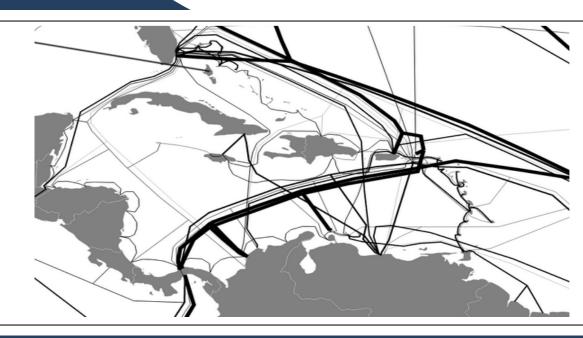# Development strategies for the information and communications technology sector in the Caribbean:

A global perspective

Robert Crane Williams

UNITED NATIONS

ECLAC

Economic Commission for
Latin America and the Caribbean

Development strategies for the information and communications technology sector in the Caribbean: A global perspective

Robert Crane Williams

UNITED NATIONS

ECLAC

Economic Commission for Latin America and the Caribbean (ECLAC)

This document was prepared by Robert Crane Williams, Associate Information Management Officer at the Subregional Headquarters of the Economic Commission for Latin America and the Caribbean.

The views expressed in this document, which has been reproduced without formal editing, are those of the author and do not necessarily reflect those of the Organization.

Contents

Executive Summary

This occasional paper examines the experiences of three leading global centres of the ICT industry – India, Silicon Valley, and Estonia – to reflect on how the lessons of these models can be applied to the context of countries in the Caribbean region.

India is an example of a developing country that has built on modern communications systems and a large, highly-skilled pool of low-cost labour to provide software development and business process outsourcing (BPO) services to companies in the developed world. Countries in the Caribbean have also been working to compete in the outsourcing industry, but find themselves at a disadvantage due to a lack of technology skills in the workforce and a limited capacity to scale in comparison to Indian competitors. Thus, Caribbean countries may do better to focus on developing outsourcing industries oriented toward smaller, niche opportunities where ability to scale is less of a concern. However, they must be careful to avoid a situation in which the many pressing needs for the development of applications to support economic and social growth in the region are sidelined because a too-high proportion of available technology talent is focused on providing services for export (Heeks 1999).

Silicon Valley is widely renowned as a world leader in both the development of technology, and in the development of technology businesses. It is home to a vibrant, venture capital-funded startup ecosystem, which is now more efficient than ever with the advent of the "accelerator" model that enables, in essence, the mass production of new technology companies. Jamaica is experimenting with ways to implement this type of model to help foster a technology cluster in the Caribbean. However, while Silicon Valley offers a highly innovative model, the framework of venture capital funding that it represents is reliant upon a high-risk, high-reward structure that may be inappropriate for a context as economically vulnerable as the Caribbean. Though an innovative startup culture can play an important research and development role focused on issues confronting the region, the Caribbean would be better suited to pursue this end through more egalitarian business models that build on organic growth and a broader distribution of returns.

Estonia is a country that is comparable in population size and GDP to Trinidad and Tobago, which has met with success in ICT despite the limitations implied by its small size. Estonia is a global leader in the development of e-government applications, and, famously, is the country where Skype was first developed. The ICT industry in Estonia has been significantly bolstered through the active participation of the government – both as an investor and, perhaps more importantly, as a customer. In

contrast, Caribbean governments to this point have largely foregone the opportunity to use their role as a customer for ICT services to help establish the region's technology industry. This is in part due to an excessive reliance on donor funding for the implementation of projects related to e-government in Caribbean countries. The acceptance of funds provided through international organizations, such as the World Bank, often brings with it the requirement for open procurement policies that preclude the ability of governments to show preference toward local companies in the selection of vendors for ICT services (Boyce 2014).

Estonia, in common with both India and Silicon Valley, also illustrates the advantage of having an educational system – and a culture – with a deeply engrained sense of innovation and the importance of technology. Caribbean educational systems have much catching up to do in terms of integrating technology skills development into primary and secondary-level curriculums, which is an important step to building the foundation of the highly skilled workforce that is a necessary component of a strong ICT industry.

Several sectors of the technology industry are considered in relation to the suitability for their establishment in the Caribbean. Animation is an area that is showing encouraging signs of development in several countries, and which offers some promise to provide a significant source of employment in the region. However, the global market for animation production is likely to become increasingly competitive, as improved technology has reduced barriers to entry into the industry not only in the Caribbean, but around the world. The region's animation industry will need to move swiftly up the value chain if it is to avoid the downsides of being caught in an increasingly commoditized market.

