

LAYING THE FOUNDATIONS FOR A SMART, SUSTAINABLE CITY

Cities are getting smarter, with technological solutions being deployed to address a variety of common issues. But a smart city is not necessarily sustainable. Five critical considerations are necessary for successful transformation into a smart, sustainable city.

THE RISE OF THE SMART, SUSTAINABLE CITY

The world is undergoing a major rural-to-urban demographic shift. There are already more people living in cities than in rural areas, and the United Nations estimates that by 2050 almost 70 percent of the world's population will be city dwellers [1].

Such rapid urbanization boosts the global influence of cities, in some respects elevating them above nation states as significant incubators of innovation, enterprise and social progress. However, the pace of change – particularly at a time of global economic, environmental and social uncertainty – creates a raft of challenges to sustainable development.

Nevertheless, cities that adopt smart, sustainable development practices are well placed to meet these challenges. In fact, in the Networked Society, it becomes possible for cities to thrive without their development taking a major toll on scarce resources. ICT allows people, knowledge and devices to be networked in new ways, and cities that embrace ICT's potential can create new value, operate efficiently and benefit from significant return on investment (ROI). All this adds up to more livable, more attractive and ultimately more competitive cities, as well as the potential for people to pursue a more sustainable urban future.

Smart, sustainable city transformations are complex and difficult, requiring a holistic approach, encompassing long-term planning, partnership and engagement. But with the right foundations, cities can put themselves on the path to sustainability and ROI, not only in traditional financial terms, but also in the so-called triple-bottom-line dimensions of economic, social and environmental sustainability. In this paper, these dimensions are all relevant to every mention of ROI.

ICT-LED TRANSFORMATIONS FOR PEOPLE, BUSINESS AND SOCIETY

The ways in which cities balance economic competitiveness, environmental pressures and social needs will impact the lives of billions of people. Indeed, the significance of cities is well recognized in the United Nations' Sustainable Development Goals (SDGs). While Goal 11 is specifically related to sustainable cities and communities, the actions of cities also have the potential to affect all 17 SDGs [2].

Complex problems require action on multiple fronts, but a common enabler across the board is ICT. Indeed, a report published in September 2015 by the Earth Institute at Columbia University argues not only that ICTs can accelerate the achievement of the SDGs, but also that the quality of institutions can be defined by the extent to which they incorporate "cutting-edge solutions to facilitate the provision, transparency, openness and efficiency of public services" [3].

As drivers of change, cities now have more and better technological tools at their disposal than ever before. In what Ericsson envisions as the Networked Society, many powerful forces converge, such as near-ubiquitous connectivity, mobility, big data, 3D printing, robotics and cloud technologies. Globally, there are now as many mobile subscriptions as there are people, and the proportion of these that are associated with smartphones is now around 45 percent and growing rapidly, vastly increasing the amount of data created and consumed. Meanwhile, the Internet of Things (IoT) will comprise 26 billion connected devices by 2020 [4]. Many of these devices will be connected through mobile networks. 4G and 5G technology will increasingly be available, enabling more capacity for the vast number of connections and applications being used simultaneously.

Cities that effectively develop their ICT maturity will create opportunities to transform people's urban lifestyles and economic prospects. And while sustainability is not an automatic outcome of ICT transformation, well-considered use of ICT can also help cities reduce their overall environmental footprint.

THE JOURNEY TO SMART SUSTAINABILITY

The significance and benefits of smart, sustainable cities are increasingly well documented and understood [5]. However, it is important not to focus on individual smart solutions, but to take a broader view of a smart, sustainable city as one that uses ICT to improve livability, workability, resilience and sustainability.

Becoming smart and sustainable is not a one-off achievement, but rather a continuous journey requiring ongoing commitment to stakeholder engagement, innovation and progress.

All cities embark on their transformation journeys from a different starting point and with different motivations. Different levels of development and varying cultural, economic, environmental and geographic circumstances will lead to diverse approaches and outcomes. However, while every city is unique, we can identify several considerations that are critical to maximizing the success of any major urban ICT transformation.

