processes. ICTs are an effective tool to engage the public in the discussions about their developmental needs. E-Participation and ICTs have the potential to empower people and improve the delivery of public services to all.

The World Bank describes e-participation in terms of a collection of tools that "are used to collect and discuss citizens' and businesses' views so their interests and need are better represented in government programs or processes." The tools include online surveys and polls, electronic newsletters, e-mail, feedback forms, and web forums where citizens can express their opinions.

ICTs can prove helpful in improving accessibility to governance for older persons and persons with disabilities. However, in developing countries, the digital divide– that is, the difference in levels of ICT access between different societal groups– needs to be bridged for the success of any e-participation program. Also, for e-participation to be effective, government officials at all levels need to be trained in the technological know-how, including how to use the information provided to improve services.

Norwegian Unix User Group (NUUG) funded the development of a Norwegian version of FixMyStreet, FiksGataMi, which also led to the FixMyStreet open source code becoming more generic, easier to install, and able to handle different maps, including OpenStreetMap. Similar systems include CitySourced came up in the USA.

In India, e-participation can be effective in the metros where there is greater access to internet and broadband services to the public. Governments that will utilize ICTs need to undertake programs of training both decision-makers and technical personnel. Governments need to adopt policies and procedures to encourage the public to participate in the decision-making processes using ICTs.



A simple interface allows users to log and track local problems. A dashboard on the home page shows the outcome of the online community's actions.

OTHER INSPIRATIONS INCLUDE

LOCATION	INITIATIVE	LINK
Australia	FixMyStreet	http://www.fixmystreet.org.au/
Germany	Mark-a-Spot	http://www.mark-a-spot.org/
Korea	FixMyStreet	http://www.fixmystreet.kr
Netherlands	Verbeterdebuurt	http://www.verbeterdebuurt.nl/
Japan	FixMyStreet	http://www.fixmystreet.jp/
Switzerland	Zurich's ZueriWieNeu	https://www.zueriwieneu.ch/
Tunisia	FixKairouan	http://fixkairouan.org/

ELECTRONIC GRAFT MANAGEMENT, KENYA

Location	Kenya
Region	Africa
Year	1999-2002
Built by	Kenya Anti-Corruption Authority (KACA), which is now called Ethics and Anti-Corruption Commission (EACC)

Project Aim

To encourage public participation in fighting corrupt practices increase and public awareness (G2C)

Context

In Kenya, the Kenya Anti-Corruption Authority (KACA) was established in 1997 to fight corruption. Before the Electronic Graft Management (EGM) initiative, KACA had been mainly dealing with large-scale corruption cases because of lack of information. The public had limited channels of access to report on the everyday petty corrupt practices countrywide. KACA was using telephone, paper mail and one electronic mail. Many citizens shied away from volunteering information to KACA because of lack of privacy.

Project description

The Information Technology Standards Association (ITSA) of Kenya launched an Electronic Graft Management project. The project used the Internet and e-mail as the channel for communication by the public for reporting. The idea was that citizens would be more willing to use the Internet and email to publicly report corruption because these methods afforded greater privacy than telephone and in-person reporting. An Internet hotline was therefore established, and citizens could access it from any corruption reporting facility (Internet café and e-Touch centres) in six towns. The media would form the source points of information which will be routed to the EGM Centre. The EGM Centre would filter this information electronically and forward it to the relevant authorities for action.

An awareness campaign about the availability of the online channel targeting for the public would use channels like youth campaign, news media, door-to-door campaign (offices, shops, etc.).

ELECTRONIC GRAFT MANAGEMENT

One of the biggest impediments to delivery of government services in many municipal bodies is entrenched graft. Corruption reduces the efficiency of service delivery, slows down the economy and discourages investments. Various successful initiatives have been undertaken worldwide by the civil society and the government agencies to help in combating corruption and introducing transparency in governance.

Replicability

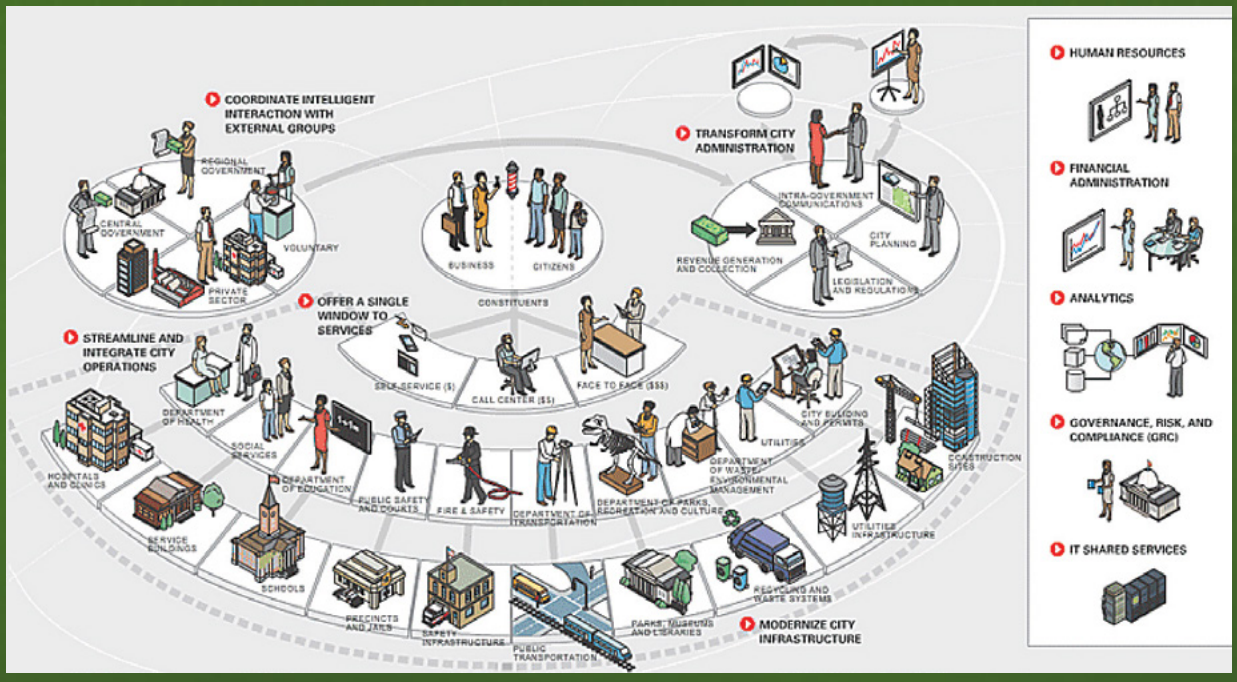
In India, electronic graft management can become an integral part of the Lokpal and Lokayuktas, and help in battling corruption by providing privacy in reporting to ordinary citizens, civil society groups and whistle-blowers.

THEME 2

URBAN ADMINISTRATION

Today, many cities are using ICT to improve performance at a departmental level, by deploying mobility, utilities, community and government e-services. Others are pushing the smart city concept even further, actively taking steps to make the concept an integral part of their development strategy. Leading cities are deploying readily-available and relatively low cost technologies – smartphones, broadband wireless internet, netbooks and tablets, consoles, sensor networks and smart meters – to improve sharing of data and information between government and citizens. By improving the city as a system, efficiency, transparency and eventually, transformation is achieved.

ICT-ENABLED APPLICATIONS
Internal and public sector management component
City administration centre
Stretegy planning in transitioning to electronic delivery of services
Quantifying cost-effectiveness of electronic service delivery
Knowledge management
Human resource management, capacity building, training and recruitment
Technology and innovation centre



BAHRAIN ADOPTS GIS FOR MUNICIPAL FUNCTIONS

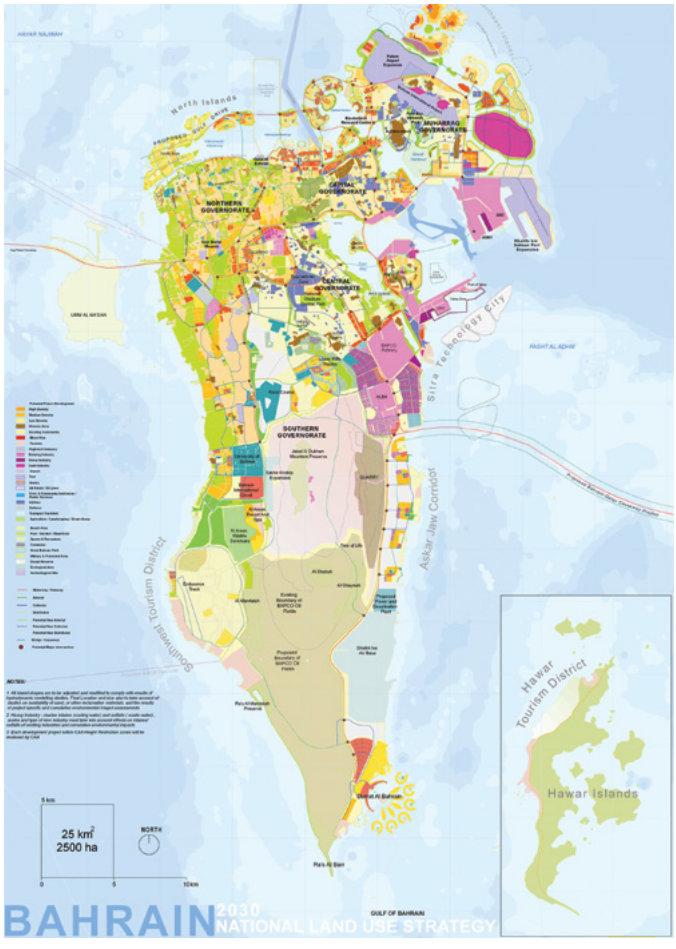
Location	Bahrain
Region	Middle-east
Year	1998

Project Aim

To develop a system that would allow municipality to share and coordinate delivery of services to its citizens across multiple administrative boundaries and property lines.

