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Strengthening ICT and knowledge management capacity in support of the sustainable development of multi-island Caribbean SIDS

Amelia Bleeker



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Amelia Bleeker



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This document has been prepared by Amelia Bleeker, Associate Programme Management Officer of the Caribbean Knowledge Management Centre (CKMC), in the subregional headquarters for the Caribbean of the Economic Commission for Latin America and the Caribbean (ECLAC), with research contributions from Wayne Butcher, Consultant with CKMC.

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Abstract

The Caribbean subregion is comprised mainly of Small Island Developing States (SIDS) and territories. Of the 26 programme countries served by the Economic Commission for Latin America and the Caribbean (ECLAC) subregional headquarters for the Caribbean, 23 are island States and territories. At least 38 per cent of these can be described as multi-island countries, where the population of a single country is divided across several separated land masses, each with various governance structures and institutions.

This study investigates the role that information and communication technologies (ICT) and knowledge management (KM) are playing in supporting sustainable development across islands in these countries. Focusing on the areas of health, education and governance, the study uses the multi-island countries of Saint Kitts and Nevis, Trinidad and Tobago, and Turks and Caicos Islands as case studies to explore inter-island differences in ICT and KM capacity and the scope for strengthening this capacity. It concludes with a series of recommendations for governments of Caribbean multi-island countries working to strengthen ICT and KM capacity across islands as well as areas for further analysis and investigation.

Introduction

With the adoption of the 2030 Agenda for Sustainable Development, United Nations Member States pledged to address the needs of the most vulnerable (UNGA, 2015). Geographical isolation and separation are key reasons that not all people benefit equally from development efforts (UNDP, 2018). This is a pressing concern for the Caribbean, a region mainly composed of Small Island Developing States (SIDS) and territories. Of the 26 programme countries served by the Economic Commission for Latin America and the Caribbean (ECLAC) subregional headquarters for the Caribbean, 23 are island States and territories. At least 38 per cent of these can be described as multi-island States and territories, where the population of a single country is divided across several separated land masses, each with various governance structures and institutions.¹

The unique characteristics of multi-island Caribbean States and territories create both challenges and opportunities for aiding sustainable development through knowledge management and ICTs. These countries are made up of one or more islands, some of which are small and spread over a large distance. They tend to have high public service costs as well as small domestic markets vulnerable to external shocks and natural disasters and difficulties creating economies of scale due to high transportation and production costs. In addition, populations in small or outlying islands can experience poorer quality and availability of public services. The evidence suggests that economic and social development in multi-island countries is mixed, implying that each multi-island country finds its own solutions to overcoming these challenges, and that size and geography are not always constraints on development. In some cases, size and geography can be overcome through public policies, aimed at resilience building and economic transformation (Bulmer-Thomas, 2001).

Information and Communications Technology (ICT) and Knowledge Management (KM) can build resilience and advance the sustainable development of multi-island countries by extending the reach and access of information and public services to people in geographically-isolated islands. Access to technology, such as broadband and wireless internet, can bridge the digital divide between populations

¹ These are: Antigua and Barbuda, The Bahamas, British Virgin Islands, Cayman Islands, Grenada, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Islands, and the United States Virgin Islands.

in small or outlying islands and main population centres. The strategic application of ICTs and KM therefore acts as an important equalizer, improving efficiency in the delivery of government services. ICTs and KM can also build resilience to economic shocks, natural disasters and climate change, an increasingly important consideration for multi-island Caribbean SIDS.

This study investigates the role that ICTs and KM are currently playing in supporting sustainable development across multi-island Caribbean countries. Governments in the region have already started to embrace e-government and implement regional and national initiatives to improve connectivity and access to technology. However, more than half of households in the Caribbean still lack access to the internet and the effectiveness of efforts to use e-government and KM to reach populations has been mixed and use of these tools inconsistent (ECLAC, 2017). Focusing on the thematic areas of health, education and governance, the study uses the multi-island countries of Saint Kitts and Nevis, Trinidad and Tobago, and Turks and Caicos Islands as case studies to explore the current contribution of ICT and KM related-solutions in supporting sustainable development in multi-island settings. It highlights possible differences in ICT and KM capacity across islands in these countries in addition to the scope for strengthening this capacity of the countries and their small and outlying islands.

The study introduces the 2030 Agenda for sustainable development and the challenges for implementing it in multi-island countries. It reviews literature on the contribution that ICTs and KM can make towards addressing the needs of the most vulnerable and achieving sustainable growth in multi-island SIDS in the Caribbean and the Pacific. Background on current use of and access to ICTs, e-government and KM in the Caribbean and regional initiatives to improve ICT capacity is then provided, in addition to an outline of the combination of approaches and sources that were used to conduct the study.

An analysis of ICT and KM capacity in select sectors follows, which begins with the demographics, governance arrangements and state of ICT development in the three study countries. It describes the current use of ICTs and KM in the areas of health, education and governance and discusses possible reasons for inter-island differences in ICT and KM capacity across islands in these areas as well as the scope for strengthening this capacity.

Finally, a series of recommendations and opportunities for further analysis are offered for governments of multi-island countries working to strengthen ICT and KM capacity across islands in pursuit of sustainable development. This study concludes with areas for future researchers to explore, based on the opportunities and challenges identified in the present research.

I. Background

A. The special challenges and opportunities of multi-island Caribbean SIDS and lessons from the Pacific

Multi-island SIDS encounter several challenges which are less severe in single-island SIDS. Their archipelagic nature means that their populations are dispersed over more than one island and their already small economies are fragmented. The dispersion of islands and populations increases the cost of providing basic essential services and infrastructure, as they must be replicated across islands, some of which have very small populations and therefore a limited tax base. This reduces their ability to achieve economies of scale. Furthermore, geographic separation necessitates inter-island travel and transportation links, which is expensive due to reliance on fossil fuel imports.² This separation also has the potential to produce island communities with distinct identities and agendas which may challenge the social cohesion of the country.

Geographic separation also increases recovery time and cost for multi-island Caribbean SIDS exposed to extreme weather events. The Caribbean is one of the subregions most heavily impacted by climate change and natural disasters. Disasters are mostly hydro-climatic events including floods and tropical cyclones (IMF, 2016). The worsening of global climate change has resulted in the increased frequency and intensity of such weather events. In September 2019, Hurricane Dorian tore through the Bahamas, a multi-island Caribbean SIDS, leaving “generational devastation” in both Grand Bahama Island and the Abaco Islands, which increased the complexity of rescue and recovery efforts (NPR, 2019).

Despite these challenges, the complexity of public service delivery in multi-island countries does not necessarily result in poor development outcomes. Many countries with dispersed geography in the Caribbean have prospered under good leadership and sustained economic growth (UNDP Global Centre for Public Service Excellence, 2014). Moreover, multi-island SIDS show comparable levels of

² Trinidad and Tobago creates fossil fuels and is thus an exception.

development to other SIDS. For example, The Bahamas, Saint Kitts and Nevis and Trinidad and Tobago have High Human Development Index (HDI) classifications which are similar to those of single-island SIDS, such as Barbados and Jamaica (UNDP, 2016).

The HDI does not consider relative levels of development among islands of multi-island SIDS and studies on the comparative position of islands in these countries reveal unequal development outcomes in some areas. A study on inter-island differences in health outcomes in the Bahamas found that populations in the Family Islands³ have higher poverty rates and poorer education and health than those in the main population centres of New Providence Island and Grand Bahama Island (Cox, Desiree and others, 2016). The authors recommend tackling inter-island health inequalities through adopting an 'equity lens' and 'health for all' policy in national health planning.

Similar disparities also exist in archipelagos in the Pacific region. For example, a 2015 diagnostic study on the Maldives found economic disparities between the main population centres and least populated atolls; high internal transportation costs; differences in educational opportunities and attainment between islands; unequal access to health services across islands; and limited access to telephone and internet connectivity in least populated atolls (Park and others, 2015). The Republic of Maldives is an extreme example of a multi-island SIDS with a small, widely dispersed population of close to 450,000 people distributed over 180 inhabited islands in 26 coral atolls covering an area over 800km long and 130km wide. The study recommended improving access to telecommunications in the atolls to enable distance learning, access to mobile banking and linkages with international markets.

Much of the research on inter-island differences in multi-island SIDS focuses on Pacific Island countries. These multi-island SIDS share several characteristics with multi-island Caribbean countries. However, extrapolation from the situation of multi-island Pacific countries to those in the Caribbean should be approached with caution. Significant differences exist, including the level of geographic isolation of the Pacific Islands, which lie in the middle of the Pacific Ocean (World Bank, 2016). By comparison, the Caribbean islands are relatively close to the Americas, and not very distant from Europe. All Caribbean multi-island SIDS reported in the 2016 Human Development Report are in the high human development category (UNDP, 2016). While several of the Pacific Island multi-island SIDS are also in this category, there are some in the medium and low human development categories.

Mobile technology has had an immense impact on the economies of Pacific Island countries, but the potential is largely untapped with low penetration and weak connections in many inhabited islands. A 2015 Mobile Economy Report for the Pacific Islands by Groupe Speciale Mobile Association (GSMA) found that satellite communication plays an important role in providing both international and domestic connectivity and that the level of mobile penetration in most countries was quite low (GSMA, 2015). At the time, mobile coverage in the region was mostly second generation (2G) with the availability of third (3G) and fourth generation (4G) technologies much lower than the developing country average and migration to 3G and 4G forecast to be gradual.⁴ Improved mobile penetration was recognized as an enabler of e-government solutions as well as solving issues with the delivery of education and health services across islands.

A study on eight multi-island Pacific SIDS, ranging from Samoa with four inhabited islands to Vanuatu with more than 70, also found that mobile phone penetration was very low in many of the study countries, with no coverage in several of the least populated islands. It noted that "small size, ... and internal dispersion combine to push up the costs of private production and public administration, lower

³ The authors use data for the Family Islands of Abaco, Andros, Bimini, Cat Island, Eleuthera, Inagua and Long Island. However, there are other islands typically included in the Family Islands grouping.

⁴ 2G was the first generation of digital mobile networks. It introduced call and text encryption, along with data services such as SMS, picture messages, and MMS. 3G technology provides an information transfer rate of at least 200 kbit/s. 4G provides, in addition to the usual voice and other services of 3G, mobile broadband internet access.

the return to market activities and narrow the feasible set of economic opportunities” (World Bank, 2016). Geographic dispersion was also identified as a factor in the high cost of public service delivery, limiting the range and quality of public services.

A systematic country diagnostic on the Solomon Islands, a Pacific Island country of almost 1,000 islands, about 90 of which are inhabited, with a population of 584,000, identified the inconvenience of accessing government services due to the need to travel to government centres and the use of paper-based processes as developmental challenges (World Bank, 2017). The diagnostic identified internal connectivity as one of the top priorities for supporting poverty reduction and delivering government services to all inhabited islands.

A number of national and regional initiatives are being employed to improve internal digital connectivity in multi-island Pacific countries. In 2019, the Government of Tuvalu entered into a public/private partnership (PPP) with the World Bank to facilitate improved access to, and reduced cost of, internet services in Tuvalu by 2023.⁵ Tuvalu has nine inhabited low-lying island atolls and is one of the least connected countries in the Pacific region. Internet access is expensive, unreliable, and limited outside the main island of Funafuti. The PPP aims to: 1) develop and implement an ICT policy and new or amended legislation and reforms for the ICT sector, including strategies for outer islands and international connectivity incorporating a submarine optical fibre cable system; 2) finance the building and operation of the international backbone and domestic access networks to connect users on Funafuti to the global internet.

Several Pacific multi-island countries, including Fiji, Samoa, Solomon Islands, Tonga and Vanuatu, have liberalized their telecommunications sectors in recent years, creating regulatory bodies and legislation to enable a competitive environment. This work has been coordinated by the Pacific Region Infrastructure Facility (PRIF), with development assistance and loans from international financial institutions, such as the World Bank and the International Finance Corporation (IFC). These reforms have resulted in expansion of broadband network size and capacity as well as reduction in prices. Early indications are that this expansion is also having a positive impact on economic growth in the beneficiary countries (PRIF, 2015). The multi-island countries of Cook Islands, Kiribati, Palau, Samoa, and Tonga also have projects underway to construct submarine cables with financial assistance from the Asian Development Bank (ADB). ADB is also providing technical assistance to improve e-governance in the Cook Islands.

Furthermore, the Asia-Pacific Information Highway 2019-2022 is a regional initiative, developed by the Economic and Social Commission for Asia and the Pacific (ESCAP), which aims to improve regional broadband connectivity through “a dense web of open access cross-border infrastructure that will be integrated into a cohesive land- and sea-based fibre network with the ultimate aims of increasing international bandwidth for developing countries in the region, lowering broadband Internet prices and bridging the digital divide in the region” (ESCAP, 2019). The four pillars of the Plan are connectivity, e-resilience, broadband for all, and traffic/network management. Strategic initiative four focuses on building resilient infrastructure in the Pacific.

⁵ For more information on this PPP, see the project documents on the World Bank’s website: <http://projects.worldbank.org/p159395/?lang=en&tab=overview>.

B. Using ICTs and knowledge management in pursuit of the SAMOA Pathway and 2030 Agenda for Sustainable Development in multi-island Caribbean SIDS

Inclusion is at the core of the 2030 Agenda for Sustainable Development⁶ with countries and stakeholders pledging to address the needs of the most vulnerable. This pledge has special significance in the context of SIDS whose own development agenda, including the Samoa Pathway, provides an underlying framework within which international cooperation and assistance to SIDS can be operationalized to achieve the SDGs.

The current SIDS Development Agenda is set out in the SIDS Accelerated Modalities of Action Pathway (Samoa Pathway), which draws on earlier SIDS conferences⁷ and calls for ‘the strengthening of the longstanding cooperation and support provided by the international community in assisting small island developing states to make progress in addressing their vulnerabilities and supporting their sustainable development efforts.’ (UNGA, 2014)

The Samoa Pathway recognizes that “access by SIDS to appropriate reliable, affordable, modern and environmentally sound technologies is critical to achieve their sustainable development objectives.” (UNGA, 2014) Both ICTs and knowledge management are important tools for delivering public services and supporting multi-island countries’ progress towards the SDGs. Indeed, the ambitious rate of transformation required by the Agenda 2030 cannot be achieved without ICTs as integral technology components (Sachs and others, 2016).

At their core, ICTs are tools used to produce, store, process, distribute and exchange information. They amplify human intellectual capabilities and mitigate the effects of distance, time and constraints of scale in accessing, sharing and using information. The ‘old’ ICTs were radio, television and telephone, while newer technologies include computers, satellite and wireless technology and the internet. Knowledge management (KM) is “the systematic processes, or range of practices, used by organizations to identify, capture, store, create, update, represent and distribute knowledge for use, awareness and learning across the organization” (UN Joint Inspection Unit, 2016). KM seeks to maximize the value which knowledge contributes to organizations and societies.

