ICT policies and plans for transition to smart and Sustainable Development in Arab region

This report on the ICT policies and plans for transition to smart and sustainable development for Arab region was prepared by Prof Muliaro Wafula under the supervision of the International Telecommunication Union (ITU) Telecommunication Development Bureau (BDT). The ITU Regional Office for the Arab region and worked closely with the expert to produce this work. In this report, special focus is given to the guidelines for the development of ICT policies and plans for transition to smart and sustainable development for the Arab region. The report was drafted prior to ITU Regional Forum on Use of ICT for transition to Smart and Sustainable Development that was held in Khartoum, Sudan, from 12 to 13 December 2016 and has been revised to include discussions and recommendations made at this event.

Please consider the environment before printing this report.

Executive Summary

This report identifies and makes recommendation on approaches towards establishing guidelines on ICT policies and plans for transition to smart and sustainable development. In brief, the Arab region is advised to invest in ICT Infrastructure and creation of an enabling environment for universal access for its citizens and all stakeholders. This will support innovative and appropriate adoption and use of ICT applications. Promotion of open data principles and practices improves transparency, accountability, and the enabling environment for smart cities and climate change management.

The report established that already 10 out of 22 Arab countries have already embraced the concept of smart sustainable cities using either the Brownfield or Greenfield transformation model. A list of selected countries such as USA, UK, China, Korea, German and Spain that are pursuing smart and sustainable development through implementation of smart and sustainable cities is given with short descriptions of their adopted strategies.

Sample strategic plans and regulatory frameworks for smart and sustainable development in this report were picked from what the study established as key domain areas that form the walls between the economic, environmental, governance and social pillars1 of sustainable development cube. These are: smart learning, smart cities, disaster management, climate change adaptation and mitigation.

Challenges faced by the Arab region are highlighted. Those that were ICT related include: regulatory environment, high software piracy, insufficient funding, lack of common and integrated regional plan, and lack of enough ICT human resource capacity. Those challenges that were none technical included political uprisings, rising extremist groups, protracted conflicts, poverty, exacerbated inequality, water and energy insecurity, an alarming number of refugees and internally displaced people, severe resource constraints and financing gap, inadequate communication infrastructure, very low utilization of ICTs, lack of information, and the high cost of mainstreaming ICTs for smart and sustainable development. It is suggested that for Arab countries to be able to transit to smart and sustainable development, the challenges need to be addressed. An effective regional institutional mechanism needs to be put in place. This report discusses several opportunities that are ICT-based that the Arab region can exploit.

A concise roadmap that the Arab region can take to smart sustainable development is presented that has been informed by the study. ICTs selected examples are mapped as catalysts on each sustainable development goal and presented to provide lessons to the Arab region. The report presents a novel strategy for smart and sustainable development with potential to achieve effectively the sustainable development goals.

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[1] The four pillars of sustainable development: economic prosperity, social wellbeing, environmental stewardship and governance (Kennecott Utah Copper, USA, (http://www.kennecott.com/?id=MjAwMDA3Mg)

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1 Introduction

Several approaches have been proposed towards smart and sustainable development across the developed Nations and developing Nations. Most developments have been recorded within the urban areas or cities. Cities are indispensable to nations they are hubs of economic growth and innovation and are cultural melting pots. They usually have unique characteristics and a cultural identity as well as present a multitude of options for business, employment, leisure, entertainment, healthcare and education. Given these attributes, cities attract people from rural regions seeking opportunities for employment, education and a better lifestyle. Hence, cities have been witnessing the megatrends of population explosion, a growing middle-class population and urbanization[2]. The Arab region has shown indication that there is more promise to develop in a sustainable manner. Sustainability is about ecology, economy and equity. The planet, inhabited by over 7 billion people, is in the midst of a massive transition in terms of the ecosystem, climate change, tectonic plate movements and biological evolution[3]. Among these, climate change, largely attributable to human activities, is one of the most critical issues impacting our planet[4]. Climate change brings with it adverse consequences such as threats to biodiversity and ecosystems, risks to human health, rising sea levels due to accelerated melting of glaciers and ice caps, increasing water stress as well as a decline in agricultural productivity. These issues are driving many worldwide economies and cities to focus on mitigating greenhouse emissions in order to combat the impact of climate change. Cities account for the majority of greenhouse gas emissions and energy consumption across the globe. As cities are economic growth drivers in most of the nations, urbanization is projected to increase further in the near future. This, in turn, will drive the depletion of non-renewable resources as well as add to the extent of carbon dioxide emissions. To cope with rising urbanization and climate change issues, innovation and digital technology must be leveraged to minimize energy consumption and improve quality of life. Innovation must be combined with energy, digital technology and information and communications technology to address urbanization challenges and ensure sustainability. Sustainability covers not just the environmental aspect but also social equity and the economy.

1.1 Smart and Sustainable Development pillars

The key steps towards smart and sustainable development

Engaging citizens for governance

Citizens are the pillars of a nation, for they choose a government and all governance policies, laws and regulations are focused on them. However, very often, inputs and ideas are not sought from citizens, and decisions are made by few elected representatives. Those decisions may or may not reflect the pulse of the people. With the advent of the smartphone revolution, social media proliferation, a dynamic media industry and instant connectivity, people are becoming increasingly aware as well as keen to voice their opinions and do their bit for society by sharing their inputs with policy- makers. Gone are the days of closed-door policy-making and imposition of laws and regulations without any consultation with citizens. Participatory governance focusses on the democratic engagement of citizens to improve citizen participation in governmental policies as well as to crowdsource ideas.

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[2] PWC, "Making cities smart and sustainable," Inf. Exch. Group's Summit, 2015

[3] I. F. G. on S. S. Cities, "Connecting the dots Smart and sustainable cities," 2015.

[4] A. Ramamurthy and M. D. Devadas, "Smart Sustainable Cities : An Integrated Planning Approach towards Sustainable Urban Energy," vol. 7, no. 1, pp. 252–272, 2013

Participatory governance does away with assumptions and solicits public opinion on upcoming policies and regulations. It also involves seeking ideas from people for the betterment of cities. Similarly, crowdsourcing gives citizens the opportunity to showcase their talents, creativity and intelligence. Participatory governance provides a platform for citizen-government interaction that bolsters the concept of democracy as well as improves service delivery and inculcates social inclusiveness. Many countries have robust platforms for citizen-government engagement for political inclusion, crowdsourcing and addressing governance problems by involving citizens in decision making.

Opening up data for transparency and service delivery

As defined by the Open Knowledge Foundation, data is open if it is free for use, reuse and redistribution without any legal, technological or social restrictions. Major features of data openness are access and availability, universal participation as well as redistribution and reuse. Management of data has become considerably important, particularly from the purview of governance. The data can be related to the environment, transport, weather, transport and traffic, statistics and finance. Open data helps in ensuring transparency across systems, driving the participation of citizens in governance and improving service delivery by virtue of leveraging data for the welfare of people at large. With open data, governments may fuel the set-up of groundbreaking services and businesses that render commercial and social value.

Active involvement of the private sector

The private sector has always been considered a receptacle of innovation and efficiency, the two key ingredients for bringing any smart sustainable city's vision to life. Businesses are expected to usher in new and innovative technological solutions and services. Large global players, with their wealth of knowledge and resources, need to invest in R&D and develop standardized yet customizable solutions that can be replicated and scaled up around the world. Not just large global companies but also innovative start-ups and local players will play a critical role. Creative solutions and approaches of the former and the local understanding and connect of the latter will work to their advantage and create an equation of mutual gain for both businesses and citizens. Many businesses have mastered the art of collaboration and can utilize this experience in creating platforms that bring together various stakeholders to deliver the much-needed integrated solutions. Public-private partnership (PPP) has been hailed as the preferred route for developing smart and sustainable city projects around the world. Substantial evidence establishes that the strategic role played by the private sector is assisting cities in realizing their smart and sustainable objectives. The World Business Council for Sustainable Development (WBCSD) Urban Infrastructure Initiative (UII) conducted an innovative global project between 2010 and 2014, wherein 14 leading global companies worked with 10 cities around the world. The project involved setting up the framework for a city-business collaboration right from the early planning stages of developing the city's smart and sustainable plan instead of involving businesses only during implementation. The project outcome clearly spelled out substantial benefits for the cities

Smart and sustainable projects centered on climate change mitigation and adaptation may access the Green Climate Fund (GCF) of the United Nations Framework Convention on Climate Change (UNFCCC). Recently, the National Bank for Agriculture and Rural Development (NABARD) was accredited by GCF as an implementing entity for undertaking climate change related projects in India. Projects with positive environmental benefits can also utilize the green bonds route which has seen a lot of activity in the recent past. Projects that are in the spirit of corporate social responsibility (CSR), as defined by

the Companies Act, 2013, may attract funds from companies with significant unspent CSR budgets. Crowdfunding has also been identified as a potential route for supporting city- wide projects.

Integrated approach in both planning and execution

The path towards becoming smart and sustainable will invariably require coordinated action by the multiple city stakeholders. The complex city management structure needs to work in harmony in order to deliver the city's vision. This will require steering away from the traditional system of different city departments and agencies working in isolation towards a more integrated approach, both during planning as well as the execution of smart and sustainable strategies. A governance model with clearly defined leadership roles needs to be established to work around the complex city administrative structure. Cities may establish a nodal agency that will work together with city officials and policy-makers, in order to ensure that municipal strategies and urban planning targets are completely aligned with the city's overall smart and sustainable vision. This agency will be able to drive active collaboration and can serve as the single window for all stakeholders.

Institutional factors for achieving sustainable development: Good governance, Planning, Legislation and policies, Financing, Public and private cooperation, Education, training and development.

Governance for a sustainable future Responsibility and accountability are integral towards making our community more sustainable. People, communal groups, organizations and businesses must recognize that the decisions they make affect the sustainability of our community. Administrations need to be accountable and responsive to their citizens, transparent in their reporting on the use of public resources and in decision-making, and create opportunities for participation in policy as well as service delivery Good governance serves as a powerful inspiration for promoting reforms in policies and programs for sustainable development. These include open and transparent opportunities for the poor and underprivileged to access information and secure their rights over land, forest and energy resources, as well as to encourage governments to implement policies that are more amenable. We must hold each other responsible for the community's sustainability and for providing future generations with environmental, economic and social resources that meet our needs

2 Guidelines on development of ICT policies and plans for transition to smart and sustainable development for Arab region

2.1   ICT Infrastructure & Enabling Environment

Policy development guidelines:

a) Enable bulk population to access broadband services eg

> ➢ Develop network technologies that enable seamless access for both fixed and mobile network,

> ➢ Establish wireless sensor networks to support and integrate IoTs

b) Enhance ICT applications development and use

c) Improve environment for use of ICT eg

> ➢ Privacy protection, provide information security, address illegal & harmful content, protect Intellectual Property, establish new social code of contact, increase information penetration to public, overcome geographic divide, conserve global environment, establish social systems & practices compatible with ICT

2.2 Open Data:

Policy development guidelines:

a) Create an enabling environment for open data-policies, principles, Stds, regulations, laws eg adopt the Open Data in a Big World international Accord[5]

b) Promote citizen centric data driven innovations that create jobs and wealth by supporting startup and new service development

c) Avail data that supports smart cities

d) Create a balanced ecosystem of demand and supply of data –Priority, quality

Figure 1 : Open Data Value for Performamce, Economy and Society

Source: EU, 2016

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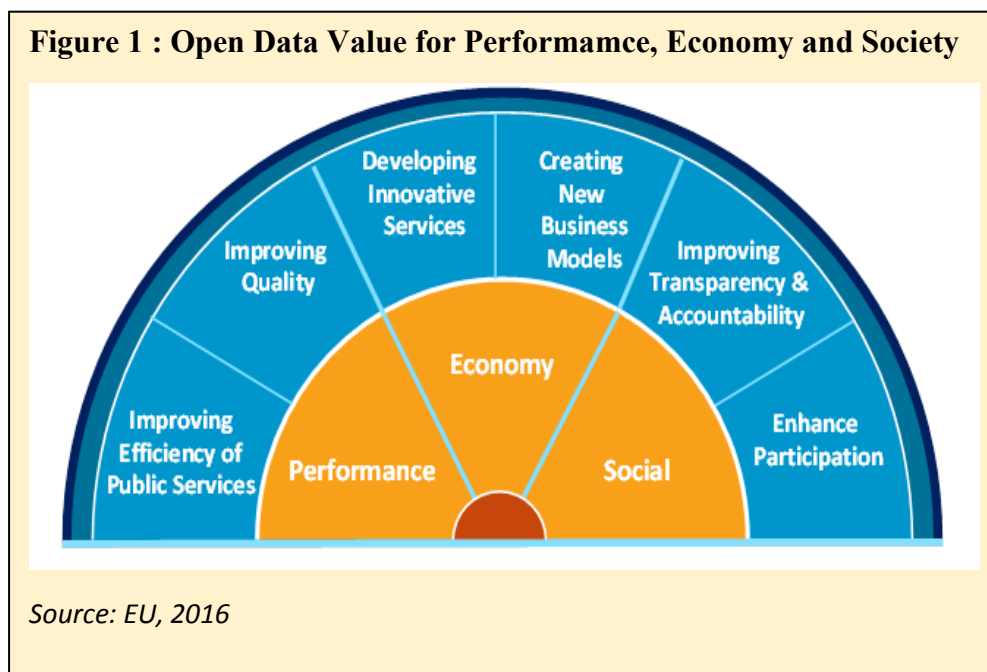
[5] http://www.science-international.org/sites/default/files/reports/open-data-in-big-data-world_short_en.pdf

2.2.1 Open Data Benefits:

Include:

- Improved accountability and transparency of the government[678]

- Citizen participation and empowerment[910]

- Promoting inclusive development[11]

- Promote innovation[12]

According to the World Bank Group 2015, open data can be used to track political, social and economic trends, improve public services, build trust in government, and promote economic growth, support development in areas that relate to the post-2015 United Nations Sustainable Development Goals.

2.2.2 International Accord on Open Data:

According to the International Accord on Open Data for Open Science, simply making data accessible is not enough. It needs to be:

- *intelligently open-* thoroughly scrutinized and appropriately reused.

- *discoverable* –search and find easily

- *accessible*

- *intelligible*

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[6] Zhang, J., Dawes, S.S. and Sarkis, J. 2005 Exploring stakeholders' expectations of the benefits and barriers of e-government knowledge sharing. The Journal of Enterprise Information Management, Vol. 18 No. 5.
[7] Janssen, K. 2011. The influence of the PSI directive on open government data: An overview of recent developments. Government Information Quarterly, 28, 446-456.