Context

In the Kingdom of Bahrain, Ministry of Municipalities Affairs and Urban Planning (MMAUP) is responsible for planning and monitoring the development, cleaning and beautification and issue permits for various activities such as building construction, advertisements, commercial activities etc. MMAUP has five municipalities as Capital, Muharraq, North, Middle and South, with Urban Development and Agricultural Directorates.



National Landuse Strategy 2030

ELECTRONIC GRAFT MANAGEMENT

The use of ICT for streamlining the city's administration as a step towards achieving efficiency in delivery of municipal services consists of three elements:

IT Strategy: The primary step is the integration of procurement, design and operational models of ICT services and infrastructure to the shape, profile and staffing of the city government. Placing ICT at the heart of city administration could result in reductions in the cost of service delivery. Capgemini (a French IT service providing corporation) puts the economic value of adopting a strategic approach to information management in UK local authorities at £18 billion per annum.

Urban informatics: The second layer of the strategy includes integrating web and mobile data within city architecture and infrastructure for delivering information to citizens and city managers. Examples might include feedback loops on energy consumption, or real-time transport information of visualisation of traffic flows.

Instrumenting resource systems: The third layer entails the design of sensor instrument networks and associated technologies that report on the activity and performance of the infrastructure. Instrumentation and monitoring of a city's activities enables the workings of operations to be turned into data points and the system is made measurable.

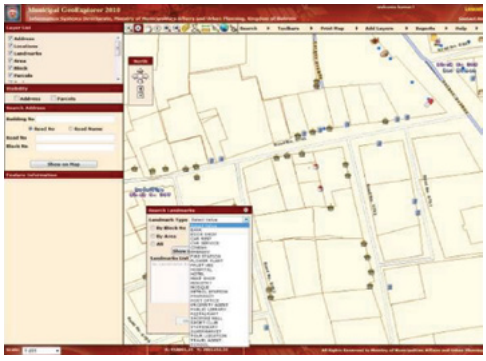
It is providing services to public from more than 24 locations across the country.

Project Description

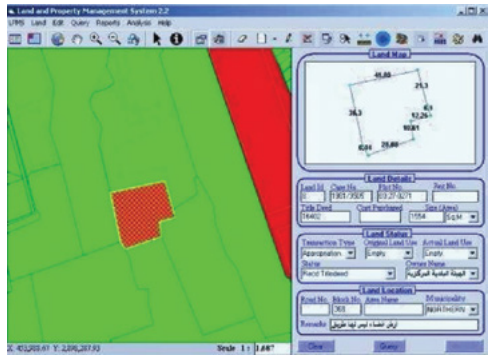
After developing a strategic business plan in 1997, to make the best use of government funds, Bahrain invested in GIS applications to improve municipal performance. The shared services model adopted by Bahrain avoids the redundancies an independent GIS program for each municipality would create and a central Information Systems Directorate (ISD) serves all the municipalities in a coordinated fashion.

Project Implementation

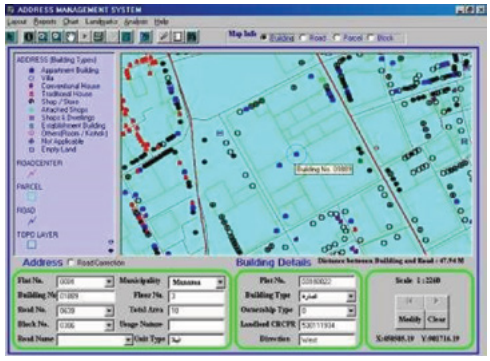
ISD is providing a centralized facility to store, analyse, maintain, Integrate and share the data between different municipalities and ministries. It facilitates sharing information, activities, and experiences across the local jurisdictions as well as linking it to data maintained by national ministries. Since ISD provides technical support to all these units of government, it has been able to coordinate and systematically build the immense network required



Municipal GeoExplorer



Land and Property Management System



Address Management System

Land Regulation Map

to run such a centralized system. ISD is also developing the applications, which are commonly used by all municipalities using various technologies like Oracle RDBMS and GIS.

Developing spatial database is an important component of GIS implementation in Municipal GIS. ISD collected numerous data sets from various ministries and agencies in various formats, and reformatted the data so that they could be integrated into the central GIS for analysis. Strategic business plan has grouped the spatial layers as base layers (required for all municipal services) and thematic layers (specific to particular municipal services. Base layers are administrative boundaries, road centreline, addresses, land boundaries, topo layers and satellite images. Thematic maps such as addresses, municipal lands, advertisement location, commercial roads, commercial shops, building permit locations, zoning and land subdivisions were developed. Ministry spatial database has contained more than 100 layers which are updated regularly at different frequencies. All the layers are stored in centralized server accessible for municipal staff.

Key Results and Impacts

- A process was established for updating of data on predetermined time periods for each base map. For example, address data are updated daily as new addresses are issued to the public.
- A map browsing system has been developed that allows the user to create a customized map of the city—for example, one that shows street locations in relationship to utility services.
- Other applications include a land and property management system, an advertisement management system that tracks the location of billboards and other types of public space advertising, an address management system, a management system for small land parcels, and a municipal investment information system.
- Many of these applications have been made available to the public via the Web, making it easier for residents to access the information needed about their municipality.

Lessons Learnt

- Training and awareness programs on the various GIS applications conducted by ISD for all the municipal staffs, which include more than 500 GIS users, has led to the successful use of GIS techniques for municipal affairs for more than 15 years.
- The use of GIS for municipal services has led to increased efficiency of public service delivery and cost saving from those efficiencies.

Replicability

The approach of Bahrain's initiative can be replicated by the state and district administrations in India for GIS-enabled data management and coordination across multiple municipalities. It is essential to implement the necessary software with suitable hardware, undertake capacity building measures, develop skilled staff, adopt proper procedures and up-to-date data for successful implementation. Technology can help the government to achieve procedure standardization in all municipalities.

INSTITUTIONAL KNOWLEDGE AND TECHNOLOGY MANAGEMENT IN CALLAO, PERU

Location	Callao, Peru
Region	Latin America
Year	2009
Agency	Regional Government of Callao

Project Aim

To increase cooperation between the local and the regional government planning, centralize and share all knowledge products, systematize the products developed by the organization and manage the spatial databases for decision-making processes

Context

The area of the Constitutional Province of Callao (Callao region) is an integral part of the Lima Metropolitan Area: the most important city of the country and centre of attraction. The responsibilities for spatial planning are developed by the Regional Government of Callao and by the Provincial Municipality of Callao. However, the existing regulations do not include that the local governments develop a framework for their planning at the local level with instruments developed at the regional level. This has led to the existence of a range of instruments for spatial planning and management without any coordination. Likewise, a variety of actors and activities intervene in the small region of Callao. There is need for a better linkage between the Provincial Municipality and the District Municipality.

Project Implementation

Since 2009, the Regional Government of Callao, through the Spatial Conditioning Office has developed a number of documents in consultation with the Provincial Municipality of Callao and the neighbouring District Municipalities of Ventanilla, La Punta, Bellavista, Carmen de La Legua-Reynoso and La Perla. They furthermore consulted with public institutions such as the Peruvian Marine institute, the Directorate of Hydrography and Navigation, the national port authority, private companies, and the civil society. The Callao regional government developed ICT-GIS-based Knowledge Management systems for the local and regional governments in the area, developing integrated planning for the region. Knowledge documents are prepared collectively by the regional government, working together with the line departments of its government, and those of the local governments, NGOs and knowledge institutes. Reports are prepared using extensive data and mapping as a basis for decision-making; these are available to the public through an open-access website.

In order to centralize and share all spatial products, an ICT-GIS product was developed as a system that combines or integrates computing tools, the internet and communications. This product is built on a GIS platform server and is called: Regional Spatial Information System (SITR). In the SITR, the outcomes are mainly published in PDF and GIS-GVB on the GIS server platform Esri, using applications developed by NET, SQL server and ESRI Flex. These applications are accessible via the internet and are known for being interactive and user-friendly. Also, on the GIS server the Spatial Conditioning Office published WMS maps, KMZ applications on Google earth, and metadata linked to the GeoNetwork server, all in conformity with the standards of the spatial data infrastructure of Peru. All the SITR information is public and via e-mail comments and recommendations can be received. The intellectual property of the knowledge product belongs to the Regional Government of Callao.

KNOWLEDGE MANAGEMENT

Knowledge management (KM) is the process of capturing, developing, sharing, and effectively using organisational knowledge. It refers to a multi-disciplined approach to achieving organisational objectives by making the best use of knowledge.

ICT is often used in Knowledge Management programmes to disseminate information about developments in the urban sector as well as to share knowledge among organizations and agencies. ICT facilitates accumulating organizational knowledge, providing access to retrievable knowledge and enhancing collaboration for knowledge sharing and creation. The main role of ICT use in Knowledge Management is to act as catalysts step up the speed of knowledge transfer to the concerned.

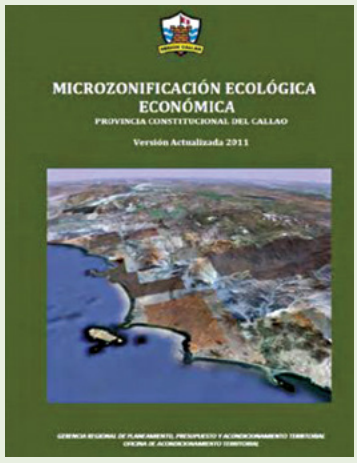
ICT enables knowledge collection, storage and exchange on a scale which was not practical in the past. Through the linkage of information and communication systems, fragmented flows of knowledge and multiple knowledge resources can be integrated, for instance, via Intranet, Internet and Database.