CITY SHAPERS AND STAKEHOLDERS – A COMPLEX ECOSYSTEM

Cities comprise a complex ecosystem of governance structures and stakeholder groups. ICT transformation happens across society and affects multiple constellations of stakeholders, but within the city context, the major shapers of ICT transformation typically include:

City departments – especially those responsible for areas such as IT, ICT and innovation, planning and strategy, health care, education, public safety, environment, business, waste management, utilities and transportation.

Local government – the municipality, which spans the various departments and coordinates and integrates activities across the city. Administrative arrangements can vary considerably around the world, but generally this layer will be ultimately responsible for overall budgeting and integrated city planning.

Other governments – cities exist within greater structures and, with a few rare exceptions, are subject to varying combinations of provincial, federal or national legislative frameworks. In this context, it is typical for city ICT transformations to be influenced by national digital agenda drivers, national government CIOs, and national broadband or telecommunication regulatory authorities.

In addition to the groupings above, other key stakeholders include:

Citizens – regardless of political system, the role of ordinary people in shaping cities is changing as technology creates more smart citizens. Increasingly connected and with more location-enabled and service-related apps available to them, smart citizens are both consumers and creators of city information [6].

Businesses – from small local operations to global head offices, businesses at all levels have a stake in the development of cities, from the effect of local economic conditions on their competitiveness, to the influence of infrastructure on their ability to innovate, to the importance of lifestyle in attracting and retaining the best staff. Beyond general business concerns, major ICT projects will also attract particular interest from businesses such as content providers, ICT providers, operators and third-party service providers.

Civil society – formal and informal groupings play many different types of roles in cities, and they include sporting or religious groups, community organizers, researchers, interest groups and others.

External stakeholders – cities depend on energy, water, food and resource supply chains that extend far beyond their limits, encompassing external stakeholder groups, such as those in satellite areas and affected rural communities.

HOLISTIC SOLUTIONS AND ENABLING TECHNOLOGIES

Many of the major challenges of smart, sustainable city transformations stem from the variety of issues and the complexity of the stakeholder ecosystem. Failure to understand and fully engage across this ecosystem compromises the success of transformation projects: in particular, projects with limited stakeholder engagement or a narrow focus risk resulting in vertical solutions that do not capitalize on ICT's full potential. There have been many "smart city" projects that have neither improved the long-term sustainability of the city nor ensured ongoing progressive development beyond the original project scopes.

Successful transformations require holistic strategies, with broad engagement across stakeholder groups to harmonize expectations and approaches and to leverage the inherent strengths of ICT to provide powerful platforms, integrated systems and reusable approaches to a vast range of situations.

To operate sustainably, cities must use ICT in ways that not only meet stakeholders' initial sustainability requirements, but which also enable ongoing rebalancing of needs, resources and other priorities, such as the right to privacy. Effective change drivers understand that economic, social and environmental demands evolve over time and will sometimes conflict, so agility and flexibility are paramount in both technology and governance. Truly sustainable solutions are those that continuously identify the sustainability requirements, build upon synergies across departmental boundaries and disciplines, achieve economies of scale and – at the same time – create new value in economic, environmental and social dimensions.

Furthermore, modern city leaders have a growing awareness of the importance of effective civic engagement based on availability of public information, efficient and integrated service delivery, and effective mechanisms for participatory governance and decision-making.

FIRST STEPS ON THE TRANSFORMATION JOURNEY

It is difficult to overstate the potential of smart, sustainable cities to improve every aspect of life for their citizens and businesses, accelerate achievement of the SDGs, and drive significant global change. But as important as such outcomes may be, city leaders work with limited budgets and resources, so all major developments must be justified by a solid business case.

Fortunately, when properly planned and managed, smart, sustainable city developments can address cities' pain points and create multiple efficiencies with compelling ROI on the economic, social and environmental fronts.

However, the diverse and complex stakeholder ecosystems involved in city governance complicate the path to ICT transformation. Narrow, vertical solutions fail to capture the full potential of ICT and may waste funds and cause setbacks to a city's transformation journey. On the other hand, when cities adopt holistic, integrated and consultative approaches, they optimize their funding and maximize their chances of achieving smart, sustainable systems and processes, with measurable improvement in their triple-bottom-line performance.