Mobile applications development has also been widely a heralded industry for the Caribbean. However, the market for consumer-oriented smartphone applications has matured very quickly, and is now a very difficult sector in which to compete. Caribbean mobile developers would be better served to focus on creating applications to suit the needs of regional industries and governments, rather than attempting to gain notice in over-saturated consumer marketplaces such as the iTunes App Store and Google Play.

Another sector considered for the Caribbean is "big data" analysis. This area holds significant potential for growth in coming years, but the Caribbean, which is generally considered to be a data-poor region, currently lacks a sufficient base of local customers to form a competitive foundation for such an industry. While a Caribbean big data industry could plausibly be oriented toward outsourcing, that orientation would limit positive externalities from the sector, and benefits from its establishment would largely accrue only to a relatively small number of direct participants in the industry. Instead, development in the big data sector should be twinned with the development of products to build a regional customer base for the industry. The region has pressing needs in areas such as disaster risk reduction, water resource management, and support for agricultural production. Development of big data solutions – and other technology products – to address areas such as these could help to establish niche industries that both support the needs of local populations, and provide viable opportunities for the export of higher-value products and services to regions of the world with similar needs.

I. Introduction

In 2012, researchers published a longitudinal study of 24 small and medium-sized enterprises that had engaged in e-commerce in the Caribbean region. The goal of the study was to determine if these companies had been successful in efforts to harness the internet as a means of reaching a newly available, globalized customer base for their products. It was discovered that, in general, these companies' efforts had not been successful.

One major problem – obvious in retrospect, but which had largely been unanticipated – was that, even as these businesses had come to view the internet as "an opportunity to reach out to the rest of the world... the rest of the world could now also reach *in* to their customers." For example, one hardware store in Guyana was surprised to discover that Lowe's, a major home improvement retailer from the United States, began competing in the Guyana hardware market, by making its offerings available for order on-line, for delivery throughout the region via a local shipper (Wresch & Fraser 2012).

This situation is emblematic of the difficulties that the Caribbean region faces in trying to draw on information and communications technologies (ICT) to enhance economic development. As regional internet connectivity improves, and brings with it opportunities for the establishment of new, knowledge-based industries, technology is also exposing the region to new competitive pressures and unfamiliar market forces that must be navigated.

Mindful of this challenge, the Caribbean Community – CARICOM – is currently engaged in negotiations to strengthen the position of the region's ICT industry through the creation of a "Single ICT Space." This is largely focused on the removal of cross-national barriers to ICT usage within the Caribbean. It seeks to harmonize regulatory policies at a regional level, and coordinate on issues such as electromagnetic spectrum management and the deployment of broadband infrastructure. Accomplishing this kind of coordination across the highly fragmented markets of the CARICOM area could bring service improvements and other benefits to people and businesses in the region. It would be a signal that the region's governments are committed to supporting ICT as a tool for economic growth and achieving development goals.

The conceptualization for a CARICOM Single ICT Space, however, is largely focused on the "communications" element of the phrase "information and communications technology." This is a reasonable place to begin, because telecommunications form the foundation upon which the broader, information technology-supported knowledge economy is constructed. Still, more strategic analysis is needed to determine how information technology, above and beyond the telecommunications sector, can best contribute to economic and social prosperity in the region.

To that end, this occasional paper will focus primarily on considering how public policy can be used to strengthen the information technology portion of the ICT industry. As a means of analysis, the paper will explore successful models of information technology industrial development taken from around the world, and consider how the lessons of their experiences can be translated into a Caribbean context. Specifically, it will look to experiences of India, Silicon Valley, and Estonia as three divergent models that the Caribbean can examine as it seeks to construct a more vibrant and robust technology ecosystem.

II. India: A global leader in the offshore services

Here we begin our examination of global leaders in ICT, for consideration as potential examples for the Caribbean to follow. The first such example is India, which has been a trailblazer among developing countries in building a technology-based industries focused on providing outsourced services to companies in the global North. Following this lead, Caribbean countries have worked to establish a foothold in the offshore software development and business process outsourcing industries. The Indian experience bears deeper examination in part because, in these markets, India is home to some of the Caribbean's toughest competition.

