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How Smart is your city?

Helping cities measure progress

IBM Institute for Business Value

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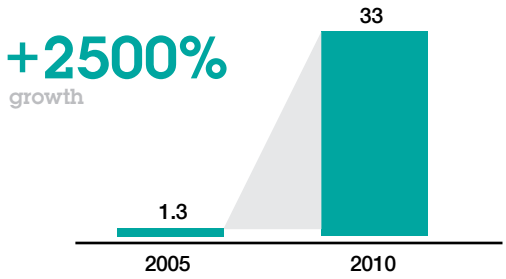
By Susanne Dirks, Mary Keeling and Jacob Dencik

The performance of core systems of today's cities is fundamental to social and economic progress. Faced with major challenges, these systems can be improved and optimized through the application of smart solutions. In this second perspective by the IBM Institute for Business Value on creating smarter cities, we show how cities can assess and monitor progress in optimizing core systems against a limited set of key parameters, as well as determine how they measure up to their peers.[1]

Today's cities, home to more than half the world's population, can be seen as complex networks of components: citizens, businesses, transport, communications, water, energy, city services and other systems. Citizens and businesses rely on infrastructure systems for their activities and well-being. Improvements – or disruptions – in transportation, communications and utility systems can have dramatic impact on the daily activities of citizens and businesses. City services integrate and coordinate the activities taking place in the other components. Understanding how cities improve and change through the lens of these elements offers cities new perspectives on the progress they are making toward achieving strategies and objectives.

As the world becomes increasingly instrumented, interconnected and intelligent in nature, cities have the chance to accelerate their journey towards sustainable prosperity by making use of new "smart" solutions and management practices.

Instrumentation enables cities to gather more high-quality data in a timely fashion than ever before. For example, utility meters and sensors that monitor the capacity of the power generation network can be used to continually gather data on supply and demand of electricity.[2] The pervasiveness and low cost of existing devices and sensors, like gas, electricity and water meters, offer the ability to measure, sense and understand the exact condition of virtually anything. Add to that new sensors and devices that offer further data gathering possibilities, such as RFID tags (more than 33 billion RFID tags will be active by 2010 – five for every inhabitant of the planet, see Figure 1).[3] These existing and new sensors and devices can now be embedded across key city systems as a first step in addressing and solving many of the challenges cities face, ranging from improving library services to maintaining sewerage systems.



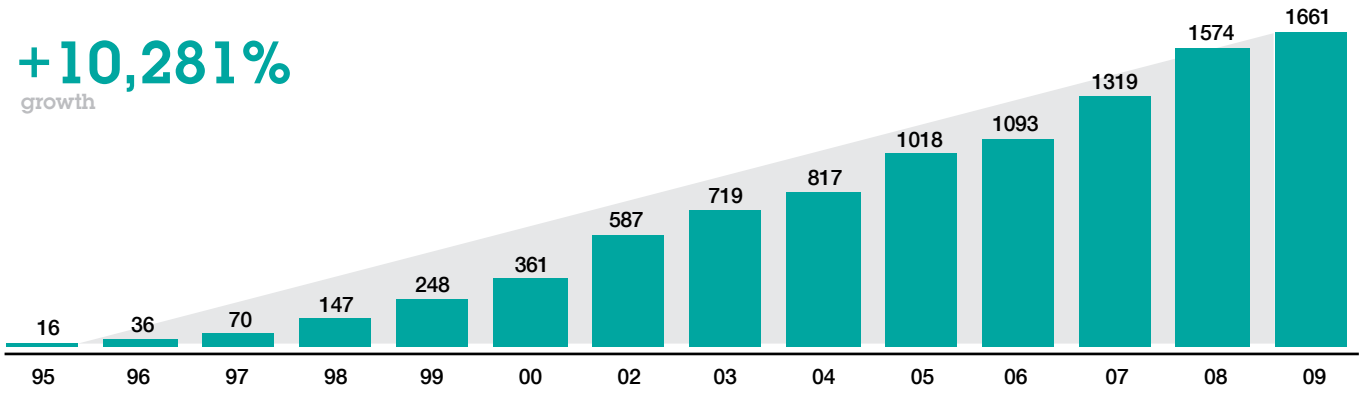
Source: "Explosive Growth Projected in Next Five Years for RFID Tags." In-Stat. 2008.