[8] PUBLIC_ACCOUNTS_COMMITTEE 2012. Implementing the transparency agenda. In: HOUSE_OF_COMMONS (ed.). London
[9] Kenei, S. 2012. Open data: Learnings from the Kenya Open Data Initiative for CSOs. Development Initiatives

[10] Schwegmann, C. 2012. "Open data in developing countries", in Platform, E. (Ed.), European Public Sector Information Platform Topic Report, Epsi Platform, Germany.

[11] Lundqvist, B. 2012. 'Digital Agenda: Turning Government Data into Gold': The Regulation of Public Sector Information–Some Comments on the Compass-Case. Available at SSRN 2148949.
[12] Huijboom, N. and Van Den Broek, T., 2011. Open data: an international comparison of strategies. European Journal of e-Practice, Vol. 12

- *usable* – there must be adequate metadata

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Figure 2: Program Structure for Supporting Innovation
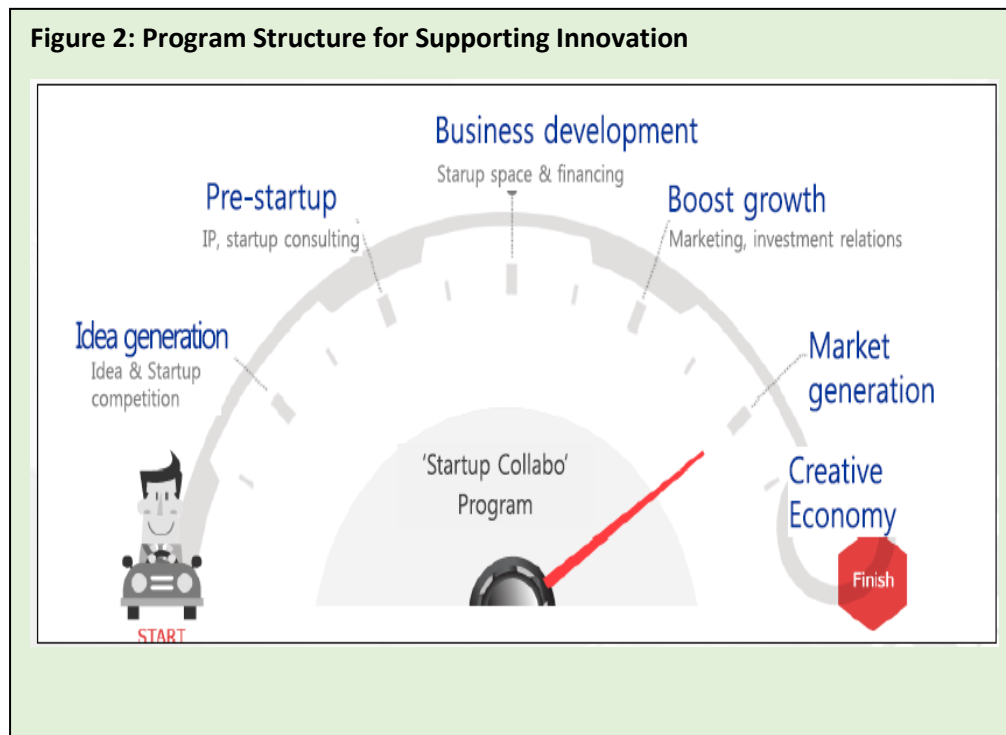
Open data despite clearly known benefits outlined in section 2.2.2, it faces numerous impediments that are legal, political, social, economic, institutional, operational and technical in nature[13]. Figure 3 shows common contributors to open data impediments that need to be surmounted in order for open data to be fully harnessed by organizations, nations and regions.

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[13] Zuiderwijk, A. and Janssen, M., 2013. Open data policies, their implementation and impact: a framework for comparison. Government Information Quarterly, Vol. 31 No. 1

Figure 3: Common Contributors to the Open Data Impediments
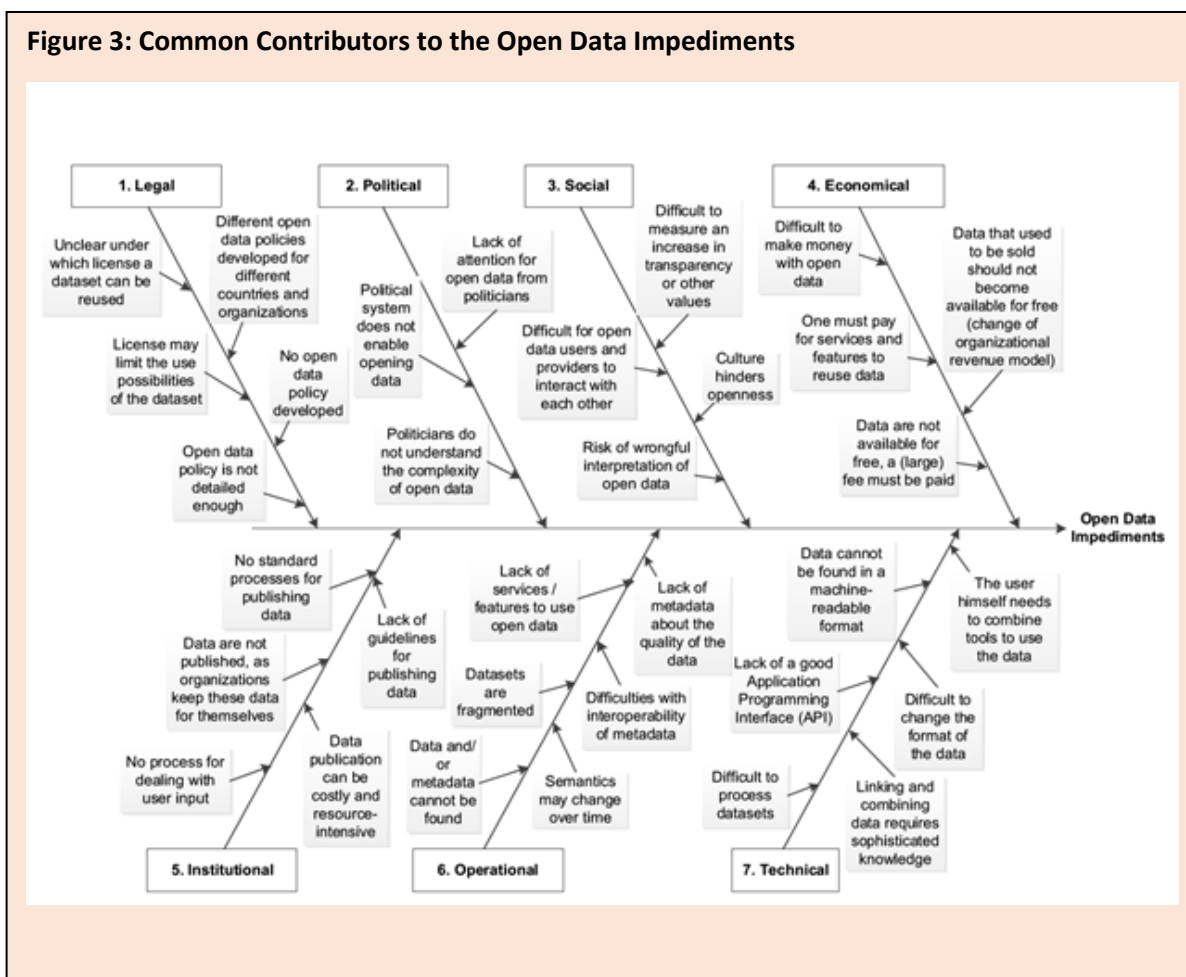
2.3 ICT for Disaster Management:

Policy development guidelines:

a) Support early warning systems

b) Enhancing coordination, cooperation, and logistics - Incorporating ICT for Disaster Recovery Management (DRM) as part of sustainable development efforts

c) Offer quick means of restoring order and disseminating lessons learnt

d) Develop databases of key disaster response agents

e) Adopt and implement Tempere Convetion- calls for streamlining of disaster relief process by waiving regulatory barriers and putting in place procedures that maximize access life-saving ICT systems[14]

f) Develop/review regularly disaster management plans

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[14] ITU Smart Sustainable Development Model Advisory Board Report 2015.

g) Establish communication with at-risk communities – Greater emphasis and priority needs to be given to the communication with people affected by disaster at all stages of DRM.

h) Provide universal access to ICT

i) Promote standardization

2.4 Smart Learning:

Policy development guidelines:

a) Make learning process adaptive, effective, efficient, engaging, flexible and accessible[15]

b) Provide learner-centred environments that are intelligent and open, and integrate digital virtual reality learning space- These environments are primarily based on constructivist learning theory, blended learning theory and modern teaching theory.[16]

c) Use quality education to achieve SDGs- Poverty, hunger, good health, quality education, gender equality, clean water & energy, economic growth, smart cities etc

2.5 Smart Sustainable Cities

Policy development guidelines:

a) Install instruments for data collection and processing in support for efficient & effective city management & planning

b) Build human capacity needed to support proper use of ICT

c) Build reliable heterogeneous ICT systems that support interoperability

d) Enable use and aggregation of data by systems and services

2.5.1 Smart Sustainable Cities Transformation models

There are two common transformation models that are being used to create smart and sustainable cities (SSC)[17]. The Greenfield model that seeks to create SSC from scratch whereas the Brownfield model seeks to crate SSC through modification of the old cities as shown in Figure 4.

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[15] Spector, J. M. (2014). Conceptualizing the emerging field of smart learning environments. Smart Learning Environments

[16] Zhong, G., & Zhang, X. (2006). A building of the current intelligent learning environment mode. Computer Science, 1, 170-171

[17] Ibrahim, M., Al-Nasrawi, S., El-Zaart, A. & Adams, C. (2015). Challenges facing E-Government and Smart Sustainable City: An Arab Region Perspective. 15th European Conference on e-Government, ECEG, pp. 369-404

Figure 4: Smart and Sustainable City Transformation Model.

Source: Ibrahim et al, 2015

2.5.2 Arab Countries SSC Initiatives

According to information summarized in Table 1, 10 out of 22 Arab countries have embraced the concept of smart and sustainable cities and have a SSC initiative. Some of the key challenges identified include (Government Summit, 2015):

a) Inadequate sustainable financial investment in SSC projects

b) Difficulty in citizen adjustment to new ways of accessing services.

c) Coordination and integration between public, private and civil bodies for the purpose of making a city function as one organism in an efficient and effective manner.

d) Inadequate ICT infrastructure; technological obsolescence; and poor inter- and intra-system interoperability.

e) Political instability and high rate of youth unemployment.

Table 1: Arab Countries with SSC Initiatives

Country	SSC Initiatives	Brownfield/Greenfield	Example of a SSC Project
Algeria	Yes	Greenfield	Cyberpark City of SidiAbdellah
Bahrain	Yes	Brownfield	Manama
Comoros	No	-	-
Djibouti	No	-	-
Egypt	Yes	Greenfield	Smart Village
Iraq	No	-	-
Jordan	No	-	-
Kuwait	Yes	Brownfield	Kuwait City
Lebanon	No	-	-
Libya	No	-	-
Mauritania	No	-	-
Morocco	Yes	Brownfield	Rabat
Oman	Yes	Brownfield	Masqat
Palestine	No	-	-
Qatar	Yes	Brownfield/ Greenfield	Lusail City – Greenfield Doha City - Brownfield
Saudi Arabia	Yes	Greenfield	King Abdullah Economic City
Somalia	No	-	-
Sudan	No	-	-
Syria	No	-	-
Tunisia	Yes	Greenfield	Tunisia Economic City (in planning stage)
United Arab Emirates	Yes	Brownfield/ Greenfield	Masdar City - Greenfield Dubai City - Brownfield
Yemen	No	-	-

3 Countries with successful strategic plans and regulatory framework on use of ICT/telecom for transition to smart and sustainable development in various spheres

Most countries that are making effort to transit to smart and sustainable development are doing so through implementation of smart cities. Examples of country-based smart cities initiatives linked to smart and sustainable development are summarized I Table 2.

Table 2: Country-based Smart Cities Initiative linked to Smart and Sustainable Development

S No,	Nation/Effort	Description and Fields related to Smart Cities
1	European Commission	1. Launched a Smart Cities and Communities European Innovation Partnership (SCC) the European Commission that aims to boost the development of smart technologies in cities. Standardisation is one of the 11 areas of work that is being undertaken 2. EU"s Seventh Framework Programme for Research(FP7) will invest €4.8 billion in thematic areas, with specific priorities in areas that include developing Smart Cities.
2	USA(NIST & ANSI)	1. Created Framework and Roadmap for Smart Grid Interoperability 2. Launched Draft Cyber-Physical Systems Framework 3. Launched a Global City Teams Challenge 4. Convened a Joint Member Forumin contributing to national and international Smart City initiatives.
3	UK (BSI)	Developing a standards strategy for Smart Cities. Several documents released or releasing including • BSI PAS180 Smart cities – Vocabulary • BSI PAS 181 Smart city framework – Guide to establishing strategies for smart cities and communities • BSI PAS 182 Smart City Data Concept Model • BSI PD 8100 on Smart City Overview – a guide for city managers • BSI PD 8101 Smart cities – Guide to the role of the planning and development process • BS 8904 Guidance for community sustainable development provides a decision-making framework that will help setting objectives in response to the needs and aspirations of city stakeholders • BS 11000 Collaborative relationship management
4	China	Several national standardization committees and consortia have started standardization work on Smart Cities, including: • China National IT Standardization TC (NITS), • China National CT Standardization TC, • China National Intelligent Transportation System Standardization TC, • China National TC on Digital Technique of Intelligent Building and Residence Community of Standardization Administration,

		• China Strategic Alliance of Smart City Industrial Technology Innovation
5	Korea	Standardization of ICT infrastructure, processes and governance norms that leads to the creation of an extensive information-led ecosystem which can deliver uniform citizen and business services. Set up U-City projects that will have an intrinsic lifecycle management process aligned to changing business and citizen requirements, thereby driving sustained competitive edge
6	Germany	Member of European Innovation Partnership (EIP) for Smart Cities and Communities. DKE (German Commission for Electrical, Electronic & Information Technologies) and DIN (GermanInstitute for Standardization) have developed a joint roadmap and Smart Cities recommendations for action in Germany.
7	Poland	A coordination group on Smart and Sustainable Cities and Communities (SSCC) was set up in the beginning of 2014 to monitor any national standardization activities. It has two thematic groups; one on terminology and links with the technical bodies in PKN, the other for the development of a wok programme
8	Spain	AENOR is running a standards programme made of 13 projects. These standards will promote smart cities in Spain and publications are expected during 2015-2016. A report has been published in July 2014 a report that includes the National standardization strategy for smartcities.