Some of India's competitive strengths in this sector are based on first-mover advantages. India began establishing itself in these markets in the late 1980s and early 1990s, drawing on the business connections of members of the Indian diaspora, especially in the technology industries of Silicon Valley. These Indians were able to persuade their American counterparts that much of the lower-level tasks that were being done could be done much more cheaply in India. For the same rate of pay as a single software developer in the United States, four developers could be employed in Bangalore or Mumbai. Since that time, the country has built upon the development of modern telecommunications networks to make the services of its massive pool of inexpensive, educated labour resources available to the world (Pandey et. al. 2004).

Initially, the Indian outsourcing industry focused on providing relatively low-skill services, such as software maintenance and testing. During the 1990s, Indian developers were able to take advantage of specific opportunities surrounding the need for software updates to address the "Y2K problem" and to reflect the conversion of European financial systems to the euro (Bresnahan et. al. 2001). Over time, the Indian workforce has continued to grow in its capability – both through the strength of its technology-focused higher education system, and through the contributions of Indians who have returned to the country after experiences in ICT industries abroad. This has enabled Indian companies to move up the value chain to provide a broader array of services to customers. The offshore services sector has also expanded its offerings into areas with similar business models, such as call centres and business process outsourcing (Gereffi & Fernandez-Stark 2010).

Lured by the potential for massive cost savings, companies in the developed world have been eager to outsource technology projects to India. There have been many failures along this path, especially in the early years. One insurance firm, AIG, outsourced the programming work of an entire division to Indian staff who were not able to adequately perform the role (Heeks 1999). However, as experience has grown over time, so too have the number of successes. In some cases, Western companies established offshore divisions of their company at employment centres in India. However, many of the most successful companies – such as InfoSys and Tata Consultancy Services – are Indian in origin.

3

Typically, Indian offshoring companies operate through a "mixed model", by setting up remote offices at or near customer sites in the developed world. Personnel at these offices are charged with managing customer relationships, and with gathering product requirements that are then relayed back to the main development centres in India. This model has helped to reduce the competitive disadvantage that Indian developers experience as a result of the large time-zone difference between India and its customers in North America. However, this time zone difference remains one reason that Indian companies have been interested in expanding operations to establish a presence in the Caribbean. The Government of India's contributions to workforce capacity building efforts for ICT in Grenada are reflective of this interest (Gill 2011).

A. Nearshore software services in the Caribbean

The term "nearshoring" was coined to reflect the notion that the Caribbean – among other locations – enjoys significantly closer physical proximity than India does to the developed markets of the United States and Western Europe. Even in an electronically connected world, this is a tangible benefit; not only are time-zone differences greatly reduced, but travel between the customer's location and the worksite is faster and less expensive.

The Caribbean is also considered "near" in terms of cultural affinity. Many Caribbean nationals have lived – or currently live – in North America and Western Europe, and this diaspora enables both familiarity and potential business connections. This advantage is hardly unique, however; the Indian and American cultures have also grown more familiar with each other in recent years as a result of increased business contacts and continued immigration from India to the United States. This comfortable relationship, combined with India's first-mover advantage and incredibly deep labour pool, ensures that the nearshore proximity factors will not necessarily be a trump card when Caribbean operators compete with Indian companies for various outsourcing opportunities.

The Caribbean's greatest challenge, when it comes to nearshoring in the software sector, is the deficit of ICT skills in the workforce. For example, in October 2013, a US software firm sought to recruit 40 Trinidadian software developers, but was only able to find three. Lawler Kang, the company director in charge of the recruitment effort said of Trinidad and Tobago: "Essentially the kids coming out of school aren't trained enough for our needs. They are very smart kids, but their technology skills and their overall readiness to work for us are for the most part just not there." Eventually, the company looked to Jamaica, where it was able to find a larger number of skilled candidates for the jobs (Burnett 2014).

In the past, attempts at establishing a software outsourcing industry in the Caribbean have been characterized by different approaches to tackle the lack of technology skills in the local workforce. For example, in the 1990s, an American company founded a subsidiary in Barbados to provide nearshore software development services to North American clients. Due to a lack of local software development expertise, most of the workers in the company were brought in from India. While it was expected that the pleasant Caribbean lifestyle would provide an incentive for Indian expatriate software developers to stay with the company, turnover was high as those who gained experience quickly left to seek more lucrative job opportunities in the United States. Furthermore, the company's cultural isolation from the rest of the country ensured that few ICT skills were transferred to local residents. Like many offshoring businesses in developing countries, the operation was a financial enclave of sorts, so economic returns to the Barbados economy were limited (Abbot & Jones 2012.)