Experience shows that, regardless of a city's current state of development, there are five critical considerations that are necessary for its successful transformation into a smart, sustainable city:

1. Define an agreed vision, strategy and targets
2. Create informed networked governance structures
3. Develop organizational capacity
4. Engage with all relevant stakeholders
5. Forge and foster long-term partnerships.

1. Define an agreed vision, strategy and targets

Technological development is an enabler of cities' sustainability objectives, and is not an objective in itself. The first stage of any city's transformation is to explore, define and communicate the vision held for it. From there, a strategy needs to be developed, documenting risks as well as targets for achieving that vision.

Premature fixation on specific technologies is a distraction, which can lead to decision-making that hinders the ultimate success of the transformation. Therefore, in the initial phase, it is important for planners and stakeholders to retain a technology-agnostic approach, with a clear focus on outcomes rather than tools.

As with any form of planning, before defining what is needed to achieve the vision, the stakeholders need to analyze their current situation, benchmarking both their level of ICT maturity and the sustainability of their current state of development, for example. The SDGs – particularly SDG 11 – provide a framework for action. Likewise, Ericsson's Networked Society City Index [7] is a good example of how to construct a set of high-level categories for tracking cities' progress in terms of ICT maturity and sustainability.

Whichever framework the city adopts, the actual metrics it develops need to capture the overall economic, social and environmental development as well as the effect of ICT. Then, at all stages of its transformation, measurements must be made in line with the guiding purpose and risk assessments, and all technology choices must be able to support and enable the city's vision.

Sustainable development is a continuous journey with no specific endpoint – all cities will continue to evolve indefinitely. It is therefore important for each city to continuously measure its progress toward fulfilling its vision.

2. Create informed networked governance structures

It is likely that many stakeholders will have a narrow set of expectations from their city's transformation. For example, it is natural for those responsible for roads to be highly focused on

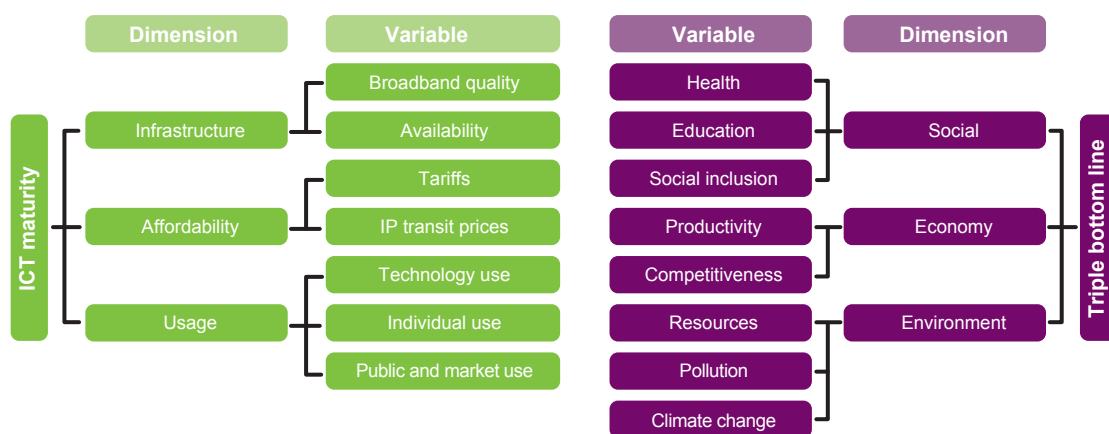


Figure 1: A breakdown of representative ICT maturity and triple-bottom-line dimensions from Ericsson's Networked Society City Index.

traffic solutions, or for waste management authorities to care only about waste-related infrastructure. Furthermore, IT departments may not have detailed knowledge of specific portfolio areas, sustainability matters or even ICT's potential to address these.

