# CHAPTER 8 – USING INFORMATION AND COMMUNICATION TECHNOLOGIES FOR SMART AND CONNECTED CITIES

*To Build a Smart and Accessible Information Society*

*Cities should recognize that information and communication technologies are essential to a vibrant social, economic and cultural life of the city. Cities should invest in information and communication technology infrastructure so as to strengthen services across multiple sectors, and to build an intelligent digital nervous system supporting urban operations. They should strengthen the use of information technology in education, reduce the digital divide, and increase the access of residents to information.*

Shanghai Declaration on Better Cities, Better Life

## 1. ISSUES AND CHALLENGES[1]

### 1.1 ICT AS A MANAGEMENT TOOL

As an urban leader, you should recognize and take advantage of the capacity of information and communication technologies (ICT) to enhance management systems. The phrase that has been coined, "ICT for smart cities," is particularly apt. Besides improving sustainability monitoring and control capabilities for city executive offices, agencies and managers, ICT connectivity can be a prime source of urban economic growth and social cohesion.

ICTs present innovative ways of managing our cities — smart buildings, intelligent traffic management, new efficiencies in energy consumption and waste management, and not least exchanging information and knowledge and communicating on the move in an increasingly converged information society. ICT approaches, including e-governance, enable access to information and time-saving convenience for citizens. When properly deployed and managed, these technologies allow cities to save capital expenditures while transforming government

[1] This chapter was authored by Warren Karlenzig, with valuable input and contributions from Chen Chao and Mohan Peck.

personnel and citizen behaviour to become more sustainable over time. Through e-governance, local governments can become more efficient both in terms of internal operations as well as through their relationships and transactions with citizens, businesses and other levels of government.

ICT allows cities to have a virtual presence on the Internet. A good website with meaningful content can be a powerful tool to attract business, new residents and tourists. A virtual city can also convey the quality of life that might be expected in the city, including the diversity of its neighbourhoods, the availability of arts and culture, as well as access to green spaces and leisure activities.

Smart cities are centred on the utilization of networked infrastructure. This digital infrastructure has the capability to improve economic, resource and political efficiency while enabling more effective social, cultural and physical urban development. Through the utilization of digital technology, it is possible for cities to achieve lower carbon emissions from land use planning, infrastructure, buildings and transportation. ICT can play an important enabling role in the avoidance of high carbon-emission development.

From the onset of your urban planning efforts, ICT can provide simulation software that can help planners and architects model the optimal locations of buildings, schools, health services, and public transportation routes to reduce mobility needs in support of low-carbon lifestyles. So called “e-planning” practices using publicly accessible portals in conjunction with geographic information system (GIS) data can also help facilitate citizen participation in urban planning processes, particularly when such approaches are used to complement (not replace) public participatory processes.[2]

In building design, ICT is being used to optimize natural solar energy and lighting and also to accommodate renewable energy use; these strategies combined can reduce fossil fuel energy consumption. New smart or intelligent buildings are constructed using ICT to help orient buildings and building features to take “passive” advantage of natural conditions, including sunlight for lighting and heating and wind for cooling. Once these structures are completed and occupied, ICTs support the maintenance of smart buildings with features such as sensors and controls designed to improve efficiency and tailor energy use to actual demand. Besides saving energy and operational costs, ICT-integrated building systems can increase personal comfort and productivity, through optimization of light (including natural lighting), cooling, heating and fresh air. Unoccupied spaces, rooms, or entire buildings can be maintained with minimal use of energy, greatly increasing overall urban building energy efficiency. These issues are covered in depth in the Chapter on Green Buildings.

ICT is an essential enabler of smart grids, which are needed to significantly increase the operating efficiency of existing power grids and their centralized electric power production facilities. ICT-enabled smart grids collect, store and distribute energy, while managing variations in electricity loading. Smart grids provide more effective monitoring and distribution of the

[2] “Handbook of Research on e-Planning: ICTs for urban development and monitoring,” Carlos Nunes Silva, University of Lisbon, Lisbon, Portugal, 2010: http://www.igi-global.com/Bookstore/TitleDetails.aspx?TitleId=41793&DetailsType=Preface

supply of energy from distributed energy systems, including solar and wind energy systems, allowing more effective use of these renewable energy technologies. Smart grids can also interact with building control systems to provide more efficient building heating, cooling, lighting and appliance power use.[3] More information on smart grids can be found in the Chapter on Science and Technology Innovation.

The mobile sector provides probably the most dynamic source of ICT micro-enterprises. In many parts of the developing world, ecosystems of mobile entrepreneurs have sprung up to serve local demand for mobiles and for associated applications and services. In many cities, there is a proliferation of shops and market stalls selling used and new mobile phones; kiosks that offer mobile phone applications, ringtones, wallpapers and content, and services such as installation and setup; device repair services ranging from swapping out components to re-soldering circuit boards to reflashing phones in a different language; and repairers who rely on informal social networks to share knowledge on common faults and repair techniques. Selling airtime on the streets employs large numbers of people in low-income countries. Such services can play an important role in sustaining the use of ICTs, especially among poor segments of the economy. In some countries, ICT micro-enterprises have also played a role in extending connectivity to rural areas to foster communication with cities and markets. According to Grameen Bank, there were more than 350,000 village phone ladies in Bangladesh by the end of 2008.

For both developed and developing nations, ICT enables online education programmes, or e-learning. In general, intelligent cities and communities are characterized by high capacity for learning and innovation, which is built into the creativity of their populations, their institutions of knowledge creation, and their digital infrastructure for communication and knowledge networks.

The complementarities between ICT and municipal service sectors are many. Consider ICT and transportation investments. Both respond to the need of improving connections between people and businesses, reducing costs of commuting and information transfers. ICT innovations applied to public transportation systems for scheduling, route changes and other logistics notification can vastly improve service quality, which increases ridership more cost effectively than large-scale capital investments.[4]

[3] "Reinventing the City: Three Prerequisites for Greening Urban Infrastructures," WWF International (in conjunction with Booz & Company), Gland, Switzerland, 2010, p.8: http://www.slideshare.net/itsgowri/wwf-low-carboncities

[4] "Cities and Green Growth: Issues Paper for the 3rd Annual Meeting of the OECD Urban Roundtable of Mayors and Ministers," 25 May, 2010, OECD Conference Center, Paris. P.15

### ENABLING ACTIONS AND TECHNICAL CHALLENGES

Because there is increasing evidence of the positive effects of ICT on productivity growth,[5,6] enabling actions for smart cities should include regulatory reforms, such as reducing barriers to entry which are critical for private investment in broadband and other ICT networks. First-movers in ICT network investments seem to enjoy significant benefits. The Paris suburb of Issy-les-Moulineaux, by providing superior broadband infrastructure, a business-friendly climate and innovative e-services, has managed in less than a decade to radically change its industrial structure, reducing local unemployment to virtually zero.

The promise of ICT in enabling urban sustainability management must be tempered with the challenges of proliferating data and other potential cultural impediments that come with digital systems. In developing effective ICT systems for sustainability management, cities will need to be able to effectively manage rapidly proliferating data from sensors, reports, databases and other sources. Currently many database systems managed by cities are developed with separate technologies, according to "siloed" functions (planning and transportation agencies, streets maintenance and sanitation, air and water environmental monitoring agencies, financial departments, etc.). Data from such entities and newly emerging systems (such as smart grids and intelligent buildings, intelligent vehicle fleets) would need to be normalized on an "apples-to-apples" basis through an integrated network. To be useful, such data would need to be aggregated, sorted and presented in a meaningful way so city decision-makers could act upon the data based on past, present and potential future conditions. Challenges to such a scenario include cultural issues around the ability of institutions and individuals to share data, and to trust the data that is being provided by outside parties.[7]

If properly designed, integrated and managed, the end result of ICT use is improved performance in management of health, safety and family services, education, energy and water supply and use, and transportation and materials logistics.