Another nearshoring company to contend with the Caribbean labour skills deficit was Indusa Global, which, in the late 1990s, sought to establish a software development centre in Jamaica's Montego Bay Free Zone (Cummings 2004). That company met the need by working with the

Government of Jamaica and various academic institutions to establish a training school, the Caribbean Institute of Technology (CIT), which offered a ten-month course to teach local persons the basics of how to be a computer programmer. This was followed by on-the-job training in software development to build additional experience. In this way, the company was able to help build up a skills base in the local workforce, and then draw upon those skills to fulfil its staffing needs (Abbot & Jones 2012).

The Caribbean can gain jobs and workforce development from the participation of nearshoring companies like Indusa Global. But this proposition also has a significant drawback: under the outsourcing services model, the fruit of Caribbean labour will primarily accrue to benefit the customers and bottom lines of companies in developed countries, rather than directly contribute to the welfare of Caribbean societies. This path will bring foreign exchange, and help workers in the region to develop ICT skills, but those skills will be practiced in the service of outside entities. As one researcher in the field of ICT-based economic development has written, "Putting your brightest software stars to work on applications that boost the growth of foreign firms and foreign economies incurs a large opportunity cost when applications to meet the many pressing domestic needs are consequently sidelined." (Heeks 1999).

B. Industry focus: Call centres and business process outsourcing

Within the context of considering how the outsourcing model pioneered by India applies to the Caribbean region, we will now examine the case of the call centre industry, which represents the entry level to the business process outsourcing (BPO) value chain. This industry has seen significant growth in the Caribbean in recent years, with the Dominican Republic and Jamaica having emerged as the regional leaders in this field. As of 2010, there were at least 13,000 call centre jobs in Jamaica, with Montego Bay acting as the centre of the country's industry. A customer service representative at a call centre in Jamaica, having several years of experience, can expect to make around $7000 USD plus $3000 in benefits annually (Arledge, 2010). In the Dominican Republic, which has built on a bilingual workforce as a competitive advantage in the marketplace, there are a reported 32,000 jobs in over 60 call centres (Business Year, 2014).

The largest call centre operator in Jamaica is the Xerox Corporation, which employs about 40% of Jamaica's call centre agents. When the head of Xerox, Ursula Burns, made a visit to the company's facilities in Montego Bay, she told journalists "What Jamaica and every BPO site has to understand is that, unlike a technology business, where the barriers to entry are generally large, BPO's initial barriers to entry can be low and it's really important, therefore, that the people who have footprints today continue to reinvent themselves.... It's really important that Jamaica continues to focus on the fact that they have a good base in this service-type area and that base will continue to be attacked by competitors so they have to keep making it better." (Richardson 2012).

Excessive reliance on the business decisions of large overseas companies represents a liability to the industry. The 1200 employees of the NCO Financial Services call centre in Barbados learned this when their jobs, servicing large North American banks, were moved to Manila, in the Philippines (Thompson 2012). The small size of the labour pool in Caribbean countries has also implied that Caribbean BPO operations will always be disadvantaged when measured against operations in India or the Philippines that have a competitive advantage in their ability to scale up quickly. Thus, the industry could gain a measure of security by diversifying its customer base toward small and medium-sized businesses with needs less suited to the strengths of the Caribbean's Asian competitors. Potential customers for this kind of outsourcing could include medical practices and hospitals with billing needs, independent e-commerce retailers and regional service industry companies that require support for customer relationship management functions, and law firms needing paralegal and e-discovery

services. In general, most of these activities would be positioned higher on the value chain than the bulk of call centre operations hosted in the Caribbean today.

This "boutique BPO model" would reduce risk by avoiding over-reliance on large customers. A second advantage is that establishing new companies in this sector would require lower capital investment, and this would enable more of the industry to be controlled by Caribbean citizens, rather than by transnational corporations that are headquartered overseas. The model would also be better suited to filling the business process outsourcing needs of small and medium-sized companies within the Caribbean region, which would enable those companies to be more competitive in the face of foreign competition.

C. Industry focus: Animation

One sector that offers significant potential for specialized outsourcing services is the animation industry. Several Caribbean countries, including Jamaica, Barbados, Grenada, and Trinidad and Tobago, have identified animation production as a possible area for growth and investment. Classes in computer animation are now offered at several post-secondary institutions in the region, and Jamaica has secured World Bank funding for an initiative to provide training in animation to youth in that country. "According to leading international animation companies," the project document states, "there is a demand gap of about 30,000 animators in the outsourcing of animation production – of which about 5,000 could possibly be sourced in the Caribbean." (World Bank 2014)

The animation industry can provide a locus of specialization for the region, but global competition in this area will be tight. Caribbean animators will be competing not just with established animation producers in Asia, but with other new entrants to the industry from around with world. As animation software technology improves, the animation industry is now seeing lower barriers to entry than it has ever had before. Animation is becoming a commoditized information product, and it is unlikely that Caribbean animators will be able to command much leverage in negotiating with large potential clients such as Disney or Sony Pictures.