4 ICT strategic plans and regulatory frameworks for smart and sustainable development:

Sample strategic plans and regulatory frameworks for smart and sustainable development in this report are picked from key domain areas namely; smart learning, smart cities, disaster management, climate change adaptation and mitigation.

4.1 Smart Learning:

Most smart learning initiatives are based on the Qingdao Declaration[18] that:

1. Recognizes the advancement in ICT and the rapid expansion of internet connectivity that has made today's world increasingly interconnected, and rendered knowledge and familiarity with ICT essential for every girl and boy, woman and man.
2. Emphasizes harnessing of ICT to strengthen education systems, knowledge dissemination, information access, quality and effective learning, and more efficient service provision.

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[18] http://www.unesco.org/new/en/education/resources/in-focus-articles/qingdao-declaration

3. Supports the importance of ICT-based solutions in ensuring that, in the wake of a conflict or natural disaster resulting in the destruction of schools or universities or in the impossibility of normal operations, the right to education is enforced.

According to the Third Arab Knowledge Report,[19] it is noted that knowledge and education is considered as one of the key pillars of a nation's development and advancement. With increasing opportunities for learning in individual contexts anytime and anywhere, the expectations of customization of learning to suit individual needs are more pressing than ever before. These advancements provide additional opportunities for individual students within the context of Smart Learning to make learning process adaptive, effective, efficient, engaging, flexible, thoughtful and accessible.[20]

Smart learning environments provide learner-centred environments that are intelligent and open, and integrate digital virtual reality learning space. These environments are primarily based on constructivist learning theory, blended learning theory and modern teaching theory, with a sophisticated interplay of equipment, tools, technology, media, textbook, teachers, students and even parents.[21] .

The following are the characteristics of smart learning environments[22]:

• *Learning resources:* Smart learning environments ought to have resources that support seamless connection and automatic synchronization of learning content and learner's progress across multiple devices, and deliver on-demand resources.

• *Learning tools:* Smart learning environments require specialized tools for effective learning. Tools that enable integration of emerging technology within existing infrastructure, and allow teachers and students to create diverse learning scenarios.

• *Learning community:* Smart learning environments enable interconnectivity of real communities through mobile devices to enable communication anytime and anywhere. They may also match various learner communities based on various characteristics. These environments depend on media literacy.

• *Teaching community:* Smart learning environments need to link teachers to create a teaching communities and a connected cross-linked regional communities.

• *Learning methods:* Smart learning environments foster knowledge construction through collaboration among learners and learner communities. They focus on high-level cognitive objectives. They support diverse assessment approaches, and promote critical and analytical thing skills.

• *Teaching methods:* Smart learning environments emphasize on activity design and guidance. They support adaptive evaluation of learning outcomes based on the cognitive characteristics of the

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[19] http://www.undp.org/content/dam/rbas/report/UNDP-GENERAL-REPORT-ENG.pdf

[20] Spector, J. M. (2014). Conceptualizing the emerging field of smart learning environments. Smart Learning Environments

[21] Zhong, G., & Zhang, X. (2006). A building of the current intelligent learning environment mode. Computer Science, 1, 170-171

[22] Huang, R., Yang, J., & Hu, Y. (2012). From digitalized environment to smart environment: the reform and trends of learning environment. Open Education Research, 18(1), 75–84

learners. They enable timely and real-time intervention in the learning activities to enable both formative and summative feedback.

4.1.1 Education and literacy Status in Arab Region:

Nature Middle East (2011)[23] reported that six million primary school-aged children in Arab world were out of school, with majority being girls. Therefore, a need was identified of finding a new approach that would revolutionize education and help reduce the number of children out of school. The use of technology to open up new avenues and opportunities in education was recommended. The World Telecommunications Development Conference 2014, recommendation to the Arab countries was that they focus on smart learning in years 2015-2017[24]. In order to implement smart learning, the following are key inputs for inclusion while forming smart learning strategies at national level:

- A team experienced in strategic planning, analysis and communication process.
- Dynamic updating of national strategies in accordance with the changes in country's strategic context and advancements in information and communication technology infrastructure
- Regular engagement with essential education and ICT experts.
- Transparent processes so as to maintain stakeholder support and momentum for further activity and investment in smart learning.
- Establishment of formal channels for obtaining feedback from stakeholders.

Smart learning Strategic planning key activities include:

• Engaging key stakeholders in creating national strategies for smart learning, the action plan and its subsequent implementation.

• Establishing institutional framework with appropriate governance mechanism at national and regional levels.

• Creating suitable environment that provides a strategic context to enable the government to make informed decisions on whether to pursue opportunities that present themselves from the education and ICT sectors towards smart learning implementation.

• Reviewing existing education environment and ICT infrastructure with a view to align with the smart learning requirements.

• Identifying and classifying as short-, medium- and long-term smart learning goals for individual countries and the region.

Smart Learning Initiatives have proved to be essential for contextualizing ICT in Education and as part of the process of sustainable development. Smart learning reinforces the quality of education, which is considered as one of the most powerful tools for achieving the Sustainable Development Goals. Table 1 maps Smart Learning support on various SDGs and explains the role of education towards achieving the goal.

Table 3: Mapping Smart Learning-enabled Education Support on Sustainable Development Goals

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[23] http://www.natureasia.com/en/nmiddleeast/article/10.1038/nmiddleeast.2011.26
[24] http://www.itu.int/en/ITU-D/Regional-Presence/ArabStates/Pages/Events/2015/SL/default.aspx

SDG Number	SDG	SDG Description	Smart Learning-enabled education support towards SDG achievement
1	No Poverty	End poverty in all its forms everywhere	Education is one of the most effective ways to reduce poverty-UNESCO
2	No Hunger	End hunger, achieve food security and improved nutrition and promote Sustainable agriculture.	There is strong evidence that a mother's education improves her children's nutrition, especially as she seeks higher levels of schooling.-UNESCO
3	Good Health	Ensure healthy lives and promote well-being for all at all ages.	Better educated people are much less vulnerable to health risks. They are more likely to be well informed about various diseases and take steps to prevent them.-UNESCO
4	Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.	Education equips learners of all ages with the skills and values needed to be responsible global citizen such as respect for human rights, gender equality, and environmental sustainability.
5	Gender Equality	Achieve gender equality and empower all women and girls.	Education enables girls and women to reach their full potential - in parity with men and boys - in their homes, communities, workplaces and institutions of influence .WB
6	Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all.	As communities become better educated about the links between sanitation and health they improve on their sanitation .-UNESCO
7	Clean Energy	Ensure access to affordable, reliable, sustainable and modern energy for all	Educated citizens are more likely to recognize and adopt new practices and technologies that help their communities prosper. Educated citizens are positioned to build and maintain energy infrastructures that is sustainable.
8	Good Jobs and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and Productive employment and decent work for all.	Education is one of the strongest drivers of economic progress and prosperity. Studies have shown that each additional year of schooling raises average annual gross domestic product (GDP) growth by 0.37%.UNESCO
9	Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	As a country's inhabitants become better educated, they are more likely to acquire their own critical technical skills and creative problem solving capacity necessary to build and sustain roads and bridges, ICT systems, ports and airports, health

			and financial systems, governance practices and the many other structures that enable life in a country to improve and flourish.
10	Inequalities	Reduce inequality within and among countries.	As more children, from across the demographic, geographic and cultural spectrum become educated, inequality reduces. UNESCO,WB
11	Sustainable cities and communities	Make cities and human settlements inclusive, safe, resilient and sustainable.	With education, people are more likely to understand, support and craft creative solutions that ensure the basic ingredients of sustainable cities and communities are in place. Good urban planning, efficient energy use, good water and sanitation management, social inclusion. WB
12	Responsible Consumption	Ensure sustainable consumption and production patterns.	Education raises the hopes that people will use energy and water more efficiently and recycle household waste, according to UNESCO. A study of Ethiopia showed that, six years of education improve by 20% the chance that a farmer will address climate change by adopting techniques such as soil conservation, variation in planting dates and changes in crop varieties.
13	Protect the Planet, Life below water, Life on land	Take urgent action to combat climate change and its impacts.; Conserve and sustainably use the oceans, seas and marine resources for sustainable development.; Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss.	With higher levels of education, people across many different societies show greater concern about the well-being of the environment. UNESCO
14	Peace and justice	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.	Education is an essential precursor to peace, tolerance and a healthy civil society. Studies have shown that people with secondary educations are more likely than those with only primary education to show tolerance for people who speak another language.

			Literate people are more likely to participate in the democratic process and exercise their civil rights. It is observed that that, if the enrollment rate for secondary schooling is 10 percentage points higher than the average, the risk of war is reduced by about three percentage points. UNESCO

Table 4: Key smart learning outputs linked to outcomes[25]

Priority stakeholder	Outcomes	Outputs
School teachers	• Improve the ability of teachers to access high quality digital resources for their courses • Provide ongoing access to training resources for teachers to improve competencies to teach 21st century skills to students • Improve the ability of teachers to monitor and track their students' performance in real time • Improve the ability of teachers to exchange student information with other teachers • Enable teachers to interact with students and parents who are located remotely • Enable teachers to collaborate with other teachers and share their expertise, concerns and best practices effectively through ICT	• National digital resources repository established • National mobile educational apps repository established • Appropriate teacher training programs established • Classroom Learning analytics based platform deployed • National smart learning data and messaging standards in place • High bandwidth data/telecommunications connectivity established to rural and remote communities • National communities of practice infrastructure established
School principals	• Improve ability of principals to access resources to implement virtual learning, online learning, blended learning and other emerging learning modes in their schools • Provide on-time and on-demand access to technical support for principals to continuously maintain ICT infrastructure in their schools	• National digital resources repository established • School-level Learning analytics based platform deployed • Appropriate technical support infrastructure established
Senior education administrators	• Support national and regional education authorities to plan ICT infrastructure improvements • Support national and regional	• National and regional level Learning analytics based platform deployed • National and regional level Academic analytics based platform

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[25] http://www.itu.int/en/ITU-D/Regional-Presence/ArabStates/Documents/events/2015/SL/Forumfinalenglishreport-clean.pdf.

	education authorities to monitor and respond to low performance of students • Support the education, training and development of the country's educator workforce • Provide reliable and quality data to inform and monitor the results of policy, investment and administrative decisions. • Provide access to quality data sources that inform service and workforce planning and management • Enable effective management of the creation, supply, distribution and availability of high quality digital learning resources	deployed • National and regional teacher training programs established • National and regional computing/access infrastructure deployed to rural and remote communities • National and regional reporting portal service established • Surveillance applications for mobile devices developed and deployed
Educational researchers	• Provide researchers with greater access to evidence-based information to support experimentation of innovative and emerging pedagogical changes in learning and assessment • Improve access to the technology-enhanced learning literature, knowledge networks and resources	• Appropriate ethics policy and standards established for educational technology research • Educational researcher network community infrastructure established • Appropriate channels of communication established between researchers and school administrators
Parents	• Improve the ability of parents to track the performance improvement of their children • Improve the ability of parents to provide technology-enhanced learning to their children in rural and remote areas • Improve parents engagement in their children's education by ensuring effective information flow between them and teachers	• Regional Learning analytics based platform deployed • High bandwidth data/telecommunications connectivity established to rural and remote communities • Reliable computing/access infrastructure deployed to rural and remote communities • Multiple channels of communication established between teachers and parents
Local educational technology industry	• Improve the ability of local educational technology industry to innovate for enhancing education within local context • Streamline the process for local educational technology industry to engage with schools • Preference to somewhat more costly local educational technology products over cheaper solutions from large multinational	• Local educational technology industry database established • Appropriate channels of communication established between local educational technology industry and school administrators • Transparent tender process supporting local educational technology industry established

4.2 Disaster Management:

Reducing disaster risk is a cost-effective investment in preventing future losses. Effective disaster risk management contributes to sustainable development. It is urgent and critical to anticipate, plan for and reduce disaster risk in order to more effectively protect persons, communities and countries, their livelihoods, health, cultural heritage, socioeconomic assets and ecosystems, and thus strengthen their resilience.

Enhanced work to reduce exposure and vulnerability, thus preventing the creation of new disaster risks, and accountability for disaster risk creation are needed at all levels. More dedicated action needs to be focused on tackling underlying disaster risk drivers, such as the consequences of poverty and inequality, climate change and variability, unplanned and rapid urbanization, poor land management and compounding factors such as demographic change, weak institutional arrangements, non-risk-informed policies, lack of regulation and incentives for private disaster risk reduction investment, complex supply chains, limited availability of technology, unsustainable uses of natural resources, declining ecosystems, pandemics and epidemics. Moreover, it is necessary to continue strengthening good governance in disaster risk reduction strategies at the national, regional and global levels and improving preparedness and national coordination for disaster response, rehabilitation and reconstruction, and to use post-disaster recovery and reconstruct. The Sendai Framework for Disaster Risk Reduction 2015-2030 outlines seven global targets for disaster risk reduction by 2030. They are:

a) Reduction of global disaster mortality
b) Reduction of the number of affected people globally
c) Reduction of direct disaster economic loss in relation to global gross domestic product (GDP)
d) Reduction in disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities
e) Increase in the number of countries with national and local disaster risk reduction strategies
f) Enhancement of international cooperation to developing countries through adequate and sustainable support to complement their national actions for implantation of this framework
g) Increase in the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people

Lack of access to ICT is at its most acute for the one billion living in Least Developed Countries (LDCs). Already vulnerable in economic terms, they are also extremely exposed when disasters strike. In many cases, the communities that suffer most from natural disasters are the most disadvantaged to begin with. In a time of continuing global financial challenge, resources are scarce. In isolation, solutions look unaffordable. But the technological options for support exist. The ITU Telecommunication Development Bureau (BDT) launched in 2012 the Smart Sustainable Development Model (SSDM) Initiative as a framework to answer both needs: supporting development through ICT, and managing disasters with ICT. When a natural disaster strikes a community, the effects are both immediate and longer term. Studies show that even when a disaster has been overcome, wider economic and social development may also be severely impacted, something that may not often be fully recognized. ICT projects in different areas are no longer in isolation. Instead, the SSDM Initiative seeks to link ICT for development (ICT4D) and ICT for disaster management (ICT4DM) naturally and coherently. This could be truly empowering. Communities may be able to respond and regenerate more easily when disaster strikes. The SSDM approach supports optimization of investments, make best use of scarce resources

and finds and shares the best practices from both areas. By identifying and addressing core issues and teaming compatible practices of ICT4D and ICT4DM, this Initiative is both smart because it unifies and leverages resources and components, thus sustainable because it addresses present needs without ignoring future ones. This rationale aligns well with initiatives such as the United Nation's Sustainable Development Goals (SDGs). Correctly combining the two approaches makes for cost-effectiveness, efficiencies, and is timely in the utilization of resources. Most importantly, where ICT resources can rapidly be switched into ICT4DM modes in the first few hours after a disaster strikes, many lives can be saved.