Key Results and Impacts

- There is availability of accurate information, maps and database of Ecological Economic Zoning, hazards in human settlements, historical monuments and ruinous properties
- There is a a GIS map server and a metadata server in place for knowledge management
- The spatial databases are being used for efficient decision-making processes, disaster risk management, spatial planning and urban development.
- The knowledge products have been published for the benefit of the local governments and public and private institutions.
- There is now a provision for receiving a feedback on the processes from various stakeholders.

The Knowledge Products are Divided in 3 Processes (Executed by the Spatial Conditioning Office)

PROCESS OF SPATIAL PLANNING



Study of EEMZ

Spatial Management Plan 2020

'Ecological Economic Micro-Zoning (EEMZ)' of the Constitutional Province of Callao was developed based on the evaluation of land use potential and restraints, using physical, biological, social, economic and cultural criteria.
Based on the EEMZ, the 'Spatial Management Plan of the Constitutional Province of Callao 2020' was developed as a proposal for integrated and efficient land use management.

PROCESS OF DEMARCATION AND SPATIAL PLANNING

'Diagnosis for delineating & determination of boundaries'

'Zoning for Spatial Demarcation & Organization of the Ventanilla district'

'Diagnosis for delineating and determination of territorial boundaries in the Constitutional Province of Callao' is a document prepared in accordance with the technical documentation of available geographic and topographic data, fieldwork with relevant instruments, and technical requirements set out in the current regulations.
It is the base for the delineating of boundaries of existing constituencies in the province.

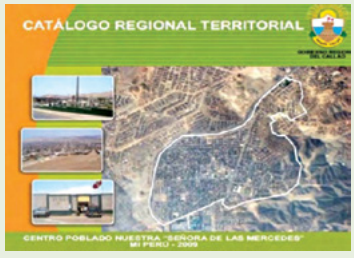
PROCESS OF INFORMATION GATHERING FOR THE SPATIAL DATABASE – GIS

Spatial Conditioning Office is responsible to develop and maintain an updated spatial database at a regional level. It prepared the following documents:

Hazards in human settlements and disaster risk management

Human Settlements of the ConstitutionalProvince of Callao

Catalogue of landmarks and ruinous properties



Document: Regional Spatial Catalogue of MiPerú

This contains information about infrastructure services, economic activities, the legal physical state of the urban centres and their margins, etc. The information was collected by field surveys and entered in GIS.

Information Catalogue of the Porcine Park Project

This contains cartographic information on demographic issues, facilities, socio-economic activities, access to basic services and infrastructure of each sector, zone, association or cooperative project.

Lessons learnt

- Information and Communications Technologies (TIC) together with the Geographic Information System (GIS) are the basis of the development and management of the knowledge products of the Spatial Conditioning Office.
- From their design on, knowledge products have a clear aim and purpose, namely: to focus on physical-urban, economic, social, environmental, watershed and risk management processes.
- The participatory character is always taken into account in the development, management and review of the information of the products. Besides the local governments (as main actors), public and private institutions and community organizations also participate.
- The knowledge products become management and guiding instruments for Regional Government, local governments and public institutions for urban spatial planning, environmental risks management and actions of demarcation.

Replicability

The development of the SITR is an initiative to be undertaken by a special body, like the Spatial Conditioning Office, formed at the regional or district level and should be seen within the context of fulfilling responsibilities and competence. Such a body should develop and maintain an updated database of spatial information at a regional level in order to use the processed data as a tool to support spatial planning and management in the entire region. In order to make the process participatory, there is a need to facilitate coordination between all the stakeholders. Regarding the public organizations, it is important to highlight the participation of the local government by providing information on land registry and as an environmental and socio-economic partner.

THEME 3

URBAN INFRASTRUCTURE PLANNING

ICT-enabled urban infrastructure can keep track of the city's operations, predicting faults before they occur, while optimizing delivery of services or resources to match the demand. Sensors located on existing infrastructure can monitor traffic flow, water quality, air quality, etc. revealing **'patterns of movement of people, waste and resources' in the city.**

The **advantage for the city authorities is** a more effective delivery of services, more efficient use of infrastructure and unprecedented strategic information on the use of the city and their services. Information feedback loops connect the systems together, enabling the city infrastructure to be managed efficiently. The strategic value derived from embedding data in the infrastructure enables the system, and the city, to learn from its own activity, transforming almost all aspects of operation, from delivery to future planning. The use of smart grids/meters for water and power transmission provides a technology-enabled solution to reduce leakage and waste and increase transparency and reliability.

The **advantage for the citizens** is that their city has a series of smart interfaces, enabling a richer, more efficient and more personalised experience. ICT-enable infrastructure aims at enabling interaction between the citizens, and the transportation systems, and smart utilities to ease the chore of urban living. A host of services focused on citizens powered by a common underlying network can provide connectivity across the city. The services thus provided should be **universally accessible** to all citizens.

INFRASTRUCTURE	ICT-ENABLED APPLICATIONS
SMART MOBILITY	Intelligent integrated transport systems
	Traffic flow analysis based on real time information
	ICT-enabled traffic control
	Smart signals, variable signage, Real-time maps, Route Guidance System
	Toll collection and traveller information systems on highways
	Transit management with passenger information systems
	Smart cards, Road pricing and electronic vehicle monitoring systems in cities
	Safety and security, accident monitoring
	Maintenance, MIS and management
PUBLIC UTILITIES	ICT-enabled (digital) metering systems
	Intelligent network transmission/distribution systems
	Real-time network condition monitoring
	Intelligent water with minimum losses and leakages
	Plugging the Non-Revenue Water (NRW) losses
	Assessing the condition of underground pipelines
	Identifying leaks using non-invasive techniques and advanced analytics
	ICT-enabled billing and payment

INTELLIGENT PUBLIC TRANSIT SYSTEM, SINGAPORE

Location	Singapore
Region	Southeast Asia
Agency	Singapore Land Transport Authority (LTA), IBM
Recognition	Intelligent City Climate Leadership Award 2013 (under the Intelligent City Infrastructure category)

Project Aim

To encourage citizens to use public transport, increase ridership, minimize road congestion, enhance the efficiency of road operations and optimize the capacity of the road network by leveraging smart technology.

Context

A growing urban population and lack of available physical space made traffic management increasingly challenging in Singapore. In total 12% of Singapore's land is occupied by roads and 15% of land area devoted to housing. Continuing to expand the road network to address the growing transportation demands has not been seen as a sustainable option. To address these demands it has been necessary to maximize the capacity of the road network. Policy tools have been complemented by technologies leveraging on intelligent transportation solutions along the entire transportation process in the city.

Project Description

LTA worked extensively with the private sector to create intelligent transport systems. The **Land Transport Master Plan** brought together the public, private stakeholders, and other government agencies to discuss the many issues Singapore faces in their land transport policy. A number of innovative approaches aiming to engage citizens were used, including **focused group discussions,** online feedback on the **Talk2LTA portal,** and **'The Great Transport Challenge 2020'** e-game, from which the insights obtained by players were taken into consideration in the Master Plan.

Project Implementation

The city has introduced various technologies, including the **Electronic Road Pricing system** (ERP – tolls that vary according to traffic flows, and work as a congestion charge). The ERP uses a short-range radio communication system to deduct charges from smart cards inserted in the vehicles.

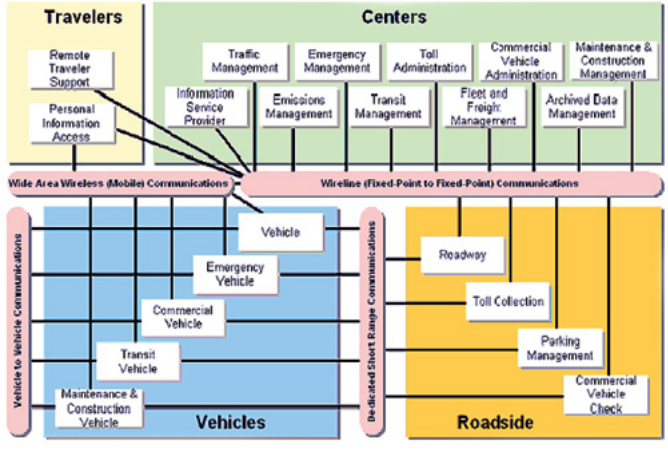
Symphony for e-Payment (SeP), a seamless national transport fare system, enables riders to use a single card of their choice to pay for all modes of travel as well as vehicle congestion charging and car parking, eliminates the inconvenience of having to carry multiple cards. The system also generates insights drawn from

INTELLIGENT TRANSPORT SYSTEMS

Interest in Intelligent Transport System (ITS) began in the late 1960s and early 1970s when the Comprehensive Automobile Traffic Control System (CATCS) was introduced in Japan and the Electronic Route Guidance System (ERGS) in the United States and Germany. These technologies attempted to integrate complex route guidance systems and in vehicle displays. However, technical slags and high costs prevented any of these systems from being accepted on a practical scale.

Starting in the mid-1980s, ITS got a boost worldwide when communication technologies became cheaper and reliable and computation capabilities expanded enormously. Large projects were launched with government-industry partnership. The European Union initiated the Dedicated Road Infrastructure for Vehicle Safety in Europe (DRIVE) in 1989 and the Program for a European Traffic System with Higher Efficiency and Unprecedented Safety (PROMETHEUS) in 1986. A few ITS applications have been introduced in India in metropolitan cities like New Delhi, Pune, Bangalore, Chennai, etc. focusing on stand-alone deployments of area-wide signal control, parking information, advanced public transportation, toll collection, etc.