Figure 1: **Unparalleled data-gathering possibilities: number of RFID tags in use, billions, 2005 and 2010.**

Interconnection creates links among data, systems and people in ways not previously possible. In 2009, for example, more than 1.6 billion people use the Internet (see Figure 2).[4] Soon, the world will be populated by more than a trillion connected and intelligent things, such as cars, appliances, cameras, roadways and pipelines, collectively creating an "Internet of things."[5] These interconnections enable communication and coordination among objects, people and systems across the city framework, opening up new ways to gather and share information.

Intelligence – in the form of new kinds of computing models and new algorithms – enables cities to generate predictive insights for informed decision making and action. Combined with advanced analytics and ever-increasing storage and computing power, these new models can turn the mountains of data generated into intelligence to create insight as a basis for action. For example, statistical models with time-dependent data feeds to predict traffic flows can be used to adjust and optimize congestion pricing according to need.[6]

A new generation of solutions that capitalizes on instrumented, interconnected and intelligent capabilities is emerging and can be applied against virtually any of a city's core systems. Further, they can help illuminate the interactions among different systems, giving leaders better understanding of what's happening in their cities and allowing for more effective action as a result (see Figure 3).



Source: Internet World Stats.

Figure 2: **Unparalleled interconnection: Internet users, millions, 1995-2009.**

System	Elements	Instrumentation	Interconnection	Intelligence
City services	• Public service management • Local government administration	Creation of local authority management information system	Interconnected service delivery	Immediate and joint-up service provision
Citizens	• Health and education • Public safety • Government services	Patient diagnostic and screening devices	Interconnect records for doctors, hospitals and other health providers	Patient-driven pre-emptive care
Business	• Business environment • Administrative burdens	Data gathering about use of online business services	Interconnect stakeholders across city's business system	Customized service delivery for businesses
Transport	• Cars, roads • Public transport • Airports, seaports	Measuring traffic flows and toll use	Integrated traffic, weather and traveller information services	Road pricing
Communication	• Broadband, wireless • Phones, computers	Data gathering via mobile phones	Interconnect mobile phones, fixed line, broadband	Information for consumers on city services, on their own time
Water	• Sanitation • Freshwater supplies • Seawater	Gather data for water quality monitoring	Interconnect businesses, ports, energy users of water	Quality, flood and drought response
Energy	• Oil, gas • Renewable • Nuclear	Fit sensors to gather data on usage across the energy system	Interconnect appliances and devices between energy consumers and providers	Optimize the use of the system and balance use across time

Source: IBM Institute for Business Value analysis.

Figure 3: **Examples of how core systems can be made "smarter" with the help of instrumentation, interconnection and intelligence.**

A smarter city approach

We have identified a number of key steps that many major cities can follow to plan continuous improvement for their systems and the overall quality of life and business they support.

A new generation of solutions that capitalizes on instrumented, interconnected and intelligent capabilities can be applied against virtually any of a city's core systems.

The essential stages of this "Smarter Cities Roadmap" are:

- Develop your city's long-term strategy and short-term goals.
- Prioritize and invest in a few, select systems that will have the greatest impact.
- Integrate across systems to improve citizen experiences and efficiencies.
- Optimize your services and operations.
- Discover new opportunities for growth and optimization.

It may seem basic, but developing a city strategy is both the hardest and most essential step to becoming a smarter city. This strategy will help determine where and when to invest, will articulate key milestones and returns on investment and can help define an integration/optimization calendar across all systems.

It is essential at this early stage to assess a city's core systems and activities. Such an assessment, ideally, should be:

- Tailored to support insights around achieving the city's specific vision and strategy to drive sustainable prosperity
- Holistic, covering all the systems that make up the city
- Comprehensive in capturing how performance would change based on introduction of new, "smarter" solutions
- Comparative, to allow benchmarking the city's performance against relevant peer cities.

(1) The assessment should be tailored to the city's vision and the impact of external factors

A smarter city assessment must take into account that cities have different visions and priorities for achieving their objectives. One way of addressing this requirement is to use a weighted scoreboard methodology that enables a tailored and comprehensive assessment. The scoreboard should contain the relevant criteria for each system. By assigning weights to individual systems and criteria, according to their importance to the city, it is possible to define and assess the overall status and ongoing performance of individual systems and the city as a whole.

Developing a city strategy is the hardest, yet most essential element in becoming a smarter city.

For example, for cities aiming to reduce their carbon footprint, greater importance should be given to factors that immediately impact the city's CO_2 emissions, such as the type and quality of the energy supply and infrastructure, and the energy use of the transport system.