Managing disasters is an integrated and multilayered process. Generally speaking, the functions of disaster management include[26]:

a) Clarifying risk and encouraging preparedness;
b) Issuing evacuation and warning;
c) Enhancing coordination, cooperation, and logistics;
d) Facilitating mitigation on the part of the public and affected communication;
e) Helping make sense of the disaster;
f) Reassuring, comforting, and consoling those affected;
g) Recreating order and meaning, facilitating renewal, and learning and disseminating lessons

In order to fulfil the above listed disaster management functions, it is indisputable that good quality of communication plays a central role and hence can strongly contribute towards the vulnerability and resilience of the society.

Merits and Demerits of ICT in Disaster Management:

ICTs facilitate access to disaster information in times of emergency and have advantages over traditional media. The following are some of the major merits:

1. ICTs can enable disaster agencies to provide information directly to the intended stakeholder bypassing the gatekeeping process usually practiced by classical media outlets. That is to say, ICTs offer disaster agencies the opportunity to create their own web pages; to constantly update information beyond space and time limitations and address audiences directly. Disaster agencies can transmit relevant content rapidly; provide content in different languages, and use different forms of presentation. Information on this basis may be more authentic than that processed through the media system and the content can include detailed information of local, national and international services.
2. New ICT technologies offer unique information and communication opportunities. It supports a new form of media that enables users to set up personal preferences for the kind of information they want to receive. Additionally, people will no longer be just passive audiences, as web-based software supports interactive tools. People are able to report incidents, post messages and start discussions.

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[26] Auf der Heide, E. (2009). The media: Friend and Foe. In Disaster Response: Principles of

Preparation and Coordination. From http://orgmail2.coe-dmha.org/
dr/DisasterResponse.nsf/section/10?opendocu ment&home=html

3. The ICT capability to support the archiving function, presents an advantage for disaster communication and sharing of lessons learnt. The electronic mode of communication enables sharing of information with other domains of disaster and risk knowledge platforms.

However, ICTs do also have demerits that are worth mentioning.

1. Internet is not yet considered reliable when it comes to disaster information seeking processes. In a crisis situation most people still remain highly dependent upon traditional mass media.
2. ICT and related information sources are yet to be considered fully credibility by the general public. Especially social network sites are vulnerable to spreading inaccurate or false information.
3. ICT raises questions concerning issues of access, exclusion and participation.

When Disaster Recovery Management (DRM) is integrated as part of a sustainable development process, the loss and damage incurred as a result of disasters is reduced. In order for development to be smart and sustainable, DRM ought to be incorporated in the development activities. So that in the event of a disaster, when the development trajectory is brought down, the DRM takes over and dominates the activity. Disaster recovery is planned and executed with the objective of bringing the affected communities back to the sustainable development path. Media is modeled as part of DRM in that it has a critical role in keeping the public aware of disaster risks and how to reduce them. It is also expected to broadcast early warning and provide humanitarian updates of disaster events, as well as report on post-event recovery so that the public is kept informed of the efforts by government and other stakeholders.

Bangladesh has been able to reduce human casualties from cyclones by spending modest sums of money on shelters, developing accurate weather forecasts, issuing warnings and arranging for evacuations (WB, 2010). All these actions cost less than the humanitarian aid provided when cyclones strike. This example of Bangladesh demonstrates a change in disaster management policy from relief to proactive DRM.

The United Nations report UNISRD (2011) highlighted the Hyogo Framework for Action 2005-2015 (HFA) that defined the role of ICTs in disaster management in terms of enhancing the compilation, dissemination and use of Disaster Risk Reduction information. HFA demands that ICTs must be deployed to support disaster management through ensuring that:

- Systems are in place to monitor, archive and disseminate data on key hazards and vulnerabilities.
- Relevant information on disasters is available and accessible at all levels, to all stakeholders.
- Procedures are in place to exchange relevant information during hazard events and disasters, and to undertake post-event reviews.

Mobile phones have been playing a part in all stages of the DRM cycle, from early warning during the pre-disaster period, one-way and two-way communication during the actual disaster, to recovery in the immediate aftermath. IFRC and other organizations have used mobile phones to allow affected families to re-establish contact or confirm to relatives that they are safe during the immediate aftermath of a disaster. Mobile phones are also increasingly used in improving transparency and accountability of aid delivering processes. Nelson (2011) reported the case of Haiti in 2010 where SMS 4636 free code service that allowed victims to send free SMS about their status.

Social media is not only an effective tool for monitoring and engaging public discourse during the crisis process, but also enables a cultural shift regarding how the public views its role as an empowered contributor. Two-way, participatory communication allows people to provide a vital source of data concerning needs, fears, rumours and perceptions, which in turn contribute to an effective response. Thousands of people in Philippines were persuaded to move to safer places or take precautionary measures before Megi struck on 18th October 2010. Social media enables members of the public to report their needs in a disaster, or recruiting volunteers from around the global.

4.2.1 ICT for Disaster Mitigation:

Disaster mitigation is the effort to reduce the loss of life and property by lessening the impact of disasters. The adverse impact of disaster often cannot be prevented fully, but its scale or severity can be substantially reduced by various strategies and actions. ICTs are effective tools for improving mitigation efforts, including the formulation of mitigation strategies and their implementation.

The principal objectives of mitigation are to save lives, minimize economic loss and disruption, reduce vulnerabilities, and lower the level of conflicts. It involves long-term measures to lessen the effects of disaster-causing phenomena, and should be part of the development efforts.

Mitigation is fundamental for reducing vulnerabilities. The following are some examples of the value of mitigation:

- Mitigation creates safer communities by reducing loss of life and property damage. For example, the rigorous building standards adopted by 20,000 communities across the United States are saving the country more than USD 1.1 billion a year in prevented flood damages.
- Mitigation allows individuals to minimize post-flood disaster disruptions and recover more rapidly. For example, in the United Sates, homes built to the standards of the Federal Emergency Management Agency's National Flood Insurance Program incur less damage from floods. And when floods do cause damages, flood insurance protects the home owner's investment, as it did for more than 200,000 Gulf Coast residents who received over USD 23 billion in payments following the 2005 hurricanes.
- Mitigation lessens the financial impact on individuals, communities and society as a whole. For example, a recent study by the Multi-hazard Mitigation Council (a council of the National Institute of Building Sciences, USA) shows that each dollar spent on mitigation saves society an average of four dollars.

Structural mitigation measures include construction of barriers, physical modification, resistant construction, and development and implementation of building codes. Non-structural mitigation measures include land-use planning/zoning, risk mapping, environmental protection regulations, insurance programmes, tax incentives, and community awareness and education programmes.

The Role of ICTs in Disaster Preparedness

ICTs provide vital support for disaster preparedness through observation, monitoring, recording, classifying, analysing, sharing, networking, communication and warning dissemination. Remote sensing and GIS have become integrated, well-developed and successful tools in disaster preparedness in the form of monitoring, forecasting, predicting, measuring and mapping of various impending

disaster events and helping disseminate early warning. Satellites offer accurate, frequent and almost instantaneous data over large areas anywhere in the world.

4.2.2 ICT for Disaster Recovery and Reconstruction (DRR)

During the whole process of recovery and reconstruction, there are different types of ICT tools that can be used as per the situation. However, in a large-scale disaster, where countries seek international assistance, a number of challenges are inevitable and have to be faced and resolved. They include:

- Duplication of data processing due to lack of coordination among working teams
- Not all post-disaster information is collected as per a plan, but rather in an improvised manner
- Political and legal set-up of the country: Certain countries prevent the use of high-tech ICTs without government approval, or forbid the use of trans-border communications equipment.
- Decisions are connected with security (e.g., Myanmar allowed a very limited number of organizations to intervene during Cyclone Nargis)
- As per the prevailing laws and regulations in the country, if the disaster occurred in high security areas, the situation further restricts humanitarian assistance and recovery efforts (e.g., restrictions on the use of mobile phones in certain areas after the Pakistan earthquake in 2005)

In readiness for such circumstance, policymakers, institutions and governments ought to do the following:

- Integrate appropriate ICT use widely in disaster response while avoiding ad hoc systems or systems that require a high level of technical capacity.
- Incorporate specialists with ICT experience in assessment and project teams to promote full use of emerging ICTs in recovery and reconstruction.
- Ensure that ICT systems are compatible with existing government systems, particularly if they will continue to be used after the disaster.
- Involve stakeholders in assessment, validation, monitoring, and other reconstruction-related activities by using accessible, collaborative technologies, including social media tools.
- Support the use of open systems and standards to ensure interoperability. Require developers to standardize and geo-reference information through specifications in contracts and terms of reference.
- Promote the use of field-level ICT systems that assist reconstruction project management, provide transparency to affected communities, and permit the unification of data.
- Encourage development of resilient information systems that can be readily restored after a disaster, and to establish agreements with local and international ICT-related stakeholders that specify mechanisms for post-disaster cooperation.
- Encourage governments to establish policies and laws that provide the right to information on hazards and risks, after a disaster and at other times, to support the incorporation of DRR measures in planning and construction.

4.3 Smart Cities

ITU made the following observations about cities in 2015:

1. Buildings produce a fifth of the world's CO2 emissions.
2. Cities account for about two-thirds of global energy demand.
3. Cities produce up to 70% of global greenhouse gas emissions.
4. Buildings account for roughly 40% of the world's energy use.
5. An estimated 80% of global GDP is generated in cities.
6. By 2050, 75% of the world population will be living in cities
7. 1/3 of people in developing countries living in cities, live in slum/squatter settlements.
8. In the world, over 750million live in urban areas without adequate shelter and basic services.
9. Almost 180,000 people are added to the urban population each day.

According to ITU and UNECE[27], A smart and sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects. ICT has been recognized as the true enabler of the smartness in every aspect of the smart city paradigm. Given the benefits and opportunities offered by ICTs/Telecoms, it is acknowledged that the Arab countries cannot effectively forge ahead with its transition to smart and sustainable cities development and environment protection agenda without putting in place appropriate ICT guidelines and framework to support and accelerate the Regional Initiatives[28]

Urban areas are getting more and more congested due to people's migration, natural population growth and environmental changes. At the same time, rapid urbanization puts pressure on resources, increasing demand for energy, water and sanitation, education, health care and public services. Cities are therefore referred to as the engines of economic growth. There is accordingly a desperate need for the cities to get smarter to handle this large-scale urbanization and to find new ways to manage complexity, increase efficiency, reduce cost, and improve quality of life.

The actual high level of urbanization is presenting a serious challenge for the sustainable development of our cities. In 2007, for the first time in the history of mankind, the number of people living in cities surpassed the number living in rural areas and it is estimated that the proportion will exceed 70% by 2050. Urban areas are responsible for considerable world's energy consumption and greenhouse gas net emissions. Urbanization leads to the continuing expansion of urban areas and urban sprawl, reducing the land available for other uses. This urbanization is often uncontrolled, creating and expanding informal settlements, whose residents may lack security of tenure and social and physical infrastructure. Furthermore, cities as planned, are not prepared for the ongoing demographic changes given that by 2050, 75% of the world population will be living in cities. Globally a large share of the population does not have access to affordable housing. This situation with all the mentioned challenges that urban areas face, has the potential to become critical and irreversible if not acted upon soon. At the same time, approaches to urban development, if aptly and timely rethought and put into practice, have the potential to become the driving force underpinning sustainable development.

It is pertinent to note that several forward looking nations have embarked upon their own standardization initiatives, national or regional strategy, and commercial solutions on smart cities. This includes the European Union, United Kingdom, United States of America, China, Korea and Germany. Much attention has been devoted in recent years to the topic of "smart cities". Multiple programmes have been successfully implemented in large cities in different parts of the world, including, for instance, in European cities of Amsterdam, London and Vienna. The EU is implementing the European

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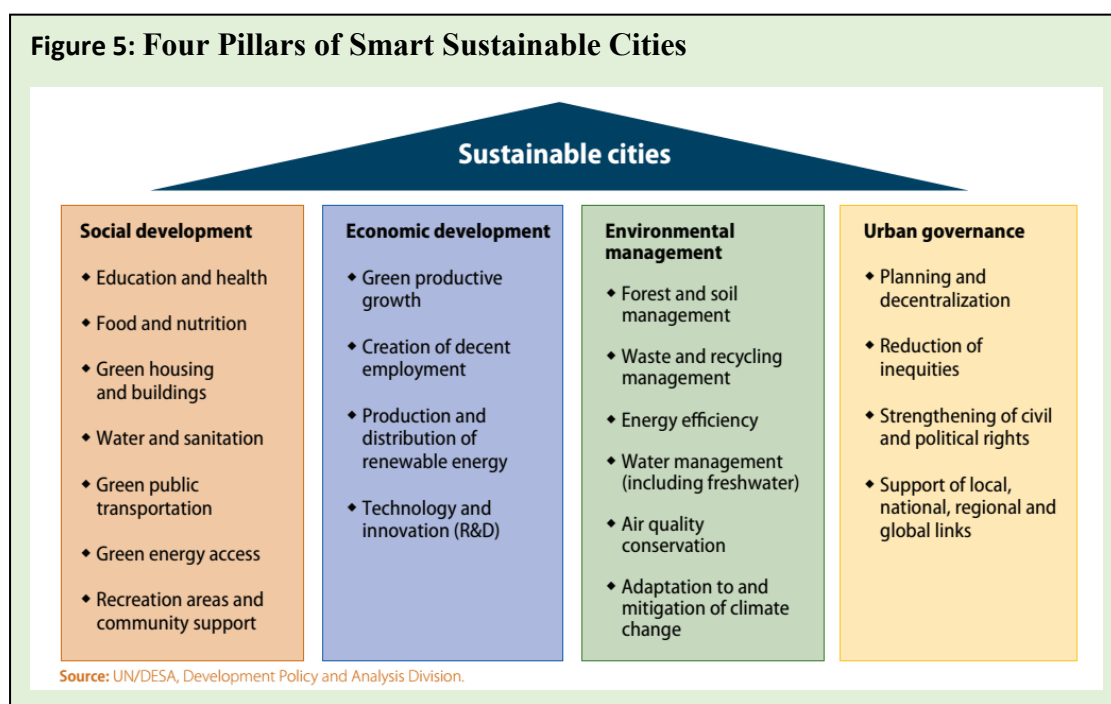[27] http://www.itu.int/net/pressoffice/press_releases/2016/CM10.aspx#.WIyJplMrKM8
[28] Dubai Action Plan 2015-2017

Innovation Partnership on Smart Cities and Communities (EIP), which is a large-scale mapping and coordination exercise of smart cities within the EU. The implemented programmes continuously demonstrate great possibilities of the application of innovative technologies and solutions in cities. They also have shown the importance of partnerships between national, local governments and private sector towards promoting smart urban solutions. For small and medium-sized cities, which have limited access to financial resources, it is much more difficult to promote smart city solutions. Countries with economies in transition where access to financial resources for investment into innovative technologies is limited are not part of those initiatives. This is unfortunate because these countries could have benefited the most from the application of the smart cities approaches by "leapfroging" in quality and diversity of services they provided to their inhabitants.