Intelligent transportation systems help in improving efficiency and resource utilization. The cities of Stockholm and London have implemented intelligent traffic management and congestion charging solutions aimed at reducing congestion, improving public transport and minimizing environmental impact. In Helsinki, Finland, GPS data from trams and buses is laid over Google Maps to show travellers where to locate their mode of transport. This kind of information offers people more knowledge of the transit network, and as a result, makes them more likely to use public transportation.



Some of the vital components within Singapore's Intelligent Transport System (ITS) network include:

ITSC OPS CENTRE
Powered by an Operation Control Centre (OCC)which runs 24/7, ITSC monitors traffic with an array of intelligent transport systems and deploy ground recovery crew to assist motorists who are in distress. Real-time traffic advisory information is also provided to motorists through electronic message signs.

I-TRANSPORT
Provides an integrated and unified platform that centralises the management of all ITS including traffic signal control, traffic monitoring, incident management, tunnel and highway monitoring and provision of real-time traffic advisory information.

EXPRESSWAY MONITORING & ADVISORY SYSTEM (EMAS)
Monitors traffic along expressways, alerts motorists of traffic accidents and ensures swift response to these incidents.

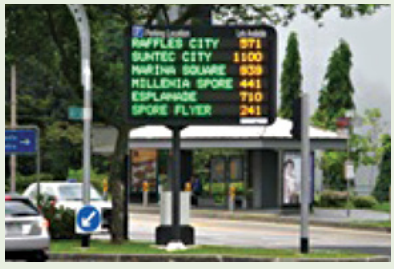
JUNCTION ELECTRONIC EYES (J-EYES)
A system of surveillance cameras that monitor the traffic condition at major signalised traffic junctions.

GREEN LINK DETERMINING (GLIDE) SYSTEM
Monitors, adjusts and optimises green time in an intelligent and adaptive manner to provide "green-wave" along main roads in response to changing traffic demand.

E-TRAFFIC SCAN
Uses taxis equipped with Global Positioning System as probes on the road network to provide motorists with information on the traffic conditions island-wide.

GREEN MAN
Extends green man time for both the elderly and pedestrians with disabilities to cross the road.

YOUR SPEED SIGN
Displays the real time speed of vehicles and alerts motorists that they are speeding.



PARKING GUIDANCE SYSTEM
Provides real-time information on parking spaces availability of shopping malls at major shopping belts in Marina Centre, Orchard and Harbour front to reduce circulation of traffic in these areas.

rider data from the trip-related transactions generated each day. This enables LTA to configure more convenient routes, schedules and fares—making public transport more attractive and increasing long-term ridership.

Technology Used

- Software Components: IBM WebSphere Application Server, IBM WebSphere MQ, IBM DB2 Enterprise Edition, IBM Tivoli Storage Manager, IBM Rational
- Hardware Components: IBM Power 570 and Power 520, IBM System x3650, IBM SAN Storage DS4800, IBM Tape Library TS3310
- Services Components: IBM Software Services, IBM High Performance On Demand Team (HiPODS)

Key Results and Impacts

- LTA has created one of the most modern, affordable and heavily used public transportation networks in the world, with nearly 3 million people riding buses and 1.6 million people riding trains on any given day (as of 2008).
- There has been 80% reduction in revenue leakage from 'lost' transactions because of systems issues and a 2% reduction in the overall lifecycle cost of the fare processing system, while doubling the system's performance capacity to 20 million fare transactions per day.
- Shorter delays and lower traffic congestion on expressways alone result in US$28 million annual savings; usage of public transport increased by 14.4% to 4.5 million between 1996 and 2007.

• Singapore is one of the least congested major cities, with an average car speed on main roads of 27 km/h, compared to 16 km/h in London, 11 km/h in Tokyo, and 5 km/h in Jakarta.

Lessons Learnt

- Full potential of an ITS program can be achieved by implementation at a network level rather than in small corridors.
- The design of an intensive ITS program encompasses technology, along with a multi-disciplinary approach involving transportation, communication, IT and human capital development.

Replicability

The success of ITS in India is dependent on:

- Evolving a national ITS standard for different ITS applications and their components
- Setting up a fully functional Traffic Management Centre for coordinating the urban and regional ITS activities
- Developing and implementing automated traffic data collection methodologies
- Developing a national ITS data archive, and models and algorithms for ITS implementations

REAL-TIME MANAGEMENT OF LARGE WATER SUPPLY NETWORK IN BANGKOK, THAILAND

Location	Bangkok, Thailand
Region	Southeast Asia
Year	2005
Agency	Thailand's Metropolitan Waterworks Authority (MWA)

Project Aim

To address the problem of water loss by improved management of water distribution by reducing the loss to 30% by 2006 and then to maintain it at this level through to the year 2017

Context

MWA supplies drinking water to 1.8 million customers in a 2,100 km2 region encompassing greater Bangkok and the neighbouring provinces of Nonthaburi and Samut Prakarn.

A significant challenge impacting the efficiency of the MWA's water distribution network was the problem of water loss caused by damage to pipes and equipment, inaccurate water meters, and other reasons. In 2005 the MWA launched a project that would address this problem through improved management of water distribution.

WATER MANAGEMENT

Sustainable water management policies have been high on the agenda of many governments around the world as there is growing pressure on the availability of fresh water resources to sustain growing demands of increasing populations and economic growth. Technologies such as satellite remote sensing in combination with semantic sensor web and GIS can be used innovatively by water authorities to obtain information in real time about water use, to track and forecast the level of rivers and to identify new sources of fresh water. The availability of information about current conditions in a particular situation on a timely basis is crucial for decision making in water resource management. ICT provides a unique opportunity for water stakeholders to access real-time information about water use, thus raising awareness about usage, locating leakages and having better control over water supply and demand.

Water distribution

Water treatment plant

Project Implementation

In order to bring the MWA a real-time monitoring and management capability, Yokogawa Thailand installed controllers along with Yokogawa pressure transmitters, magnetic flow meters, and ultrasonic flow meters at key points throughout this distribution network.

To meet the increasing water demand, the MWA built more than 1000 block stations and set up branch piping for each of these stations. Real-time data monitoring at each of these block stations is essential to bringing the water loss issue under control. Achieving an accurate water loss management system while keeping the running costs to a minimum was a real challenge in this project. Yokogawa met this challenge by providing field control junction (FCJ) controllers that function as intelligent remote terminal units (RTUs). Specific advantages of the FCJ controller include:

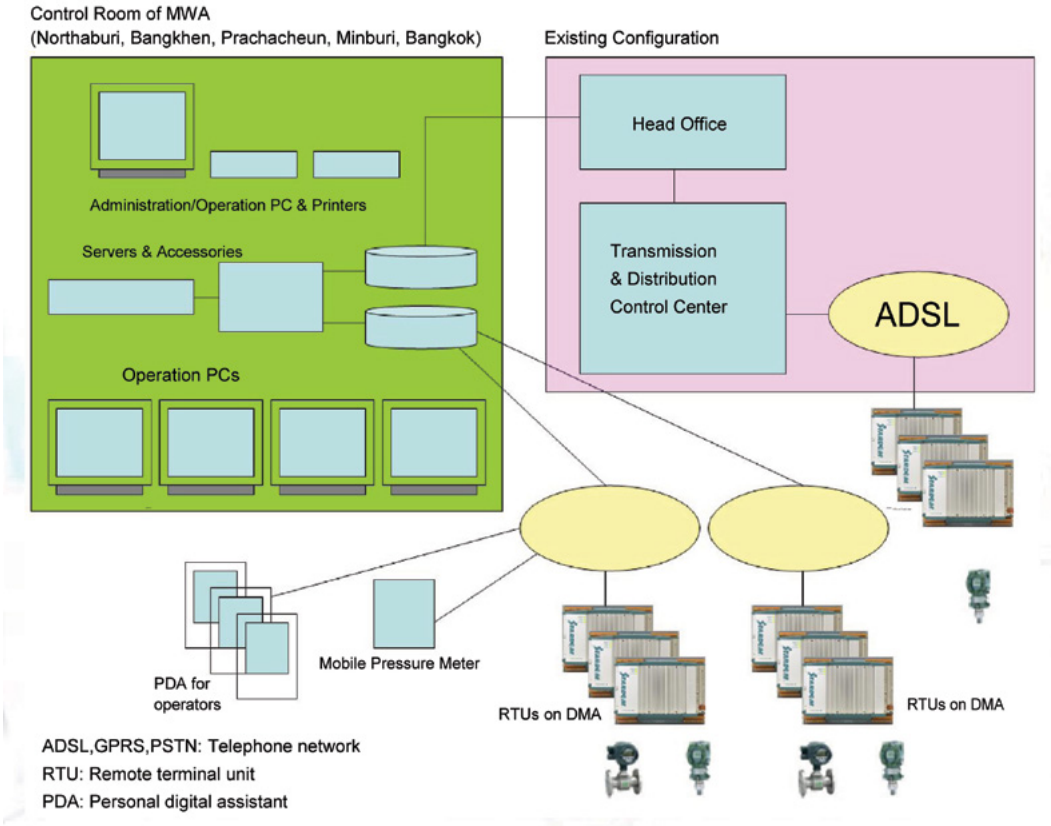
- Interfaces that support the use of GPRS, PSTN, and ADSL networks
- Embedded network fail-over detection and automatic reconnection functions that reduce GPRS network instability
- Data logging functions to protect against data loss in the event of network failure
- Supports flexible system scalability and interconnectivity with other systems

More than 200 Yokogawa FCJ controllers have been installed to date, enabling the MWA's monitoring system to collect data from widely dispersed block stations and monitor for leaks using a leakage check algorithm. A central operations centre continually monitors this system.

Key Results and Impacts

The MWA procured a total of 220 STARDOM FCJ controllers and 1400 Yokogawa meters for this monitoring system. Yokogawa completed work on this project in May 2008. The increased accuracy and reliability of the water distribution data helps reduce and control losses.