However, the Networked Society calls for networked forms of governance and coordination – uncoordinated pursuit of multiple problem areas is likely to result in siloed, vertical solutions each with a value constrained to a single area. Extended across the entire city, such an approach would create a fragmented technology landscape, unable to scale or capitalize on the advantages of a unified, interoperable platform.

To refer back to the example above, if common platforms, data formats and monitoring systems are in place, road and waste management authorities may be able to share information for mutual benefit in ways that were previously impossible (such as using sensors around the city providing data to simultaneously enhance transport, public safety and waste collection activities). Furthermore, IT departments that understand the sustainability potential of ICT services may speed up developments on the sustainability front.

Within the city stakeholder ecosystem, it therefore becomes necessary to create a networked governance structure capable of retaining the holistic, macro view of the city's needs, and to ensure that all projects follow a common vision, integrating both ICT and environmental priorities. Understanding and buy-in from all stakeholders is vital to securing lock-in of major decisions and avoiding vertical implementations. Creating such a structure requires a strong consultative and educational approach.

Ideally, the governance mechanisms should reflect the long-term value of standards-based and interoperable technologies designed not only to solve the problem at hand, but also to scale and adapt to future, unforeseeable problems.

Informed decision-making is essential, so data collection and big data analytical techniques should be established to support the networked governance mechanisms and allow continuous feedback and adjustment in line with the overall city vision.

Reflecting the distributed, decentralized nature of networking technologies, the governance structure itself needs to actively involve multi-stakeholder participation and embrace partnership models for more efficient, responsive management.

3. Develop organizational capacity

The technology landscape is evolving rapidly, so it is important to develop a continuous ICT learning culture among the city's transformation drivers, sharing new developments and exploring emerging possibilities and approaches.

To this end, a productive strategy is to support pilot programs within the city that are able to test new sustainable business models and services. In some cases, this may mean developing new mechanisms for cities to approve pilot programs that would otherwise be constrained by existing regulatory frameworks. For maximum value to be gained from pilots, they should be carefully planned within a clear timeframe, well defined and measured against the pursuit of the city's overall sustainability vision.

Leveraging ICT can help a city become more efficient and resilient. Communicating the benefits of these gains will be a major success factor in achieving a high level of effective service integration. One possible outcome of this approach could be combining multiple sectors into a single city coordination center for a high degree of responsiveness, resilience and efficiency.

4. Engage with all relevant stakeholders
 The day-to-day work of any city is to balance overlapping and often competing interests in every aspect of city policy and service delivery. At no time will this be more evident than in large-scale ICT projects. The city's multiple and diverse constellations of stakeholders – public and private, individual and collective – will all be affected by the transformation, so all their input will be crucial to its success.

Communication is the key to maximizing stakeholder understanding and buy-in of the city's vision of smart, sustainable development. Effective outreach and engagement should be a major part of the planning, decision-making and evaluation phases of an urban transformation project.

Broad engagement is vital to identifying and ranking the city's pain points and stakeholders' concerns, and it also brings a source of ideas and solutions that can help shape the overall vision.

The smart, sustainable city value chain comprises several interconnected ICT layers – infrastructure, enablers, devices and applications [8] – which can also help to shape engagement models. For example, consultation with appropriate stakeholders at the infrastructure and enabling layers can build awareness of the long-term business case advantages for shared, standards-based infrastructure as opposed to closed, vertical deployments.

Likewise, engagement at the device and application layer can spark third-party development of innovative city-based services that build upon the synergies and data created by smart, sustainable development. This could include things such as transit planning apps, car pooling services, or crowd-sourced municipal fault reporting [9]. While not a formal part of city development, such innovation adds value to the city and contributes to the overall ROI.

The technologies that enable smart, sustainable development also provide new possibilities for creative stakeholder engagement. For example, many cities have staged hackathons that bring together programmers, designers and other developers for brief events focused on rapid innovation on city-related issues.

Gamification is another emerging method used to inspire alternative forms of civic participation and engagement. In Nepal, for example, civic leaders have used the game Minecraft as a way of directly engaging young citizens in the design of public urban spaces.

5. Forge and foster long-term partnerships

Any large ICT transformation is inherently complex – great efficiency gains for cities come from building infrastructures, systems and processes that develop synergies across industries, creating new levels of efficiency, coordination and service delivery.