Caribbean countries already have relatively comprehensive ICT infrastructure, with some exceptions (Internet Society, 2017). National networks are typically made up of a combination of fibre-optic, copper and wireless technologies. Most countries are also rolling out third-generation and fourth-generation wireless technologies to support mobile broadband internet. There has been steady investment in submarine cable systems to increase broadband bandwidth and better connect the Caribbean with the Americas. The expansion of mobile technology in the region, in conjunction with newly established wireless networks and service providers offering a range of data plans, has been a major contributor to increased internet adoption and use. In 2019, 51 per cent of the region’s population were using the internet, while 73 per cent of the total population had mobile subscriptions (We are Social, 2019).

⁶ On 25 September 2015, the UN General Assembly adopted the 2030 Agenda for Sustainable Development, a plan of action for people, planet and prosperity (UNGA, 2015). This Agenda comprises 17 Sustainable Development Goals (SDGs) and 169 indicators, which build on and seek to complete the work of the Millennium Development Goals.

⁷ Priority areas relating to SIDS were identified in the Barbados Plan of Action (BPOA), which was adopted at the First United Nations Global Conference on Small Island Developing States held in Barbados in 1994. The BPOA is a 14-point programme that identifies specific actions necessary for addressing the special challenges faced by SIDS, including climate change, waste management and natural disasters. A ten-year review of the BPOA took place in 2005 resulting in the Mauritius Strategy for the Further Implementation of the BPOA.

While ICTs have contributed to economic and social development across the globe, there are many whose lives they have not impacted. Despite the Caribbean's rapid expansion of mobile and broadband technology in the past decade, more than half of households in the region still lack access to the internet (ECLAC, 2017). Levels of access vary between countries, mostly reflecting their varying levels of economic development. In 2014, only 11 per cent of Haitians had internet access compared to almost 80 per cent of the population in Barbados and the Bahamas (Internet Society, 2017). Quality of access is also an issue in the subregion, with connection speeds improving but not keeping pace with the rest of the world. At the national level, internet penetration is poorer in rural areas than urban, and rich households are more likely to have internet access than those in the poorest quintile of income distribution (ECLAC, 2017).

Where internet access exists, use of this technology does not always follow due to lack of affordability, skills or relevant local content. This disparity between access and use particularly affects women and marginalized groups, such as persons with disabilities (ECLAC, 2018). While internet access figures show parity among men and women, the use of internet remains uneven, with men eight percentage points ahead of women in some countries. ECLAC research also shows that internet use by persons with disabilities in the Caribbean lags behind that of persons without disabilities, even after accounting for age differences of persons with and without disabilities (2018). Furthermore, Caribbean women, although increasingly more successful in educational attainment than Caribbean men, continue to lag behind men in enrolment and matriculation in the science and technology fields (ECLAC, 2018a).

This 'digital divide' must be addressed if we are to achieve the SDGs and deliver on the commitment to inclusiveness. It is therefore necessary to foster digital ecosystems that give local communities agency to develop technology and digital content that meets their needs (ITU, 2017). Individuals and organizations must be able to access ICTs, adapt them to their needs, and commercialize them. While the application of ICTs and KM are essential to achieving all goals of the SIDS and 2030 Agendas, we explore the contribution they can make in the areas of governance, healthcare and education:

1. ICTs and KM for good governance (SDG 16)

Governance is the quality of the way in which public institutions conduct public affairs and manage public resources. While the term good governance is used flexibly, its main components are the rule of law, participation, equity, transparency, effectiveness and accountability. Good governance is then the standard that is achieved when public institutions conduct their affairs and manage their resources in a manner that is participatory, consensus-orientated, accountable, transparent, responsive, effective and efficient, equitable and inclusive and follows the rule of law (ECLAC, 2013). Good governance is specifically identified in SDG 16 on peace, justice and strong institutions, but underpins all of the SDGs.

Many SIDS are plagued with inefficient use of public resources (UNDP Global Centre for Public Service Excellence, 2014). In multi-island countries, this exacerbates unequal availability, access and quality of public services across islands, as resources are concentrated in main population centres.

E-government, or the application of ICTs in government for delivering public services, presents untapped opportunities for improving public service delivery and governance outcomes in small or outlying islands of multi-island SIDS. It can minimize the impact of distance between islands, and the constraints of diseconomies of scale and limited human resources. By contrast, e-governance refers to the use of ICTs for political purposes and the organization of political activity in a country (ITU, 2008). The UN Project Office on Governance (UNPOG) has found a positive correlation between SIDS' e-government deployment and performance in good governance and sustainable development indicators (UNPOG, 2015). To serve as an enabler of sustainable development, e-government requires

not only ICT infrastructure but a culture of innovation across the public sector at pace with ever-changing technology.

Multi-island countries can also use e-government platforms to promote exchange of knowledge and best practices across islands. KM processes and tools offer “a framework to uncover, further develop and unleash the creative, traditional and rich cultural heritage and traditional knowledge of the Caribbean.” (ECLAC, 2010) Effective use of KM tools also relies on robust communication links and governments fostering a culture of innovation across departments.

2. ICTs and KM for good health and wellbeing (SDG 3)

Provision of health care is largely an information and knowledge intensive activity. The World Health Organization identifies a “... gap between what is known and what is done in practice” in health systems (WHO, 2005a). ICTs and KM can be used to address this gap and ultimately achieve SDG 3. In multi-island countries, e-health can increase the range of health services offered in small or less populated islands and reduce the need for inter-island travel and the cost of health care. KM promotes sharing of health-sector knowledge across islands, resulting in improved quality of care.

The application of ICTs to the health sector, or e-health, is “...the cost-effective and secure use of information and communications technologies in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research ...” (WHO, 2005). Its impacts extend to healthcare users, medical personnel, and those developing and administering health policies. E-health is essential to the achievement of universal health coverage, but it requires a policy and legislative framework to govern a wide range of issues, such as data privacy, and personnel in the health system with ICT knowledge and skills to use and support the technology (WHO Global Observatory, 2016).

The range of e-health systems matches the breadth of health care itself, including those facilitating clinical practice; institutional systems, which manage public health information, including disease surveillance and disaster management; and systems facilitating care at a distance, health education and telemedicine services (Piette and others, 2012). Some common systems include electronic health records (EHRs), tele-health and mobile-health (M-health).

EHRs store a patient’s health and medical treatment history digitally in an electronic system specifically designed to collect, store and manipulate data and to provide safe access to complete data about patients (WHO, 2017). Tele-health involves use of ICTs to provide healthcare remotely. It can be used to deliver a range of services, including teleconsultation, teleradiology, telepsychiatry, and telesurgery. M-health utilizes mobile telephone technology, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs) and other wireless devices, to deliver health services, collect data, and raise health awareness (WHO, 2011).

3. ICTs and KM for quality education (SDG 4)

ICTs are also an essential tool for achieving high quality education, supporting access and inclusion, improving learning quality, and enabling lifelong learning in pursuit of SDG 4. For students in multi-island countries, ICTs enable distance learning in less populated islands and access to similar learning opportunities as in main population centres. They help “...individuals to compete in a global economy, by enhancing learning and creating a skilled workforce, by reaching learners in rural and remote regions, by improving teachers’ training, and by minimizing costs associated with the delivery of traditional instruction” (Sharmin and others, 2017).

Integrating ICTs in education delivery requires a supportive policy framework, institutional changes to teaching methods and curricula, professional development of teachers, and a supportive ecosystem, including reliable electrical power, ICT infrastructure, and facilities. A range of ICTs and

related services can play a role in the delivery of education, including connected digital devices and learning environments, distance learning, open standards and open source software, online courses, including massively open online courses (MOOCs), and education information management systems.

OpenEMIS is an open source, royalty-free education management information system, which has been implemented in several SIDS. It is used to capture, analyze and manage education data to support managers, policy-makers and decision-makers in the education sector. It has been deployed in countries such as Barbados, the Maldives and Turks and Caicos Islands (CSF, 2016, 2017 and 2017a).

C. Regional initiatives to increase ICT and KM capacity in the Caribbean

This study focuses on recommendations for individual Caribbean countries seeking to leverage ICTs and KM to improve public service delivery, healthcare and education, but encourages regional collaboration among Caribbean multi-island countries and separate island administrations to tackle common ICT and KM challenges. Multilateral cooperation in developing e-government and ICT infrastructure offers many advantages, including the sharing of investment costs and reaping economies of scale.

Several regional initiatives already exist to close the digital divide in the Caribbean and improve ICT infrastructure and access. HIPCAR, a joint initiative of the International Telecommunications Union (ITU), CARICOM and the Caribbean Telecommunications Union (CTU), is an example of a Caribbean-wide effort to harmonize planning in the ICT sector. The project, which was concluded in 2013, sought to create common ICT policies and legislation for the 15 CARICOM member countries in the areas of privacy and data protection, universal service and access, access to information, e-commerce, interconnection, cybersecurity and crime, and interception of communication. However, only a few countries adopted the model legislation and some of the resulting legal frameworks have been criticized for inconsistency with international standards and technically and legally flawed provisions (Jamil, 2014).

In 2016, a regional project funded by the International Development Bank (IDB) aiming to improve access to broadband was concluded. The Broadband Infrastructure Inventory and Public Awareness in the Caribbean (BIIPAC) covered eight beneficiary countries - Barbados, Belize, Dominican Republic, Guyana, Haiti, Jamaica, Trinidad and Tobago, and Suriname - and was executed by CANTO, the Caribbean Association of National Telecommunications Organizations. The projects overall aimed to "...to identify an inventory of the existing broadband infrastructure in the participating countries, and practical guidelines for the ubiquitous implementation of broadband access technologies in an efficient manner that is consistent with globally adopted standards and international best practices" (CANTO, 2015). It culminated in recommendations for each participating country to work towards national and regional broadband strategies and improve access to broadband technologies.

Current regional initiatives include the Caribbean Regional Communications Infrastructure Programme (CARCIP) funded by the World Bank and coordinated by the Caribbean Telecommunications Union (CTU) for Grenada, Saint Lucia, and St Vincent and the Grenadines. The project has three components: 1) development of a regional approach to address challenges to the ICT sector; 2) bridging the remaining gaps in broadband communications in the participating countries; and 3) advancing the development of an ICT-enabled services industry. Initially set to be completed in 2017, the project has been extended to 2020.⁸ The main mode of delivering projects has been public-private partnerships. For example, in July 2018, the three participating countries signed contracts with regional telecommunications provider, Digicel, for the construction of new government wide area networks,

⁸ For more information regarding CARCIP, see the official website: <http://carcip.gov.vc/carcip/>.

educational networks for schools, libraries, and community centres, and a new submarine cable connecting St. Vincent and the Grenadines and Grenada (Jamaica Observer, 2018).

Another regional project is CARICOM's Single ICT Space, which aims to create an ICT-enabled borderless space that fosters economic, social and cultural integration for the betterment of Caribbean citizens. Launched by CARICOM Heads of Government in 2017, the project is conceptualized as the digital layer to the Caribbean Single Market Economy (CSME). Member States continue to work towards a regionally harmonized ICT policy, legal and regulatory regimes, robust national and regional broadband infrastructure, common frameworks for governments, ICT service providers and consumers, and effective, secure technology and management systems (CTU, 2017). A key pillar of the project is supporting the digitization of government and the economy by promoting the free flow of data, the standardization of e-services and the development of digital skills. However, Member States are behind in meeting many of the project's 2019 implementation deadlines, and renewed collaboration is necessary to deliver fully on the ambitious plan.

D. Research methodology

This study investigates the role that ICT and KM play in supporting sustainable development across multi-island Caribbean countries. It explores both the current contribution of ICT and KM and how their roles can be further developed. The study uses three multi-island Caribbean countries, Saint Kitts and Nevis, Trinidad and Tobago, and Turks and Caicos Islands, as case studies and focuses on the thematic areas of health, education and governance.

The research had three stages. The first comprised country visits and interviews. Each island in the case study countries was visited for interviews with government officials. The purpose of these interviews was to collect quantitative data on the sustainable development of the respective islands in the study's thematic areas as well as qualitative information on the roles being played by ICT and KM in supporting each island's development. Based on these interviews, it was concluded that insufficient quantitative data was available disaggregated by island to draw definitive conclusions about any inter-island development differences of the case study countries in the three thematic areas.

Secondly, a questionnaire and further interviews were conducted in order to gain further insights on information collected during the first part of the study. The questionnaire, which was sent to officials who had previously been interviewed, was qualitative in nature. Where respondents were available, the questionnaire was supplemented by interviews either before or after submission of the questionnaire. The questionnaire response rate was low, and no responses were received from the Turks and Caicos' Family Islands, or the island of Tobago.

Thirdly, telecommunications providers and further government officials were interviewed and provided data on ICT capacity in the study countries to substantiate information previously provided by officials. The researchers also relied on secondary information from official documents and other sources to supplement the findings. Appendix I provides a list of the officials interviewed at the first and third stages of the research, while Appendix II lists the respondents to the questionnaire conducted at the research's second stage.

II. Analysis of ICT and knowledge management capacity in select sectors

This chapter explores inter-island differences in ICT and KM capacity in the multi-island Caribbean SIDS of Saint Kitts and Nevis, Trinidad and Tobago, and Turks and Caicos Islands. These countries share the commonality of having more than one island, but differ in their size and demographics, geography, governance arrangements and economic performance. These differences are reflected in the roles that ICT and knowledge management play in the areas of governance, health and education in each country. Because the countries vary, they provide a good basis for comparison with other Caribbean SIDS in similar circumstances.

This chapter describes the demographics and governance arrangements of the selected SIDS and then explores the use of ICT and KM in the three thematic areas across the islands of each country. To this end, it highlights possible differences in the capacity of ICT and KM related-solutions to beneficially impact the three thematic areas and discusses the scope for strengthening ICT and KM capacity in each island.

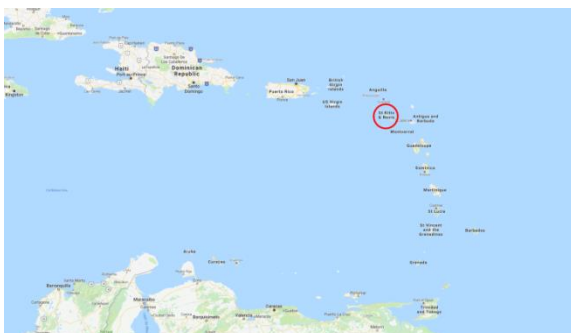
A. Demographics, governance arrangements and ICT development

1. Saint Kitts and Nevis

(a) Demographics

Saint Kitts and Nevis is an independent Caribbean SIDS, comprised of two islands, and located in the northeast corner of the Caribbean Sea. Saint Kitts is separated from Nevis by The Narrows, a 3km wide channel with a depth of 9m. Table 1 shows the land areas and populations of Saint Kitts and Nevis (Government of Saint Kitts and Nevis, 2012). More recent data places Saint Kitts and Nevis' population at 56,100 (We are Social, 2019a).