The rapid increase in population coupled with financial constraints, the convergence of technologies and desire to reduce environmental impact is creating new challenges and opportunities for cities in areas such as energy use, mobility, security, infrastructure, healthcare and governance. The solution to this challenges is to transit to smart sustainable cities.

The concept of 'Smart' and 'Sustainable' City varies among cities and around the globe. Requirements of different cities may depend upon local factors and its objectives, but a sustainable smart city should have forms of smart communication/ ICT infrastructure, smart mobility, smart living, smart economy, smart environment, smart governance and smart citizens. It is also not about technology providers offering solutions, but integrating solutions, proving interoperability and cohesion among systems within a city in full collaboration with all stakeholders involved. Around the world there are examples of smart cities emerging and many countries have developed plans for facilitating these.

Beatley et al, (2012) suggested that building a "green" city is in line with sustainable development. Many countries are planning and engaged in building green cities and "eco-cities" as starting points of sustainable development. Yet, it is important to understand cities' sustainability as a broader concept which integrates social development, economic development, environmental management and urban governance- that refers to the management and investment decisions taken by municipal authorities in coordination with national authorities and institutions. Achieving the sustainability of cities can be conceived as entailing the integration of four pillars: social development, economic development, environmental management, and urban governance. Fig. 4 shows the integration of the four pillars.

Figure 5: Four Pillars of Smart Sustainable Cities

Sustainable cities

Social development	Economic development	Environmental management	Urban governance
• Education and health	• Green productive growth	• Forest and soil management	• Planning and decentralization
• Food and nutrition	• Creation of decent employment	• Waste and recycling management	• Reduction of inequities
• Green housing and buildings	• Production and distribution of renewable energy	• Energy efficiency	• Strengthening of civil and political rights
• Water and sanitation	• Technology and innovation (R&D)	• Water management (including freshwater)	• Support of local, national, regional and global links
• Green public transportation		• Air quality conservation	
• Green energy access		• Adaptation to and mitigation of climate change	
• Recreation areas and community support			

Source: UN/DESA, Development Policy and Analysis Division.

Smart cities need robust and resilient technologies that:

a) Facilitate interoperability of heterogeneous ICT-systems.

b) Support reliable automation of most city functions.

c) Facilitate indiscriminate data capture, storage, analytics and preservation

d) Make data exchange fluid and rapid between different types of network topology and using different types of communication and transmission;

e) Facilitate the use and aggregation of data by systems and services that may not have initially generated them;

f) Allow for data to be presented in a variety of formats, dependent on the context and the person or technical system needing it, allowing it to be analysed, visualised, accessed, and acted upon more easily, thus making it much more useful

4.3.1 Smart and Sustainable Cities in the Arab Region

The new urbanization model is universal and adaptable to different national circumstances, based on key urbanization challenges and opportunities shared by all countries. Implementation of the model must be integrated to address the inter linkages between the environmental, social and economic objectives of sustainable development, and the concerns of different levels of government. It must also enable the empowerment of civil society, thus expanding democratic participation and reinforcing collaboration. The agenda must encompass green cities and environmental sustainability, which involves establishing a critical connection between science, environment, economic growth, urban planning and governance. The key to achieve this move forward is innovation, learning and knowledge sharing, which entail the creation of supportive education, science, technology and innovation policies as well as development of capacities. One of the most important element that enables movement towards more inclusive, resilient and sustainable cities in the Arab region is a global data revolution to attain effective and results-based implementation and monitoring of the new urban agenda at the local, national and global levels. There are a number of enabling tools and reports which can facilitate

this move such as the Cities Prosperity Index, the Arab Sustainable Development Report, the State of Arab Cities Report, and other national and regional reports.

Table 5 summarizes the Arab countries smart and sustainable cities initiatives projects[29]. 10 0ut of 22 Arab countries have SSC initiative projects. The rest can learn best practices from them.

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[29] Ibrahim, M., Al-Nasrawi, S., El-Zaart, A. & Adams, C. (2015). Challenges facing E-Government and Smart Sustainable City: An Arab Region Perspective. 15th European Conference on e-Government, ECEG, pp. 369-404

Country	SSC Initiatives	Brownfield/Greenfield	Example of a SSC Project
Algeria	Yes	Greenfield	Cyberpark City of SidiAbdellah
Bahrain	Yes	Brownfield	Manama
Comoros	No	-	-
Djibouti	No	-	-
Egypt	Yes	Greenfield	Smart Village
Iraq	No	-	-
Jordan	No	-	-
Kuwait	Yes	Brownfield	Kuwait City
Lebanon	No	-	-
Libya	No	-	-
Mauritania	No	-	-
Morocco	Yes	Brownfield	Rabat
Oman	Yes	Brownfield	Masqat
Palestine	No	-	-
Qatar	Yes	Brownfield/ Greenfield	Lusail City – Greenfield Doha City - Brownfield
Saudi Arabia	Yes	Greenfield	King Abdullah Economic City
Somalia	No	-	-
Sudan	No	-	-
Syria	No	-	-
Tunisia	Yes	Greenfield	Tunisia Economic City (in planning stage)
United Arab Emirates	Yes	Brownfield/ Greenfield	Masdar City - Greenfield Dubai City - Brownfield
Yemen	No	-	-

Table 5: Greenfield and Brownfield SSC Initiatives in Arab Region

4.4 Climate Change

Climate change threatens to increase vulnerability, undermine economic gains, hinder social and economic development, and worsen access to basic services and the quality of life of citizens. ICTs are a cross-cutting technologies that can drive the deep transformation needed in the global effort to combat climate change and advance the implementation of the Convention and the Kyoto Protocol[30].

ICTs are being integrated into the fight against climate change, by contributing to the reduction of greenhouse emissions in major industries, supporting adaptation efforts, and helping to build the resilience of communities, industry sectors and countries Climate change negatively impacts on cities and ICT infrastructure, hence affecting key sectors of the economy such as agriculture and construction. It compromises the citizens' quality of life as it affects provision of key public services that are crucial dimensions for sustainable development.

Similarly, rapid urbanization and population growth worsens the impact of climate change on cities. The Department of Economic and Social Affairs of the United Nations (UNDESA), estimated that by 2050, about 66% of the world's population will be expected to live in urban areas, and over 60% of land is projected to become urban by 2030[31]. This high concentration of population and economic activity makes cities particularly vulnerable to climate change[32]. There is a growing number of experiences of ICTs use to support countries to better adapt to climate change. For instance, remote sensing for monitoring of natural disasters such as floods and tidal waves, improved communications to help deal with natural disasters more effectively, or satellite and surface-based remote sensors for environmental observation. According to research on the role of ICTs in the formulation of climate change adaptation strategy at the national level,[33] ICTs have the capability to support climate change adaptation strategies within three broad categories namely:

a) Generating information and knowledge;
b) Capturing and storing information and knowledge; and
c) Processing and disseminating information and knowledge among an increasingly interconnected society.

ICT tools enable information dissemination and analysis. They help to manage, analyze and disseminate geographic information that can be used for contingency planning, disaster assessment and post-disaster response. ICTs also support climate modeling research, and provide new opportunities for policy makers and urban planners to understand cities and to project future scenarios.

During the disaster prevention phase, the use of ICTs such as Geographic Information Systems (GIS) in local hazard mapping and analysis can help to identify and illustrate evacuation routes as well as to locate housing, business and structures that are at risk.[34] ICT can aggregate, create, and integrate data, delivering a comprehensive set of information, appropriate for each end user. Real-time information on the changing climate can support risk assessments, strengthen early warning systems (EWS) and

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[30] https://unfccc.int/resource/docs/convkp/kpeng.pdf

[31] https://esa.un.org/unpd/wup/publications/files/wup2014-highlights.Pdf

[32] UNDESA, 2014.

[33] Ospina, A. V. & Heeks, R. (2011) ICTs and Climate Change Adaptation: Enabling Innovative Strategies, Strategy Brief, Centre for Development Informatics, University of Manchester, UK, www.niccd.org/ICTs_and_Climate_Change_Adaptation_Strategy_Brief.pdf

[34] NICCD, 2011

enhance disaster preparedness. ICT tools capture, transmit and disseminate data on climate and whether conditions, providing useful information on the environment for policy makers. ICTs provide information dissemination and opportunities for urban planners to assess risks and work with future scenarios, thus contributing to the city's adaptive capacity, including its ability to design and implement both preventive and reactive measures.

Box 1: Selected examples of national application of ICT for Climate change

1. The Disaster Early Warning Network (DEWN) was launched in Sri Lanka on 30th January 2009.
   http://www.niccd.org/sites/default/files/NICCD_Disasters_Case_Study_EarlyWarning.pdf
2. Virtual centre on climate change -The Mexico City Government has identified a number of strategic adaptive actions that need to be taken to react to these climatic changes (GDF 2008.
   http://www.niccd.org/sites/default/files/NICCD_Strategy_Case_Study_MexicoCentre.pdf
3. In 2008 a partnership between the regional government of Brittany and UNDP, established a climate science and technology hub in Brest, France: fromClimSAT.
   http://www.niccd.org/sites/default/files/NICCD_Monitoring_Case_Study_ClimSATModelli ng.pdf
4. Telecom network risks management in lima peru
   http://www.itu.int/en/ITU-T/climatechange/Documents/Publications/Resilient_Pathways-E.PDF
5. Initiatives for increasing resiliency in the telecommunications system in New York City, USA. http://www.nyc.gov/html/sirr/html/report/report.shtml
6. The City of New York, 2014. Progress report: Sustainability & resiliency 2014.
   http://www.nyc.gov/html/planyc/downloads/pdf/140422_PlaNYCP-Report_FINAL_Web.pdf.
7. Real-time monitoring for responding to saline intrusion in Can Tho, Vietnam= Source: Asian Cities Climate Change Resilience Network (ACCCRN)
   http://www.acccrn.org/initiatives/vietnam/can-tho/city-projects/developing-and-implementing-real-time-salinity-monitoring-
8. Sustainable urban development planner for climate change adaptation; The case of Wuppertal, Germany.
   https://www.wuppertal.de/pressearchiv/meldungen-2012/oktober/102370100000448723.php
9. ICTs for climate change adaptation in agricultural sector, Japan.
   http://jp.fujitsu.com/solutions/cloud/agri/uecs/
10. Maua town, city of Sao Pablo, VIVO-Clima Precipitation Public Information
    http://www.itu.int/en/ITU-T/climatechange/Documents/Publications/Resilient_Pathways-E.PDF
11. Social media for rising temperature adaptation in Eldoret, Kenyahttp://www.trust.org/item/20130716085920-k63xg/?source=spotlight

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4.4.1 Best Practices for mainstreaming ICT in Climate Change strategies

- **Fostering coherent, long-term strategies based on content, structures and processes-** Actions aimed at integrating ICTs and climate change adaptation strategies take place in complex contexts, characterized by the impact of both climatic and non-climatic development stressors. Therefore, countries should adopt well-structured approaches based on three key areas of action: the development of ICT and climate change *content*, the design of ICT and climate change *structures*, and the implementation of ICT and climate change *processes*.

- **Public sensitization of ICTs current and emerging areas of potential-** The development of content in ICTs and climate change should acknowledge the low level of awareness that still exists on the subject, given its relative recent emergence in the policy and strategic realms. Thus, clear concepts and terminology should be used. Likewise, considering the rapid development of the ICT sector, strategies should remain flexible in order to integrate the potential of both traditional and emergent ICT applications.

- **Supporting inclusive and participatory structures, led by trusted institutions -** The design of policy structures should consider principles of representativeness and integrate mechanisms for multi-level and multi-sectoral participation in the decision-making processes. Hence, structures should not only acknowledge and integrate the diverse set of stakeholders involved in ICTs and climate change issues, but also be fostered by credible and trusted leaders that can facilitate the articulation of efforts from the government to local authorities.

- **Addressing prevailing challenges of connectivity, access and use-** Ensure universal access to ICTS to the general public and citizens.

5   Challenges in Arab countries

5.1 ICT Challenges

Arab countries are not exempted from ICT challenges that are common across the world. The following ICT challenges have been reported to be specific to the Arab region[35][36]:

- **Obstacles relating to the environment -**Most challenges in ICT adoption and usage lie in the political and regulatory environment. They include legal and regulatory issues, weak ICT strategies, chronic R&D shortages, excessive reliance on foreign technology, and weak ICT implementation.

- **High software piracy rates jeopardize confidence-** Arab countries have been reported to be among those with the highest software piracy rates in the world. Arab states suffer bad press and a lack of credibility.

- **Insufficient funding for ICT research and development-** The shortage of ICT R&D funding commitments has constrained the development of the much needed national Arab ICT and software industries thus promoting dependence on foreign expertise.

- **No common plan: foregoing ICT efficiency opportunities -**There is no clear common strategic Arab plan for ICT, and sufficient cooperation on the matter. Although all Arab states have ICT and e-commerce on their agendas, their approaches are often competing and fragmented, replicating the divide between the Gulf and other states.

- **Telecommunications deregulation: slow and limited-** Most Arab states are still at planning stage for telecommunications deregulation. Deregulation has mostly applied to mobile telecommunications networks (GSM) and Internet Service Providers (ISP). Gulf States have been discussing deregulation and privatization possibilities over the last few years, but have not yet fully implemented GSM privatization. Most land lines, fibre optic connectivity, and broadband offerings remain government monopolies, with little deregulation and privatization. Consequently, unless steered in that direction by the state, national incumbents have few incentives to promote connectivity. Government monopolies leave little room for

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[35] Zahlan, A. (1999), "Arabs and the challenge of Science and Technology, Progress without Change," Center for Arab Unity Studies (CIUS), Beirut, March 1999

[36] UNDP (2002), "Human Development Report (2002): Deepening Democracy in a fragmental World," UNDP- New York- Oxford- Oxford University Press (2002).

private infrastructure funding and pan-Arab connectivity initiatives. Consequently; forcing high connectivity charges.