## 2. MENU OF OPTIONS: INFORMATION AND COMMUNICATION TECHNOLOGIES

### 2.1 EXECUTIVE DECISION-MAKING SUPPORT

When deployed at the executive management level, ICT can enable better support for complex decision making for urban sustainability. A variety of information technology based systems, including sustainability "dashboards" are using visual indicators to help managers more easily understand—and take action—regarding a variety of physical, scientific, environmental and

[5] "Cities and Green Growth: Issues Paper for the 3rd Annual Meeting of the OECD Urban Roundtable of Mayors and Ministers," 25 May, 2010, OECD Conference Center, Paris. P.15

[6] "Investment in ICT and Broadband for Economic Recovery and Long-Term Growth," Robert Atkinson, International ICT Summit on ICT Economic Stimulus," Ankara, Turkey, 17 February 2010 http://www.slideshare.net/atifunaldi/investment-in-ict-and-broadband-for-economic-recovery-and-longterm-growth

[7] "Reconteur on Smarter Cities," Reconteur Media, London, 1 June, 2010, p. 5: http://www.itm-power.com/cmsFiles/media/TimesRaconteur_010610.pdf

economic conditions. One technological solution example is called *City Cockpit* –an integrated management information and decision support system that can assist city authorities in managing the growth and changes within a city based upon key performance indicators related to areas such as traffic, environment, and finance.[8] The emerging city of Masdar, Abu Dhabi uses sustainability indicators on greenhouse gas emissions generated through energy, waste and water use that are compiled in a "dashboard" for the master developer and project managers showing whether potential buildings, transportation, infrastructure and even the travel activities of construction contractors can meet the city's carbon neutral goals.[9,10]

**Operations Center for Emergency Response – Rio de Janeiro**

The city government and a leading technology provider teamed to build an operations Centre that integrates data and processes across city departments and agencies. The aim is to improve city safety and reduce response times to various types of incidents, from flash floods and landslides to traffic accidents. Part of the Centre includes a high-resolution weather forecasting and hydrological modelling system for the city, which can predict heavy rains up to 48 hours in advance. The Rio Operations Centre consolidates data from various urban information systems for real-time visualization, monitoring and analysis. The system was initially designed to forecast floods, which are a recurring natural disaster in the city. However, the system is being extended to cover many other types of events occurring in the city, whether that is the annual Carnival, the exit of fans from a stadium soccer match, or a traffic accident. The Centre will allow city leaders to make decisions in emergency situations based on accurate, real-time information.

## 2.2 E-GOVERNMENT

In many countries local governments are successfully deploying publicly accessible web portals in support of "e-government" capabilities. Citizens can use these Internet sites to make applications, get service updates and lodge complaints related to areas such as solid waste management, storm water drains, roads & traffic, factories, licensing issues, water supply, pest control, and building permitting. Executive management and city agencies can benefit from e-government by reduced volume of customer service costs and more efficient internal processes, document and information management. One excellent example of e-government services is the publicly accessible internet site that was initiated by The Municipal Corporation of Greater Mumbai (MCGM) in 2007. It serves its numerous city agencies and more than 12 million

[8] "City of the Future," Siemens, Page 2. http://www.it-solutions.siemens.com/b2b/it/en/global/Documents/Publications/city-of-the-future_PDF_e.pdf

[9] "Pacific Cities Sustainability Indicators Metrics Workshop Agenda," Gordon Falconer, Cisco, Singapore, 23 August 2010. Communication with author

[10] "Interview: A sustainable future," RFP magazine, Issue 44, August 2008: http://www.rfpmagazine.com/rfp_pages/interviews_16.htm

citizens, as well as countless users outside of Mumbai. The Indian state of Maharashtra introduced e-governance to its municipalities to provide "single-window" city services to its citizens to increase efficiency and productivity of its cities, and to provide timely and reliable management information.[11] Mumbai's portal helps the city and its many agencies manage birth and death registrations, waste, transportation, medical services, schools, medical colleges, disasters, taxes, town planning, city infrastructure, retail shops as well as social programmes. The system is available to the public at: http://www.mcgm.gov.in.

## 2.3 E-LEARNING

e-learning is being increasingly adopted by municipal education systems to enhance learning. It generally refers to the use of technology as classroom aids, although over time, there has been a gradual increase in fully online learning. Computer-supported collaborative learning is one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology. It focuses on collaborative or group learning whereby instructional methods are designed to encourage students to work together on learning tasks.

Online courses allow students to proceed at their own pace. If they need to listen to a lecture a second time, or think about a question for awhile, they may do so without fearing that they will hold back the rest of the class. Through online courses, students can earn their diplomas more quickly, or repeat failed courses without the embarrassment of being in a class with younger students. Students also have access to an incredible variety of enrichment courses in online learning, and can participate in college courses, internships, sports, or work and still graduate with their class.

Virtual classrooms can often use a mix of information and communication technologies. Participants in a virtual classroom can use emoticons to communicate feelings and responses to questions or statements; they can 'write on the board' and even share their desktop. Other communication technologies available in a virtual classroom include text notes, microphone rights, and breakout sessions. Breakout sessions allow the participants to work collaboratively in a small group setting to accomplish a task, as well as allow the teacher to have private conversations with individual students.

In addition to virtual classroom environments, social networks have become an important part of e-learning. Social networks have been used to foster online learning communities around various subjects. Mobiles, such as handheld computers and cell phones, can be used to assist in such things as language learning. It is generally considered that schools have not caught up with the latest social networking trends.

[11] eGovernance@city: Integrated Solution for Mumbai City Management, Siemens Corporation, August, 2007. Also see "City Portal Reference, Municipal Corporation of Greater Mumbai, Siemens Corporation: http://www.citylabs-live.com/Portal/ref/ref_mumbai.pdf

## 2.4 MORE EFFICIENT MANAGEMENT OF URBAN TRANSPORT

Urban transportation systems have seen some of the most active areas of deployment of ICT, particularly through mobile devices that citizen users can easily access, such as cell phones. Cell phone alerts can provide information on public transit route and schedule changes, while e-payment options for handheld devices including phones can make transit ticket purchases and payment discounts more convenient.

Social media, such as Twitter for instance, are being used to enable ridesharing for taxis and other forms of transportation. Korean municipalities are particularly active in the deployment of ICT technologies as a means of enhancing energy efficiency of urban infrastructure. The Gangnam-gu district of Seoul, home to corporate headquarters, multinationals and information technology venture firms, first adopted a carbon mileage system that can be used through mobile devices and is now pioneering other innovative service provisions for reducing corporate and personal carbon footprints via wireless technologies. These technologies are best implemented or adopted, in the case of social media, by urban and regional transit management agencies.[12] A case study on the application of information and communication technologies to traffic demand management is found in Chapter 4 on Sustainable Urban Transport.

**Smart Transportation System – Shanghai[13]**

Shanghai, host of the 2010 World Expo, is making a concerted effort to harness ICT to manage data connected to the city transport network. The city is committed to developing a "smart" transportation sector. Efforts are focused around three major projects:

*Electronic ID management system***.** One major headache for public transportation management in Shanghai has been the rampant spread of unlicensed taxicabs. To combat this and to better monitor public transport, the city has issued smart ID license tags and cards to most of the city's 180,000 public transportation vehicles, 48,000 taxis and 180,000 transport workers. All major transport stations and vehicles are now equipped with smart card readers in order to prevent the forgery of transport licenses and the operation of unlicensed vehicles.