In spite of this complexity, there is a growing body of knowledge of smart, sustainable city transformations. By forming strong partnerships with companies and NGOs with a global presence and high levels of expertise, cities are able to access that body of knowledge, benchmark their visions and progress against other comparable cities, and employ best practices.

However, establishing and managing partnerships between governments, the private sector and civil society is also a complex challenge.

For these reasons, the importance of an experienced and capable systems integrator cannot be overstated. As the leading partner in the city's transformation, the systems integrator must have the scale and capacity to drive major, long-term projects, as well as the broad range of skills and expertise required to work across all layers in the value chain.

Furthermore, most major projects are likely to involve competing stakeholder needs and preferences and varying degrees of legacy infrastructure and systems. Therefore, the systems integrator must be proficient at working in multivendor, mixed technology environments with multiple stakeholders.

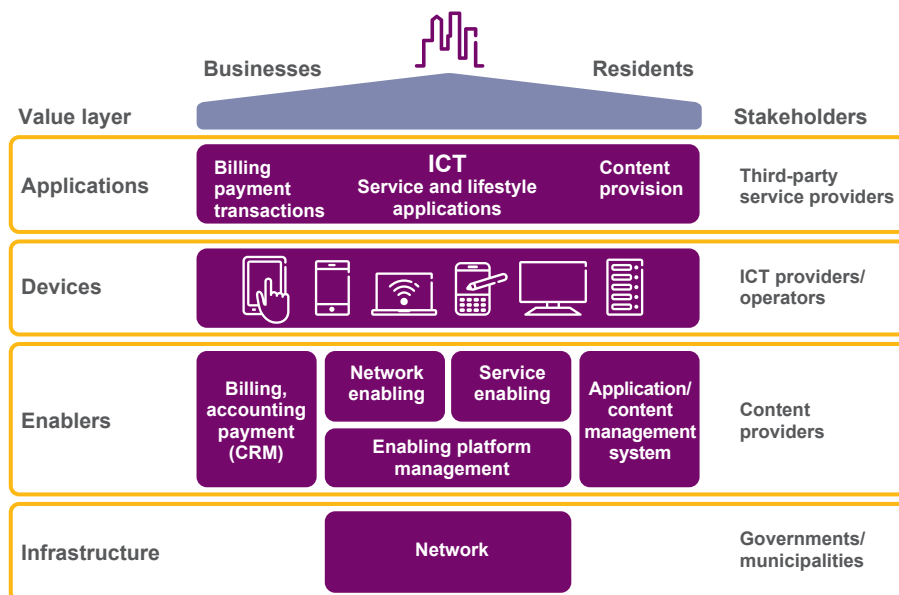


Figure 2: Value layers, technology layers and stakeholders in a smart, sustainable city.

CASE STUDY

STOCKHOLM ROYAL SEAPORT – A SHOWCASE FOR INNOVATION AND SOURCE OF ROI INTELLIGENCE

Stockholm Royal Seaport is a high-profile mixed-use project within Stockholm, Sweden intended as an international model for sustainable city development [10]. Located in the northeastern part of the city, Stockholm Royal Seaport is due to include 12,000 homes and 30,000 workspaces, with a wide diversity of architecture and lifestyles.

The development is a leading example of long-term planning, with a far-reaching vision that has been secured and agreed to by the various public and private stakeholders. Stockholm Royal Seaport aims to limit climate impact, be free from fossil fuels by 2030, and be adaptable to present and future climate change challenges. This vision is supported by overarching goals relating to “energy use, environmentally efficient transport, adaptation to a changed climate, cycles and cyclical models at system level and lifestyle issues” [11].

At the heart of the development are collaborative partnerships between the City of Stockholm, private enterprise and the research community, with Ericsson as one of the lead ICT partners and advisors. Major collaborative projects that are either planned or in development include a smart urban grid, a vacuum-powered smart waste collection system and a shared ICT infrastructure to provide an efficient communication system for sustainable city development.