Map 1. Location of Saint Kitts and Nevis



Source: Google, INEGI.

Map 2. Map of Saint Kitts and Nevis



Source: Academia Maps.

Table 1
Land area and population of Saint Kitts and Nevis

	Saint Kitts	Nevis	Saint Kitts and Nevis
Land area	168.4 km ²	93.2 km ²	261.6 km ²
Population (2011 census)	34,918	12,277	47,195
Percentage of total population	74.02 per cent	25.98 per cent	100.00 per cent

Source: Government of Saint Kitts and Nevis, 2012.

(b) Governance arrangements

The Federal Government of Saint Kitts and Nevis governs the whole of Saint Kitts and Nevis. There is also a Nevis Island Administration with responsibility for Nevis, except in matters relating to national security and trade, which fall under the purview of the Federal Government. There is no separate corresponding island administration for Saint Kitts as its affairs are governed solely by the Federal Government.

Saint Kitts and Nevis has a unicameral National Assembly. The 1983 Constitution requires a minimum of eight electoral constituencies for Saint Kitts and three for Nevis. If there are more than 11 constituencies, at least one third of them must be in Nevis. The National Assembly consists of one representative from each of the constituencies and three or more senators. The senators are appointed by the Governor General, one third on the advice of the Leader of the Opposition and the rest on the advice of the Prime Minister.

Nevis has a unicameral Nevis Island Assembly, which is structured similarly to the National Assembly. It consists of one elected member for each electoral district and three or more nominated members. The nominated members are appointed by the Governor General, one third on the advice of the Leader of the Opposition in the Assembly and the rest on the advice of the Premier, The Honourable Mark Brantley. The number of nominated members must not be more than two thirds of the number of

elected members. The Nevis Island Administration is the government of Nevis and is drawn from the Nevis Island Assembly and headed by the Premier.

The Constitution gives the Nevis Island Administration exclusive responsibility for administration of airports and seaports, education, extraction and processing of minerals, fisheries, health and welfare, labour, land and buildings vested in the Crown, and licensing of imports and exports. The Premier can give general direction to the heads of the police and the defence forces in Nevis. In the event of an inconsistency between the directions of the Premier and those of the Prime Minister, the directions of the Prime Minister prevail. The country's tax revenue is divided proportionally between the Federal Government of Saint Kitts and Nevis and the Nevis Island Administration according to the population of the two islands.

(c) ICT development

In 2017, Saint Kitts and Nevis had a high ICT Development Index (IDI) value of 7.24, slightly up on 7.18 in the previous year. The IDI is a composite index created by the International Telecommunications Union (ITU) based on 14 indicators measuring ICT infrastructure and access, usage and skills.⁹ It shows a country's progress in ICT development, and the extent to which ICTs can be used to enhance growth and development in the context of available capabilities and skills. A shortcoming of the IDI for the purposes of the current study is that it does not assess inter-island differences in ICT infrastructure and access, usage and skills where multi-island countries are concerned. The following table shows the key indicators used to assess the IDI for Saint Kitts and Nevis in 2017:

Table 2
Key IDI indicators for Saint Kitts and Nevis (2016)

Fixed-telephone subscriptions per 100 inhabitants	31.2
Mobile-cellular subscriptions per 100 inhabitants	136.9
Fixed-broadband subscriptions per 100 inhabitants	29.3
Active mobile-broadband subscriptions per 100 inhabitants	77.1
3G coverage (per cent of population)	100.0
Mobile-cellular prices (per cent GNI pc)	2.0
Fixed-broadband prices (per cent GNI pc)	2.8
Mobile-broadband prices 500 MB (per cent GNI pc)	1.1
Mobile-broadband prices 1 GB (per cent GNI pc)	1.2
Percentage of households with computer	71.7
Percentage of households with Internet access	72.6
Percentage of individuals using the Internet	76.8
Int. Internet bandwidth per Internet user (kbit/s)	165.4

Source: ITU, June 2017.

Saint Kitts and Nevis has well-developed telecommunications infrastructure, with penetration rates mostly above regional and global levels and improvements in service pricing in recent years. In 2019, 78 per cent of individuals were using the internet, equating to 43,600 active users (We are Social, 2019a). The ITU attributes Saint Kitts and Nevis's ICT successes to increased investment and collaborations with regional organizations, such as the Eastern Caribbean Telecommunications Authority (ECTEL) (ITU, 2017a).

⁹ ICT access is measured by fixed-telephone subscriptions per 100 inhabitants, mobile-cellular subscriptions per 100 inhabitants, international Internet bandwidth per Internet user, the percentage of households with a computer and the percentage of households with Internet access. ICT usage is measured by the percentage of individuals using the Internet, fixed-broadband Internet subscriptions per 100 inhabitants and active mobile-broadband subscriptions per 100 inhabitants. ICT skills are approximated by mean years of schooling, secondary gross enrolment ratio and tertiary gross enrolment ratio.

The National Telecommunications Regulatory Commission (NTRC) regulates the telecommunications sector, including the development of ICT infrastructure, and works closely with ECTEL to ensure a competitive market. According to the NTRC, Saint Kitts and Nevis has already achieved high levels of telecommunications service, but access is lacking (NTRC, 2019). Under the country's universal service programme, the NTRC has recently approved a project to provide WiFi in Nevis community centres.

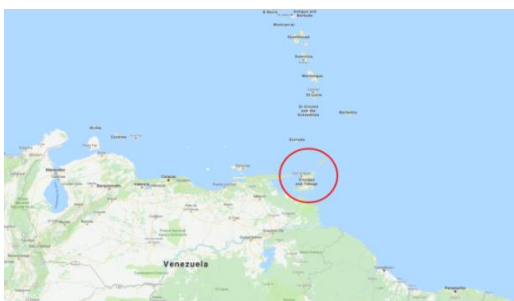
The country's overall mobile penetration is 137 per cent but only 34 per cent of mobile connections are 3G or 4G broadband-enabled (We are Social, 2019b).¹⁰ Many people have two cell phones, one from each of the two main telecommunications providers, Digicel and Flow. Another provider, Cable & Wireless, is the sole provider of landline telephone connections. The country also has a broadband services provider, The Cable, which is upgrading its network on both islands with the aim of increasing internet speeds by up to 50 per cent (Telegeography, 2019).

Fixed broadband penetration in Nevis is similar to St. Kitts at approximately 90 per cent (Nevis Island Administration, 2019).¹¹ However, the speed, reliability and cost of broadband services is an issue on both islands. The Department of Information Technology in the Ministry of Justice, Legal Affairs and Communications reports that, regardless of the choice of provider, households receive fixed broadband bandwidth of up to 6Mbps on the standard package costing approximately US\$35 per month. Households must upgrade to broadband packages ranging from US\$50 to \$185 per month for bandwidth capable of supporting video streaming and multiple devices. Furthermore, while businesses now have access to fibre infrastructure, households in both islands still rely on copper lines using asymmetric digital subscriber line (ADSL) technology. As a result, many individuals opt to use mobile broadband internet on their cell phones instead.

2. Trinidad and Tobago

(a) Demographics

Map 3. Location of Trinidad and Tobago



Source: Google, INEGI.

Map 4. Map of Trinidad and Tobago



Source: Academia Maps.

Trinidad and Tobago is a twin-island republic located in the south eastern corner of the Caribbean, just to the northeast of Venezuela, separated from it by narrow channels at its north-western and south-western tips. Trinidad and Tobago are approximately 35 km apart at their nearest points. Table 3 shows the size and population of the islands of Trinidad and Tobago.

¹⁰ Mobile penetration is defined as the number of mobile-cellular subscribers per 100 inhabitants. Mobile subscriptions do not represent unique individuals, so figures over 100% indicate multiple mobile subscriptions per person.

¹¹ Fixed broadband penetration refers to the number of fixed broadband subscribers per 100 inhabitants.

Table 3
Land area and population of Trinidad and Tobago

	Trinidad	Tobago	Trinidad and Tobago
Land area	4,828 km ²	300 km ²	
Population (2011 census)	1,267,145	60,874	1,328,019
Percentage of total population	95.4 per cent	4.6 per cent	100.00 per cent
Population growth per annum	0.4 per cent	1.1 per cent	0.5 per cent

Source: Central Statistical Office, 2012.

(b) Governance arrangements

The 1976 Constitution of Trinidad and Tobago provides for a bicameral parliament consisting of the President, with whom executive authority is vested, the House of Representatives and the Senate. The members of the House of Representatives are elected representatives, 1 from each electoral constituency, of which there are 36. At least 2 of the electoral constituencies must be in Tobago. There are 31 members of the Senate appointed by the President, 16 on the advice of the Prime Minister, 6 on the advice of the leader of the opposition and 9 at the discretion of the President. The Government of Trinidad and Tobago consists of the Prime Minister, who is a member of the House of Representatives, and ministers who are members of parliament.

There is a unicameral Tobago House of Assembly, whose membership, powers and functions are set out in the Tobago House of Assembly Act 1996. The Assembly is comprised of 12 elected assembly members and 4 appointed councillors. Responsibility for conducting the functions of the Assembly rests with the Executive Council, which consists of the Chief Secretary, elected from among the assembly members, the Deputy Chief Secretary and other secretaries.

The Assembly is responsible for formulating and implementing policy for Tobago in several areas, including finance; infrastructure, including air and sea transportation, wharves and airports and public utilities; telecommunications; health services; library services; education including curriculum; and statistics and information. The areas outside the Assembly's responsibility are national security, foreign affairs, immigration, and legal affairs including the registration of legal documents. There is no corresponding island administration for Trinidad as its affairs are governed solely by the national government.

Cabinet allocates finances to the Assembly each financial year based on the Chief Secretary's estimate of revenue and expenditure. A Dispute Resolution Commission can resolve disputes between the Assembly and the Government regarding budgetary allocations. Cabinet must take the following considerations into account when considering Tobago's budget estimates:

1. physical separation of Tobago by sea from Trinidad and Tobago's distinct identity;
2. isolation from the principal national growth centres;
3. absence of the multiplier effect of expenditures and investments (private and public) made in Trinidad;
4. restricted opportunities for employment and career fulfilment;
5. the impracticability of participation by residents of Tobago in the major educational, cultural and sporting facilities located in Trinidad.¹²

¹² Section 43, Tobago House of Assembly 2006 Act.

(c) ICT development

Trinidad and Tobago achieved an IDI value of 6.04 in 2017, an improvement on 5.71 in the previous year. It had an overall country rank of 68 in 2017, ranking somewhat lower than Saint Kitts and Nevis at 37. The following table shows the figures for the key IDI indicators used to calculate Trinidad and Tobago's IDI value:

Table 4
Key IDI indicators for Trinidad and Tobago (2016)

Fixed-telephone subscriptions per 100 inhabitants	20.2
Mobile-cellular subscriptions per 100 inhabitants	160.6
Fixed-broadband subscriptions per 100 inhabitants	19.0
Active mobile-broadband subscriptions per 100 inhabitants	47.3
3G coverage (per cent of population)	75.0
LTE/WiMAX coverage (per cent of population)	10.0
Mobile-cellular prices (per cent GNI pc)	1.0
Fixed-broadband prices (per cent GNI pc)	1.4
Mobile-broadband prices 500 MB (per cent GNI pc)	1.3
Mobile-broadband prices 1 GB (per cent GNI pc)	2.3
Percentage of households with computer	71.4
Percentage of households with Internet access	70.9
Percentage of individuals using the Internet	73.3
Int. Internet bandwidth per Internet user (kbit/s)	182.8

Source: ITU, June 2017.

Trinidad and Tobago's service adoption rates lag behind other Caribbean countries, but these have been on an upward trend over the past decade (ITU, 2017). The telecommunications sector has seen vast improvements in recent years, with a competitive environment for fixed-broadband and increasing mobile subscriptions. Internet penetration is high, with 80.4 per cent of households having fixed internet subscriptions and 25 per cent of individuals having fixed internet subscriptions (TATT, 2018). Mobile penetration is among the highest in the world, standing at 150 per cent in 2018 (TATT, 2018). A significant expansion of the country's telecommunications infrastructure made this growth possible (Government of Trinidad and Tobago, 2018).

In 2004, the Telecommunications Authority of Trinidad and Tobago (TATT) was created to oversee the liberalization of the telecommunications sector. It regulates the industry and oversees the country's Universal Service Fund, which aims to ensure universal access to affordable basic telecommunications services for the entire population. Current projects include a national WiFi initiative and a project to improve broadband infrastructure in underserved communities on both islands.

Tobago experiences poorer ICT access than the larger and more populated island of Trinidad. Of the Tobagonians surveyed in the 2013 Digital Divide Survey, 18.9 per cent reported not having access to the internet, while only 15.5 per cent of Trinidadians reported lacking access.¹³ 31 per cent of Tobagonians did not have access to a desktop, tablet or laptop at home. However, only 25 per cent of Trinidadians reported having no access to these devices (TATT, 2013).¹⁴ According to the National ICT Division of the Ministry of Public Administration, ICT access in Tobago's capital city, Scarborough, lags behind that of urban Trinidad, but the situation in rural Tobago is similar to that of rural Trinidad.

¹³ For the purposes of this statistic, TATT questioned 127 Tobagonians and 1822 Trinidadians.

¹⁴ For the purposes of this statistic, TATT questioned 669 Tobagonians and 11,929 Trinidadians.

Tobago has experienced slower ICT uptake than Trinidad, particularly among individuals and businesses (Government of Trinidad and Tobago, 2018). As a result, the two islands are at different stages of ICT readiness with respect to infrastructure, connectivity, skills, and access and ICT initiatives need to be tailored to meet Tobago's specific needs.

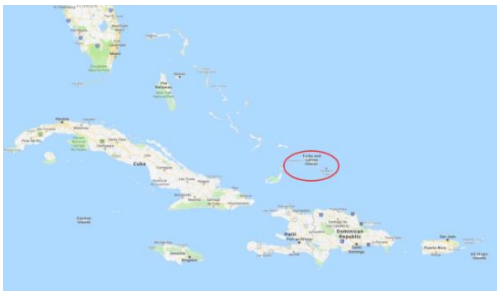
The National ICT Division attributes this situation to several factors. It reports that the Ministry of Public Administration and, by extension, the Central Government has gazetted responsibility for ICTs and therefore the THA relies on the central government for funding of ICT initiatives. Although the Tobago House of Assembly Act 1996 lists telecommunications as one of the THA's responsibilities, the island relies heavily on network infrastructure housed in Trinidad.

Furthermore, Tobago has an Information Technology Unit in the Office of the Chief Secretary, but the THA has not identified a single lead division, agency or department with responsibility for ICT development. Instead, this responsibility has been dispersed across several divisions and agencies under the THA, including the Information Technology Unit, Tobago Information Technology Limited (TITL), the Division of Planning, and the Office of the Chief Administrator. A further factor is that, while Tobago is incorporated in the country's NICT Plan 2018-2022, it does not have its own specific ICT plans or development programmes and has limited ICT professionals. Tobago's Comprehensive Economic Development Plan 2.0 (CEDP), which expired in 2017, did not align to any national ICT plans.