*Public transport smart cards***.** Smart integrated circuit (IC) cards are widely used by the public in Shanghai for public transport, as well as for purchases in some retail stores. The city uses the data captured by usage of the smart IC cards to improve the collection of passenger flow information. This is achieved by integrating card readers with GPS tracking, so that city transportation office can understand the pattern of passenger flow.

*Bus smart information system***.** Under this system, Shanghai's city buses have devices on them that allow real-time communication between the vehicles, operators and bus stops. This enables the operator to monitor usage and vehicle position as well as passenger flow and other data, such as fuel consumption. GPS data for each bus is fed to the operator's

[12] "Managing Asian Cities: Sustainable and Inclusive Urban Solutions," Asian Development Bank, 2008, p. XI

[13] "ICT for City Management," Economic Intelligence Unit, 2010, p.64

information system and disseminated by an exclusive digital broadcasting signal. Information screens on the buses and at bus-stop signs relay scheduling news, predicting how long a wait before the next bus arrives.

## 2.5 REDUCING THE DIGITAL DIVIDE

As an urban manager in a developing country, a first priority should always be increasing access to ICT services by investing in the expansion of ICT infrastructure (broadband and wireless networks). Increasing access to ICT services reduces the digital divide and has positive impacts on lifting the incomes and providing access to financial services of impoverished families. Mobile phones have become the primary means for global ICT connectivity, with over 5 billion[14] subscriptions to mobile phone services as of 2010, according to the International Telecommunications Union (ITU). One study estimated that increasing the number of mobile phones per 100 people by just 10 increases GDP growth by as much as 6 per cent in developing countries.[15] In Africa, for instance, mobile phones are used to transfer money instantly for those who don't have bank accounts. Through such an electronic credit system, the poor in Kenya are buying high-efficiency stoves through their mobile phone electronic credit or they can receive deposits for goods sold to city markets. The cell-phone-based Carbon Micro Credit system uses unique identifiers to allow millions of developing world families to claim on a bi-weekly or monthly basis carbon offsets they produce by using more efficient cooking methods such as a modern charcoal stove or solar cooker, instead of using polluting cook stoves burning firewood or organic material.[16]

## 2.6 DIGITIZATION OF LAND REGISTRATION AND INFORMATION SYSTEMS

As discussed in Chapter 2, Delivering *Effective Urban Management*, land registration and information systems require urgent improvement in many developing nation large cities. ICT holds promise in providing developing nation cities with new ways to track, store and manage this critical information. In Asian cities, for instance, more than 50 per cent of urban populations live on land where title is disputed or unknown. With GIS system information, planners have access to rich information on natural resources (wetlands, vegetation types and geological formations, including potential hazard zones) and human activity (illegal settlements, construction, and encroachment). When digitized land registration systems are combined with frequently updated data from geographical information systems (GIS), disparities in land title, zoning and observed land uses can be better understood, reconciled and updated. Planners can then ultimately act based on more current and accurate information. The entities leading in the

[14] http://www.itu.int/net/pressoffice/press_releases/2010/06.aspx

[15] "One cell phone per child," Dan Costa, PCMag.com, 1 May 2009: http://www.pcmag.com/article2/0,2817,2344283,00.asp

[16] "Transforming the African brand through sustainability," Richard Seireeni, *The Huffington Post*, 7 May 2010: http://www.huffingtonpost.com/richard-seireeni/transforming-the-african_b_199242.html

implementation of these technologies might include metropolitan, regional and state land and transportation planning entities.[17]

# 3. CASE STUDIES

## 3.1 SINGAPORE DIGITAL MASTER PLAN 2015[18]

Singapore has launched a ten-year information and communication master plan that will propel the nation into the future with a line-up of activities and goals that spell benefits for its citizens, businesses and global partners. The vision is to turn the country into an Intelligent Global City, powered by information and communication technologies. It will change the way Singaporeans live, learn, work and play.

Minister for Information, Communications and the Arts, Dr. Lee Boon Yang states that, "Innovation, integration and internationalisation are the basis of the master plan. The capacity to innovate and create new business models, solutions and services will enable Singapore to be more competitive in a globalised environment. Equally important is the ability to integrate resources and capabilities for economic progress and digital opportunities for all Singaporeans."

The master plan was developed with broad participation of government, citizens, educators and the business community. A steering committee chaired by the Information and Communication Development Authority (IDA) with representatives from the ICT industry, sectors like education, healthcare, manufacturing & logistics, finance, tourism & retail and digital media, as well as the government, are guiding the implementation of the plan.

The goals of the plan are ambitious. It wants Singapore to be No. 1 in the world in harnessing ICT to add value to the economy and society. It wants to achieve a two-fold annual increase in value-added[1] to the economy of the ICT industry to S$26 billion. It aims for a three-fold increase in ICT annual export revenue to S$60 billion. It aspires to create 80,000 new additional jobs. Finally, it aims for at least 90 per cent of homes using broadband, and 100 per cent computer ownership for all homes with school-age children.

The master plan is not only about economic competitiveness. It also explores ways to ensure that the elderly, less-privileged and people with disability can also enjoy connected and enriched

[17] "Managing Asian Cities: Sustainable and Inclusive Urban Solutions," Asian Development Bank, 2008, p. XI

[18] This case study was summarized from information available at http://www.ida.gov.sg

lives or self-improvement and life-long learning. This helps bridge the digital divide and creates opportunities for all.

To achieve the targets, the master plan outlined four key strategies:

1. to spearhead the transformation of key economic sectors, government and society through more sophisticated and innovative use of ICT;

2. to establish an ultra-high speed, pervasive, intelligent and trusted ICT infrastructure;

3. to develop a globally competitive ICT industry; and

4. to foster a savvy ICT workforce and globally competitive ICT manpower.

In harnessing ICT technologies for the key economic sectors, activities will be directed to enhancing healthcare, education, tourism and e-government and to provide seamless delivery of financial services and supply-chain management.

The Next Generation National ICT Infrastructure is under construction and will be completed by 2012. It will be capable of delivering broadband speeds up to 1 Giga byte per second and will offer pervasive connectivity around the country. The infrastructure will enable a host of new broadband-enabled services and applications, such as immersive learning experiences, telemedicine, high definition TV, immersive video conferencing and grid computing.

To develop a globally competitive ICT industry, initiatives are strengthening the domain and technology capabilities within the industry. Local ICT enterprises are being supported for expansion and growth into overseas markets. Efforts are providing networks and market intelligence. The focus is on providing ICT solutions and research and development.

To support the growth of the economy and the ICT industry, the ICT competencies of the general workforce are being raised. Techno-strategists who have both the technical and business expertise are being groomed to achieve business and organisational goals through the strategic and innovative use of ICT. Incentives and other initiatives are in place to attract the best students from schools to take up ICT as a career.

*Education*

In the education sector, the goal is by 2015 for all schools to be competent users of information and communication technologies in education. Efforts to enhance education include three components. The iACCESS component will provide pervasive and cost-effective ICT access for learning anytime, anywhere. The iLEARN component will provide interactive digital resources for independent learning. The iEXPERIENCE component will empower learners through collaborative, intelligent applications that are adaptable to different learning styles.
Fifteen to twenty per cent of schools will be designated as *Experimental Schools*. They will be the ones to trial innovative applications of ICT in teaching and learning. Another five per cent will be identified as *Schools of the Future*, as they will maximize the use of information and communication technologies to empower education, to raise the bar in technology use.