- **Digital poverty-**Most Arab countries are suffering from poor internet services. This is due to lack of direct communications among Arab ISPs. There is a big digital gap among Arab countries. Countries such as UAE, Kuwait, Qatar, and Bahrain are more developed in internet usage compare to countries like Comoros, Djibouti, Somalia, Yemen, Mauritania, and Sudan.
- **Digital divide -**The digital divide is caused by a combination of the structural fragmentation of societies and the lack of leadership in many Arab states with regard to ICT policies and implementation. The divide is aggravated by the absence of cross-Arab initiatives, lack of financing, and poor education.
- **Weak local ICT capabilities-** Statistics on Arab ICT procurement decisions show that nearly all equipment is imported. In the absence of local ICT production, Arab ICT, e-commerce, and related industries cannot be thought of as having a bright future unless local technological development plans are elaborated on and adopted, either by one champion nation, or through an inter-Arab decision. Weaknesses in local software development capabilities increase reliance on foreign technology, especially in terms of programming, language standards definition, and software development. The proportion of software published and translated into Arabic is low, reflecting limited Arab software development demand.

5.2 Political, Environment, Social and Economic Challenges

The Arab region is currently facing a series of political, environmental, social and economic challenges on multiple fronts. Arab region over the years has faced a number of socio-economic and political challenges that include uprisings, rising extremist groups, protracted conflicts, poverty, exacerbated inequality, water and energy insecurity, an alarming number of refugees and internally displaced people, severe resource constraints and the financing gap, inadequate communication infrastructure, very low utilization of ICTs, lack of information, high cost of mainstreaming ICTs for smart and sustainable development. Others include: dramatic increases in conflict, violence and terrorism, rising numbers of refugees and internally displaced persons (IDPs), persistent injustice, mounting frustration over unemployment and rising rates of poverty, unequal access to scarce natural resources.

The complex and interlinked array of challenges faced by the region underscore the need for a transformative, integrated and long-term development agenda for Arab countries. The immediate major challenges facing Arab countries include:

- Shifted priorities away from ICT due to the current political situation in the region
- Poverty and exacerbated inequality
- low participation of women in the labor market
- Water and energy insecurity
- An alarming number of refugees and internally displaced people.
- The Arab region faces severe resource constraints and the financing gap was estimated by ESCWA to be in the order of $85billion for 2015-2016.
- The region is marked by unemployment and conflict, which prevents focus on farming, strongly affects markets, transportation and trade, and further exacerbates the fragility of the region
- Significant progress has been made on improving living standards and on the Millennium Development Goals (MDGs), however progress has not been homogenous or equitable, and in some cases the gains made have not proven to be resilient over time in the face of shocks and instability.

- On the environmental front, water scarcity, land degradation, and worsening climate change impacts raise serious questions regarding water and food security and leave the region vulnerable to shocks.
- Demographic trends are aggravating these problems: the Arab population has nearly tripled since 1970 and over half the region's population now lives in cities placing strain on governments to deliver basic services.
- Unemployment rates are on the rise, with one out of four Arab youths and one out of five Arab women jobless in 2013. With a growing bulge in the youth population, millions of decent jobs need to be created each year to service the growing demand.
- Recently the region, economic performance and development have been strongly affected by political instability, whether domestic, regional or international.
- An extremely worrying trend in the region is the high incidence of conflict: 41% of all Arab countries suffered at least one conflict during the five-year period from 2009 to 2013, one of the highest rates in the world. As a result, the Arab region now accounts for the largest number of refugees, both in absolute and relative terms.
- Largely responses to the problems have been uncoordinated and far apart in the region.

For Arab countries to play a meaningful role in the global economy and be able to transit to smart and sustainable development, these challenges must be addressed. Therefore there is need for the Arab countries to put in place effective regional and global institutional mechanisms that provide capacity building, support monitoring and evaluation, enable experience sharing and access to information, and ultimately incentivize countries to act.
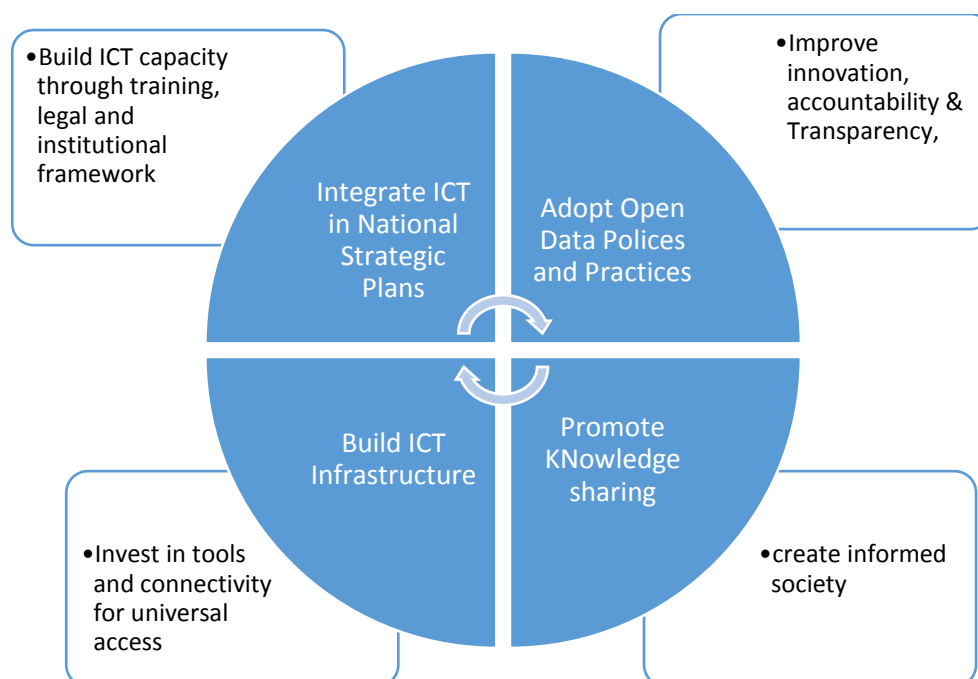
6 Opportunities for the Arab Countries

There are several opportunities that are ICT-based that Arab countries can exploit if they take the following actions:

- Develop a regional Arab plan for funding their ICT sector taking into account the comparative advantage of every Arab country
- Develop the Arab region ICT infrastructure that is based on independent technology and local human resources
- Increase competitiveness of Arab ICT services and industries through facilitating access to technology, encouraging innovations, changing regulations, and developing new technologies
- Support Capacity building through establishment of institutes of higher learning focused on research and development
- Focus on youths and attracting them to ICT sector with emphasis on Arab educational system that promote integration of foreign languages and the Arabic languages.
- Foster international cooperation on telecommunication/ICT development issues
- Foster an enabling environment for ICT development.
- Enhance confidence and security in the use of telecommunications/ICTs, and roll-out of relevant applications and services
- Strengthen human and institutional capacity.
- Provide support for open data practices that conform to open data standards and policies.
- Promote digital inclusion

- Enhance environmental protection, climate-change adaptation and mitigation and disaster-management efforts through telecommunications/ICT
- Raise awareness of the importance of sustainable development and environmental protection, and formulate legislation and regulatory frameworks in support for smart and sustainable development.
- Formulate strategic plans and regulatory frameworks for the transition to smart and sustainable development in various relevant spheres
- Exchange expertise between Arab countries in the field of smart and sustainable development in various spheres.
- Address the challenges of scarce resources, for example water, in the Arab region by means of smart management of those resources using telecommunication/ICT applications
- Use telecommunications/ICTs to confront the consequences of climate change for the Arab region.

7. Roadmap for Arab Countries towards Smart Sustainable Development

- Build ICT capacity through training, legal and institutional framework

- Improve innovation, accountability & Transparency,

Integrate ICT in National Strategic Plans

Adopt Open Data Polices and Practices

Build ICT Infrastructure

Promote KNowledge sharing

- Invest in tools and connectivity for universal access

- create informed society

8 Mapping ICT as key catalysts on sustainable development goals

In September 2015, Governments worldwide adopted the 2030 Agenda for Sustainable Development, with17 ambitious goals (SDGs) at its core. Success or failure in implementing the SDGs and post-2015 agenda largely depend upon national action. Therefore, there is need for the Arab countries to mainstream the SDGs and national targets into their national development plans and strategies.

However, the post-2015 agenda has come at a challenging time for the Arab region. The recent calls for change in the Arab region created a rare wave of upheavals. Economic performance and development in recent years have been negatively impacted by political developments, conflict and instability. Governance deficiencies and inequalities in the distribution of development gains appear to have undermined political and social stability. Arab countries now face challenges or crises on multiple fronts – economic, social, environmental and political – and development is paralyzed in several countries. The complex and interlinked array of challenges faced by the region underscore the need for a transformative, integrated and long-term development agenda for Arab countries.

According to the Ericsson Report 2015, there are five major ways in which ICT can dramatically speed the achievement of SDGs[37]. ICT offers an acceleration of technology uptake in all 17 goals. They do so by reducing the unit costs of service delivery; expanding the range of services that can be offered; economizing on scarce resources, and accelerating the institutional learning through online communities. The uptake of mobile phones, computers, the Internet, and social media, have been the fastest adoptions of technology in human history. ICT not only empowers other technologies and services, it in itself is also one of the technologies that can accelerate uptake. The accelerated uptake of ICT-based services constitute the key to achieving the Sustainable Development Goals by their target date of 2030. ICT can substantially reduce the cost of the deploying new services. For instance, in healthcare, ICT makes possible to expand the role of low-cost Community Health Workers (CHWs), enabling many diagnoses and treatments to be made at the community level (during CHW visits to the households) rather than at high-cost facilities. In education, ICT enables students to access quality online teaching even when no qualified teachers are locally available while online finance allows individuals to obtain banking services even when no banks are present. ICT can dramatically speed up public awareness of new services and technologies, and therefore increase demand. ICT can accelerate technology diffusion by providing low-cost online platforms for training workers in the new technologies.

8.1 Government ICT Action Plan for SDGs
- Rollout of ICTs in support of universal access for citizens and the public sector.
- Establish timelines for universal broadband connectivity of public facilities and public services no later than 2020 to achieve the SDGs by the target date of 2030;
- Digitize public services so that businesses and citizens can interact with the public administration online for purposes of payments, transfers, tax administration, vital registrations, documents, and other purposes. This e-governance will lower the cost of public services, reduce the opportunities for corruption, and create a flow of open data that can be collected, processed, and analyzed to improve public service delivery and to support evidence-driven policymaking.
- Partner with the universities to scale-up ICT training programs and to create innovation hubs to develop new ICT applications;
- Foster Public-Private Partnerships to accelerate the development and uptake of locally designed and targeted ICT applications;
- Upgrade STEM (science, technology, engineering, and mathematics)education in primary and secondary education to build long-term skills and technology readiness;

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[37] How Information and Communications Technology Can Achieve The Sustainable Development Goals. https://www.ericsson.com/res/docs/2015/ict-and-sdg-interim-report.pdf

- Create national online and open databases that incorporate data from public service provision and from satellites, remote sensors, and other connected devices in the Internet of Things. This real-time online data will be a critical resource for achieving the SDGs, and for promoting investments by the private sector.

9 Selected examples of ICT solutions towards attainment of SDGs
The World Summit on the Information Society (WSIS): WSIS - SDG Matrix (2016) is the main reference for the examples cited under this section[38].

Goal 1. End poverty in all its forms everywhere
ICTs can be used to better manage money and to make money through the formation of ICT enabled microenterprise, including ICT-based retailing (e.g.sales of mobiles, accessories and calls), creation of digital content (e.g. music, photographs), digital services (e.g.cyber kiosks, telecentres), and digital production (e.g. data entry, digitization). ICT can help reduce poverty for farmers by enhancing their sale strategy; developing their capacities to understand markets and take good decisions; and increasing farmers' organization around market information and sales strategies.

Goal 2. End Hunger, Achieve Food Security and Improved Nutrition and Promote Sustainable Agriculture
ICTs can be used to access information and knowledge to strengthen local agriculture and livestock production systems. Applications such as mobile phones and community radios can be used to disseminate information in appropriate, simple formats on new seeds and crops variety, livestock breeds, irrigation applications, reminders about planting dates, pest and disease control, livestock vaccinations, alternative fertilizers, among others.

The use of ICTs such as mobile phones can also help to improve market access (through information on prices and consumer trends) and support capacity building opportunities for local farmers via better links to suppliers. GIS and related applications provide essential data for monitoring short and long terms agricultural trends that inform policy formulation and implementation. For instance, agriculture extension services in Bangladesh are highly dependent on extension agents and entail many challenges, such as access to poor farmers. Cellular telephony is a rapidly expanding means of communication in Bangladesh that already accounts for over 120 million subscribers. Krishi Call Centre (Agriculture Call Centre) is a public-private initiative that supports the SDG 2, by aiming at ending hunger and achieving food security by promoting sustainable agriculture. It is based on the toll-free short number 16123, for the provision of easy, rapid, real-time and low-cost extension services to all farmers, particularly smallholders and the marginalized. In Trinidad and Tobago, the AgriNeTT project by the St. Augustine campus of the University of the West Indies, is geared toward research and development on Intelligent Decision Support for Enhancing Crop Management. It aims at increasing food production through collaborative ICT research and development. TheAgriNeTT team is currently building mobile apps and Web-based applications that can assist farmers and policy makers. With a

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[38] World Summit on the Information Society (WSIS): WSIS - SDG Matrix May 2015 https://www.itu.int/net4/wsis/sdg/Content/wsis-sdg_matrix_document.pdf

view to addressing the data gap, an Open Data Repository has been developed to house agriculture data on a national level. The repository will house different data sets from institutions and associations, including farm level production data, commodity prices and volumes, farm land spatial data, soils, weather, and pest and diseases tracking data.

The Techno-links for Improved Access and Income project aims at helping local businesses develop financial and technology-related products and services so that they can better respond to the needs of smallholder farmers and enterprises in Zambia, Nicaragua and Peru. By doing so, the project is in line with target 2.a of SDG 2, which deals with the increase of investment in rural infrastructure and agricultural research. The expected outcomes for this project include: rural households, enterprises and farmers, including women, demonstrating increased usage of new technologies and financial services to increase their productivity, and build assets and/or mitigate risk with results, methodologies and lessons learned being shared with a range of audiences.