3. Turks and Caicos Islands

(a) Demographics

Map 5. Location of the Turks and Caicos Islands



Source: Google, INEGI.

Map 6. Map of Turks and Caicos Islands



Source: Education Sector Plan 2018-2022.

Turks and Caicos Islands is an archipelagic, internally self-governing overseas territory of the United Kingdom. It lies to the north of Hispaniola and southeast of The Bahamas and consists of the Caicos Islands to the north and west, separated from the Turks Islands to the southeast by the Turks Island Passage.

The capital of Turks and Caicos Islands, Cockburn Town, is located in Grand Turk, which is the country's administrative hub. It had the largest population until the 1980s when it was overtaken by Providenciales, the country's economic, commercial and tourism centre. The remaining islands are usually referred to as the Family Islands. Table 5 shows the relative sizes of the inhabited islands of the Turks and Caicos Islands and their populations (Government of the Turks and Caicos Islands, 2018).

Table 5
Land area and population of the Turks and Caicos Islands

	Grand Turk	Providenciales	North Caicos	Middle Caicos	South Caicos	Parrot Cay	Salt Cay	Turks and Caicos Islands
Land area	18 km ²	98 km ²	116.4 km ²	144 km ²	21.2 km ²	6 km ²	6.7 km ²	
Population (2012 census)	4,831	23,769	1,312	168	1,139	131	108	31,458
Percentage of total population	15.4 per cent	75.6 per cent	4.2 per cent	0.5 per cent	3.6 per cent	0.4 per cent	0.3 per cent	100.0 per cent
Population (2018 estimate)	6,287	32,095	1,365		1,199			41,485

Source: Government of Turks and Caicos Islands, 2018.

(a) Governance arrangements

The 2011 Turks and Caicos Islands Constitution provides for a legislature, which consists of the British monarch, acting through the Governor, and a House of Assembly. The House of Assembly consists of a speaker, 15 elected members, 4 appointed members and the Attorney-General. 5 of the elected members are elected by the Turks and Caicos Islands electorate as a whole. The remaining 10 are each elected by each of the 10 electoral districts. The Cabinet of the Turks and Caicos Islands consists of the Governor, a Premier and no more than 6 other Ministers. The Governor is responsible for defence, external affairs, internal security, regulation of international financial services, and public service appointments.

The 2014 Caicos District Boards Ordinance establishes district boards, appointed by the Governor, in the islands of North Caicos, Middle Caicos, South Caicos, Salt Cay and Providenciales. These district boards have a limited remit, including public health, water supply, cultivation of land and the provision of fees and charges. There are also 5 district commissioners who coordinate the activities of the public service in their respective districts.

(b) ICT development

Turks and Caicos Islands has two main telecommunications providers, Flow and Digicel, who have been upgrading the country's ICT infrastructure following Hurricanes Irma and Maria in 2017. Both providers have prioritized upgrades in the most populated islands of Providenciales and Grand Turk but have projects to provide community Wi-Fi zones throughout the country. Underground fibre projects are being rolled out to provide ultra-high-speed broadband connections to Providenciales and Grand Turk. For the first time, the core of the country's ICT infrastructure will be located underground to build resilience against natural disasters.

The Turks and Caicos Islands' Telecommunications Commission regulates the country's telecommunications market. It aims to maintain a competitive market and ensure access to reliable state-of-the-art telecommunications services at affordable prices. In 2005, it created Universal Service and Public Telecommunications Regulations to establish a universal service obligation and universal service fund. Universal service funds aim to increase access to telecommunication services through projects funded by legally-mandated contributions from providers, but these regulations have not been brought into operation.

In 2019, the total number of active internet users in Turks and Caicos Islands was 30,000 or 83 per cent of the population (We are Social, 2019c). The number of active mobile internet users was 28,000, equating to 77 per cent of the population. Furthermore, the total number of mobile subscriptions was

42,800 or 118 per cent. However, only 34 per cent of mobile connections were broadband-enabled. According to CARICOM's ICT Statistics and Indicators 2011-2017, Turks and Caicos Islands had 11.65 fixed telephone lines per 100 inhabitants in 2015. In 2004, there were 10.55 fixed internet subscriptions per 100 inhabitants and 88.98 mobile cellular subscriptions per 100 inhabitants. A comparison of these figures shows that both mobile subscriptions and internet penetration are improving across the country as a whole.

Nonetheless, mixed levels of ICT development at the island level are evident. While all inhabited islands have approximately 98 per cent wireless and mobile broadband penetration, only Grand Turk and Providenciales enjoy fixed broadband and television access. Fixed broadband services have not been restored to the Family Islands since the 2017 hurricane season, except for in limited areas of North Caicos. As a result, these islands rely on wireless broadband and mobile services only.

The speed of mobile wireless broadband services varies across islands. Providenciales receives the fastest mobile broadband access of 15-20 Mbps per user via fibre optic cables, while users in Grand Turk and Middle Caicos receive a bandwidth of approximately 10Mbps. North and South Caicos have the slowest connection speeds of between 6-10 Mbps per user. Lower connection speeds in Grand Turk and the Family Islands are due to bandwidth limitations on microwave transmissions to these islands.

Both Grand Turk and Providenciales have 99 per cent fixed broadband penetration with 65 per cent of households using broadband and television services provided by Digicel (Digicel, 2019). Connectivity in Providenciales is provided by direct fibre or coaxial connection, but Grand Turk relies on microwave link with an added fibre network to improve internet speeds. Households in Providenciales receive a bandwidth of 10-100Mbps, while subscribers in Grand Turk only have a connection speed of 10Mbps due to limitations on the microwave transmission.

B. ICT and KM capacity in governance

This section explores the contribution made by ICT and knowledge management to govern and provide public services across the islands of the three study countries. It considers both current ICT and knowledge management capacity and the scope for expanding this capacity. In doing so, it analyses the causal factors impacting the ability of local populations to benefit equally from government services.

1. Saint Kitts and Nevis

The Department of Technology in the Ministry of Justice, Legal Affairs and Communication is responsible for ICT for the government of Saint Kitts and Nevis. It has an ICT Governance Board and an ICT Technical Committee responsible for hardware, networking, databases and information security.

A government wide area network is under development, which will connect all government offices in Saint Kitts. There is also an e-government portal which provides access to some government services and the land and civil registries. The Inland Revenue Department provides for online filing and payment of 20 types of taxes and it is also possible to apply for a driver's license online. However, no other transactional services are available from the e-government portal, and many of the government web pages provide only limited information. According to the Ministry of Justice, Legal Affairs and Communications, ICT support to government bodies in Saint Kitts is decentralized and less effective than in Nevis.

Nevis has an Information Technology Department in the Ministry of Education of the Nevis Island Administration which is responsible for ICT on the island. Nevis Island Administration uses a fibre optic wide area network to connect its offices. It operates its own e-government portal, providing government information. It is possible to pay electricity bills online, but this appears to be the only type

of e-transaction supported. Nevis also has some ordinances in place dealing with ICT and information security and offers centralized ICT support to its ministries and government departments.

Saint Kitts and Nevis does not have a policy on the use of ICT for governance, although ICT was identified as a pillar for development in the 2006 National Adaptation Strategy (Government of Saint Kitts and Nevis, 2006). A National Information and Communications Technology (ICT) Strategic Plan was also produced in 2006 (Government of Saint Kitts and Nevis, 2006a), but this plan has not yet been updated. The country has at least three pieces of cyber legislation, including the Electronic Crimes Act 2009, the Interception of Communication Act 2011, and the Data Protection Act 2018.

The central government is currently developing a broadband strategy, in consultation with telecommunications providers. According to the Department of Technology, the cost of broadband currently limits its use in e-government, business and for private purposes. Although ECTEL is drafting new quality of service regulations that would apply to broadband, it currently does not regulate the provision of broadband in its Member States. As a result, the broadband market in Saint Kitts and Nevis suffers from a lack of competition and competitive pricing. Through the strategy, the government aims to deliver cost-effective fibre broadband to both islands with reliable, high-speed connections.

Officials in both Saint Kitts and Nevis identify a lack of financial resources and skilled ICT professionals, in addition to a failure to implement and update policies and strategic plans where they exist, as constraints to the further development of e-government. According to the Department of Technology, Saint Kitts and Nevis is at a disadvantage in developing its ICT and e-government infrastructure compared to the ECTEL Member States participating in the Caribbean Regional Communications Infrastructure Programme (CARCIP). In July 2018, the three participating countries, Grenada, Saint Lucia, and St Vincent and the Grenadines, entered into agreements for the construction of new government wide area networks, educational networks for schools, libraries, and community centres, and a new submarine cable connecting St. Vincent and the Grenadines and Grenada.

2. Trinidad and Tobago

Trinidad and Tobago's National ICT (NICT) Plan 2018–2022 has as one of its five strategic thrusts the development of digital government. It aims to have 50 per cent of key government transactions conducted online by 2022. Table 6 shows the five strategic thrusts and associated strategies of the plan:

Table 6
Trinidad and Tobago National ICT Plan 2018 - 2022 strategic thrusts and strategies

Strategic Thrusts	Strategies
1. Improving Connectivity	<ul style="list-style-type: none"> • Enhancing ICT infrastructure • Modernizing the legal and regulatory framework • Strengthening safety, security and resilience
2. Increasing Human Capacity	<ul style="list-style-type: none"> • Building ICT human capital • Improving access to human capital • Promoting digital inclusion
3. Digital Government	<ul style="list-style-type: none"> • Offering end-to-end digital services • Driving user adoption • Increasing government efficiency • Promoting open government
4. Fostering Economic Development	<ul style="list-style-type: none"> • Advancing e-commerce • Diversifying the economy through ICT sector development • Advancing digital content production
5. Advancing Environmental and Societal Benefit	<ul style="list-style-type: none"> • Promoting green ICT

Source: NICT Plan 2018-2022.

The Plan recognizes that Tobago is at a lower level of ICT readiness than Trinidad in terms of infrastructure, connectivity, skills and access. This has resulted in slower uptake of ICT, particularly among individuals and businesses. It also notes Tobago's different governance arrangements and adjusts the strategies accordingly. For example, given the importance of tourism for Tobago, the government aims to target the tourism and hospitality industries in order to improve access to ICT human capital and encourage digitization and automation on the island.

Under the strategic thrust of developing digital government, the Plan seeks to develop e-governance infrastructure to interconnect schools, the Tobago Health Authority and the THA. This will enable direct integration of Tobago with central government. Furthermore, to foster collaboration and reduce duplication between the national government and the THA, enterprise-based and interoperable network services will be deployed across THA bodies.

One of the Plan's strategies is to improve connectivity through modernizing the legal and regulatory framework. Trinidad and Tobago has a raft of cyber, e-commerce and data protection legislation, including the Computer Misuse Act 2000, the Telecommunications Act 2001, the Interception of Communications Act 2010, the Data Protection Act 2011, and the Electronic Transactions Act 2011. However, in some cases, only parts of these Acts have been brought into effect. The NICT Plan mentions specific legislative changes required in Tobago to move towards electronic payments.

The Ministry of Public Administration has overall responsibility for coordinating the development of the National ICT Plan, supporting its implementation, monitoring and evaluation through the National Information and Communications Technology (NICT) Division. There is also a National ICT Company (iGovTT) which provides implementation and advisory services for the government.

The government has established a wide area network, which connects all government entities, including schools and health facilities, throughout the country. The network is being upgraded, and full connectivity for the Tobago House of Assembly is planned for 2019. There is a division under iGovTT called ttConnect, which operates an e-government portal, providing access to government information and websites. The portal has an e-Tax service through which taxpayers can access and manage their tax account information and file income tax returns electronically. Other online services include land and civil registry searches. ttConnect also operates services centres, kiosks and a mobile phone portal through which the public can transact a subset of government services. Furthermore, an online government platform, TTBizLink, enables electronic approvals for over 25 government to business services, including work permits, import/export licenses and company registration.

In Tobago, the Information Technology Unit in the Office of the Chief Secretary has responsibility for ICT and operates an e-government portal. However, this portal only provides limited information and does not appear to provide any services. The Tobago House of Assembly also has special purpose company called Tobago Information Technology Limited, which operates a 211 Contact Centre providing information on government services in Tobago and 24-hour access to Tobago emergency services. This company also provides an emergency text messaging system.

Since the launch of the NICT Plan, service providers in Tobago have been rolling out infrastructure projects, which are beginning to reduce the ICT infrastructure gap between Trinidad and Tobago (Ministry of Public Administration, 2019). Nonetheless, ICT access in Tobago's capital city, Scarborough, still lags behind that of urban Trinidad, but the situation in rural Tobago is similar to that of rural Trinidad (Ministry of Public Administration, 2019). Tobago's lower level of ICT capacity can be attributed to the THA's reliance on the central government for funding of ICT initiatives and network infrastructure housed in Trinidad, among other factors. While Tobago is incorporated in the country's NICT Plan, it does not have its own current ICT plans or development programmes.

3. Turks and Caicos Islands

The Central Information Technology Unit in the Ministry of Finance, Investment and Trade has responsibility for ICT and e-government. The 2018-2019 draft budget identifies as one of the strategic priorities of the Ministry improving "...the accessibility to government services through e-government technology" (Government of Turks and Caicos, 2018a). However, no information was available from the Central Information Technology Unit about any e-government plans.

The government's website provides information about how to apply for government documents, such as passports and police certificates, but only a small number of e-services are available (e.g. land registry application tracking) and applications usually require a form to be posted or a visit to a physical office. The small size of the Family Island populations, compared to those of Grand Turk and Providenciales, impacts the availability of services on those islands. In many cases, government offices are located in Providenciales or Grand Turk and persons based in the Family islands must travel to access them. For example, services of the Registration and Citizenship Department and the Border Control and Enforcement Department can only be accessed in Providenciales or Grand Turk, while NHIP services can only be accessed from Providenciales.

Officials from North Caicos and Middle Caicos reported that, while a limited range of government services in the Family Islands are accessible via e-government, they are not considered to be very effective. One of the main reasons is that fixed line broadband access has not been restored to the Family Islands since the 2017 hurricane season, except for in some areas in North Caicos. Furthermore, Family Island officials have not been adequately trained or resourced to promote the use of these services.

4. Inter-island differences in and scope for strengthening ICT and KM capacity

Trinidad and Tobago and Saint Kitts and Nevis both have a national government with responsibility for the affairs of the whole country in addition to separate island administrations for Tobago and Nevis. Turks and Caicos Islands, on the other hand, has one national administration governing all its islands. As a result, the populations of Nevis and Tobago can access both e-government services provided at the national level and by their separate island administrations. In the Turks and Caicos Islands, any e-government services are provided at the national level.