*Digital Media*

The master plan will support Singapore's efforts to become a global centre for digital media. (See case study in chapter on science, technology and innovation). It focuses on developing Singapore into a centre for the creation and commercialisation of digital media exchange technologies, and making available technologies and platforms for media and entertainment companies to create content and services. It aims to provide core services for storing, trading and distributing digital assets; and providing the infrastructure for the processing, management and delivery of digital entertainment content and services. An early focus will be on research and development and these efforts will be supported by a technology and resource centre that initially targets game developers and animation studios.

*Healthcare*
The master plan aims to accelerate the transformation of the healthcare sector through an ICT-enabled healthcare delivery system, to achieve high quality clinical care, service excellence, cost effectiveness and strong clinical research. The plan will help move the focus from the treating of diseases to its prevention, health promotion and wellness care. It will empower the public to keep closer tabs on their health through accessibility to personal health records and relevant health information. It will adopt an integrated and patient-centric system of healthcare, away from the current fragmented kind of care. It will strive towards the widespread usage of ICT systems that can analyse test results and quickly offer doctors the relevant medical information for treatment, based on widely-accepted guidelines. It will try to speed research to improve clinical care and outcomes by transforming biomedical research to healthcare delivery. It will help hospitals, clinics, patients and care providers to work together in an integrated and coordinated manner, enabling holistic care. Patients will be empowered to manage and monitor their health at home. Through remote monitoring solutions, patients with chronic diseases can stay connected to their healthcare provider and/or family members.

*Supporting industry and logistics*
The master plan also focuses on raising the operational competitiveness of the manufacturing and logistics companies in Singapore through innovative use of ICT. It strives to enhance efficiency of supply chain infrastructure, such as ports and an information exchange platform for international trade. By doing so it seeks to attract international companies' regional / global supply chain management operations to Singapore.

Companies can tap an *adaptive supply chain programme* to pilot new supply chain processes and technologies, and to develop local expertise in order to better reach their regional network. The programme also aims to provide better integration between them and their suppliers, service providers, customers and partners in Singapore. It also seeks to anchor global/regional supply chain management of manufacturers and logistics companies in the city. The *tradeXchange programme* aims to link up currently disparate national trade information systems into an integrated national platform, making the exchange of such information highly efficient and cost-effective. This will make it easier to carry out international trade from Singapore. Finally, an *Infocomm@Airport/Seaport programme* aims to give Singapore's sea- and air-ports, an advantage over their competitors through new

ICT-enabled services. For example, ICT will be used to enhance the security of cargo flow through Singapore and improve the information linkages between port operators and their users.

*Financial Services*

The digital master plan is also helping to develop Singapore into a trusted financial gateway to Asia by establishing Singapore as a centre for ICT innovation in financial services. I-wealth Management is a programme to strengthen Singapore as a wealth management hub of Asia. ICT will enable innovation and build new capabilities in front-end customer service and advisory services, middle office management and back office operations. Next Generation e-Payments is a programme to develop a nation-wide e-payments infrastructure to enable new payment solutions that allow greater convenience to users and open up opportunities in new market segments. Finally, corporate financial information exchange is another programme to smooth the flow of corporate information and create greater transparency. It will introduce new electronic standards in corporate reporting.

*e-Government*

The master plan will also increase the outreach and volume of e-government services, in particular by making them more accessible via mobile phones. A single SMS will be adopted for all Government services delivered through mobile phones. This will help gain insights into citizens' needs and preferences so that more pro-active, responsive and integrated e-services can be delivered. ICT is also being used to strengthen the Government-citizen relationship as citizens are increasingly engaged in the policy-making process. The Government Consultation Portal will be enhanced to better suit the needs of different user groups. Finally, efforts are being made to enhance Singapore's strength in e-government solutions. One of the ways is to work with local ICT companies to jointly develop and export such solutions. The relevant intellectual property rights of e-government solutions will be released to companies, where possible, for them to market these solutions abroad.

## 3.2 MUMBAI, INDIA -- E-GOVERNANCE


*Around the world, local governments are successfully deploying public web portals providing e-government services that provide municipal information, applications, and service requests.* Image credit: www.dit.mp.gov.in

The Municipal Corporation of Greater Mumbai (MCGM) instituted in 2007 a new information technology system serving its agencies and citizens. MCGM serves more than 12 million citizens, managing births and death registrations, waste, transportation, medical services, schools, medical colleges, disasters, taxes, town planning, city infrastructure, retail shops as well as social programmes.

Under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM), the Indian state introduced e-governance to its municipalities to provide "single-window" city services to its citizens to increase efficiency and productivity of its cities, and to provide timely and reliable management information.[19] The system is available to the public at: http://www.mcgm.gov.in

Citizens can use the site to make applications, get service updates and lodge complaints related to solid waste management, drainage, storm water drains, roads & traffic, factories, licensing issues, water supply, pest control, and buildings.

Mumbai's e-governance system, which went live in 2007, required training of 500 employees as internal change agents as well as role-based training to 2000 employees with low IT knowledge. The single system manages operations and records for 16 water reservoirs and the city's water billing system, property taxes, human resources, fleet management, material management, 27 fire

[19] eGovernance@city: Integrated Solution for Mumbai City Management, Siemens Corporation, August 2007, also see City Portal Reference, Municipal Corporation of Greater Mumbai, Siemens Corporation: http://www.citylabs-live.com/Portal/ref/ref_mumbai.pdf

stations, 25 hospitals, five waste dumps, schools services, and other licenses and permitting.

An independent third-party study by the *Economic Times of India* was conducted to assess the state of e-governance and other related characteristics of India's 35 cities with million-plus population. In the category of "information" attributes, Greater Mumbai was the only city with a perfect score.

The survey examined whether information for building sanctions and drainage/water connections was online. It also ascertained if links exist to the Indian Right to Information Act (RTI). The survey also assessed public information system access to important locally-provided public services such as water supply, sanitation, sewerage, solid waste management, roads and street lighting, along with a map of the city and contacts for the city.

In the area of services, Mumbai was the only Indian city providing everything from a provision for online payment of property taxes, water charges, online registration of birth and death, online complaints registration, online feedback and whether provision existed for online tendering and auction.[20]

The Mumbai Municipal Government site also contained information about sustainability programmes and services, such as "Eco-housing applications," rainwater harvesting and provided participatory cultural services, such as an open source site for citizens to write about their reaction to a 2006 train bombing and the terrorist attacks of November 26th, 2008 that killed more than 150 people: http://www.mumbaivoices.com/

**Lessons Learned**

The portal used by Mumbai as an e-governance platform resulted from careful planning and integration across numerous city agencies, departments and customer (citizen) needs. Extensive training of employees included considerations for employees with low information technology awareness and experience, which likely served the city well in achieving better system usability with a citizen base that has anywhere from a great degree to very little information technology experience. Mumbai's information and communications technology subsequently has been recognized by an independent third party as an effective management and transactional aid as well as a cultural communications resource.

[20] "Are Our Cities ready for e-governance?," *The Economic Times of India*, 7 January, 2010: http://economictimes.indiatimes.com/news/politics/nation/Are-our-cities-ready-for-e-governance/articleshow/5418281.cms

## 3.3 E-LEARNING VISION OF LEEDS, UK


*Computer-supported e-learning is one of the most promising innovations to improve teaching and learning with the help of modern information and communication technology.*

Building Schools for the Future is the name of an ambitious UK Government investment programme in secondary school buildings. As part of that programme, the City of Leeds has developed an e-learning vision, known as "Entitlement for All". It states that through e-learning students are entitled to:

- an appropriate range of online educational services;
- 24 hour access to those services from any location;
- high quality, stimulating and challenging educational resources;
- a safe and supported ICT environment;

- technologies that free the user; and
- assurances that the e-learning programme will be continuously reviewed and improved.