System Configuration



1. RTU FCJ cabinet *2. FCJ/AXF/EJA* *3. Operation room at the water loss management*

office

THEME 4

ENVIRONMENT AND ENERGY

The challenges of climate change, resource depletion and increasing greenhouse gas emissions mean that the world's cities need to adapt to survive and thrive in the twenty first century. ICTs can help transform energy-hungry urban centres into low-carbon cities of the future. With ICT-enabled systems, city administrators and residents can know with much greater precision, and in real-time, how much energy and resources they are consuming. Having better access to such information can help them to deploy strategies for saving energy. ICT can play an important enabling role in the avoidance of high-emissions infrastructures. It supports the construction of green buildings with features such as leverage sensors and controls designed to improve efficiency and tailor energy use to demand. The feedback loop produces information that helps people make better choices. These ideas relate to the combined use of information architecture, informatics and instrumentation to better connect people with information that they can use to make choices that reduce energy consumptions and reduce urban greenhouse gas emissions.

ICT-ENABLED APPLICATIONS
Integrated environment measures
Energy networks, smart grids
Renewable energy grid
Green buildings, smart meters
Environmental resource management
Electric vehicle
Power quality monitoring
Intelligent management/maintenance, MIS

MAPPING THE SOLAR POTENTIAL OF ROOFTOPS: GERMANY'S SUN-AREA RESEARCH PROJECT

Location	Germany
Region	Europe
Year	2006-08
Award	GIS Best Practice Awards by DVW (German association for surveying and mapping), 2008 German Solar Prize by the European Association for Renewable Energy, 2009 Prize for innovation of the Fachhochschule Frankfurt am Main, 2011

RENEWABLE ENERGY RESOURCES

Faced with grim predictions of energy supply and consumption, governments are responding with tremendous efforts to capture and cultivate renewable resources like wind, solar, geothermal, and biomass energy. Cities are searching for cleaner, smarter, and more conscientious methods of energy production, transmission, and distribution. Various technologies are supporting and paving the way for the progress of this transition.

Project Aim

To determine how solar energy resources can be optimized by placing photovoltaic panels on rooftops around the country.

Project Description

SUN-AREA researchers developed solar power potential maps of each roof area, each city, and each county or district in Germany. The team began its work with an examination of the northern German city of Osnabrück. They started by gathering data, and then devised a digital analysis method for identifying high-potential areas. Rooftop data was collected with aerial laser scanners.

The methodology adopted was as follows:

- Using ArcGIS Desktop tools, including ArcGIS Spatial Analyst, the researchers identified all necessary rooftop data, such as outer form, inclination, orientation, and clouding. Important data included the angle and alignment of the roof, the sun's path across the sky, shadows cast by a chimney or another rooftop, and the seasonal change in hours of sunlight.
- ArcGIS Desktop ModelBuilder was used to determine the solar potential of all roof areas.
- The ModelBuilder application gave the team an intuitive interface to implement necessary data and tools to model solar power.

The SUN-AREA project also calculated solar suitability, potential power output, CO2 reduction, and investment volume for each subarea of a roof.

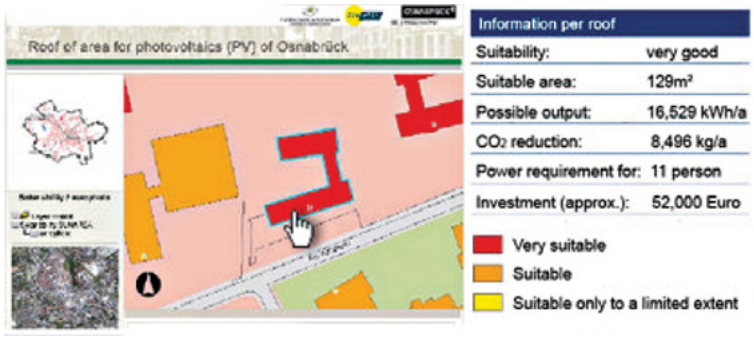
Key Results and Impacts

- A solar power potential map of Osnabrück with an exact catalogue of all suitable rooftops was prepared. As a result, the city doubled its solar energy installations within a year.
- Preliminary findings of the SUN-AREA project estimate that, at full potential, solar power could meet the entire energy needs of homes throughout Germany.
- According to the results from the SUN-AREA Research Project, about 20% of the country's rooftops are suitable for solar power production.

Lessons learnt

- Because renewable energy resources vary considerably from one geographic location to another, optimal siting of renewable energy systems requires knowledge of the specific resource characteristics, (like availability, magnitude, and variability) at any given location.
- GIS can be used to create dynamically-generated maps of renewable energy resources that determine which energy technologies are viable solutions in the particular location.

Potential solar power yield per building calculated using ArcGISapplications, Osnabruck



An extractof the roofs inspected in Osnabruck

USE OF TECHNOLOGY TO ASSIST A CITY WITH MEETING ITS SUSTAINABLITY GOALS: MASDAR CITY

Location	Masdaar, Abu Dhabi, United Arab Emirates
Region	Middle East
Year	2005
Agency	Masdar Company

Project Aim

To integrate technology in the full project cycle for increasing efficiency in the design of the city to meet its goals of zero waste, sustainable living and, ultimately, carbon neutrality.

Project Implementation

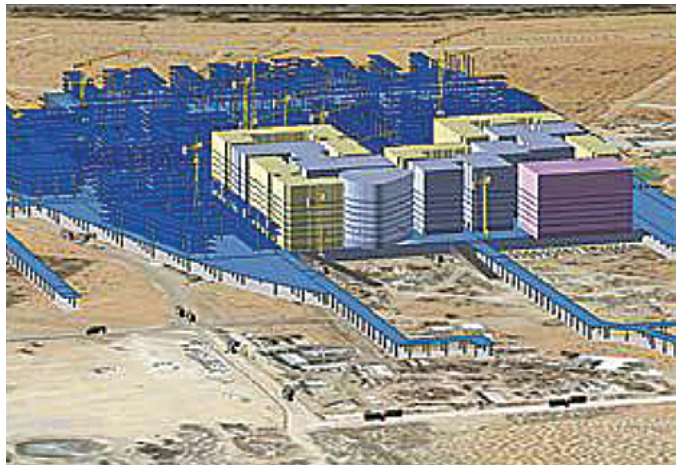
ArcGIS was the tool adopted to manage and analyse information throughout the city's life cycle. For the city to meet its challenging goals, the design team carefully considered the geography of the area: sun angles, wind patterns, street widths, and building density and height. The orientation of buildings on a diagonal grid to provide maximum natural shading was modelled in ArcGIS.

Key Results and Impacts

- **From Models to Real Life:** GIS ensured that the carbon-neutral status of the city translates from a concept to design. Changes happening during construction were tracked and recorded to monitor the effect on carbon neutrality. ArcGIS was used to even choose the most efficient location of construction materials during the building phase for reducing transportation-related emissions.
- **Maintenance and Monitoring:** ArcGIS will be used and integrated with a computerized maintenance management

PLANNING FOR SUSTAINABLE DEVELOPMENT

ICT can help to reduce the environmental footprint of what we do. It can facilitate the networks, partnerships and actions we need to work things out in a complex and connected world. The vision of a sustainable city is that of an urban centre that is healthy, green, and energy efficient because all the structures—whether used for power, water, waste management, or transportation—are designed, constructed, and maintained with the use of advanced, integrated materials, sensors, electronics, and integrated networks. This vision can be made possible by a host of underlying technology components.

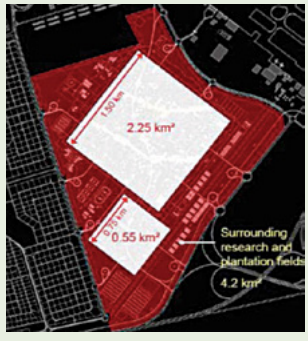


GIS used for modelling building information throughout the life cycle of the project

CONTEXT

Masdar City is a planned urban cluster that has been designed with the principles of sustainability, combined with environmental technologies to create a carbon neutral, low waste city.

Location	30 kms from Abu Dhabi
Total Site Area	700 ha
Resident Population	40,000
Commuters	50,000
Residential Density	140 people/Hectare
Peak Daily Density	245 people/Hectare



The site of Masdar City

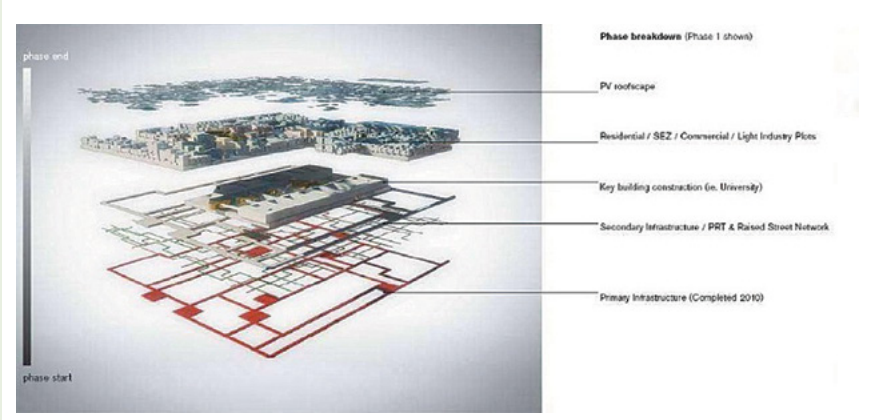
An artist's conception of an aerial view

Masdar Innovative Strategies

SITE CONTROL
Managing the overall spatial information needs of the Masdar city:

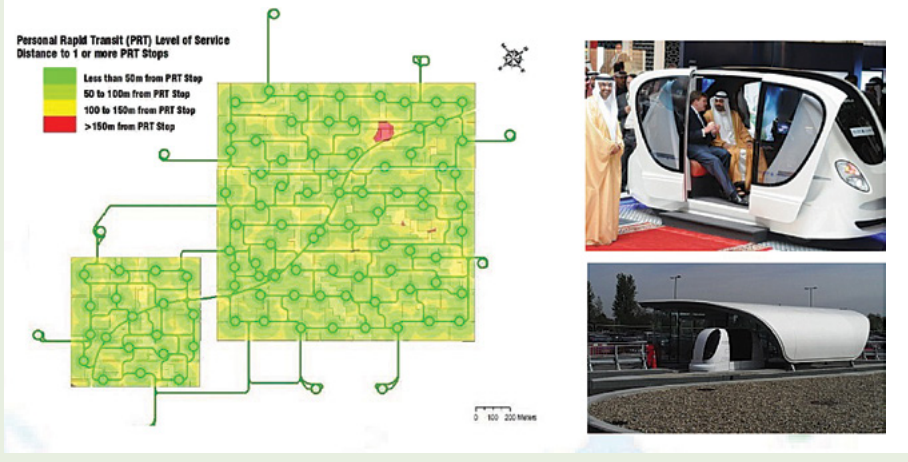
- Use of a geo-database to enforce use of a single, shared coordinate system and datum across the project.
- Building a common base map to support planning, design, construction, and ultimately, operations and maintenance of Masdar
- Overseeing and integrating all survey work
- Developing analysis tools for decision support (desktop and web)
- Spatially enabling business processes (e.g., sustainability, asset management, real estate management, etc.)

Landuse Map of Masdar City



DATA LAYERS
Data layers contained in the geo-database included information such as transportation, vegetation, drainage, structures, boundaries, elevation, biodiversity, buildings, and utilities, as well as terrain elevation, bathymetric data, and remotely sensed imagery. Information from tabular databases is incorporated into the map layers, as well as GPS coordinates and geo-referenced photographs.

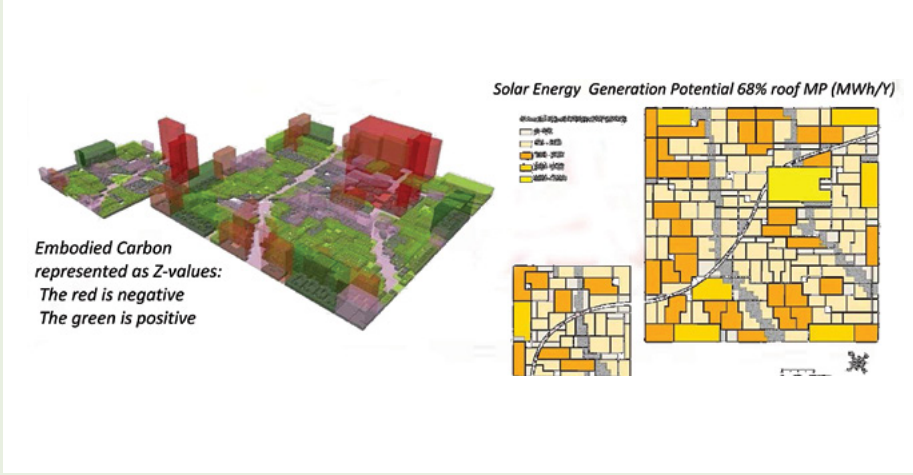
SUSTAINABLE TRANSPORT SYSTEM
A Personal Rapid Transit (PRT) system running on solar-charged batteries has been designed to transport residents around the city. ArcGIS was instrumental in visualizing all routes for the PRT network and testing predicted walk times between PRT stations.

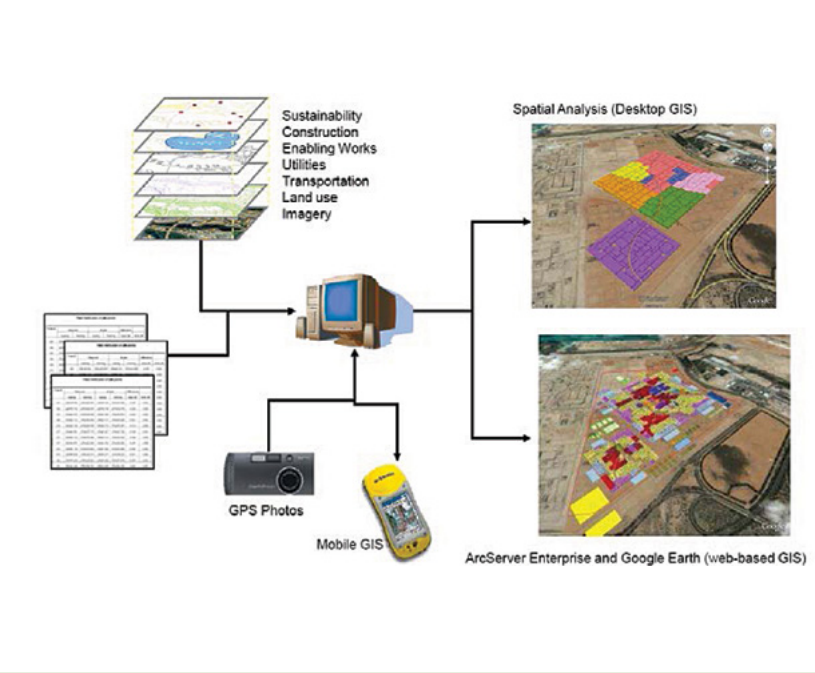


ENERGY

• The city is designed to use renewable energy sources like solar power, photovoltaic, waste-to-energy technologies, recycling, geothermal.

• Optimized Facility Placement: ArcGIS introduced the spatial analysis and modelling necessary for the most efficient placement of facilities (water and sewage treatment plants, recycling centres, a solar farm, geothermal wells, etc) in the city using traditional planning principles.





GIS WORKFLOW

• All the construction-related information, including cost, schedule, and carbon tracking data, has been tied together by location, making it more accurate and efficient to use. ArcGIS Server was deployed to enable the more than 100 organizations involved in developing Masdar City to access maps, data, and analytic services, thus reducing problems of multiple data versions in circulation.

• A Web browser-based virtual city visualization and navigation tool uses master plan data from the geo-database and links it to the program scheduling software. This tool is used to visualize the construction of the city over time. Construction managers navigate anywhere in the city; track the project timeline; identify spatiotemporal clashes, accessibility problems, and other logistical issues.

system that will include of all infrastructure assets: gas pipes, smart grid infrastructure clean, grey, and black water networks, and the transportation network.

Lessons Learnt

- Using GIS to visualize the massive amounts of data easier communication about the project.
- Asset management using ArcGIS means all systems can be visualized, maintained, and tracked efficiently. An enterprise geo-database to be used throughout the city's life cycle.
- Moving forward, GIS will make facilities maintenance easier and enable the tracking of resource use and reuse and the overall carbon balance of the operational city.
- GIS will also be used in city governance, where it will form part of the city's sustainability performance feedback service.

Replicability

Governments embarking on new city development can optimally utilize their investments by planning appropriate use of technology. The key to this approach lies in developing an ICT master plan that integrates technology with all the vital components of the city.

URBAN ECOMAP FOR REDUCING GREENHOUSE GAS EMMISSIONS, SAN FRANCISCO

Location	San Francisco, U.S.A.
Region	North America
Year	2009
Agency	San Francisco's Department of Environment (SF Environment), Cisco

Project Aim

To help the city reduce carbon emissions and reduce costs of delivering utilities by building community activity around emissions reduction using an interactive web service.

Project Description

The SF Environment and Cisco have jointly applied an Urban Services Platform approach towards emissions reduction. urbanecomap.org is an interactive web service that displays environmental footprints for San Francisco (footprint comprises CO2 emissions, waste and transportation activity, broken down by postal code). Urban EcoMap provides communities with relevant data regarding the primary GHG contributors. It attempts to raise awareness and build community activity around reduction of GHG emissions. Its goal is to help spur a shift to climate-friendly behaviour in cities. The services include citizen engagement, collaboration, professional geo-referential data, real-time environmental and energy metering and monitoring, simulations for real estate development, transportation planning and location marketing.

PEOPLE'S PARTICIPATION IN EMMISSIONS REDUCTION

Because cities produce 80% of greenhouse gas (GHG) emissions worldwide, and are the major contributor to their nations' economies, they present the largest opportunity for innovation and social behavioural changes. As we move from educating people about climate change to taking action to mitigate climate impacts, we need technology, process, and culture to help spur a shift to climate-friendly social behaviour in cities.

Project Implementation

Urban EcoMap consists of two key features:

- Discover Your City's Neighbourhoods: Urban EcoMap shows GHG emissions data, in addition to displaying a set of transportation, energy, and waste indicators to assist residents in visualizing both the specific actions they can take to fight climate change, and the impact of those actions. Factors include alternative-fuel vehicle ownership, recycling, and energy use / efficiency per household. All this information is aggregated on a neighbourhood level, organized by the city's zip codes, allowing users to highlight data that can

Urban EcoMap Allows San Franciscans to View GHG Emissions by Zip Code

Urban EcoMap Estimates the Effort, Cost, and Impact of Various Climate Actions

be directly compared by zip.

- Take Climate Actions: Citizens have the ability to select climate-related actions to help decrease the carbon footprint of their zip code and their city. Citizens can view and select actions based on the level of effort required to make the change, the associated cost or financial benefit, and the environmental impact of the action. Based on their selections, citizens can take appropriate climate actions for transportation, energy, and waste, and then share them with others.