The latest results of the World Bank's Worldwide Governance Indicators project for 2014 show that Caribbean countries have made strides towards achieving good governance but more needs to be done. Trinidad and Tobago scored 64.4 in the percentile rank for government effectiveness, while Saint Kitts and Nevis fared worse for this dimension with a percentile ranking of 51 (World Bank, 2014). The project measures six dimensions of governance: voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law and control of corruption. Government effectiveness includes an assessment of the quality of public services. It assesses nearly all Caribbean countries but does not include Turks and Caicos Islands nor consider inter-island differences in multi-island countries.

Most Caribbean countries included in the 2018 UN E-Government Survey had reached the 'high' or 'middle' level of the E-Government Development Index (EGDI). This includes Saint Kitts and Nevis and Trinidad and Tobago, which both have high EGDI ratings. All Caribbean countries had improved their EGDI scores in the 2018 survey when compared with the 2016 results. The EGDI measures the readiness and capacity of national institutions to use ICTs to deliver public services and is a composite of telecommunications infrastructure, human capital and online services indexes. Similarly, Saint Kitts and Nevis and Trinidad and Tobago ranked 98th and 99th respectively in the UN E-Participation Index in 2018, up from rankings of 133th and 101th in 2016. Compared to the EGDI, the UN E-Participation

Index focuses on the quality and use of on-line services in government and citizen interaction, stakeholder engagement, and decision-making processes.

However, the EGDI may in fact overstate Caribbean performance in the deployment of e-government services as it gives substantial weight to metrics that are not directly related to the implementation of e-government (ECLAC, 2016). It also does not consider inter-island differences in readiness and capacity to use e-government. As a Non-Self-Governing Territory (NGST), Turks and Caicos Islands is not included in either the EGDI or E-Participation Index.

Of the three study countries, Trinidad and Tobago makes the most extensive use of e-government to deliver public services and is the only one with a current ICT strategic plan. This plan adjusts the strategies for Tobago noting its distinct governance arrangements and lower level of ICT readiness. Saint Kitts and Nevis and Turks and Caicos Islands have a few government services available online, but those offered in Turks and Caicos Islands are not considered very effective. Fixed broadband access has not been restored to the Family Islands since the 2017 hurricanes, and inadequate resources have been deployed to encourage use of these services via mobile and wireless broadband services. As a result, inter-island travel is often required to access services at government offices. Saint Kitts and Nevis is in the process of updating its 2006 ICT plan and producing a broadband strategy, however no information was available on the situation in Turks and Caicos Islands. Knowledge management does not play a significant role in governance in any of the countries.

Expanding the availability and scope of e-government to include more end-to-end digital transactions would help to address unequal availability, access and quality of public services in small and outlying islands of multi-island Caribbean SIDS. ICT officials in Saint Kitts and Nevis and Trinidad and Tobago indicated that major challenges to the development of e-government were the availability of finance and skilled human resources. Resistance to reform and lack of skills to support the uptake of new technologies are also seen as major impediments to the further implementation of e-government. Furthermore, ministries and governments often work in silos, resulting in adoption of different ICT systems, duplication of efforts and resources, and lost opportunities for coordination and collaboration.

Careful planning and leadership are necessary to stimulate the organizational change and acceptance critical for the development of e-government. Systems and service delivery approaches must also be tailored to local needs and the capacity of existing ICT infrastructure and include adequate training and support. They must work in harmony with inter-island governance arrangements and be coordinated within and across government departments. A unified whole-of-government framework for the entire public sector will assist countries to exploit the potential of ICTs and to deliver e-government in a coordinated manner. A cross-government knowledge management programme would work in unison to enhance the delivery of public services and the uniformity with which they are provided.

If common national standards can be harmonized, these benefits could be further realized at the regional level. HIPCAR is an example of a Caribbean-wide effort to harmonize planning in the ICT sector. This joint initiative of the CTU, ITU and CARICOM was concluded in 2013 and sought to create common ICT policies and legislation for the 15 CARICOM member countries in several areas, such as privacy and data protection. However, only a few countries have adopted the model legislation and some of the resulting policies and legislation have been criticized for inconsistency with international standards and technically and legally flawed provisions (Jamil, 2014). Lessons from past regional projects, like HIPCAR, must be learnt to ensure the success of future e-government initiatives.

ECTEL Member States, Grenada, Saint Lucia, and Saint Vincent and the Grenadines, are currently benefiting from the Caribbean Regional Communications Infrastructure Programme (CARCIP), which has projects to bridge the remaining gaps in broadband communications in and between these

countries, develop a regional approach to joint ICT challenges, and advance the development of ICT-enabled service industries.

C. ICT and KM capacity in health

Delivering health services is an information-intensive activity, and as such benefits immensely from the application of both ICT and knowledge management. These benefits multiply in multi-island settings. In this section, we consider the current use of ICT and knowledge management to deliver health services in the case study countries, as well as the potential for expanding their role in the delivery of health care across islands.

1. Saint Kitts and Nevis

The Ministry of Health delivers public health care services in Saint Kitts through 11 health centres, 2 hospitals, a medical centre and a day treatment centre. The Nevis Island Administration also has a Ministry of Health, which is responsible for public health services in Nevis. It operates a hospital, a nursing home and 6 district health centres providing primary care.

Primary care services at health centres in both Saint Kitts and Nevis are free of charge. Patients at hospitals on both islands are required to pay fees for in-patient and out-patient services, except for children under eight, those over the age of 62 and the indigent. The country is currently developing a universal health coverage plan, a key component of which will be a national health insurance plan.

All public health providers in Saint Kitts and Nevis have internet connectivity. A hospital information system is being implemented by the Republic of China at a hospital in Saint Kitts for the management of patient data. The same system has been implemented at the hospital in Nevis, but the two systems are not connected. There are other ICT systems at facilities in both Saint Kitts and Nevis, which focus on specific aspects of health service delivery, such as radiology, pharmacy and laboratory operations. However, officials indicate that these systems operate in silos and are not integrated.

The Saint Kitts and Nevis Ministry of Health includes a Health Information Unit, which performs a knowledge management role. It is responsible for health data processing and management and supports evidence-based health policy formulation and decision making. The Nevis Health Promotion Unit plays a similar role in Nevis. However, these Units have not integrated knowledge management throughout their business processes in a systematic or structured way.

2. Trinidad and Tobago

Trinidad and Tobago has a decentralized health system. The Ministry of Health has overall responsibility for, and oversight of, the country's health sector. It also provides a range of vertical services and national and special programmes. The Division of Health, Wellness and Family Development of the Tobago House of Assembly is responsible for implementation of government health policies in Tobago.

There are five autonomous regional health authorities (RHAs), four in Trinidad and one in Tobago. Each RHA operates the health facilities within its region. The boards of the Trinidad RHAs report to the Minister of Health, while the Tobago Regional Health Authority (TRHA) has responsibility for health in Tobago and is subject to the provisions of the Tobago House of Assembly Act 2006. Citizens can access health care free of charge at all public health facilities in Trinidad and Tobago. There are also many private sector entities, which offer medical services in Trinidad and Tobago on a for-profit basis. Patients in Tobago must travel to Trinidad to receive some forms of specialized care, including haemodialysis and certain diagnostic procedures. However, this is to some extent mitigated by the government paying for travel costs.

The 2012-2016 strategic plan of the Ministry of Health identifies ICT integration in the health sector as one of the core priorities of the Ministry (Government of Trinidad and Tobago, 2011). Trinidad and Tobago has a national Health ICT plan that it is currently being revised. It proposes to transform health and social care delivery through innovative technology and partnerships that advance public health programs by enabling connected citizen care, improving quality of care and safety, and reducing the health and social care cost burden. The National ICT Plan 2018-2022 makes no mention of e-Health or ICT support for the health sector.

There is an ICT Division in the Ministry of Health, which has responsibility for the Ministry's ICT. Each of the RHAs also has its own ICT department. This has led to a situation where there are different e-health systems in the various RHAs. However, the Ministry of Health and all RHAs have implemented the Microsoft Dynamics GP product as their financial management information system.

Trinidad and Tobago is included in the latest Atlas of eHealth Country Profiles produced by the WHO, which presents countries' health-related indicators, policy and legislative framework to support e-health and use of e-health systems. Trinidad and Tobago's profile shows a reasonable policy and capacity building foundation for e-health. There are gaps in the e-health legislative framework for data sharing. Furthermore, there is no national electronic health record system and no use of e-Learning in the in-service training of health professionals. Some use is made of social media to deliver health information, while the use of m-Health is not well-established and big data¹⁵ is not used (WHO Global Observatory, 2016a).

Patient information systems have been implemented in all the RHAs, but they do not all use the same system. The North West, South West and Tobago RHAs use a system called Cellma. One RHA uses a system built in-house, while another uses a customized version of an open-source application. The systems are not integrated, each operating only within its own RHA. They are also at different stages of implementation, as shown in Table 7:

Table 7
RHAs' implementation status of patient information systems

Eastern RHA	<ul style="list-style-type: none"> Over 50 users Enables patient registration, and ward and bed allocations at the Sangre Grande Hospital
North Central RHA	<ul style="list-style-type: none"> Over 30 users Enables patient registration at the Eric Williams Medical Sciences Complex
North West RHA	<ul style="list-style-type: none"> Over 100 users Enables patient registration function at all facilities
South West RHA	<ul style="list-style-type: none"> Over 13 users Implemented at the San Fernando General Hospital, the Pt. Fortin Area Hospital, and one health centre Enables patient registration, scheduling, triage and pharmacy functions, and allows patient assessments for the rheumatology and mental health clinics
Tobago RHA	<ul style="list-style-type: none"> Over 50 users Enables patient registration and pharmacy functions at all facilities

Source: interviews with RHA officials.

Patient information systems capture all information for a patient in a single record, significantly reducing duplication of records and making patient demographic and allergy information and treatment history readily available to health care practitioners across islands in multi-island countries. In the Tobago RHA, duplication of prescriptions has been reduced, as drugs are dispensed against a single

¹⁵ In the healthcare setting, 'big data' refers to large sets of consumer, patient, physical, and clinical data that may be analysed to reveal health trends, individualize medical treatment and provide patients with optimal care.

patient record. However, these benefits only apply for services delivered within a single RHA and not at the national level.

Computerized maintenance and management systems are used in all RHAs but are at different stages of implementation. The Eastern, North Central, North West and Tobago RHAs each have over five users and use the system only for their biomedical, engineering, and operations services. The South West RHA has over 13 users and uses the systems for all services, including biomedical, engineering, electrical, ICT and plumbing.

All the RHAs have identified limited funding as a constraint to implementing more integrated and comprehensive ICT systems. In the case of the Tobago RHA, systems were implemented without addressing risks associated with failure of individual system components and without developing the ability to expand the systems for increased demand. The Authority has been unable to secure funding for equipment upgrades and to expand the patient information system to include the laboratory and radiology functions. Change management was identified as another challenge, as projects to implement ICT systems in the RHAs have been led by ICT departments, rather than the respective process owners. This has resulted in slow adoption, lack of monitoring and poor compliance with new systems and processes.

There is a need to integrate the existing ICT systems, both within the RHAs and nationally. Existing medical records also need to be digitized and a national electronic health record implemented. Other issues identified included the need to adopt an equipment life-cycle policy to provide for the replacement of obsolete health equipment. Furthermore, neither the Ministry nor the RHAs use a formal knowledge management process. Intranets are used to some extent to share knowledge but there is a need to institutionalize and document best practice in an organized and integrated manner across these organizations.

3. Turks and Caicos Islands

The Government of Turks and Caicos Islands operates public health clinics in each of its inhabited islands. There are two each in Providenciales and North Caicos and one in Grand Turk, Middle Caicos, South Caicos and Salt Cay. New clinics are being constructed in North Caicos to replace the existing buildings. Middle Caicos is served by one nurse and a doctor based in North Caicos, who is shared by the two islands. There are also seven nurses in North Caicos. There are several private primary care clinics in Providenciales. Secondary care in the Turks and Caicos Islands is provided by two public hospitals operated by InterHealth Canada under a public-private partnership arrangement.

The country's public health clinics provide a range of services, including obstetrics, gynecology, orthopedics, anesthesiology, maxillofacial surgery, psychiatry and internal medicine. Tertiary care is provided through visiting specialists and a Treatment Abroad Programme. There is no pharmacy in North or Middle Caicos but clinics stock small quantities of a limited range of pharmaceutical items. Prescriptions are filled by a local food store in each island, who offer a free service with a two day turn-around time from Providenciales.

Turks and Caicos Islands has a compulsory contributory National Health Insurance Plan (NHIP) covering essential medical services, medication, maternity care, public health services, ambulance services, including travel from the Family Islands to Providenciales or Grand Turk to access secondary care, and the Treatment Abroad Programme. While the NHIP covers the cost of health-related travel between islands, officials indicated that the Family Islands have difficulties accessing medications and that delays are experienced transporting patients, including those in critical condition, to Providenciales for care.

The public health system makes some use of ICTs. All health care facilities have good internet connectivity, except for those in islands where connectivity is still affected by the 2017 hurricanes.

Digicel has been working with public health facilities to provide high-speed Wi-Fi access to patients and staff and has restored internet service to all facilities that were connected before the hurricanes, with a few exceptions. Social media and government websites are used for public health education and service announcements. Telehealth is used to support administrative meetings, but its diagnostic or therapeutic use is limited. The Ministry of Health has been working for some time, with the support of the Pan American Health Organisation (PAHO), to establish a national Electronic Health Record (EHR) in all facilities.

The Ministry of Health, Agriculture and Human Services has a National Health Sector Strategic Plan for 2016-2020 (Government of the Turks and Caicos Islands, 2015). According to the Plan, health clinics in the Family Islands experience difficulties recruiting skilled primary health care workers as postings in the Family Islands are viewed as less attractive due to the working conditions, high cost of living and limited opportunities for professional development. The Plan identifies the need for an electronic health information system. It states that the absence of such a system is a key weakness of the country's health system, along with the inability to access certain forms of health data.

While the Turks and Caicos Islands' health sector does not have a formal knowledge management programme, the National Epidemiology and Research Unit (NERU) performs some knowledge management functions (Government of the Turks and Caicos Islands, 2015). It is responsible for disease surveillance and health research, and produces the data required for evidence-based policy development, decision making and health interventions. It also forms the data hub for the Ministry of Health and maintains a migrant health database.

4. Inter-island differences in and scope for strengthening ICT and KM capacity

Untapped opportunities exist in all three countries to apply ICTs and KM to the delivery of healthcare. Less populated islands in the study countries offer a more limited range of health services and patients often travel between islands to access services. This is even the case for Tobago which has a relatively large population by regional standards. None of the countries have a national EHR in place and limited or no use is made of tele- and mobile health.