These building blocks shaped the approach to engagement with all partners. The key partners in the e-learning programme are Education Leeds, RM Education PLC, E4L, Leeds City Council, students and staff. Education Leeds and RM have worked effectively with staff and students from the outset of the project to implement the entitlements in the programme.

*Engaging stakeholders*

In 2007 over 300 students and school staff took part in a Leeds Better Schools for the Future Design Festival. They spoke with ICT specialists, architects, interior designers and construction leaders to explain their vision and what they would like to see in their school. There was considerable experimentation with new technologies for learning such as games consoles and a range of mobile devices. This produced interesting results that showed that although students were attracted to and found useful applications for iPods, game consoles and video recorders, they mainly preferred laptop computers to support their schoolwork. Students and teachers were able to identify the positive impact of the various electronic devices on learning. It also allowed the schools and experts to make informed decisions when developing ICT solutions. The impact of student engagement in one project with young people with autism was instrumental in developing a different approach to the use of technology in their lessons, particularly in developing the ICT skills of the staff.

*Training and professional development*

Training for all users is essential to optimising the e-learning strategy and to ensuring that all are equipped with the skills necessary to make best use of the technology available. Innovative student training programmes enhance ICT capability and allow students to achieve accreditation for key ICT skills, thus enhancing employment opportunities. A comprehensive programme of continuing professional development for all educational staff has been built into the ICT programme. This allows educators to improve the quality of learning and to develop innovative approaches to teaching; it also enables staff to have the confidence to adapt to learners' needs.

*ICT in action*

The ICT solution for Leeds is actually a range of focused solutions tailored for each school. It utilizes the very latest technologies such as an electronic whiteboard which was still in development when it was selected. To make sure that students in Leeds had the opportunity to use this technology, partners worked together with the manufacturer even before the final specification was complete.

The ICT solutions employed by the schools focus on adaptable technologies that support the curricula in all subject areas and throughout the school. Students benefit from a range of technologies including Apple computers, Windows-based PCs, laptops, data loggers, voice recorders, cameras and anything that will promote effective teaching and learning.

The ICT programme is meant to ensure continuous innovation and exploratory use of ICT solutions to provide a more flexible education. Each school is evaluated annually to ensure that the ICT solutions are at the forefront of 21st century technology. All schools have adaptable learning areas with 'breakout spaces' and lightweight partitions. This 'anytime, anywhere' approach gives teachers the confidence to adopt a wide range of teaching styles to promote personalised and independent learning experiences for students.

LCD screens positioned around each school provide up to the minute communication systems and electronic timetabling to ensure flexible and efficient use of learning spaces. The 'show and tell' spaces at some schools have integrated electronic recording and transmission equipment. This challenges students to exploit the technology and work collaboratively to produce and record presentations of their work according to modern workplace standards.

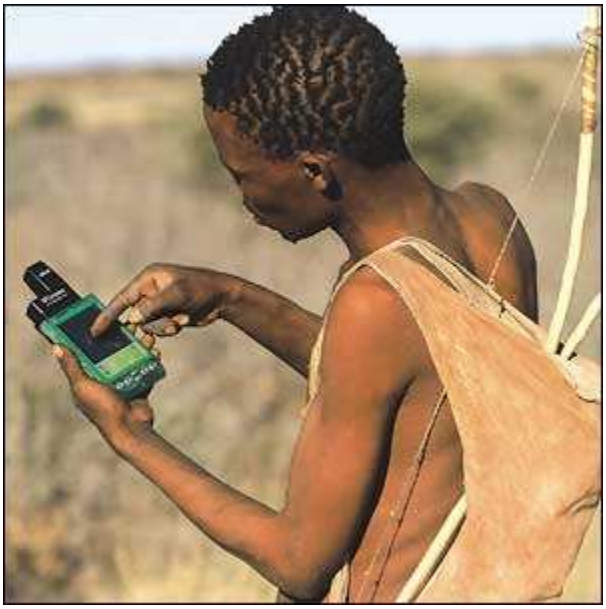
**Lessons learned**

Leeds' approach to ICT in education led partners to rapidly expand the programme from a few pilot schools to all schools in the City. Originally targeted to high schools, the programme has expanded to provide tailored solutions for primary schools, as well.

Staff and student satisfaction with the ICT solution is extremely important to the Leeds programme and a mechanism is in place to formally evaluate satisfaction twice a year. Online survey work is conducted with staff and students to test changes in attitude and satisfaction. Feedback to date has been highly positive.

A key factor in the Leeds success was the fact that the school system partnered with leading technology providers having active corporate social responsibility programmes that were committed to enhancing education in the city. Actively engaging the students and teachers in the selection and application of technologies ensured their strong interest in the programme. While the benefits of ICT to business are well known, its applications and innovations for education are only now starting to be realized.

## 3.4 MOBILE PHONES: BRIDGING THE DIGITAL DIVIDE IN AFRICA[21]



*In Africa, mobile phones are used to access market information and to transfer money for those who don't have bank accounts.*

The International Telecommunication Union (ITU) estimates that there are 3.3 billion mobile phone subscribers worldwide.[22] According to industry estimates, there are now more than 500 million mobile phone subscribers in Africa, up from 246 million in 2008.[23] In developing countries, mobile phones have revolutionised the lives of millions of urban and rural poor by connecting and involving them in viable economic activities. Mobile telephony is affordable, scalable, self-sustaining and empowering.

Mobile phones provide a wide range of services at a reasonably low cost. Handsets cost between US$40-50. Airtime is also affordable – this is why prepaid services are so popular in Africa. If one person in a village has a mobile phone, others can use it – a mobile phone is not necessarily confined just to one person.

[21] Summary of an article by Roxanna Samii, Manager, Web, Knowledge and Distribution Services, International Fund for Agricultural Development (IFAD)

[22] www.itu.int/ITU-D/ict/publications/world/world.html

[23] http://www.mobilemonday.net/reports/MobileAfrica_2011.pdf

Mobile telephony has contributed substantively to reducing the digital divide – something other ICTs such as computers did not manage to achieve. Mobile telephony is providing timely, localised and relevant access to information, which has helped reduce production and transaction costs. For example, poor rural people use mobile telephony to receive commodity price information via mobile phone text messages, or Short Message Service (SMS), to gather market intelligence so that they can make targeted trips and save on travel and transportation costs. Mobile phones are also being used to provide medical services such as using SMS to remind patients of medical appointments and vaccinations or to disseminate information about sexually transmitted diseases and to monitor patients.

**Rural connectivity: a revolution within a revolution**

A recent World Bank study states that 'there is a myth that the rural poor are not able or not willing to pay for mobile telecommunication services'.[24] Observations in the field are that mobile phone accessibility is helping to facilitate previously marginalised groups to take a more active part in the economic and social spheres of their communities and beyond; this includes women, landless workers, herders, fishers, small-scale farmers, indigenous peoples and illiterates with no access to basic services. Many poor rural households now spend 4–8 per cent of their income on mobile telephony.[25]

The liberalisation of the telecommunications sector supported by sound regulatory mechanisms can open the market to competition. This is taking place across Africa; it has encouraged private sector investment and increased competition among different operators. As a result, consumers are benefiting from better services at better rates.