Goal 3. Ensure healthy lives and promote well-being for all at all ages

ICTs such as community radio can help to raise public awareness on methods to prevent or mitigate the spread of some vectorborne (i.e.malaria and dengue) and waterborne diseases. Web and mobile applications can draw data from, and provide guidance to, healthcare professionals. For instance, the Online Toxicology Analysis Requests & Results System (OTARR) implements a fully integrated Online Toxicology Analysis that automates all services provided by the Poison Control and Forensic Chemistry Centers across the Kingdom of Saudi Arabia; including installing, configuring and integrating with the Laboratories information management system (LIMS). In addition to that, it includes implementing and integrating with call center and IVR systems as well as providing medical libraries related to toxicology to PCC staff. Developed by the Ministry of Health, the project highlights how e-health strategies may assist decision makers in health planning; indeed, multiple governmental agencies are sending requests and checking results through this integrated system (e.g. Ministry of Interior, Ministry of Finance, Ministry of Civil Services, Ministry of Justice, General Prosecution and investigation Department, Industrial Safety Sector, Saudi Airlines, etc.).The enablement of these e-Services results in Improvement of Patient Care by supplying essential guidelines regarding diagnosis and management of poisoned patient, overcoming shortage of poisoned patient's clinical data, speeding TAT of Toxicology Analysis and swift delivery of PCC analytical work result with prioritization of cases.

It is fundamental to provide access to quality essential health care services and to essential medicines and vaccines for all. The project Open Hospital (OH) is an example of an open source, free software by Informatics Senza Frontiere for hospitals daily management in developing countries, currently installed and used in several hospitals in Africa and Middle East. A collaboration agreement between ISF and some big NGOs promotes the diffusion of the software in many other African hospitals. It is used also in Italy, for the management of particular realities, providing medical services for immigrants without residence permit and health card. OH demonstrates how ICTs may contribute achieving higher level in patient's management, above all in places with challenges of managing personal data. Facilitating access to medical knowledge and content resources may strengthen public health research and prevention programmes, strengthening the development of health workforce in developing countries. *Infomed* is the name of the first electronic health information network in Cuba, which emerged as part of a project to facilitate the electronic exchange of information between a set of libraries, information centres and other entities that make up the National Information System of Medical Sciences in the Ministry of Health. An important aim of the project is to design a national strategy to improve Cuba's

health information services and consolidate an information and knowledge system supported by a network of institutions and individuals involved in its construction. Part of that aim involves enhancing the quality of the sources, information products and services, ensuring universal access, developing lifelong learning and health research, as well as continuously improving the technical, logistical and organizational infrastructure and ensuring its efficient and safe use, while at the same time strengthening interaction between the system and other national and international networks.

Goal 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all

Platforms, such as Massive Open Online Courses (e.g. Coursera,Udacity, edX, iVersity, Khan Academy) which are available for free through the Internet highlight how (even specialized) knowledge can be made available to a wide public. Furthermore, online social networks and Web 2.0 platforms (such as YouTube) are widely used to spread knowledge via the internet in order to facilitate lifelong learning.

Another success story in providing information and education to everybody is the online encyclopedia Wikipedia which is a free-of-cost encyclopedia developed by using the knowledge of the community.

Open Access publications, such as Springer Open, are gaining popularity and support the accessibility of scientific contributions. Further, research social networks, such as Research Gate, establish the exchange between researchers and scholars all over the world. Open Source products (e.g. Linux, LibreOffice, Eclipse) and initiatives pose alternatives to expensive software suites and minimize thereby inequalities in education. Initiatives setting common standards in education of digital competencies, such as the European e-Competency Framework (e-CF) and the ICT profiles project building upon, highlight which ICT competencies should be taught in order to address today's challenges.

Goal 5. Achieve Gender Equality and Empower All Women and Girls

In Nepal, achieving gender equality and empowering all women and girls is a major goal of an interesting private-sector initiative: Fight Violence against Women (Fight VAW). This ICT-based initiative provides the victims of violence against women (VAW) with an alternative means of reporting their case by telephone, SMS or online. It uses an integrated case management system to assist victims of VAW and organizations engaged in reducing its impact in Nepalese society. Fight VAW brings together government stakeholders, donor agencies, development partners and social organizations, using ICT to address the VAW that continues to threaten the attainment of SDG-5.

Empowering Women literacy and financial self-efficiency, leads to the empowerment of society as a whole. Empowerment of women is promoted through enhancement of use of enabling technology such as ICTs. In Madhya Pradesh and Chhattisgarh, NICT have around1600 Customer Service Points/Common Service Centers working under Government of India, Department of Electronics. These CSPs/CSCs are in rural areas and are under the network of NeGP implemented through Public Private Partnership. Out of 1600 CSP's, 172 are been managed by woman entrepreneurs trained on ICT and woman entrepreneurship. These social IT entrepreneurs are catalyzing socio-economic grow at grass roots providing various services, such as Financial Inclusion, Micro banking and Micro Insurance, Government Services, Utility Bill Payment and Revenue Services, and Woman Maternity Grand Distribution. Also the Campaign, a global initiative by Telecentre Women Digital Literacy, in the Philippines, seeks to help and empower disadvantaged and underserved women community, through the knowledge of ICT for personal growth in order to expanded opportunities for better lives. The

initiative, as can be clearly understood, represents a vivid example of how ICTs can be fully exploited to implement Sustainable Development Goals in the area of gender equality and women empowerment via ICT capacity building. Overall, this initiative aims to reach out to one million women (unreached and untouched by ICT and its promise) and help them to acquire digital literacy via tele-centers and networks throughout the world.

Goal 6. Ensure availability and sustainable management of water and sanitation for all

ICT applications such as GIS and remote monitoring supports the improvement of water resource management techniques, and the monitoring of water resources. Software and ICT-based models can contribute to water security by helping to manage and document scarce water resources (e.g.melting glaciers, salinization and pollution of fresh water sources), and water distribution. ICTs such as mobile phones can be used in participatory monitoring systems, enabling users to provide near-real time data during the occurrence of floods or droughts. ICT tools help in monitoring water supply levels and the degradation of water quality due to increased temperatures and pollutants, providing updated data that can inform policy processes including those related to pricing and irrigation. For instance, Sustain Water Med (SWIM) aims to improve the sustainable management of wastewater treatment and reuse in four countries across the Southern-Mediterranean region. A major focus lies hereby on the demonstration and dissemination of innovative and cost-effective approaches; the project website plays a major role in this endeavor offering an interactive information-exchange platform for project teams across the region but also to policy-makers and the wider public. The website thereby serves as a catalyst between lessons learned on the field and water users and policy-makers across the Arab world. The Somalia Water and Land Information Management (SWALIM) is a long term programme aimed at enabling Somali institutions to provide crucial information in support of decision making in natural resources management, early warning, preparedness and resilience building by relevant institutions and other users in Somalia. The project has built a comprehensive set of Somali water and land resources information knowledge bases through field surveys and assessments, desk studies and the recovery of information lost in 1991. The key datasets have been organized into a number of structured information systems. Further, SWALIM has established a capacity development programme for Somali government institutions that includes six ministry data centres, a ministry staff support scheme, a training of trainers programme and a support facility for ministry field monitoring.

Thailand project IT for Environmental Sustainable Development in the desert area of Ban Limthong, is a good example. Thailand used IT for surveying, data collecting and analysis. Now the community can accurately plan the rehabilitation and protection of local water resources. The sustainable water resource management project delivered better living standard to the community. This initiative from Thailand represent a clear example on how ICTs can impact deeply the achievement of SDGs, in this case by ensuring availability and sustainable management of water and sanitation for all.

Goal 7. Ensure access to affordable, reliable, sustainable and modern energy for all

ICTs can facilitate evidenced-based policy making and greater involvement of citizens in scientific and policy processes. For instance, Optimal Strategy to Innovate and Reduce Energy Consumption In urban rail Systems (OSIRIS) introduced the entire discovered knowledge into a Decision Support Tool, to aid strategic decision-making for operators and public authorities. It promotes the enhancement of the interface between policy, science and society, facilitating a better harmonized policy-making. The Security of Energy Systems (SOes) is a two years research project developed with the financial support of the Prevention, Preparedness and Consequence Management of Terrorism and other Security-related Risks Programme by the European Commission. It is designed to answer to the pressing

demand of knowledge and best practices on the cyber security of smart energy grids, the project has been conceived to raise the know-how of government bodies and operators by providing a comprehensive analysis of ICT architectures, vulnerabilities, interdependencies, standards and best practices related to the smart grids. The consortium partners brought into the project their interdisciplinary expertise in energy, security, control and ICT as required for developing secure smart energy systems.

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

In Argentina we find a brilliant initiative that points out clearly the role ICTs can have in achieving SDG, in particular Goal 8 which focuses on inclusive and sustainable economic growth, full and productive employment and decent work for all. The PROPET is a Program to promote Employment with Telecommuting, created by the Department of Telecommuting of the Argentine Labor Employment and Social Security Ministry. The program promotes the inclusion of unemployed in the form of telework, by implementing financial incentives to companies that decide to increase its staff under this modality. It generates a legal certainty and stability framework that allows companies to implement telecommuting in their organizations, with work safety, health standards and human resources management.

Secondly, the PROPET ensures the active social inclusion for all by promoting participation in the labor market, especially those, whose rights have been violated. The participants of the program can balance work and family, generating an improvement in labor quality or saving money for commuting.

The Ministry of Communications and Information Technology in Egypt launched a needs assessment project entitled Training and Qualifying for Employment (TQE) and focusing on the needs of persons with disabilities. The programme's main objective was to help persons with disabilities to find better job opportunities by building their ICT capacities.

TQE is a public–private partnership programme that offers two grants with the aim of eradicating IT illiteracy, opening new communications and knowledge acquisition channels, and providing job-specific training as well as job opportunities in the ICT private sector, thereby supporting independence and empowerment. To particularly tackle youth unemployment, the Ministry of Sport and Youth Affairs of Georgia designed a special webpage, myprofession.ge that provides youngsters in Georgia with information on insights and best practices for various professions in Georgia. The webpage was designed as part of the Ministry's continuous support for the development of state youth policy. As part of these efforts, a special webpage was designed to support the professional orientation of young people and to serve as a guidebook for those wishing to take up various professions.

Goal 9. Build Resilient Infrastructure, Promote Inclusive and Sustainable Industrialization and Foster Innovation

In Azerbaijan, the Trans-Eurasian Information Superhighway (TASIM) project is a major regional transnational fibre-optic initiative targeting primarily the countries of Eurasia, from Western Europe to East Asia. The TASIM is clearly in accordance with the SDG number 9 as it builds resilient infrastructure, promotes inclusive and sustainable industrialization and fosters innovation.

The project is also recognized by the international community as an important ICT project, as reflected in United Nations General Assembly resolutions adopted in 2009 and 2012.

The African Internet Exchange System (AXIS) project – in Ethiopia – is particularly obedient to the target; it aims to promote keeping intra-African Internet traffic local by providing capacity-building and technical assistance to facilitate the establishment of Internet exchange points at the country level, regional Internet exchange points and regional Internet carriers in Africa. The project, which forms part of the Programme on Infrastructure Development in Africa, is an important example on how information and communication infrastructure are essential foundation for SDG number 9, which calls for the creation of resilient infrastructure and the promotion of inclusive and sustainable industrialization.

Georgia has introduced e-Governance in Local Governments. Through this initiative, it has developed the necessary infrastructure, to support local governments in strengthening their capacity and improving the service they provide to the local population.

Goal 10. Reduce inequality within and among countries

In Colombia, the Convertic project is a brilliant example of how ICTs can help people reducing inequality among countries. This initiative enables visually impaired people to have autonomous access to information and knowledge, education, job opportunities and entertainment through the use of ICTs. By means of this project, blind and visually impaired people are provided, free of charge, with the best screen reader and magnification software available on the market, enabling them to have independent access to computers, commonly used Office applications, music and video players and the Internet. Since a single license for the software is not affordable for an ordinary Colombian under normal circumstances, Convertic provides an economy-of-scale model that enables the State to offer this vital tool to every single one of the country's 1.2 million visually impaired citizens, for free.

A second deserving initiative aiming at reducing inequality and achieve SDG 10 comes from India. It is said that One Empowered Woman empowers entire family and eventually community. The Swawlamban project, which means "self-sustainable", empowers rural, slum and sub-urban women as one of major ICT based Micro Banking Kiosk Operator inculcating habit of micro savings, bringing financial sustainability to their families and communities. Thanks to

Turkey has an impressive Internet penetration & growth figures however, a gap still exists due to economic, social and physical barriers. "Life's Simpler with Internet" project of Turkey offers a solution, through trainings for disconnected citizens especially women, who are in need of basic information, and help them overcoming their reluctance in taking the first step to the digital world. The project spearheads the efforts in Internet literacy and aims to increase Internet usage in Turkey.

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

The Dubai smart city strategy is one of the examples where e-government is working towards making cities and human settlements inclusive, safe, resilient and sustainable, as indicated by SDG 11. This strategy aims at increasing customer satisfaction, and, among others, has started implementing new payment means in Dubai taxis along with existing cash payment. POS machines that support NFC, contactless and Swipe payments are installed and connected to existing taximeters to create an automated payment scheme. The World Bank Smart City Gran Concepción project in Chile carried out in partnership with the Chilean Ministry of Transport and Telecommunications introduced bottom-up smart-city methodologies that help local and municipal governments to (i) learn how to use smart-city tools with better real-time interaction with beneficiaries and greater citizen response, and (ii) create partnerships and synergies between local and municipal government and other key actors (e.g.

universities, private sector, civil society) to foster their active and ongoing participation in solving local challenges through ICT solutions. It focuses on the transport sector and comprises four operational phases: (i) co-designing mobile applications with local and municipal government participants to provide solutions to daily technical challenges in the transport sector; (ii) working jointly with local and municipal governments, citizens, the private sector and civil society to prepare a vision of the future and a roadmap for mobility in Gran Concepción; (iii) developing solutions for urban transport challenges through co-creation competitions and citizen engagement; (iv) co-designing an urban ICT innovation centre to help solve local challenges and inspire citizen participation.

In Japan, Shiojiri City represents a clear and brilliant example of how ICT can implement SDG Goal 11. Especially dealing with the protection of the poor and vulnerable people. The city constructed its own communication infrastructure using optical fibre and ad-hoc wireless networks in addition to the fixed and mobile networks provided by incumbent operators such as NTT, NTT DoCoMo, KDDI and Softbank. The platform on these networks can provide ICT services within the city, such as healthcare, social welfare, disaster mitigation, tracking of children and elderly people using wireless tags, weather observation, etc. The data collected through the municipal info communication networks are saved at the centre for analysis and displayed by location, time and event. Shiojiri Incubation Plaza (SIP), accommodated in an independent building, is the centre for IT ventures and entrepreneurs in the city. Shiojiri continues to make strides towards the smart city by promoting capacity building for data analysts and data scientists to ensure that the big data collected through the networks are fully utilized.