In Turks and Caicos Islands, the Ministry of Health uses telehealth for administrative purposes and is working with PAHO to establish an EHR. It also plans to implement an electronic health information system. Saint Kitts and Nevis' three hospitals have electronic health information systems, but their systems are not connected. With an electronic health information system in each medical facility, Trinidad and Tobago makes the most extensive use of e-government in the health sector but these systems are not integrated and therefore patients cannot move between them easily.

Different health information systems and governance arrangements within and across islands provide a challenge for coordinating e-health initiatives and activities. Prioritizing national EHRs and tele- and mobile health in national health planning would enable these systems to be integrated and operational at the national level. Furthermore, the need for inter-island travel and the delays and impact on health outcomes it entails could be limited using tele- and mobile health. Where travel is still necessary, a national EHR would enable seamless access to services on other islands.

All countries identified difficulty securing funding for e-health systems and projects as an impediment to increasing their use. Establishing the necessary ICT infrastructure will require a short-term investment, but resources can be saved long-term in reduced costs from inter-island travel and improved health outcomes. Alternative funding approaches are possible such as public-private partnerships, which are already being used in Saint Kitts and Nevis and Turks and Caicos Islands, to develop ICT infrastructure for health. Where systems are acquired through public-private partnerships or funding from international donors, care must be taken to ensure their compatibility and integration

with existing systems. Investment is also necessary to provide local ICT professionals with the skills to implement and maintain e-health systems and ensure their sustainability.

Trinidad and Tobago's experience implementing patient information systems also shows that adequate attention must be paid to change management to ensure the success of new systems. Ensuring commitment to and systematic use of new ICT systems by medical staff requires consensus on the need for change, integration with existing practices, and customization for local and clinical needs. Careful planning and ongoing evaluation of progress are essential, along with provision for long-term system maintenance and changeability. System usability is undermined by narrow bandwidth or intermittent wireless networks and can negatively impact users' attitudes to them.

Furthermore, the three study countries make limited use of knowledge management in the health sector. Given that health facilities in each island share several common challenges and similarities in the health concerns with which they are presented, institutionalizing and documenting best practice across islands would help to improve the quality and timeliness of health care and could also limit the need for accessing services on other islands.

A basic challenge for increasing the application of knowledge management in the health systems of multi-island countries is convincing health care providers of its importance and potential. A knowledge management strategy should pay attention to change management and measures to encourage its adoption and integration. Like with new ICT systems, persons must be committed to knowledge management and the system must be usable. Reliable internet connectivity is the primary factor affecting usability. Once countries establish EHRs, knowledge management tools can be used in conjunction with them to organize the collected data for increasing cooperation between health care providers and enhancing quality of care.

D. ICT and KM capacity in education

In multi-island countries, the availability, accessibility and quality of educational opportunities in small or outlying islands is often more limited. The typically smaller population of these islands tends to limit the local availability of teachers, administrators and support resources, increase costs, and challenge the viability of some subject areas. ICT and knowledge management can contribute to addressing these issues. However, this requires developing ICT infrastructure and mobilizing resources to provide schools with ICT equipment and technical support.

1. Saint Kitts and Nevis

National responsibility for ICT in education rests with the Ministry of Education of Saint Kitts and Nevis. The Nevis island administration also has its own Ministry of Education responsible for Nevis. School-age children can access early childhood centres and primary and secondary schools in both Saint Kitts and Nevis.¹⁶ Saint Kitts has 6 public secondary schools and 17 public primary schools, while Nevis has 2 public secondary schools and 7 public primary schools. However, due to a limited number of courses at the Nevis Sixth Form College, some secondary school students from Nevis commute to Saint Kitts or board there to access a full range of courses. Commuting students receive subsidized ferry passes, but still experience disadvantage in terms of lost travel time and distance from family. Tertiary education is available in Saint Kitts through the University of the West Indies (UWI) Open Campus and Clarence Fitzroy Bryant College of Further Education.

All primary and secondary schools in Saint Kitts and Nevis are connected to the internet. Recent bandwidth upgrades have taken place in public schools in Saint Kitts to meet office administration and

¹⁶ Education is compulsory in Saint Kitts and Nevis from ages 5 to 16. Children between the ages of 0-5 can access early childhood centres.

pedagogical needs. All public schools in Saint Kitts now use coaxial and fibre broadband technology for pedagogical purposes, while administration is still supported by copper lines. Secondary schools have internet upload speeds of 15 Mbps and download speeds of 40 Mbps, while for primary schools the upload speeds are 5 Mbps and 20 Mbps for downloads. The Nevis Island Administration provides fibre broadband to public secondary schools in Nevis. This has enabled these schools to offer CXC examinations online and use online education applications. However, primary schools still rely on internet access using ADSL technology via copper lines, putting them at a disadvantage to primary schools in Saint Kitts.

Saint Kitts and Nevis has a 2017-2021 Education Sector Plan, which sets out the country's education goals and associated programme areas (Government of Saint Kitts and Nevis, 2017). The Plan identifies the need to develop a strategy for integration of ICT into teaching and learning:

Table 8
Saint Kitts and Nevis' 2017-2021 Education Sector Plan - policy goals and programme areas

Policy Goals	Programme Areas
I. Improve equitable access to and participation in education at all levels	• Access and participation
II. Strengthen the quality and relevance of education at all levels to improve learning outcomes	• Curriculum and assessment
III. Enhance governance, planning, and management to improve efficiency and effectiveness throughout the sector	• Quality and relevant teaching and learning
	• Professionalizing the teaching force
	• Knowledge management for decision-making
	• Leadership and accountability

Source: 2017-2021 Education Sector Plan.

Four cross-cutting themes are identified as central to achieving the policy goals: policy development, ICT integration as a value-added pedagogical and management tool, increased focus on equity in education, and technical and vocational education and training as a driving and valued force in education sector development. Furthermore, knowledge management is one of the six programme areas proposed to support the policy goals.

The Plan identifies several challenges in the country's education sector, including weak data collection, which negatively impacts analysis and education sector planning and management; limited enrolment in the Nevis Sixth Form College, partly due to narrow course offerings; and limited funding available for capital projects in the education sector. As a result, development assistance is often sought for education initiatives. The Plan acknowledges that the education system's data collection challenges are largely due to the limitations of its education management information system (EMIS). A 2016 Education Policy Review carried out by UNESCO identified "(1) an implementation gap, (2) the scarce use of data to inform policy-making and (3) an important issue of internal and territorial coordination between the two islands" (UNESCO, 2016).

The Ministry of Education in Saint Kitts reports that the education sector's coordination of data collection and management is much improved since 2016. All public schools in Saint Kitts and Nevis have adopted the same EMIS, and private schools are being encouraged to adopt this system too. The EMIS captures student enrolment information, transitions, learning outcomes, and achievements as well as information about staff. A major challenge for improving the EMIS's effectiveness was resistance of teaching staff to the administrative burden of electronically capturing student's data. However, this resistance has been countered to some extent through the provision of ICT support to teaching staff, automating the collection of student data, and increased use of cloud computing.

The Education Sector Plan identifies knowledge management among its six programme areas. The Ministry of Education is using the deployment of the EMIS across schools in both islands as an opportunity to develop its data collection for KM purposes. It has created data warehousing systems to produce disaggregated trend information in each academic area.

Other challenges identified in the implementation of ICT in the education sector are insufficient computers in schools for administration, teaching and learning, and lack of expertise within schools to support use of ICT. In particular, primary schools in both islands are very underserved in terms of computer equipment and ICT facilities. Education officials have sought to improve this situation by appointing small teams in each island to maintain computers and offer ICT support in schools. In Saint Kitts, public-private partnerships have been used to upgrade computer rooms of public primary schools, including new equipment and furniture to support a curriculum for differentiated instruction.

Furthermore, new computers have been acquired for schools as part of a Technical and Vocational Education and Training (TVET) Enhancement Project funded by the Caribbean Development Bank, and this is expected to improve the situation in both islands somewhat. The distribution was more comprehensive in Nevis (relative to population size), which received approximately 50 computers, while Saint Kitts was allocated over 100.

The Ministry of Education in Saint Kitts recognizes that barriers still exist to the country and system-wide adoption of ICTs in education. It is developing an ICT Integration Strategy and Policy, in line with curriculum reform, to be piloted in five Saint Kitts schools and five Nevis schools. As part of the Strategy, students and teachers will test tablets, mobile devices and computers. The Strategy is still in its embryonic stages with a pilot phase earmarked to begin at the end of 2019. A draft policy on open educational resources was developed by UNESCO and the Commonwealth of Learning for Saint Kitts and Nevis in 2013 and is currently also being considered for adoption.

2. Trinidad and Tobago

Both Trinidad and Tobago have an adequate number of public primary and secondary schools for their school-age populations. However, Tobagonian secondary school students often travel to Trinidad during exam time for extra lessons due to their limited availability in Tobago. There are also private primary and secondary schools in each island, some of which follow their own curriculum. Some universities and other tertiary institutions have campuses in Tobago, including the University of the Southern Caribbean (USC) and the University of the West Indies (UWI), and The Tobago Hospitality and Tourism Institute (THTI) is based in Tobago.

The government provides internet connectivity to secondary schools in Trinidad and Tobago at a bandwidth of approximately 35 Mbps but many schools purchase additional bandwidth to supplement this. Schools in both Trinidad and Tobago experience connectivity challenges due to limitations of the telecommunications infrastructure and do not have the infrastructure or facilities in classrooms to allow broadband access throughout schools. An initiative is underway as part of the Ministry of Education's 5-Star ICT in Education Programme to increase the bandwidth supplied to 100 Mbps per school in both islands.

The Ministry of Education has an ICT Steering Committee, chaired by the Permanent Secretary, and an ICT in Education Committee, which reports to the Steering Committee. The management of ICT in the Ministry falls under the Chief Education Officer. There is also an ICT Division and a curriculum specialist with responsibility for ICT. The Ministry has not implemented a national education management information system (EMIS). However, some schools have implemented their own learning and education information management systems.

In 2018, the Ministry of Education provided 13,600 laptops to secondary schools in Trinidad and Tobago for curriculum support. In a previous programme, beginning in 2010, the government

distributed over 50,000 laptops to secondary school students. Lack of teacher training and ICT technical support were cited as challenges in implementing that programme. As part of the 2018 initiative, teachers have been trained using United Nations Educational, Scientific and Cultural Organization (UNESCO) competency standards, and there are 100 IT technicians to support the schools. Ministry officials state that 735 teachers at 77 schools in Trinidad and 7 in Tobago have received ICT training. Computer hardware has also been supplied to support school administration. Furthermore, in 2019, the Ministry of Education embarked on a project to introduce e-testing for the Caribbean Secondary Education Certificate (CSEC) of the Caribbean Examination Council (CXC) into secondary schools. This project has been delayed to 2020 while efforts are made to increase internet connectivity and bandwidth to schools.¹⁷

The Ministry of Education has developed a national ICT in Education Policy for the early childhood, primary and secondary levels (Government of Trinidad and Tobago, 2018b). However, it makes no specific reference to the situation of students in Tobago. The Policy is one component of the Ministry's 5-Star ICT in Education programme, which also aims to develop 1) a governance structure for the management and coordination of all ICT initiatives, 2) enhanced ICT infrastructure and digital devices in schools, 3) curriculum reform, and 4) training and professional development of teachers. It also contains a framework within which a set of more specific ICT-related education policies are identified:

Table 9
ICT in education policies, categorized by dimensions of the Policy Framework

Connecting with the World	Interacting with Each Other	Teaching and Learning with ICT	Capacity Building with ICT	Managing with ICT
Internet and Connectivity Policy	Social Media Policy	ICT Integration in Pedagogy Policy	Teacher Training and Development Policy	Education Management Information Systems Policy
Inclusiveness and Equity Policy	Cyberbullying Policy	Flexible Delivery Policy	Continuous Improvement Policy	Learning Management Systems Policy
Bring Your Own Device (BYOD) Policy	Data Privacy Policy	Mobile Learning Policy	Open Educational Resources (OER) Policy	ICT Asset Management Policy
Mobile Phone (Cellular Phone) Policy	Data Security Policy	Game-based Learning Policy	Technology Enabled Learning Environments Policy	Value for Money ICT Procurement Policy
Green Computing Policy	Responsible Use Policy	Open and Distance Education Policy	Free/Libre/Open Source Software Policy	Fit-for-Purpose ICT Policy

Source: National ICT in Education Policy, 2018.

Together with the Ministry of Education, the Division of Education, Innovation and Energy of the Tobago House of Assembly has shared responsibility for education in Tobago. Tobago schools are well served with internet connectivity, though the respective roles in this of the Ministry of Education and the Tobago House of Assembly are unclear. The Tobago Comprehensive Economic Development Plan 2013-2017 identifies significant roles for ICT in addressing what it identifies as Tobago's deficiencies in educational attainment, both in absolute terms and relative to Trinidad (Kairi Consultants Limited, 2012). It also identifies the need for improvement of the island's telecommunications infrastructure.

3. Turks and Caicos Islands

Turks and Caicos Islands has public primary schools in all populated islands as well as private primary schools in some islands. Public secondary schools are located in North and South Caicos, Grand Turk and Providenciales. There are also several private secondary schools in Providenciales. Primary school students tend to progress into secondary school on their island, except for primary school students from

¹⁷ Trinidad and Tobago Newsday (2019), 'TT not ready for CXC online', (online) <date retrieved: 27 June 2019> <<https://newsday.co.tt/2019/06/17/tt-not-ready-for-cxc-online/>>.

Middle Caicos who typically go to secondary school in North Caicos and those from Salt Cay who typically go to Grand Turk. After sitting the Caribbean Secondary Education Certificate (CSEC) examinations in Form 5, students either continue their education at the Turks and Caicos Islands Community College, which has campuses in Grand Turk and Providenciales, or at another institution, or seek employment.

The Turks and Caicos Islands Education Sector Plan 2018-2022 focuses on eight strategic imperatives, several of which involve the use of ICT (Government of the Turks and Caicos Islands, 2018b). An ICT in Education Policy has also been developed. However, the Policy does not address the situation of students in the Family Islands beyond mentioning the use of ICT for inter-island communication. It focuses on developing an ICT-literate population, and improving educational effectiveness using ICT in instruction and administration.

The Policy, which has recently been approved by Cabinet, provides for an ICT Education officer and an ICT Committee charged with responsibility for its implementation. The Central Information Technology Unit, located in the Ministry of Finance, Investment and Trade, supports the work of the Ministry of Education.

The Ministry of Education provides all schools in the Turks and Caicos Islands with an internet connection in their administration buildings and computer labs, through an arrangement with local telecommunications providers. However, some schools in the Family Islands are yet to have their internet connections restored after the 2017 hurricane season. These schools receive internet via microwave transmission without supporting fibre infrastructure, so are at a disadvantage to schools in Grand Turk and Providenciales.