Prepaid subscriptions, the 'pay as you use' business model, offers numerous advantages to poor people. Almost 90 per cent of African mobile phones use this option. There is no formal registration or waiting list. The user does not need to submit financial and physical data, and s/he can control costs, especially when savings and incomes are low. Most importantly there is no need to present a credit history.

**Mobile phones and small businesses**

Mobile phones have spearheaded a host of new and innovative income-generating activities for small businesses. These include recharging mobile phone batteries, selling prepaid cards, renting out phones and/or airtime and other services such as reading and sending SMS messages. In Africa and elsewhere, occasional labourers put up adverts in centres with a mobile phone number to offer services, or subscribe to receive job alerts via SMS from unemployment centres. Mobile phones can also minimise travel costs allowing people to move when there is a concrete

[24] Bhavnan, A., Won-Wai Chiu, R., Janakiram, S., Silarszky, P. (2008). *The role of mobile phones in sustainable rural poverty reduction*. World Bank.

[25] Hammond, A., Kramer, W J., Tran, J., Katz, R., and Walker, C. (2007). *The Next 4 Billion: Market Size and Business Strategy at the Base of the Pyramid*. World Resources Institute (WRI) and International Finance Corporation (IFC).

economic opportunity. A 2005 London Business School study found that 'for every additional 10 mobile phones per 100 people, a country's gross domestic product (GDP) rises 0.5 per cent.'[26] In many African countries, 85-95% of small businesses rely solely on mobile phones for telecommunications.

*Mobile phones and access to market information*

Small producers trading in rural areas in Africa face enormous challenges such as lack of access to reliable and up-to-date market information, poor transportation infrastructure and competition. Small producers are vulnerable to unscrupulous traders and middle-men giving them prices at below-market rates. Producers may be reluctant to diversify into different products for fear of not finding a profitable market for their output. The relatively affordable airtime of mobile phones has made transfer and exchange of information easier. Information dissemination happens either through structured services and subscriptions, such as Tradenet.biz and Zambia SMS Market Information Service, or through unstructured and informal use of mobile phones – and by blending formal and informal services.

## Cellular banking: the bank of the urban poor

Mobile phones are now providing 'cellular banking' to 'unbankable' clients. For example, millions of poor rural people now use their mobile phones to send money home and to deliver micro credit loans where there are no banking facilities. According to the Consultative Group to Assist the Poor (CGAP), approximately 1.5 billion mobile users in developing countries have little or limited access to formal financial services.[27] With limited formal banking infrastructure there are fewer options to transfer money and access banking services. CGAP argues that the mobile phone can provide a low-cost alternative to banking via the Internet, cash machines or point-of-sale, cutting costs by up to 50 per cent. Micro credit and microfinance institutions have enough evidence to unleash the potential of cellular banking and start creating 'branchless banking channels using mobile phones.'

## SMS Market Information Service, Zambia

The International Fund for Agricultural Development supports the Smallholder Enterprise and Marketing Programme (SHEMP) in Zambia. Working with the Zambia National Farmers Union (ZNFU), it identified the need to provide market intelligence to farmers. In August 2006, the programme introduced an innovative, simple and cost-effective way to access commodity prices, using an SMS Market Information Service. The service provides weather information, business news, up-to-date market prices, and lists buyers for 14 major commodities in a cost-effective, accessible and reliable manner. For those with Internet access, the system is also supported by a website.[28]

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[26] Waverman, L., Meschi, M. and Fuss, M. (2005). *The Impact of Telecoms on Economic Growth in Developing Countries*. London Business School: London

[27] www.cgap.org

[28] www.farmprices.co.zm

To obtain the best prices for a commodity, farmers simply send an SMS message containing the first four letters of the commodity name to 4455. Within seconds, they receive a text message with the best prices by buyer using abbreviated buyer codes. To get best prices in a specific district or province, farmers simply include the province/district code after the commodity code. The farmers then send a second SMS message with the selected buyer code to 4455. A text message is sent back with the buyer's contact name and phone number, the company name and address and simple directions for reaching both. Farmers can then call the contact and start trading. The farmers pay US$0.15 for each text message.

This popular market intelligence system is empowering farmers to negotiate deals by offering time-sensitive information and fostering transparency in pricing. SHEMP and ZNFU continuously update prices on a daily and weekly basis. To ensure sustainability the system is managed by local institutions. They also conduct public advocacy activities to attract corporate sponsorships. Over 100 traders and processors are now providing weekly price updates. Website visits and the number of SMS messages are continuously increasing. For example, in 2007 between February and June, 520 weekly SMS messages were exchanged. Between July and August that number increased to over 1220 weekly messages.

**Lessons learned**

It is now apparent to policy makers and development agencies that, of all ICTs, mobile phones have the best potential to stimulate growth in Africa – and that investing in mobile services can contribute to both economic and social development. Phone manufacturers and service providers now recognise that the poorest people have turned out to be one of their biggest markets.

Mobile telephony has not only helped bridge the digital divide but has been a catalyst to eradicate rural poverty and improve the livelihoods of the marginalised and poor. To truly make mobile telephony the first universal access ICT there is a need to:

• put in place sound ICT policy in collaboration with government, civil society, private sector actors and consumers;

• invest more in mobile infrastructures and services in rural and disadvantaged areas;

• strengthen the capacity of rural entrepreneurs and farmers' organisations to better exploit the potential of mobile phones;

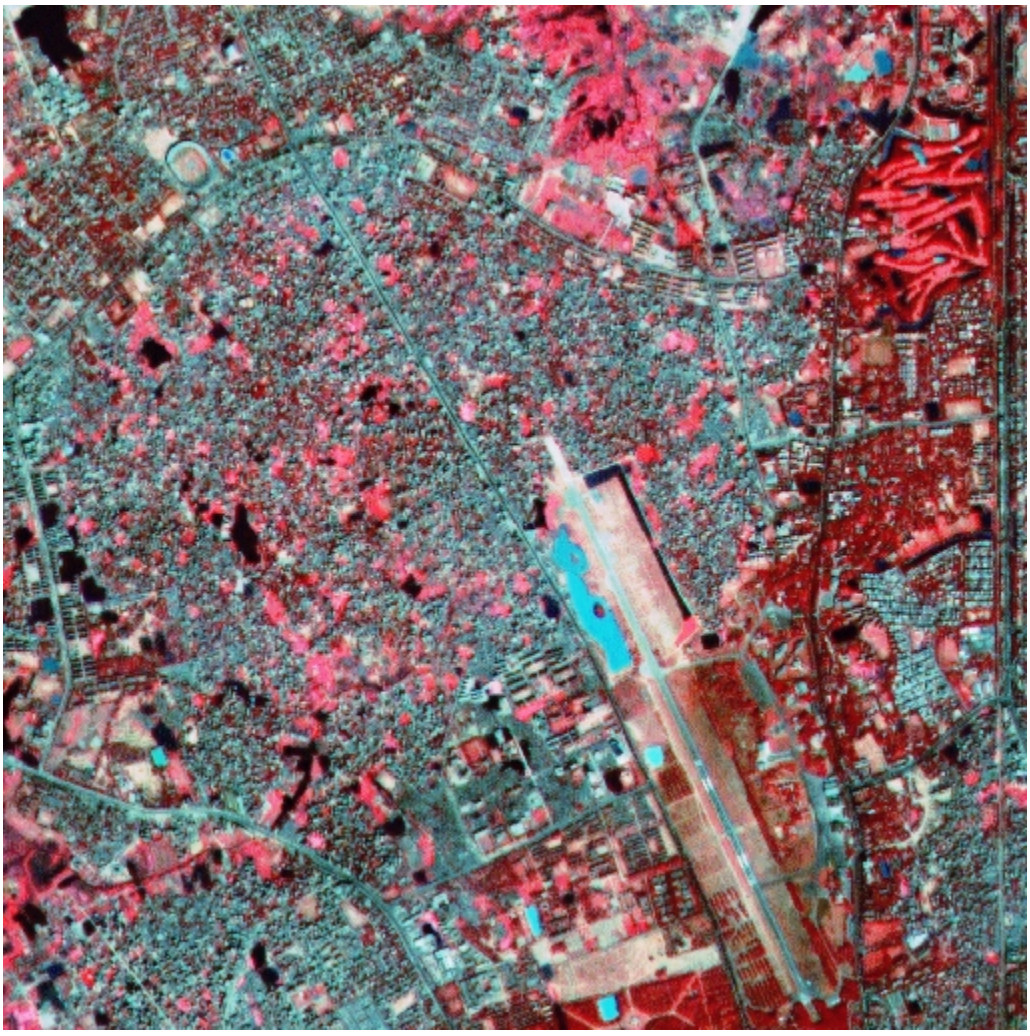
• deliver relevant and timely content and further develop peer-to-peer information systems;