Key Results and Impacts

- Urban EcoMap allows citizens to see the impact of their climate-change activities, while also motivating people and creating competition among neighbourhoods.
- It supports decision-making for policymakers and business organizations towards energy efficiency and carbon emission reductions.
- The service helped in eliminating equivalent of 3428 tonnes of CO_2

THEME 5

PUBLIC HEALTH AND SAFETY

A key element for reducing health care costs and improving community health is increased access to primary care and preventative health services. Geographic information systems (GIS) have the potential to assess patterns of health care utilization and community-level attributes to identify geographic regions most in need of primary care access. ICT can also play a crucial role in mitigating the effects of natural disasters in human settlements.

Public safety and security solutions integrated with ICT help prevent, detect, and respond to security requirements. Real Time Crime Centers (RTCCs) and integrated emergency response solutions are technology-enabled solutions that have been used successfully world-wide to increase efficiency and reduce response time. The New York Police Department RTCC has reduced the crime rate by 27%; the police use analytics and visualization tools to decipher crime patterns as they are forming. Cities like Songdo are building public safety and security solutions based on citywide surveillance systems that are centrally monitored and integrated with emergency response capabilities.

GIS FOR HEALTHCARE IN SUB-SAHARAN AFRICA

Location	Kenya, Zambia, Rwanda
Region	Sub Saharan Africa

Project Aim

To be able to assess and predict the risks of the outbreak of a disease in space and time with the help of technology in order to channelize the resources to prevent the outbreak.

Context

Worldwide over 42 million people are living with HIV/AIDS, and nearly 75% of these infected people live in sub-Saharan Africa. With HIV/AIDS at epidemic levels throughout Africa, health organizations struggle to determine appropriate treatment methods and intervention strategies for working with antiretroviral therapy (ART) patients. (ART therapy is a drug treatment program that suppresses or stops the replication of HIV and other retroviruses.)

Health care professionals need the ability to predict the geographic spread of disease, demonstrate temporal disease trends, analyse health service gaps, and design HIV prevention campaigns to stop the spread of the disease. With such information, better treatment and care can be provided to those living with HIV/AIDS, allowing them to live longer and healthier lives.

Project Description

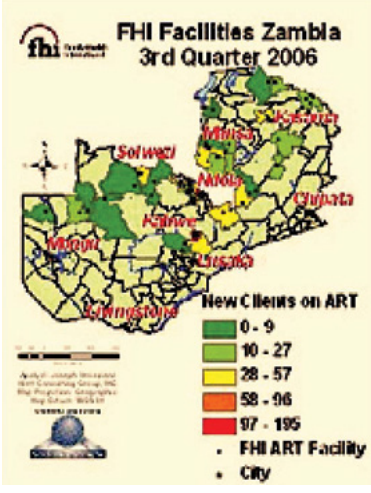
Family Health International (FHI) works with health organizations in many sub-Saharan African countries to prevent the spread of HIV and improve care among those at highest risk. FHI has used many methods to meet health care challenges

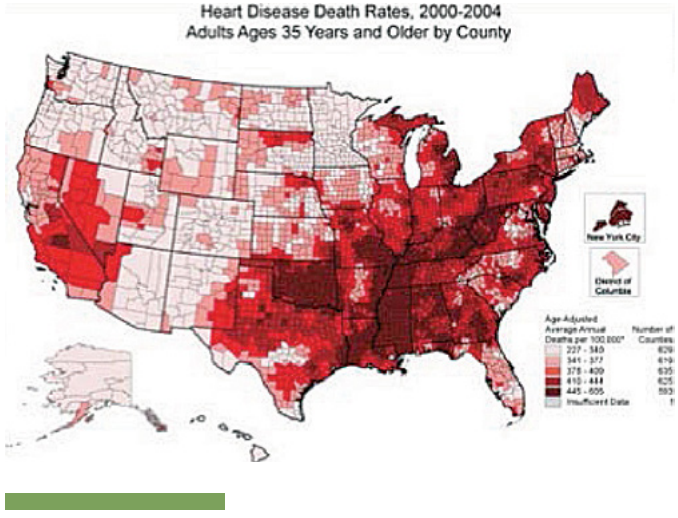
PUBLIC HEALTH PLANNING

Hospitals and other organizations, with GIS and big data resources have the ability to collect geographic information from their patients and study trends in illnesses based on where the patients live now and have lived in the past. By displaying this information on a map it allows healthcare workers to visually see trends in illnesses and predict which communities will most likely be impacted in the future. Maps are created based on socio-economic status, population density, insurance status, and emergency department and primary care safety-net utilization.

A GIS study conducted in China determined the next likely at-risk region for the H7N9 avian flu virus to be located in a northern region of Vietnam. They were able to determine this information by mapping previous cases of the flu virus which created a trail that helped them predict northern Vietnam. GIS applications can help city planners to appropriately plan and locate new health infrastructure. The use of GIS technology and big data analytics in planning healthcare infrastructure is an emerging area of application.

ICT-enabled health services, which connect hospitals to remote facilities for consultation, diagnosis, and sometimes training, are increasingly finding acceptance as a means of increasing accessibility and reducing cost of delivering health services. In Chongqing, southwest China, two hospitals in the Shapingba district, South Western and Xinqiao, have implemented telemedicine solutions, connecting with other participating hospitals.





throughout Africa. A recent initiative using geographic information system (GIS) technology uses different types of spatial data to improve strategic planning for HIV/AIDS programs in rural and urban areas.

Project Implementation

FHI began mapping the location of health facilities by collecting global positioning system (GPS) points. Detailed information about the prevention, care, and treatment programs associated with each health facility was also recorded, as were pertinent data on ART patients in the area. This information was then combined with geographic information collected for the health care facilities and stored in a "geo-database."

A GIS application uses the GPS data and other information to create maps that show locations of patients relative to health care facilities. For Kenya, Rwanda, and Zambia, FHI has created national maps that show the geographic reach of their prevention, care, and treatment programs.

Key Results and impacts

- With this new tool, FHI staff are better able to analyse the quality and breadth of services provided in relationship to the needs of the population.
- The maps generated from the GIS have facilitated more effective communication with policymakers and funders about the need for different types of services in different places.

Lessons learnt

- GIS analysis has helped the organization make better decisions about resource allocation and service provision.
- The system helps FHI provide better health care and save lives throughout Africa.

Replicability

FHI's approach of applying GIS to commonly available community and patient level data can be used to rapidly identify areas most in need of increased access to primary care services in India.

GEOINFORMATICS FOR RECONSTRUCTION PLANNING IN COLOMBIA

Location	Armenia, Colombia
Region	Latin America
Year	1999

Project Aim

To obtain an inventory of earthquake damage right after a seismic event using aerial photographs for the purpose of relief operations and reconstruction planning.

Context

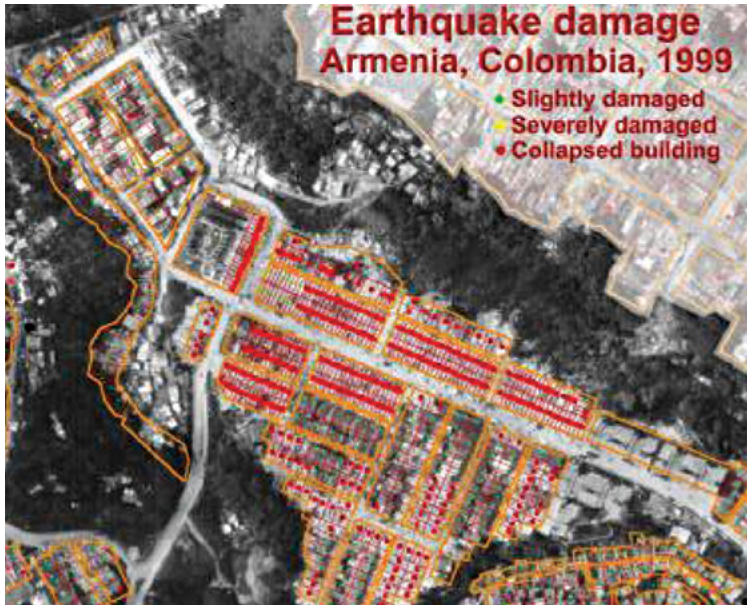
On 25 January 1999, an earthquake occurred in Quindío, Colombia. With a magnitude of 6.2 on the Richter scale, it destroyed and damaged approximately 45,000 houses and thousands of people were killed or injured. Armenia (population around 250,000) was the main city that was severely damaged.

Project Description

In order to make a rapid assessment of the damage inflicted by this earthquake and to make recommendations for the reconstruction of the damaged areas, the Colombian authorities, with assistance from the Dutch government, initiated the "Rapid Inventory of Earthquake Damage (RIED)" project to prepare inventories for the damaged areas.

Project Implementation

Firstly, all the relevant geographic and geologic information was acquired and cooperation arrangements were established between different organisations in Colombia. An aerial survey was conducted during which several series of high-resolution aerial photographs were taken, both vertical and oblique. The vertical aerial photos had scales ranging from 1:6,000 to 1:8,000. Furthermore pre-earthquake aerial photos were used (scale 1:10,000 from 1995) to carry out a rapid damage assessment in the city of Armenia.



Aerial photograph interpretation was carried out in order to find the buildings, which were affected by the earthquake and had different levels of damage. The following damage classes were used: total collapse, roof collapse, roof partly damaged, and no visible damage, but rubble in street. The damaged buildings were drawn by hand and then digitised in GIS to create a point map, which was used in combination with a set of ortho-photos and a cadastral vector database.

Key Results and Impacts

- The damage inventory by aerial photographs gives a reasonable impression of the damage for reconstruction purposes.
- Major geological, geotechnical, and morphological features that influenced the damage are easily recognizable. Their presence was considered in the planning for reconstruction.

Lessons learnt

- By combining the aerial photographs with existing cadastral and topographic information, a comprehensive GIS database was set up in a short amount of time.
- The results of a damage inventory by aerial photographs can be available more rapidly after an earthquake, as compared to a ground survey. This is of great benefit for relief operations and for reconstruction planning.