An education management information system, OpenEMIS, is used in public primary and secondary schools throughout the country. Private schools are also being encouraged to connect to the system. Officials indicate that it has stimulated students and teachers, and improved communication, information accessibility and sharing. One of the country's two telecommunications providers, Flow, has launched a study program for all students sitting CSEC examinations, which allows students to access a learning database at no cost.

Inadequate internet bandwidth and computers in schools are identified as challenges for further integrating ICTs into education. These challenges primarily affect schools in North Caicos, Middle Caicos, and South Caicos, whose internet connections are provided by microwave links without supporting fibre infrastructure (Digicel, 2019). This is being addressed by an ongoing programme of ICT upgrades in schools, which also involves installation of smartboards and other equipment. Teachers must also be trained in new ICTs to ensure they are fully integrated into the learning process.

In interviews, officials reported that the application of ICTs in the education sector has produced several benefits, including improved student engagement with the learning experience, greater enthusiasm on the part of teachers, greater access to education sector data, increased information sharing, and improved inter-island communication and reduced communication costs. However, the education sector has no systematic or structured application of knowledge management.

4. Inter-island differences in and scope for strengthening ICT and KM capacity

Each country has a current national education plan, which identifies the need for ICTs to be integrated into the country's education system. Trinidad and Tobago and Turks and Caicos Islands also have ICT in Education policies specifically aiming to expand the use of ICTs in learning processes. However, these plans do not address the issue of inter-island governance or the challenges experienced by students in small and outlying islands. While officials are cognizant of these matters, they must be addressed in national education and ICT plans and policies if maximum benefit is to be received from an investment in ICT in schools.

Schools in less populated islands of multi-island countries report that inadequate internet bandwidth limits teachers' ability to integrate ICTs into education. For example, internet connections are yet to be restored to some schools in the Family Islands in Turks and Caicos Islands following the 2017 hurricane season. Where internet has been restored, it is delivered via microwave transmission, which is slower and less reliable than the fibre broadband available in Grand Turk and Providenciales. Public secondary schools in Nevis have access to fibre broadband, while primary schools use less reliable ADSL technology via copper lines.

Inadequate internet bandwidth is also an issue for more populated islands. Schools in both Trinidad and Tobago report not having ICT infrastructure or facilities capable of facilitating broadband access throughout schools. Meanwhile, Saint Kitts has recently upgraded its ICT infrastructure in schools with secondary schools now having internet upload speeds of up to 60 Mbps and primary schools up to 30 Mbps. As a result, schools in Saint Kitts can now integrate ICTs into education more readily than their counterparts in Nevis.

It is unclear what impact a lack of internet connectivity in small and outlying islands has on inter-island differences in educational outcomes in the study countries. This data must be collected to inform policy formation in the education sector and to address any differences between islands. Available information does, however, indicate a more limited range of educational opportunities in small and outlying islands in these countries. This results in students commuting between islands or boarding away from home to receive education.

Distance learning and other ICT and knowledge management interventions can be used to limit the need for students to travel and board in other islands. However, integrated use of distance learning and ICT in schools is dependent on the availability and quality of ICT infrastructure. While nearly all schools in the study countries have internet connectivity, the bandwidth is often insufficient to run ICT applications and teachers are forced to return to traditional teaching methods. This should be addressed in each country as a matter of priority.

Furthermore, both teaching at a distance and increased use of ICT in onsite teaching require educators to be trained in the use of new technologies and online pedagogy. The University of the West Indies (UWI) and the Inter-American Development Bank (IDB) partnered in 2018 to provide more Massive Open Online Courses (MOOCs) at the tertiary level in the Caribbean. Such partnerships are also needed at the secondary education level in Caribbean multi-island countries to increase course availability via distance learning for students from islands with small populations.

A knowledge management programme, which identifies and develops best practices for individual subjects, can also make a significant contribution to improving access to and quality of education in the small and outlying islands of multi-island countries. As part of this programme, schools should be encouraged to make publicly funded educational materials available through an open education license policy.

E. Conclusions

The ability of multi-island countries to benefit from ICT and knowledge management in the delivery of government services depends on a range of factors, including the cross-island availability of ICT infrastructure, the population's access to ICT infrastructure and services, and a comprehensive e-government framework across government agencies. This framework must be adapted to the layered governance arrangements of multi-island countries and the needs of populations in small and outlying islands.

ICT infrastructure in the Family Islands and Tobago is less developed than in Grand Turk and Providenciales and Trinidad. However, Trinidad and Tobago's NICT Plan 2018-2022 has encouraged

new infrastructure projects in Tobago in order to bridge the divide in mobile and broadband penetration between the two islands. In Turks and Caicos Islands, the Family Islands rely on wireless broadband and mobile services as fixed broadband has not been restored to the Family Islands since the 2017 hurricanes, except for in limited areas of North Caicos. Fixed broadband will be restored to the Family Islands, but advances are slow due to the small populations on these islands, the high cost of building infrastructure and corresponding profit disincentives.

The situation appears to be more equitable in Saint Kitts and Nevis, with broadband penetration of approximately 90 percent on both islands. While there are areas with poor or no telecommunications service in small or outlying islands of all the study countries, this is also the case in larger islands in these countries. Saint Kitts and Nevis and Trinidad and Tobago have universal service funds that aim to deliver universal access to telecommunications service to areas that would otherwise be viewed as unattractive for investment.

While Caribbean countries overall have relatively good ICT infrastructure, the reliability and quality of internet and mobile connections vary in multi-island countries and this problem is particularly acute in small and outlying islands. Wireless and mobile broadband is provided to the Family Islands in Turks and Caicos Islands via microwave transmission, which is slower and less reliable than the broadband delivered to the most populated islands, Grand Turks and Providenciales, using fibre optic and coaxial cables.

This has numerous impacts on the delivery of education, healthcare and governance in these locations. Students living in small and outlying islands in the case study countries have a more limited range of educational opportunities. Reliable internet connectivity would enable them to access more subjects through distance learning and allow teachers to efficiently use ICT as an educational tool. This would reduce the need for students to commute between islands or board away from home.

In the health sector, a variety of tools become available to medical professionals with access to reliable, high-speed internet connections. This includes a fully digitized EHR, telemedicine and mHealth to increase the availability of healthcare services in small or outlying islands and prevent the need for inter-island travel. Providing high-speed connections using satellite or broadband technology to remote parts of multi-island countries should therefore be addressed as a matter of urgency.

The ability of island populations to access ICT infrastructure and services also depends on their ICT skills, access to equipment and its affordability. Local government, including public education and health facilities, must also build their ICT competencies to support the integration of ICT into service delivery. Therefore, training and continued support for civil servants should be part of a carefully planned change management process that encourages buy-in and demonstrates the need for and potential of new ICT and KM systems.

A cross-government e-government framework is also necessary to reduce duplication of efforts and avoid systems operating in silos. This facilitates interoperability of systems, an essential feature of successful government-wide systems of e-government. Sector-specific frameworks for education and health can also be developed to meet the special needs of these sectors. The following section makes recommendations and identifies opportunities for further analysis for facilitating the integration of ICT and KM into local government and improving capacity in both areas in small and outlying islands of Caribbean multi-island countries.

III. Recommendations and opportunities for further analysis

Caribbean multi-island countries are presented with a unique set of challenges and opportunities when seeking to achieve sustainable development. These countries typically have small populations on some or all islands, multi-layered governance structures, large public services relative to population size, and transport links reliant on fossil fuels varying in their affordability. ICT and knowledge management are valuable tools to support sustainable growth and the delivery of public services in this challenging setting. They can provide virtual connectivity to mitigate the effects of physical constraints on movement of people and goods between islands. Multi-island Caribbean countries should focus attention on realizing this potential.

The study makes recommendations on the application of ICT and knowledge management to support delivery of public services, both generally and in the areas of governance, education and health. These recommendations focus on leveraging ICTs and knowledge management to overcome the challenges associated with dispersed geography and insularity. The study also identifies opportunities for further research in this area.

A. ICT infrastructure

ICTs can reduce the effects of constraints on physical connectivity resulting from islands being distant from each other. Caribbean countries have relatively comprehensive ICT infrastructure but, in many islands, insufficient bandwidth and unreliable connections prevent the effective, integrated use of internet in education, health and other sectors. This study recommends that:

1. Multi-island countries invest in reliable high-speed communication infrastructure in all inhabited islands and navigated waters. This infrastructure should support fixed and mobile telephony and fixed and mobile broadband internet and be available to the public sector, households, individuals and businesses at affordable prices.

2. As a region prone to natural disasters, it is extremely important that Caribbean multi-island countries place special attention on ensuring reliable, robust and resilient ICT infrastructure. A robust network of ICT infrastructure ensures that communication and coordination is available during critical moments of the post disaster recovery process. Furthermore, uninterrupted connections in the ICT sector act as an essential stimulus for the recovery of government operations, and the productive and social sectors.
3. Key areas to consider for strengthening ICT infrastructure for disasters are: physical preparedness and financial preparedness. Physical preparedness includes, but is not limited to, identifying and reducing risks to ICT infrastructure – such as antennae, cellular towers and utility poles – through yearly inspections and maintenance. Insurance facilities that cover potential damages and losses to ICT infrastructure caused by disasters can realize financial preparedness. These recommendations can be used alongside the Global Framework on Disaster Risk Reduction (GFDRR) to improve the preparedness of ICT infrastructure as well as overall ICT operations within the context of disaster preparedness and response.
4. Flexible and innovative funding approaches are needed to facilitate investment in ICT infrastructure. This can include regulatory instruments, such as license conditions and universal service funds, subsidies and other market-based mechanisms, and public-private partnerships and infrastructure-sharing arrangements:
 - a. Two of the countries have universal access and service funds (USFs), which aim to ensure universal access to telecommunications through a levy on telecommunications providers. Saint Kitts and Nevis's mechanism began collecting money in 2010 and has funded projects to improve internet in high schools on both islands and provide Wi-Fi in Nevis community centres. Trinidad and Tobago's USF will commence its first projects in 2019 for the provision of assistive devices to person with disabilities, free public Wi-Fi coverage at various locations, and broadband infrastructure for underserved communities on both islands. Other multi-island countries can investigate whether a USF or other mechanism could bring reliable, affordable connectivity to rural areas and less populated islands where a return on investment is not guaranteed to telecommunications providers.
 - b. Public-private partnerships are already being used in the health sectors of two of the countries. Furthermore, regional projects are underway to improve the availability of the internet, such as the Caribbean Regional Communications Infrastructure Programme (CARCIP) in Grenada, Saint Lucia, and Saint Vincent and the Grenadines and CARICOM's Single ICT Space project. However, there is a still a need to bridge remaining gaps in regional broadband communications infrastructure.
5. Information security is a prerequisite for the widespread use of networked ICT systems and the data they produce and manage. A comprehensive legislative and regulatory framework is necessary in each Caribbean multi-island country to safeguard the confidentiality of individuals and protect their privacy and other interests.
 - a. Countries should create and regularly update their regulatory frameworks for data protection and cyber security paying attention to the specific needs and capacity of small and outlying islands. These frameworks should be sufficiently dynamic to respond to changing threats to information security and rapid change in the global ICT environment.
 - b. Where a multi-island country has separate island administrations, it may be necessary to create separate regulations or legislation for these islands. Any separate regulatory

documents should be developed in coordination with the national government to limit bureaucracy and ensure a coherent and compatible framework for the country as a whole.

- c. Caribbean multi-island countries could work together to create regional information security standards, including model regulations, for adoption in each country. Harmonizing regulatory frameworks in this way would enable information-sharing arrangements between participating countries and their islands and contribute to regional security and interconnectedness.

B. Knowledge management

The sharing of knowledge and information has the power to transform multi-island countries to knowledge societies and empower populations through increasing access to information. For small or outlying islands operating under tight resource constraints, KM can provide tools to leverage the larger human resource pool, knowledge base and experience of other islands. Countries in the region have begun to use ICTs and KM systems to improve access to public services for populations in remote areas. However, the country case studies show that their use is inconsistent, although there is a clear commitment to take advantage of the benefits that ICT can offer. A corresponding commitment to the use of KM in support of public service delivery was not observed in the study countries.

A precondition for widescale adoption of knowledge management is ICT infrastructure and appropriate hardware and software. However, information provided by officials shows that in many cases it is not ICT infrastructure lacking but a commitment on the part of government bodies to make knowledge management a priority, and the availability of the technical support to implement it. The study recommends that:

1. Caribbean multi-island countries develop knowledge management programmes for their public sectors, which include monitoring and assessment mechanisms to ensure relevance and effective delivery of services. International and regional organizations can support governments to identify and implement projects which can both deliver value to island communities and demonstrate the importance and potential of knowledge management.
2. Building a successful knowledge management programme for the public sector requires careful planning and change management. Implementation of the programme should be guided by a knowledge management strategy consisting of various stages and processes. Where governance arrangements do not promote coordination between national and separate island administrations, this is an obstacle that needs to be overcome.

C. Data collection

A major challenge of this study was the unavailability of disaggregated data with which to make comparisons between islands in the countries.¹⁸ Strategies for the application of ICT and knowledge management to support sustainable growth should be supported with relevant data. This requires Caribbean multi-island countries to prioritize the systematic collection of data necessary to monitor and support evidence-based decision making. Open access to government data provides citizens with information that they require for their day-to-day activities and allows them to hold their governments to account.

¹⁸ Researchers concluded that insufficient quantitative data was available disaggregated by island to draw definitive conclusions about any inter-island development differences of the case study countries in the three thematic areas of education, health and governance.

1. A key area of focus for Caribbean multi-island countries should be the strengthening of national statistical systems in accordance with regional standards and the United Nations Fundamental Principles of Official Statistics. For multi-island countries, this includes coordinating the collection, compilation and dissemination of statistics at the island, regional and national levels.
2. Both the collection of data and production of statistics should be disaggregated by island to enable the comparability of statistics for each island and to ensure no-one is left behind in small or outlying islands in multi-island countries. This requires information-sharing agreements and systems to be put in place to ensure coordination between national governments and island administrations. Central government should also organize capacity-building initiatives for statistical bodies in small and outlying islands.
3. Countries should commit to making accurate and representative information about the economic, demographic, social, welfare and environmental situation in the country publicly available in an easily accessible form and in a timely manner, including facilitating access to microdata for research purposes. Projects are recommended in the Caribbean multi-island countries to identify citizens' data access priorities, and design and implement ICT systems to store and manage the data and provide access to it.
4. Automated data collection should be an integral part of government and business processes, rather than being additional activities to which scarce resources must be diverted, and which may be delayed, neglected or subject to error-prone data entry.