Stockholm Royal Seaport is also used as a showcase for sustainable urban development and partnerships, featuring pilot projects and an innovation center for collaborative research. The city hosts regular study visits for knowledge- and experience-sharing on some of the key projects, such as the Smart Grid Pilot or the Urban Smart Grid.

The openness of this development contributes to innovation, research and development in other cities, and provides a vital source of data for partners and other cities, helping them to develop their own visions with realistic ROI assessments.

Stockholm Royal Seaport’s interest in supporting an ROI-based approach is further demonstrated in the Smart ICT for Living and Working in Stockholm project, conducted by Swedish ICT to develop new business models to support a shared ICT infrastructure for reduced investment costs, more efficient resource allocation and development of new services. The idea of this strategy was to help catalyze the type of political consensus required to overcome potential market barriers to infrastructure sharing and standardization [12].

CASE STUDY

SÃO JOSÉ DOS CAMPOS, BRAZIL

– VISIONARY CITY LEADERSHIP AND PARTNERSHIPS FOR SOCIAL SUSTAINABILITY

São José dos Campos is a city with over 650,000 inhabitants, located 80km from São Paulo in Brazil. It is considered a national benchmark for technology and quality of life in Brazil, with an established technology park that attracts ICT investment and innovation.

The city leadership in São José dos Campos has demonstrated a long-standing commitment to multi-stakeholder engagement and support for partnerships, particularly within the research and commercial sectors.

In 2011, in response to concerns over rising crime rates, the municipality set the following challenge for São José dos Campos:

- Modernize the city public safety ICT systems, assuring the best efficient operation model by a proven tech-based company, and allowing the establishment of long-term partnerships with a view to establishing a smart city.

This challenge led to a long-term partnership between the municipality and Ericsson to develop an emergency response system based on an integrated operations center, fiber-optic network infrastructure, a video platform and managed services.

The resulting emergency response system integrates the city's traffic, police, civil defense and ambulance systems in a common communication and management platform, providing real-time, coordinated protection of people and public property.

São José dos Campos' Integrated Operations Center managed 50,000 incidents in 2014, with reports coming from monitoring officers working there as well as members of the public. The range of events included the straightforward investigation of unprotected persons, fire, accidents, administrative offenses, and crimes against life and property.

Already, the system has contributed to significant reductions in public safety incidents. For example, in areas monitored by camera-based surveillance systems, the overall crime rate has decreased by 70 percent, with an almost 20 percent drop in the homicide rate. Importantly, the cross-agency collaboration and shared platform and services allow for future developments and integrations that build upon the existing infrastructure.

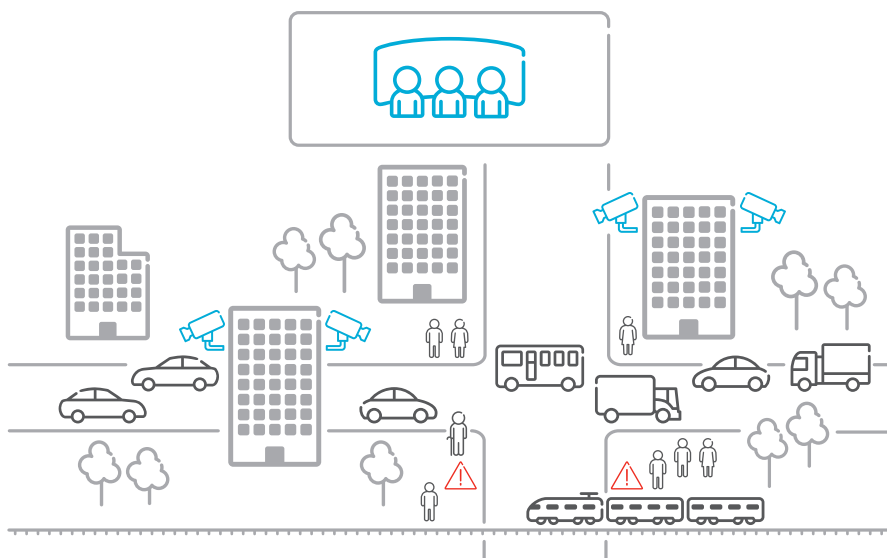


Figure 3: An integrated operations center providing real-time protection of people and public property.