Replicability

The approach of preparing an inventory of damage using aerial photographs can be used right after natural disasters by municipal authorities and state governments to facilitate rescue, relief and rehabilitation in areas where manpower is not available for an instant ground survey or the areas are inaccessible due to the extent of damage caused by the disaster.

DISASTER MANAGEMENT

India has been vulnerable to natural disasters on account of its unique geo-climatic conditions. Floods, droughts, earthquakes and landslides have been recurrent phenomena. The devastating tsunami experienced by the Indian coastline in December 2004, the 2005 Maharashtra floods and the cloudburst in June 2013 centred on Uttarakhand, which caused devastating floods and landslides, are all disasters that led to loss of lives along with damage to private, community and public assets.

While some disasters cannot be avoided or prevented, their impact can be mitigated if relevant information and planning is in place. Information and Communication Technologies (ICTs) are vital to effective management of all phases of the disaster management. The geomatics technology in terms of remote sensing (RS), Global Navigation Satellite Systems (GNSS), Geographic Information Systems (GIS) and Global Positioning System (GPS) can be well utilized for disaster management in the future. With the combination of these technologies one is able to display the 'Field/ Actual Site' on a PC and make informed decisions.

APPLICATION OF GIS AND GPS CAN BE DONE IN THE FOLLOWING ASPECTS OF DISASTER MANAGEMENT

- **Step 1.** Establish probability of a natural disaster occurrence
- **Step 2.** Identify at risk locations
- **Step 3.** Calculate severity of disaster on at-risk communities
- **Step 4.** Develop predictive vulnerability/ hazard maps
- **Step 5.** Develop local warning systems

EXAMPLES OF GEO–INFO APPLICATIONS IN DISASTER MANAGEMENT

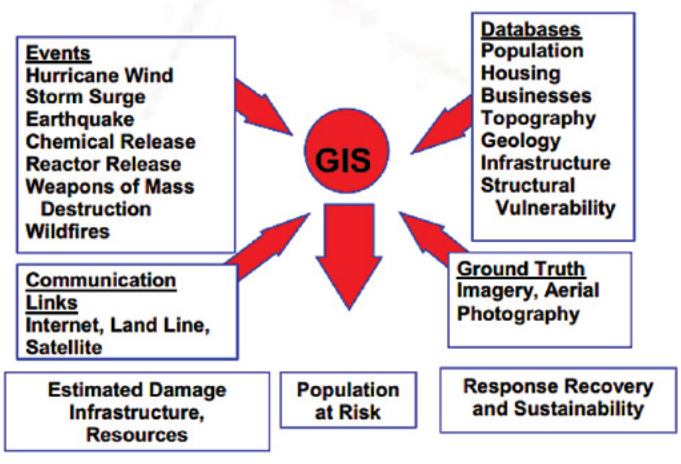
Pre disaster: Hazard mapping, Vulnerability and Risk Assessment, Preparedness Plans; Early Warning and monitoring, Risk Modelling, etc.

During Disaster: Public warning systems; emergency operations; search and rescue, evacuation planning, distribution of relief.

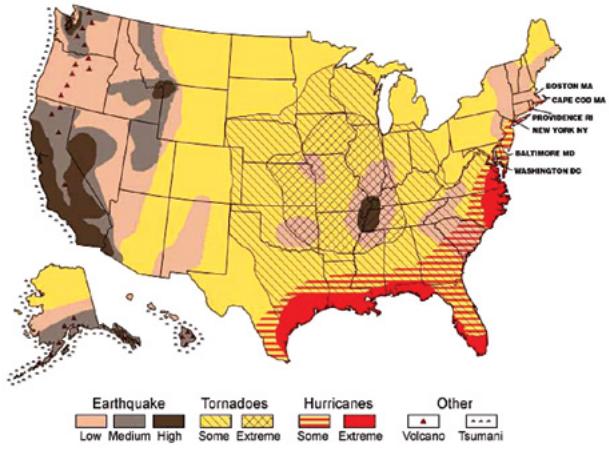
Post Disaster: Damage assessment, temporary shelters; claims processing and grants; reconstruction, etc.

Hazard Risk Mapping: Figure shows a typical example of a Multi-hazard risk map for the US showing the areas potentially affected by various hazards.

GIS IN DISASTER MANAGEMENT



NATURAL DISASTER RISK PROFILE



ANNEXURE

CONTACT DETAILS OF IMPLEMENTING AGENCIES FOR THE CASE STUDIES

Location	Source of Information	Agency's Contact
Theme 1: PUBLIC SERVICE AND GOVERNANCE		
Seoul, Korea	• www.seoul.go.kr • english.seoul.go.kr/ (accessed in July 2014)	Information Planning Division, Seoul Metropolitan Government Deoksung-gil 15, Jung-gu, Seoul 100-739, Republic of Korea Tel: +82-(0)2-2133-2925 Email: policyshare@seoul.go.kr
Dongcheng, Beijing, China	• mgov.cn/innovation/index.htm • "Mobile Government: Towards a Service Paradigm," a paper by Gang Song and Tony Cornford in the Proceedings of 2nd International Conference on e-Government, 2006, University of Pittsburgh, USA, accessed in July 2014: www.mgov.cn/ICEG_2006_paper.pdf	mGov Lab China Email: mgovlab#gmail.com
London, UK	• www.fixmystreet.com/ • en.wikipedia.org/wiki/FixMyStreet accessed in July 2014	mySociety Ltd, 483 Green Lanes, London, N13 4BS, United Kingdom Email: hello@mysociety.org, fixmystreet-owner@lists.mysociety.org
Kenya	"E-Governance and Developing Countries", a report by Michiel Backus, accessed in July 2014: editor.iicd.org/files/report3.doc	Ethics and Anti-Corruption Commission Integrity Centre, Milimani/Valley Road Junction 61130 00200, Nairobi , Kenya Tel: 020-2717318, 020-310722 Fax: 2719757 Email eacc@integrity.go.ke
Theme 2: URBAN ADMINISTRATION		
Kingdom of Bahrain	"Improving Municipal efficiency using GIS," a paper by NV Kumar, Khulood Murad Ali, Selvaraj Krishnan, Information Systems Directorate, Ministry of Municipalities Affairs and Urban Planning, Kingdom of Bahrain, accessed in July 2014: www.mapmiddleeast.org/magazine/2005/jul_aug/effective.htm	Ministry of Municipalities Affairs and Urban Planning P.O.Box. 53, Manama, Kingdom of Bahrain Tel: 80008188 Email: prinfo@mun.gov.bh
Callao, Peru	• "Spatial Knowledge Management in Urban Local Government: E-Governance in India, Brazil, South Africa, and Peru", 2013, fieldwork report by Isa Baud, Dianne Scott, Karin Pfeffer, John Sydenstricker-Neto, Eric Denis, Luz Consuelo MuguruzaMinay • sitr.regioncallao.gob.pe/sitr/	Regional Government of Callao Avenida Elmer Faucett No. 3970 - Callao Tel: 5755533 / 5751075 Email: lmuguruza@regioncallao.gob.pe, wmenacho@regioncallao.gob.pe

Location	Source of Information	Agency's Contact
Theme 3: URBAN INFRASTRUCTURE PLANNING		
Singapore	• www.lta.gov.sg/content/ltaweb/en/e-services.html • "Singapore Land Transport Authority maximizes ridership to minimize traffic congestion." IBM website, accessed in July 2014. https://www-07.ibm.com/sg/clientstories/pdfs/LTA.PDF	Singapore Land Transport Authority 1 Hampshire Road, Singapore 219428 Tel: (65) 62255 582 Email: feedback@lta.gov.sg
Bangkok, Thailand	www.mwa.co.th/main.php?filename=index, accessed in July 2014	Metropolitan Waterworks Authority, 400 Prachacheun Road, Tungsonghong, Laksi, Bangkok 10210, Thailand Tel: 0-2504-0123 Email: mwa1125@mwa.co.th
Theme 4: ENVIRONMENT AND ENERGY		
Germany	SUN-AREA Brochure accessed in July 2014: www.sun-area.net	Steinbeis-Transferzentrum Geoinformations- und Landmanagement Bachgasse 8, 97990 Weikersheim Tel: 0 79 34 . 99 288-8 info@sun-area.net
Masdar City, UAE	"Using GIS technologies to help plan and build a sustainable city", by Derek Gliddon, Masdar City, accessed in July 2014: proceedings.esri.com/library/userconf/proc09/uc/papers/pap_1854.pdf	Masdar City Khalifa City 'A', Opposite Presidential Flight, P O Box 54115, Abu Dhabi, UAE Tel: +971 2 653 3333 Email: joinus@masdarcity.ae
San Francisco, USA	• urbanecomap.org/ (accessed in July 2014)	SF Department of Environment 1455 Market Street, Suite 1200 San Francisco, CA 94103 Tel: 415 355 3700 Email: environment@sfgov.org, support@urbanecomap.org
Theme 5: PUBLIC HEALTH AND SAFETY		
Kenya, Zambia, Rwanda	"Geographic Information Systems Strengthen FHI Program Planning," by Mary Dallao, Family Health International, accessed July 2014: search.fhi.org/cgi-bin/MsmGo.exe?grab_id=92480164&extra_arg=&page_id=1515&host_id=1&query=GIS&hiword=GIS	Family Health International 1115 Burnett Street, Hatfield Square, Building 3, 4th Floor, Hatfield, Pretoria 0083, South Africa Tel: 27 12 762 4000 Email: BPP@fhi360.org
Armenia, Colombia	doc.utwente.nl/79950/1/ingeokring2001.pdf (accessed in July 2014)	

Erwin Soo

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सत्यमेव जयते

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