• reduce both airtime and handset prices; and

• put in place better and enabling regulations to allow mobile services to thrive and expand.

The most successful systems are those offering two-way communication rather than the simple delivery of information, enabling farmers to sell products directly. Also important is the teaching component. Market information is only useful if farmers know how to use it.

## 3.5 DHAKA, BANGLADESH -- MONITORING LAND USE AND LAND COVER CHANGE USING REMOTE SENSING



*With remote sensing and geographic information systems, planners can better map and manage natural resources and human activity related to land use such as illegal settlements, construction, and encroachment.* Photo credit: www.nrsc.gov.in

In an increasingly urbanized world, monitoring and mapping urban growth, and its land-use and land-cover change impacts, are of growing importance in developing countries. Land use/cover changes due to human activities are often occurring rapidly in developing countries, and it has been projected that by the year 2015, most of the world's large cities will be in developing

countries.[29] Remote sensing can reveal growth trajectories of cities, which provide a better understanding of the impacts of urbanization on ecosystems and ecosystem services, as well as socio-economic risks from unregulated and unplanned settlements.

Urbanization is one of the most widespread man-made causes for the loss of arable land, habitat destruction and decline in natural vegetation cover. Though urban areas cover only about three per cent of the Earth's land surface, they have a significant impact on environmental conditions at both the local and global scales, including climate change.[30]

The mapping of urban areas remains one of the most challenging tasks of remote sensing data analysis. This case study[31] examines an approach to using digital imagery and communications technologies to monitor and measure Dhaka's recent urban growth. Dhaka was the fastest-growing large city in the world in 2007, with an annual growth rate of 3.3 per cent forecast from 2005 to 2010.[32]

The study examined maps and analyzed urban growth from multi-sensoral data for the Dhaka large city region between 1990 and 2006. The approach is widely applicable and could potentially facilitate regional urban growth maps in similar complex and dynamic environments. Dhaka's dense urban landscape, its river delta location and the highly dynamic monsoon-related climate call for a sophisticated analysis approach that is able to separate seasonal land-cover variations from urbanization.

Land-use and land-cover analysis is critical to addressing the environmental and socio-economic sustainability of Dhaka, as it has been negatively impacted by rapid growth resulting in widespread environmental and social challenges. Unplanned urbanization has been exacerbated by extensive poverty and substantial growth of urban slums, which has led to exploitation of natural resources and mismanagement of limited land resources, including arable land and wetlands. Meanwhile unplanned slum settlements in wetlands have been besieged by recurrent episodes of flooding that may become more common with the impacts of climate change.

Imagery from the Landsat series of satellites is a useful asset for such an analysis due to its comprehensive coverage of large urban areas as well as its unique historical archives. The study incorporated images over time for each monitoring year (1990, 2000, and 2006). The resulting

[29] "World population monitoring, focusing on population distribution, urbanization, internal migration and development," United Nations Economic and Social Council, January, 2008, pp. 12-13

[30] "Monitoring land use and land cover change using remote monitoring," Ashraf M. Dewan, Yasushi Yamaguchi *Applied Geography, Volume 29, Issue 3, July 2009, Pages 390-401*

[31] Ibid.

[32] "World population monitoring, focusing on population distribution, urbanization, internal migration and development," United Nations Economic and Social Council, January, 2008, p. 15

datasets reveal spatial-temporal patterns of urban land-use and land-cover changes. Derived land use/cover maps were further validated by using other high-resolution images and field data.

The study methodology successfully mapped relevant land-cover classes and resulted in overall accuracies better than 83 per cent for all years considered. Analysis of land-use and land-cover changes revealed a profound expansion of urban areas at the expense of prime agricultural areas and wetlands. During the 1990s, change was primarily characterized by a densification of urban settlements. More recent changes included vast in-filling of low lying land. The analysis revealed that substantial growth of built-up areas in Greater Dhaka over the study period resulted in a significant decrease in the area of water bodies, cultivated land, vegetation and wetlands. Urban land expansion has been largely driven by elevation, population growth and economic development. Rapid urban expansion through infilling of low-lying areas and clearing of vegetation resulted in a wide range of environmental impacts, including diminished habitat quality.

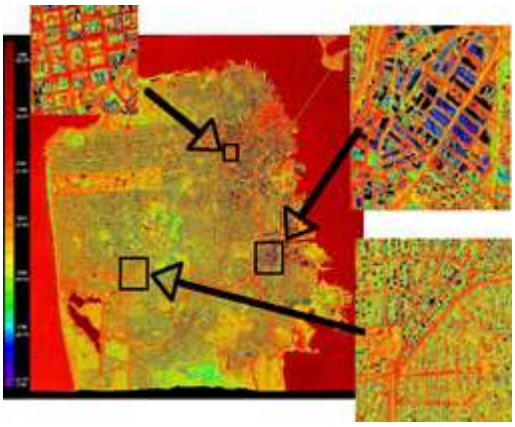
The maps showed that between 1960 and 2005 built-up areas increased approximately 15,924 hectares, while agricultural land decreased 7,614 hectares, vegetation decreased 2,336 ha, wetland/lowland decreased 6,385 hectares, and water bodies decreased about 864 hectares. The amount of urban land increased from 11 per cent in 1960 to 344 per cent by 2005. Similarly, the growth of landfill/bare soils category increased by 256 per cent in the same period.

The study's quantification of land use/cover changes over the 45 year period for the Dhaka Metropolitan area constitutes a valuable resource for urban planners and decision makers to devise sustainable land use and environmental plans in this fast-growing city. As reliable and current data were previously lacking for Bangladesh land use, the land use maps produced in the study could contribute to both the development of sustainable urban land use planning decisions and also for forecasting possible future changes in growth patterns. These data are useful in modelling risks associated with potential climate change impacts, such as flooding during monsoon season and rising sea levels.

**Lessons Learned**

As fast-growing large cities such as Dhaka face the increase of unplanned settlements of the poor, they will need to use ICT technologies such as time-based digital land form mapping to assess the impacts of such activities on natural resources, untitled land tenure, and community risks to natural disasters. Similarly digital mapping technologies will be a requirement for understanding how landforms and existing or historic natural resources can help guide standards, planning and management of new settlements in peri-urban areas. Finally digital mapping scenarios can help planners understand the consequences of potential climate change impacts in regard to risks such as flooding and wildfires.