D. Thematic areas

1. Governance

Governance issues between islands in Caribbean multi-island countries are often complex and politically charged, and have the potential to negatively impact the planning, resourcing and implementation of ICT initiatives to support sustainable development. In some cases, informal or ad-hominem work-arounds are used, but this is often fragile and unsustainable. The study makes the following recommendations:

1. E-government should be used to deliver the widest range practicable of public services online. This would increase the availability and accessibility of services and reduce service delivery cost. Online service delivery should be seamlessly integrated with face-to-face delivery, so that residents can choose the most appropriate mode of access. The study recommends projects to support multi-island countries to develop their e-government services, with emphasis on supporting service delivery in small or outlying islands. This would involve identifying the service needs of island communities and prioritizing those services with the greatest potential impact.
2. A regional approach to developing e-government could be used through multilateral cooperation in procurement, capacity building, and industrial development for the ICT sector. This would enable the sharing of investment costs and economies of scale. The Caribbean Regional Communications Infrastructure Programme (CARCIP) for Saint Lucia, St Vincent and the Grenadines and Grenada is an example of such an approach.
3. Central governments in Caribbean multi-island countries should work closely with administrations in each of their islands to clarify and formalize approaches to all areas of governance and public service delivery, which can impede effective planning and implementation of sustainable development initiatives. Areas of governance, like health and education, demand sector-specific responses tailored to the country's multi-layered

governance arrangements. For example, health officials on each island should agree to implement the same patient information system in each of the country's hospitals and health facilities in order to reduce bureaucracy and improve the delivery of health care. This also applies to education management information systems (EMIS) at the primary and secondary levels in the education sector.

4. Countries must foster a culture of innovation in governance and public service delivery to keep pace with ever-changing technology and users' needs. Many Caribbean ministries, government departments and agencies take a siloed approach to public service delivery resulting in duplication of resources and effort, along with the adoption of different ICT systems and lost opportunities for coordination and collaboration. For example, government ministries often develop e-government tools without providing links for users to related public services sitting in other ministries, reducing the usability and effectiveness of these tools. States should move to a unified whole-of-government model to exploit the potential of ICTs and to deliver services in a coordinated manner. Such an approach requires government agencies to work together across portfolio confines, rather than operating as isolated silos.

2. Health

None of the countries have a current national eHealth strategy or plan. The study encourages Caribbean multi-island countries to develop eHealth plans adapted for national and health sector governance arrangements and other considerations that apply when delivering health services across several islands in multi-island countries. A comprehensive eHealth plan should provide for:

1. *Electronic Health Records (EHRs)*: Creating an EHR is a resource intensive process, but it yields a range of benefits in the provision of healthcare, its administration, and research and surveillance for the sector. An essential feature of an EHR in a multi-island country is interoperability across medical facilities. This enables seamless inter-island communication of clinical information as a patient moves throughout the healthcare system. Many health providers in the Caribbean still use paper-based records. These records should be digitized at each medical facility as part of introducing an EHR.
2. *Integration of patient information systems*: Public healthcare facilities using similar patient information systems are encouraged to work with system providers to integrate these systems, while facilities installing new systems will benefit from migrating to the most commonly used software to contribute to the integration of patient information systems across the health system.
3. *Telemedicine*: Telemedicine involves the use of ICT networks to access health care providers located at a distance. It includes use of text, audio and audio-visual communication, wearable sensors and mobile diagnostic equipment and transfers of documents, images, videos and other files. Telemedicine can be used for consultations between clients and healthcare providers and between healthcare providers. Both forms of intervention can increase the availability of healthcare services in multi-island countries by providing access to healthcare expertise on small or outlying islands without the need for inter-island travel.
4. *mHealth*: mHealth takes advantage of the wide availability of mobile devices and communication infrastructure to provide an additional channel for interaction between the healthcare system and its clients. It also serves to deliver health services to patients in any location.
5. *Legislative and policy framework*: an eHealth plan must be supported by appropriate legislative and policy framework. The policy framework would guide the organizational changes that will be required in the health sector to realize the benefits of eHealth. Legislation should address

issues such as patients' ownership rights, rights to alter their EHRs, transfer of EHRs between institutions, use of EHRs for clinical, public health and research purposes, and access to and use of EHRs by third parties, such as insurance companies.

3. Education

The case study countries all have policy documents or strategic plans to support the use of ICT for the delivery of education. However, these documents do not consider these countries' multi-layered governance arrangements and the needs of students in small and outlying islands. The study gives the following recommendations for developing ICT and KM capacity in the education systems of multi-island Caribbean countries:

1. Each country should implement an integrated national education management information system (EMIS) to enhance the planning, coordination and administration of education within and across islands.
2. Countries should supplement existing educational services with asynchronous distance education to provide access to a full range of courses on all islands. This would limit the need for inter-island travel and expand students' choice of learning mode, allowing them to take greater responsibility for their own learning.
3. Many schools in multi-island countries, particularly those situated in small and outlying islands, do not have adequate bandwidth availability or capacity to enable the effective use of ICT as an educational tool. Governments should prioritize connecting all primary, secondary and tertiary learning institutions to high-speed networks and providing sufficient bandwidth to deliver a digital curriculum. Universal service programmes are one source of funding for school projects, but countries may require both private and public investment and a range of technologies, including fiber optic and wireless broadband, to meet this aim.
4. National plans to deliver high-speed networks and increase bandwidth should also equip primary and secondary schools with modern ICT equipment, including tablets, smartboards and laptops, and learning facilities for students who do not have access to computers. This equipment would provide access to the internet and to various information sources and educational materials. Arrangements should also be made for the ongoing maintenance of ICT equipment and facilities and provision of technical support to teachers and students.
5. Government officials and primary and secondary schools should work together to establish a knowledge management programme focused on identifying and developing best practice in the teaching of individual subjects. The programme would share this best practice with all schools and teachers and include a forum through which teachers can share their knowledge and contribute to the continuous improvement of the education system.

E. Opportunities for further analysis

This study identified a range of areas requiring further research and policy development relating to the sustainable development of multi-island countries. To secure the commitment and participation of stakeholders, research should be designed and carried out with active input from government bodies, the private sector and other stakeholders from each island. This will ensure participatory outcomes consistent with the development priorities of both central governments and island administrations.

Although the remit of this scoping study was limited to exploring the role that ICTs and KM are currently playing in supporting governance, health and education delivery in multi-island Caribbean countries, it also highlighted the importance of further investigating the following areas:

1. The extent of any inter-island differences in SDG attainment for each of the SDGs. Due to difficulties sourcing disaggregated data per island in the study countries, it was not possible to conclude whether each island in the case study countries is making equal progress in the study's three focus areas of health, education and governance.
2. The specific contribution that ICTs and knowledge management can make in addressing any disparities in sustainable development outcomes between islands. Sector-specific frameworks, including change management processes, could be designed for policy makers to use ICT systems and knowledge management as a development tool in health, education and other areas of governance in multi-island countries.
3. Whether existing or new mechanisms should be used for regional collaboration among Caribbean multi-island countries and separate island administrations to tackle common ICT and knowledge management challenges.
4. Whether a common e-government plan and regional e-government software and KM systems would increase the uptake of e-government in the region and contribute to its success.
5. Identifying coverage gaps in the Caribbean's ICT infrastructure, including government networks, submarine cables and broadband networks, with the aim of developing a harmonized regional approach to increase broadband and mobile technology penetration.
6. Whether a framework and/or best practices for collecting disaggregated data at the island level in multi-island countries would assist countries with capacity-building and contribute to facilitating the comparability of inter-island data in accordance with regional and international standards.
7. Which community ICT initiatives, such as community access points and training, are needed in small and outlying islands as well as rural communities of Caribbean multi-island countries to reduce barriers to ICT access created by digital illiteracy and lack of equipment and support.
8. Whether digital inclusion policies are also necessary to ensure that the benefits of ICT infrastructure reach remote communities in addition to women, youth, older persons, persons with disabilities, and indigenous people.

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Annexes

Annex 1

Officials interviewed

Saint Kitts and Nevis	
Government of Saint Kitts and Nevis	Kevin Arthurton, Project Research Officer, Ministry of International Trade, Industry, Commerce and Consumer Affairs
	Ophelia Blanchard, E-Government Coordinator, Department of Information Technology, Ministry of Justice, Legal Affairs and Communications
	Samantha Boone, Trade Policy Officer, International Trade Department, Ministry of International Trade, Industry, Commerce and Consumer Affairs
	Pierre Bowrin, ICT Policy Advisor, Department of Technology, National ICT Centre.
	Philip Browne, Director of Industry, Commerce, and the National Entrepreneurial Development Division, Ministry of International Trade, Industry, Commerce and Consumer Affairs.
	Eurta Chiverton, Systems Coordinator, Department of Information Technology, Ministry of Justice, Legal Affairs and Communications
	Dr. Tricia Esdaille, Senior Assistant Secretary, Ministry of Education
	Christopher Herbert, Christopher Herbert, Director, EMIS, Ministry of Education
	Gaile Gray-Phillip, Senior Director, Department of Statistics, Ministry of Sustainable Development.
	William Hodge, Permanent Secretary, Ministry of Education.
	Alsted Pemberton, Director, Social Policy and Sustainable Development Unit, Ministry of Social Development, Nevis Island Administration.
	Carlton Phipps, Senior Director, Department of Statistics, Ministry of Sustainable Development.
	Lavern Queeley, Director, Economic Affairs and PSIP/SDG Focal Point, Ministry of Sustainable Development.
	Delores Stapleton-Harris, Permanent Secretary, Ministry of Health
Nevis Island Administration	Mentrice Arthurton, Statistician, Statistics Department, Ministry of Finance.
	Kevin Barrett, Permanent Secretary, Ministry of Education.
	Joan Browne, Assistant Secretary, Ministry of Finance.
	Anselm Caines, Senior Policy Officer, Social Policy and Sustainable Development Unit, Ministry of Social Development
	Althea Campbell, Legal Counsel, Legal Department
	Craig David, Assistant Director, Information Technology Department.
	Edson Elliott, Permanent Secretary, Ministry of Human Resources
	Kellee France, Registry Officer – NHR, Ministry of Social Services
	Gary Liburd, Chief Labour Officer, Department of Labour, Premier's Ministry.
	Shelisa Martin-Clarke, Health Planner, Ministry of Health.
	Joyce Moven, Deputy Director, Department of Social Services, Ministry of Social Services.
	Shenel Nisbett, Health Statistician, Ministry of Health.
	Alsted Pemberton, Director, Social Policy and Sustainable Development Unit, Ministry of Social Development.
	Delroy Pinney, Project Development Officer, Social Policy Unit
	Quincy Prentice, Director, Information Technology Department.

Trinidad and Tobago	
Government of Trinidad and Tobago	Janelle C. Alexander, ICT Director, ICT Division, Ministry of Health
	Annie Baldeo, Executive Officer, Economics, Telecommunications Authority of Trinidad and Tobago
	Cory Belfon, ICT Director, Ministry of Education.
	Ryan Biran, ICT Compliance and Standards Specialist, National Information and Communications Technology (NICT) Division, Ministry of Public Administration
	Kene Bryan, ICT Director, Ministry of Planning and Development.
	André Blanchard, Director of Statistics (Ag.), Central Statistical Office (CSO)
	Satee Boodoo, Central Statistical Office (CSO)
	Abigail Bynoe, Manager, Policy, Strategy and Monitoring, Strategic Services Division, Ministry of Public Administration
	Shelly-Ann Clarke-Hinds, Executive Manager, External ICT Relations, National Information and Communications Technology (NICT) Division, Ministry of Public Administration and Communications
	Dale Cudjoe, ICT Manager, Ministry of Planning and Development.
	Adianna George-Sharpe, Assistant Director Technical Corporation Unit (TCU), Ministry of Planning and Development
	Tyrone Gopaul, Central Statistical Office (CSO)
	Kirk Henry, Chief Executive Officer, National ICT Co. Ltd.
	Lisa Henry-David, Director of Educational Planning Division, Ministry of Education
	Lisa Madray-Valadere, Planning Officer III, Educational Planning Division, Ministry of Education
	John Outridge, Head, Consulting Unit, National ICT Co. Ltd.
	Desron Palmer, ICT Policy and Strategy Development Specialist, National Information and Communications Technology (NICT) Division, Ministry of Public Administration
	Peter Smith, Educational Researcher, Ministry of Education
	Gerard Phillip, Curriculum Specialist with responsibility for ICT, Ministry of Education.
	Ryan Ramcharan, ICT Director, Ministry of Health
	Simone Rawlins, Central Statistical Office (CSO)
	Stephan Samuel, Central Statistical Office (CSO)
	Dr. Harry Smith, Principal Medical Officer – Epidemiology, Ministry of Health
	Chrystal-Anne Taylor-Lewis, Research Officer, Ministry of Education
	Rick Logan Stanford, ICT Technical Officer, Ministry of National Security
	Gary Turpin, ICT Director, (NICT) Division, National Information and Communications Technology (NICT) Division, Ministry of Public Administration
Tobago House of Assembly	Bobby Andrews, Planning Coordinator
	Jacqueline Job, Administrator, Division of Education, Innovation and Energy
	Raye Sandy, Chief Administrator
Turks and Caicos Islands	
Grand Turk and Providenciales	Dr. Nadia Astwood, Director of Health Services, Ministry of Health, Agriculture and Human Services
	Dr. Perle Brewster, Director of Policy and Planning, Ministry of Education, Youth, Culture and Library Services.
	Carolyn Dickenson, Director of Gender Affairs, Ministry of Home Affairs, Transportation and Communication

	Sherlin Forbes, Chief Statistician, Strategic Planning and Policy Department, Ministry of Finance, Investment and Trade
	Clara Gardiner, Permanent Secretary, Ministry of Home Affairs, Transportation and Communication
	Amin McCartney, Deputy Permanent Secretary, Ministry of Education, Youth, Culture and Library Services
	Tamera Robinson, Deputy Permanent Secretary, Ministry of Health, Agriculture and Human Services.
	Patterson Williams, Computer Systems Analyst, Ministry of Education, Youth, Sports and Library Services
	Sinead Ó Marcaigh, Chief Executive Officer, Digicel Turks and Caicos Islands
Family Islands	Fredrico Johnson, District Commissioner, Middle Caicos.
	André Gibson, Chairman of the North Caicos District Board.
	Cynclair Musgrove, District Commissioner, North Caicos.

Annex 2

Respondents to Questionnaires

Saint Kitts and Nevis	
Government of Saint Kitts and Nevis	Delores Stapleton-Harris, Permanent Secretary, Ministry of Health
Nevis Island Administration	Craig David, Assistant Director, Information Technology Department.
	Shelisa Martin-Clarke, Health Planner, Ministry of Health.
Trinidad and Tobago	
Government of Trinidad and Tobago	Janelle C. Alexander, ICT Director, ICT Division, Ministry of Health
	Shelly-Ann Clarke-Hinds, Executive Manager, External ICT Relations, National Information and Communications Technology (NICT) Division, Ministry of Public Administration and Communications
	Inshan Mohammed, Professional, Policy, Research & Measurement, National Information and Communication Technology Company Limited (iGovTT)
Turks and Caicos Islands	
	Dr. Perle Brewster, Director of Policy and Planning, Ministry of Education, Youth, Culture and Library Services.



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