Connected devices, sensors and other ICT solutions can make urban basic services more productive, sustainable and efficient. For example, smart water systems that measure water flow and pressure have the potential to significantly reduce water leakage and loss. ICT-enabled governance systems enable feedback to be delivered to urban authorities, ranging from maintenance requests to gathering views on priorities for improvements in city development programs.

Urban transportation needs of the future can be addressed through innovative applications of broadband, mobility and cloud services.

Proposed developments include:

1. Smart vehicles and infrastructure – vehicles and roadways to communicate with one another through networks, leading to safer and more efficient transportation and to driverless vehicles.
2. Transportation as a service – residents to shift from owning vehicles to paying for access to shared vehicles.
3. Multimodal transportation – the entire transportation system will be knit together, making it possible for individual travelers to optimize their journey through the city across multiple modes of public and private transportation.
4. Redefined city spaces – reshaping city spaces, reducing distinctions between work/shopping/living areas, and transforming the city itself into a service.
5. Virtual presence – use of improved tele-presence technology that more closely replicates personal experience, thereby limiting need for travel.

With the above, urban planning does not have to include as much space for vehicles parking and driving, hence freeing space for organized urban settlements.

As ICT transforms society, it also has the potential to transform way that participatory planning and management processes are carried out. By putting effort into strengthening collaborative capabilities,

cities can be more prepared for collaboration with groups that are focused on responding to social issues and urban development.

Virtual communities, gamification, e-petitioning and e-panels provide potential of enhancing and complementing existing community participation processes as well as developing new ways of reaching previously hard-to-reach groups. Collaborative government institutions, citizens, companies and industries can work together to further democracy and human rights and improve urban planning.

Information services, open communication platforms, virtual presence and other innovations offer opportunities to increase knowledge about engagement in and collaboration for preserving vital cultural heritage. In addition, as the world becomes increasingly digital, there is also an emerging digital heritage - texts, databases, still and moving images, audio, graphics, software and web pages, among others. Many of these resources have lasting value and significance and should be protected and preserved for current and future generations.

ICTs can contribute to the monitoring of for instance water flows and provide more effective early warning systems. They can make humanitarian response actions more efficient, by supporting early responders in time for controlled actions and provide fast deployable, mobile solutions supporting various emergency response functions. In this area, ICTs can be useful for enhanced disaster risk management, for improving city resilience and adaptive capacity and to promote informed adaptation decision making. For example, ICT solutions that integrate hazard data from different sources can automatically calculate hazard impacts and disseminate subscription-based warnings and response recommendations to users, based on their data needs and communication channels.

ICTs have the potential to reduce global carbon emissions with 16% by 2020 according to the SMARTer2020 study. ICTs can help make buildings more energy efficient through facilities like smart metering and smart building control and they are a prerequisite for including renewable energy into the electricity grid as well as making existing grids more efficient, reducing losses and increasing speed.

ICTs further enable better use of resources, for example through more efficient and optimized transport systems. Video and other collaboration tools provide further alternatives to travel and commuting. The use of public transport can be increased by enhancing user experience with better information and improved fleet management. Digitization and electronic distribution, in media, finance and retail instead of physical logistics are further opportunities. ICT are also a vital component of the development of a low carbon agriculture sector.

Furthermore, ICT can help raise people's awareness of their environmental influence and, in turn, help them to make informed choices and adapt their behavior.

ICT supports optimized waste management, including the collection, transport, processing, disposal, managing and monitoring of waste materials. ICT can also connect people better and encourage collaborative consumption with shared ownership and re-usage in many different areas.

Technology adaptation and penetration are tools to create a more connected and safe city. ICT can be used in a variety of ways, from advanced security and agreed monitoring systems to public safety information system, to make public spaces safer and more accessible. To promote access to public spaces for online users and bring previously private activities to the public realm, public wireless internet and the use of gaming and augmented reality technologies can be used.

Using digital tools can bring new dimensions to public art and encourage interaction between citizens and enrich cultural and urban experiences, for examples by adding layers of digital interaction. Digital projections in public spaces can provide a range of functions – art, education, public information, advocacy and more.

Applying multisectorial ICT-based innovation in cities can yield multiplier effects that benefit the entire economy, leading to more interconnected sustainable communities. High-speed broadband will enable connection to green power sources, high-definition video conferencing for remote medical diagnoses, and intelligent transport systems to mention a few examples. Civic engagement through ICT can assist in development planning by tailoring development projects to local needs as well as communication access in rural areas. Mobile banking, transfer systems and other mobile platforms can encourage inclusive socio-economic development.

ICT plays a fundamental role in supporting the Hyogo Framework for Action, for example through building a knowledge base on risk and disaster risk management; establishing hazard monitoring programmes including early warning systems, enhancing access to information and an understanding of risk and risk management; involving the media community in risk assessment and risk communication; and organizing and coordinating emergency operations, disaster response and recovery capability. ICT can support more proactive decision-making by providing city leaders with appropriate, up to- date and actionable intelligence.

For the collection of data, urban sensors and advanced analytics has the potential of providing cities with access to a rich range of current spatial and environmental information.

Transformative ICT solutions can deliver smart buildings with substantially reduced energy consumption and CO_2 emissions while relying on decentralized micro-grids to increase community resilience. ICT can also support multi-stakeholder financing, by reaching out to a stakeholders.

Goal 12. Ensure sustainable consumption and production patterns

In relation to Sustainable Development Goal 12, and in particular aiming at tools to monitor sustainable production patterns, the National Institute of Statistics of Rwanda (NISR), the country's primary data producer, is fostering a deserving initiative. The Institute produces mandatory statistics such as the gross domestic product, consumer price index, producers price index, external trade figures, population statistics and other special-purpose statistics from surveys including the demographic and health survey, household living conditions survey and census. It also conducts specific joint surveys, namely the agriculture survey and service provision assessment survey, in partnership with the relevant institutions. The information published in the National Statistics Portal is available to the public.

As a second example of ICTs implementing SDGs in the field of sustainable consumption and production patterns, the Farmer Query System (FQS) can be considered. It is a platform of designing and implementing an agricultural advisory service to farmers in Bangladesh remotely through an android based mobile application where there is scarcity of agriculture extension services. The project assessment identified that ICT informediary backed by expert agriculturist's advisory services can be a gateway for effective and authentic solution for farmers. It proved that how smart phone application can solve farmer's cultivation challenges and also bring them closer to an agriculture expert for necessary real-time information in an inadequate agriculture extension service system. This system aims to reduce the gap between an expert agriculturist and farmers through ICT channels.

Goal 13. Take urgent action to combat climate change and its impacts

The Thailand Utokapat Foundation initiative seeks to encourage and promote the community water resource management to protect the environment, foster economic growth and sustainable agricultural development with the communities in the rural areas of Thailand. Agro Informatics for Community-Based Climate Change Adaptation promotes indeed the ICTs application as the significant tools to empower people and upgrade their capacity in learning, sharing, and knowledge creation to achieve self-reliance, ownership, and sustainable development in community water resource management. A second promising example for the Sustainable Development Goal 13 is the Leveraging web and mobile platforms to broadcast disaster alerts, developed by the the National Digital Strategy of Mexico partnered with National Weather Agency to redesign public alert processes for extreme hydrological events in Mexico, which account for more than 20 annually. The project streamlined the meteorologist's workflow in order to generate and publish bulletins "automatically" in open formats following the Common Alerting Protocol, to enable third parties to broadcast alerts to a larger audience.

Sustainable Development Goal 13, which basically deal with climate change national policies, strategies and planning, and institutional capacity.

The aim of SDG 13, in particular target 13.3, is improving climate change education in particular, to combat climate change and its impacts. The target is clearly found in a deserving project that was established as an active national reference research point in the field of e-Science in Iran.

Looking for future scientific cooperation, the participating researchers, universities professors, and students in the network can exchange the ideas and scientific information through a web-based platform. E-Science-Net conducts expert surveys on e-Science and the role of science and technology in building and sustainable development of the information and knowledge societies in different scientific subjects. The project targets to make an information network of researchers located in the universities in entire of Iran and abroad, to exchange the new and innovative idea in scientific subject such as agriculture, climate change, and disaster risk reduction. Through this process, the results of experts' surveys are published to be used in decision making in selected subjects for the project at national level.

Goal 14. Conserve and sustainably use the oceans, seas and marine resources for sustainable development

The Abu Dhabi Blue Carbon Portal is one of the best examples in line with SDG 14. . It contains all outcome materials from the Abu Dhabi Blue Carbon Demonstration Project, which delivered local data-sharing, supported regional adaptation and contributed to international knowledge on Blue Carbon. Featured in the portal are publications, images, videos and other multimedia elements including the Blue Carbon Mapping Tool, which allows users to learn about the important role of coastal marine ecosystems and their ability to absorb and store atmospheric carbon dioxide. The UNESCO/IOC Oceanographic Data Exchange Policy supports attainment of SDG 14.

Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss

In order to restore and promote sustainable use of terrestrial ecosystems and forest, combat land desertification and degradation, halt biodiversity (as stated in SDG 15), the Central Agency for Information Technology of Kuwait has been running a project in the domain of access to knowledge and information. Environmental Monitoring Information System of Kuwait (eMISK), an ambitious system initiated by the Environment Public Authority, aims to establish, build and maintain a comprehensive geo-environmental database for Kuwait, together with an enterprise-level GIS system for accessing, updating and analysing the environmental data. This database is made available through eMISK to the decision-makers and stakeholders within EPA, outside agencies and the public at large. The main goals of eMISK include making all levels of society more aware of environmental issues, and placing authoritative scientific information at the centre of decision-making. The Environment Public Authority (EPA) has taken the initiative to establish Kuwait Official Environmental Portal "Beatona.net"; a GIS-based web portal that aims at sharing authentic environmental information with the public over the internet. Beatona.net ("our environment" in Arabic) is a network that offers information about Kuwait's environment from various national, regional and international organizations on one single platform. It also allows the public to participate and interact in the preservation and protection of the environment by reporting environmental phenomena and problems. This is expected to play a leading role in raising awareness of the value of the environment.

'My Garden My City is an annual competition which aims to increase green spaces in suburban areas across Abu Dhabi and spread awareness in the community about the importance of sustainability in daily lives, as per the Sustainable Development Goal 15, which stresses the importance of sustainable use of terrestrial ecosystems. The competition has proved that the participants had a well-established sustainability knowledgebase through the management of natural resources (such as irrigation water), the utilization of solar power, selection of plants and non-plant elements in gardening. This verifies that "My Garden My City" competition has been able to achieve its goals in augmenting the field of agricultural development. An application has been developed to allow users tracking the number of plants, their growth and other factors in their own garden. It also provides environmental beneficial information on their accomplishments. This also shows the other users' progress while having a platform that allows users to share ideas and realize the environmental benefit.

Goal 16. Promote Peaceful and Inclusive Societies for Sustainable Development, Provide Access to Justice for All and Build Effective, Accountable and Inclusive Institutions At All Levels

Open Data is one of the five main enablers of the National Digital Strategy of Mexico. Its objective, releasing open data to create an ecosystem of co-creation of public services, triggering economic growth, driving transparency and reducing corruption in the country, clearly exemplifies SDG 16, which aims at promoting peaceful and inclusive societies for sustainable development. To leverage this enabler, the Government of Mexico is implementing an Open Data Policy, which mandates all federal agencies to follow an 'open by default' standard for all their public data.
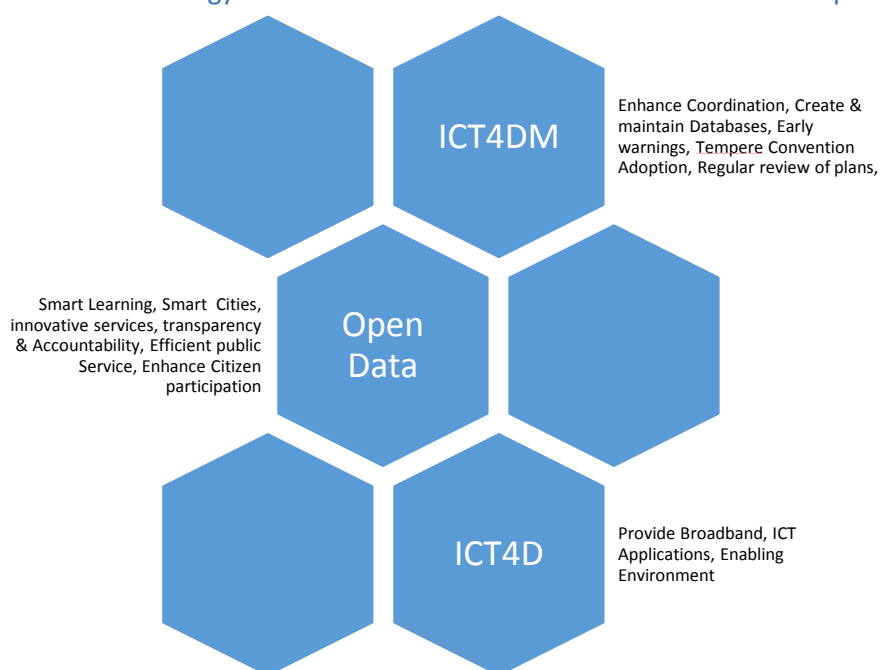
Fable is a promising software application that manages the national broadband development project to support Thailand's Digital Economy Initiative, comprising five areas of focus: hard infrastructure, soft infrastructure, service infrastructure, digital economy promotion and digital society. Fable does enhance the transparency, accountability and efficiency of the Thai government by broadening network access, reducing costs and avoiding duplication of investment.

Goal 17. Strengthen the means of implementation and revitalize the global partnership for sustainable development

In Switzerland, the Geneva Internet Platform (GIP) is a digital policy platform, observatory and capacity-building centre whose purpose is to assist governments, civil society, academia, technical communities, and other information-society stakeholders, with a special focus on small and developing countries - in finding resources related to digital policy and governance, formulating digital strategies and engaging with other stakeholders' policy debates. The GIP, an initiative of the Swiss authorities operated by DiploFoundation, is an excellent paradigm of the use of ICTs to implements SDG 17, which deals with strengthening means of implementation toward sustainable development, in various fields.

The eCLAC2015 initiative from Chile is a brilliant long-term vision plan based on the philosophy of Sustainable Development Goals, according to which ICTs are instrumental for economic development and social inclusion.

10 Recommended strategy for transition towards smart & sustainable development for Arab region

ICT4DM

Enhance Coordination, Create & maintain Databases, Early warnings, Tempere Convention Adoption, Regular review of plans,

Smart Learning, Smart Cities, innovative services, transparency & Accountability, Efficient public Service, Enhance Citizen participation

Open Data

ICT4D

Provide Broadband, ICT Applications, Enabling Environment

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