## 3.6 ECO-MAPS IN AMSTERDAM AND SAN FRANCISCO



*An urban eco-map is a tool that empowers individual citizens to make informed choices about their daily lives and their impact on their urban environment.* Photo credit: www.nasa.gov

Amsterdam and San Francisco, California instituted in 2009 an interactive online Eco-Map (http://urbanecomap.org/), developed by an international business services corporation and other partners, which provides citizens with data and information related to greenhouse gas emissions by neighborhood and by different industry categories (transportation, electricity, waste).

Eco-Map data displays are also linked to city agency programmes aimed at reducing greenhouse gases, such as online destination transit system planning tools and maps of city and bicycle-coalition recommended bicycling routes. In San Francisco, the map is linked to a portal of real-time information on bus and tram scheduling and logistics, so users can see when the next bus or train is scheduled to come to their location, and when it is expected to actually arrive.

Citizens can view their neighbourhood data through visual displays summarizing greenhouse gas emission results from transportation, energy and waste categories. This information enables individuals or even neighbourhoods to set goals and take specific actions to reduce their climate change emissions using approaches such as alternative-fuel vehicle ownership, recycling, and reducing household energy use.

The Eco-Map provides estimates of carbon emission reduction results from such transportation-related activities as biking or walking to work, using public transit, car sharing and commuting outside peak traffic hours. Greenhouse gas reductions and energy savings in the home — customized from city utility data — are provided for actions such as turning off electronic devices, using energy-efficient appliances, turning down heating and cooling, and minimizing usage of clothes dryers.

Users can prioritize their personal efforts through approaches that are either low cost, low effort or high impact. The Eco-Map facilitates sharing of specific low-carbon actions that people have

taken through social networking capabilities, such as publicizing personal results through Facebook,[33] Twitter,[34] and Flickr.[35] Users can see profiles with photos, videos and other information from other users of the map.

The Urban Eco-Map pilot in Amsterdam is a cooperative initiative between the city of Amsterdam, Amsterdam Innovation Motor (AIM), Amsterdam Smart City, and the Swiss Federal Institute of Technology Zurich. In San Francisco, the Eco-Map is sponsored by the City and County of San Francisco, the San Francisco Department of the Environment, the National Aeronautics and Space Administration (NASA) and corporations from the private sector.[36]

**Lessons Learned**

The Eco-Maps developed by San Francisco and Amsterdam provide a way to engage citizens and other interested parties (journalists, subject matter experts, academics) in climate change mitigation on the familiar basis of city neighbourhoods as well as personal activities. Through the creation of linkages with related city services that help reduce carbon emissions, particularly public transportation schedules and route information, users are provided a practical and utilitarian context for how their own actions can impact climate change. Linkages from the Eco-Map to social media enable users to follow updates from other users, creating a shared community for citizens, business and government collaboration.

[33] http://www.facebook.com/group.php?gid=75025872489

[34] http://twitter.com/urban_ecomap

[35] http://www.flickr.com/photos/urban_ecomap/

[36] "Urban Eco-Map," accessed 20 August 2010: http://urbanecomap.org/

# 4. BETTER CITY, BETTER LIFE: SUMMARY OF POLICY OPTIONS FOR ICT FOR SMART CITIES

| | |
|---|---|
| *Strategy 1: Enable executive decision-making support* | |
| Policy Option 1 | Invest in integrated management information and decision support systems that can assist city authorities in managing the growth and changes within a city based upon key performance indicators related to areas such as traffic, environment, and finance. |
| Policy Option 2 | Institute policies, programmes, and projects supporting ICT, such as high-speed internet access, use of digital storage and media, teleconferencing, and telecommuting. |
| *Strategy 2: Shift toward e-governance* | |
| Policy Option 3 | Provide public access to city services, records, plans, departments and city government workers through a government web portal. The portal can also provide information on the city's laws, regulations, institutions and policies. |
| Policy Option 4 | Enable e-planning approaches to complement physical urban planning meetings and feedback mechanisms in order to enhance public participation and social inclusion, wherever feasible. |
| *Strategy 3: Support e-learning programmes* | |
| Policy Option 5 | Develop a collaborative programme for e-learning that engages students, educators, and local technology providers and that aims at providing challenging educational resources that are available to students 24 hours a day. |
| *Strategy 4: Reduce the digital divide* | |
| Policy Option 6 | Reduce barriers to region-wide or city broadband internet and mobile telephony implementation, in order to provide an enabling environment for private sector investment in ICT infrastructure and to thereby bridge the "digital divide". |

| | |
|---|---|
| Policy Option 7 | Adopt social equity as a planning and design criteria in the design, development and implementation of information and communications technologies. Provide appropriate access to ICT at lower cost for low-income citizens, the elderly, illiterate and disabled. |
| *Strategy 5: Utilize ICT for transport management practices* | |
| Policy Option 8 | Adopt Intelligent Transportation Systems , such as electronic fare and road user charging systems, transport control centres, and real-time user information, when applicable. |
| Policy Option 9 | Provide access to public transit system information, including service changes, schedules and maps. Provide alerts for outages, including mobile devices. |
| Policy Option 10 | Develop online or mobile device payment access for public transportation, tolls, parking and metro congestion management systems. |
| *Strategy 6: Use ICT to strengthen urban management, monitoring and emergency services* | |
| Policy Option 11 | Use ICT to establish an environmental monitoring system in order to monitor pollutant emissions and air quality, and to track hazardous materials. |
| Policy Option 12 | Use ICT to enhance public safety and reduce response time to emergencies, such as fires, natural disasters and crowd control. |
| Policy Option 13 | Adopt ICT digital land use monitoring (satellite technologies) and land use and zoning registration policies for economic development, urban planning and natural disaster risk management. |

## 5. LINKS FOR FURTHER INFORMATION

http://www.slideshare.net/itsgowri/wwf-low-carboncities
"Reinventing the City: Three Prerequisites for Greening Urban Infrastructures" WWF International (in conjunction with Booz & Company), Gland, Switzerland, 2010

http://www.itm-power.com/cmsFiles/media/TimesRaconteur_010610.pdf

"Raconteur on Smarter Cities," Raconteur Media, London, 1 June, 2010

http://www.smart2020.org/
Website for The Climate Group, Metropolis and Cisco: "Smart 2020 Cities" initiative

http://ibm.com/smarterplanet/us/en/sustainable_cities/ideas/
"Smarter Cities": IBM website on city management in transportation, water, health care and other areas using information and communications technology.

http://www.cisco.com/web/CN/expo/en/index.html
http://www.cisco.com/web/strategy/docs/scc/Digital_Urban_Renewal.pdf

http://www.cisco.com/web/strategy/docs/Is_your_city_smart_enough-Ovum_Analyst_Insights.pdf

http://www.urenio.org/2010/07/02/crowdsourcing-public-data/
"Crowdsourcing public data," Urban and Regional Research and Innovation, July 2010

http://www.slideshare.net/connectedurbandev/connected-and-sustainable-ict-infrastructure-whitepaper-presentation
"Connected and Sustainable ICT Infrastructure," Wolfgang Wagener, paper written for Connected Urban Development Conference, Amsterdam, 2008

"ICT for City Management," Economic Intelligence Unit, 2010
http://www.businessresearch.eiu.com/sites/businessresearch.eiu.com/files/Siemens_Reports_2010_FINAL%20TO%20PRINT.pdf

www.istiee.org/te/papers/N41/41_3_abs_vanGeenhuizen.pdf
"ICT applications on the road to sustainable urban transport," Marina van Geenhuizen, European Transport, n. 41 (2009): 47-61, Delft University, 2008

Tradenet: www.tradenet.biz

Zambia Market Information System: www.farmprices.co.zm

Africa Connect: www.connectafrica.net