If the immediate concern is to become a global location for innovation and high-tech industries, factors pertaining to skills and the business environment are relatively more important. Hence, the different priorities of the city, and their relative importance, will have direct implications for what weights are attached to different factors.[7]

(2) The assessment should take a holistic view of the city

As the myriad systems of a city interact with and affect each other, changes to one system will invariably impact others. Thus, the assessment needs to consider the entirety of the city framework. For example if a city assesses an individual system (e.g. energy), in isolation and without ascertaining how other systems, such as transport, business and water, depend upon and affect energy consumption, the conclusions may lead to corrective action that is detrimental for the city as a whole.

(3) The assessment should be comprehensive in measuring system-wide progress

By definition, a smarter city assessment should aim to be comprehensive in capturing how individual systems might be transformed when smart solutions are applied. Specifying relevant criteria and variables for the prerequisites of each system, their management, the use of solutions and expected outcomes make this possible. By using well-structured criteria, a comprehensive overview of the transformation of each system can be achieved (see Table 1).

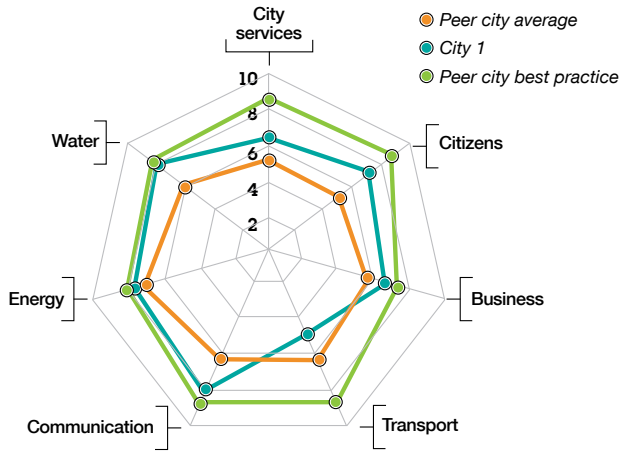
System	Pre-requisites	Management	Smarter systems	Outcomes
City services	Local government expenditure Local government staff	Coordinated service delivery	E-government Application and use of ICT for service delivery and management	Efficiency and effectiveness of public service delivery
Citizens	Investment in education, health, housing, public safety and social services	Joined-up management and coordination of service delivery	Application and use of ICT and smart tech for human and social services	Education, health, housing, public safety and social outcomes
Business	Access to finance, administrative burden, barriers to trade, business real estate	Joined-up and efficient regulation and administration of the business system	ICT use by firms, new smart business processes, smart tech sectors	Value added, business creation, innovation
Transport	Investment in transport infrastructure and public transport. Quality of basic infrastructure.	Joined-up governance of transport system	Use of smart traffic technologies. Congestion pricing	Congestion levels; Accessibility within and to city; Energy intensity of transport system
Communication	Investment in communication infrastructure	Coordinated regulation of communication system	High-speed broadband, Wi-fi	Communication system quality and accessibility
Water	Investment in water infrastructure; access to clean water; access to sewage	Regulation and governance of water system	Use of smart technologies for water management	Water use; Water waste/loss;
Energy	Investment in energy infrastructure	Coordinated regulation of energy system	Presence of smart grids; use of smart metering	Energy waste/loss; Reliability of energy supply; Renewable energy

Source: IBM Institute for Business Value analysis.

Table 1: Sample criteria and factors for assessment.

(4) The assessment should be comparative and benchmark a city against suitable peer cities

As important as what and how to measure is what to measure against. Choosing appropriate peer cities that share key characteristics, challenges and priorities can yield valuable insights and foster subsequent sharing of best practices and other useful insights borne out of the experiences of other public officials and their communities (Figure 4).



Source: IBM Institute for Business Value analysis.

Figure 4: Example of assessment results for target city and selected peers.

Conclusion

Cities continue to develop and refine their economic and social goals and the strategies to achieve them. To take advantage of how smarter city approaches can help advance those strategies, city authorities and stakeholders need to understand how their city is performing today and where progress is being achieved in infusing intelligence into their systems.

This calls for a systematic assessment of a city's position in relation to its peers. Such an assessment can identify and help communicate emerging strengths and weaknesses. It can highlight where real progress is occurring and inform a plan for future improvements. As such, an assessment can help cities prioritize actions.

We encourage city leaders to consider this kind of an assessment to gauge their maturity and help inform their development plans.

To learn more about the IBM Smarter City Assessment Tool

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