CONCLUSION

Smart, sustainable cities hold many of the keys to ensuring better economic, social and environmental conditions. And deployed effectively and with sustainability as a core target, ICT can accelerate progress toward the related goals.

ICT is transforming cities everywhere, and it is a key enabler of smart, sustainable solutions. As 4G/5G, IoT and big data technologies become widespread, the potential for ICT to solve cities' problems will only grow. But ICT projects alone do not necessarily make cities smart or sustainable. Indeed, poorly planned, short-sighted developments have the potential to hinder a city's long-term progress.

Partnership, planning and engagement can make all the difference between a city that owns and controls its transformation and one that is a victim of fragmented, unsustainable transformation.

Creating a smart, sustainable city is a continuous process, requiring vision, ongoing measurements and constant rebalancing of complex, often competing needs. To ensure the best chance of success, those shaping the future of cities must lay a solid foundation for transformation, based on purpose-driven planning, networked governance structures, organizational capacity building, broad stakeholder engagement and effective long-term partnerships.

Forming strong partnerships with ICT companies and NGOs with a global presence and high levels of expertise – particularly in systems integration – can enable cities to accelerate their transformation journey. However, partners must have the scale and capacity to drive long-term projects, as well as the broad range of skills and expertise required to work across all layers in the value chain of a smart, sustainable city.

GLOSSARY

ICT	information and communications technology
IoT	Internet of Things
ROI	return on investment
SDGs	Sustainable Development Goals

REFERENCES

[1] United Nations, Department of Economic and Social Affairs, Population Division, World Urbanization Prospects: The 2014 Revision, (ST/ESA/SER.A/366), 2015, available at:

<http://esa.un.org/unpd/wup/FinalReport/WUP2014-Report.pdf>

[2] United Nations, Sustainable Development Goals, accessed December 2015, available at:

<http://www.un.org/sustainabledevelopment/sustainable-development-goals/>

[3] Earth Institute, Columbia University and Ericsson, ICT & SDGs – How Information and Communications Technology Can Achieve the Sustainable Development Goals, September 2015, available at: <http://www.ericsson.com/res/docs/2015/ict-and-sdg-interim-report.pdf>

[4] Ericsson, Ericsson Mobility Report, November 2015, available at:

<http://www.ericsson.com/res/docs/2015/mobility-report/ericsson-mobility-report-nov-2015.pdf>

[5] Ericsson, Shaping Sustainable Cities in the Networked Society, 2011, available at:

http://www.ericsson.com/res/thecompany/docs/corporate-responsibility/2011/shaping_sustainable_cities_in_the_networked_society1.pdf

[6] Ericsson, Smart Citizens – How the internet facilitates smart choices in city life, November 2014, available at:

<http://www.ericsson.com/res/docs/2014/consumerlab/ericsson-consumerlab-smart-citizens.pdf>

[7] Ericsson, Networked Society City Index 2014, November 2014, available at:

<http://www.ericsson.com/res/docs/2014/networked-society-city-index-2014.pdf>

[8] Ericsson, Shaping Sustainable Cities in the Networked Society, op. cit.

[9] Heland, F., Bondesson, A., Nyberg, M. and Westerberg, P., The Citizen Field Engineer: Crowdsourced Maintenance of Connected Water Infrastructure, 2015, available at:

http://www.atlantis-press.com/php/download_paper.php?id=25836161

[10] Stockholm Royal Seaport, accessed December 2015, available at:

<http://www.stockholmroyalseaport.com>

[11] Stockholm Royal Seaport, Vision 2030, accessed December 2015, available at:

http://international.stockholm.se/globalassets/ovriga-bilder-och-filer/visionsrs2030_medium.pdf

[12] Stockholm Royal Seaport, Sustainability gains through shared ICT infrastructure, April 2014, available at: <http://www.stockholmroyalseaport.com/en/news-and-events/sustainability-gains-through-shared-ict-infrastructure/#.VioHILzZ564>