For long-term success in this sector, Caribbean animators will need to move quickly up the value chain, from 2D animation to 3D animation, and perhaps into providing animation support to the booming video games industry. To gain some measure of additional power in the market, Caribbean animators would be well-served to seek to reduce their dependence on foreign buyers by establishing studios capable of providing the end-to-end creation of animated content – including conception, writing, animation, sound engineering, final production, distribution, and marketing.

Moreover, it is important to establish a regional market that will support Caribbean-produced animation products; the Caribbean market can be a testing ground where producers gain the skills and experience needed to develop high-value products suitable for export. To that end, governments should look for opportunities to fund animation projects as part of their support for the arts, and to commission animated content for public service announcements and campaigns aimed at promoting tourism. Private sector companies can demonstrate good corporate citizenship by hiring Caribbean animators to produce their commercials, and citizens can be encouraged to patronize Caribbean-produced content and help it to reach a broader audience.

III. Silicon Valley: venture capital-backed entrepreneurship

As the Caribbean region seeks to build new industries, such as independent animation studios and boutique business process outsourcing, there is need for the development of support structures that can facilitate the creation and funding of new businesses. This is what is commonly known as a "startup ecosystem," and it generally encompasses institutions that support workforce education, research and development, and business capitalization – as well as the startup companies themselves. The most famous startup ecosystem in the ICT world is in Silicon Valley. The Silicon Valley experience offers many creative and powerful ideas, some of which are already being applied in the Caribbean.

Silicon Valley – a nickname for the southern portion of the San Francisco Bay Area in the US State of California – is the world's premier centre of technology development. The region grew to prominence with the rise of the semiconductor industry in the 1960s, buoyed by extensive government and private sector support for research and development centred around Stanford University. Today, Silicon Valley is home to the headquarters of several large companies of the Internet Era, such as Apple, Google, and Facebook. It also hosts a thriving technology startup culture that is supported by a strong venture capital industry.

These companies choose to operate in the Silicon Valley technology cluster because of the benefits of being in close proximity to other technology industry participants. Chief among these benefits is the availability of a highly skilled technology workforce. The strength of this workforce is in large part attributable to Silicon Valley's proximity to a diverse array of educational institutions, which, in addition to Stanford, include the nearby University of California – Berkley as well as a number of other State universities and community colleges. There has also been a recent emergence of privately run, technology-focused "boot camps," which are designed to provide quick, basic training in specific skills to fill the ICT's industry's labour needs. At all levels, these educational institutions are a vital part of Silicon Valley's technology ecosystem.

Communities around the world have endeavoured, with varying degrees of success, to adopt Silicon Valley's model for a regional technology cluster focused around the presence of a major University. The Government of Jamaica is promoting this type of development in the Greater Kingston area, with the campus of University of West Indies – Mona as the core educational institution. The Government is now working to develop an innovative startup ecosystem for the country, by funding initiatives such as the DigitaJam technology expo and the Start-Up Jamaica business accelerator. The appeal of high tech entrepreneurship as a means of fostering economic growth is clear, but there is a concern that what works in Silicon Valley may not necessarily be a good fit for the Caribbean. It is therefore worth taking a closer look at what exactly a startup culture entails.

One way to think about the role of startup companies is as a means by which modern economies are funding research and development (R&D). In recent decades, it has become somewhat less common for large companies to engage in the expensive, high-risk, early-stage R&D needed to develop new products for the marketplace. This function has increasingly fallen to myriad venture capital-funded startup entrepreneurs, who aim to develop new product ideas and build them into companies. These companies are funded by angel investors – generally high-net-worth individuals that are investing personal funds, and venture capitalists, who operate large funds using institutional money and seek to spread investments over a wide array of high-risk startup companies. Angel investors and venture capitalists fund startup companies with the expectation that the exceptional returns generated by a few high performers will cover the broader cost of a much larger number of failed investments.

Those startup companies that are successful – and relatively few are – either go public by selling their shares on a stock exchange, or, more commonly, get acquired and integrated into larger corporate organizations. For example, when Google wanted to enter the mobile device market, it didn't build the Android operating system from scratch. Rather, it paid $50 million to acquire a two-year old startup called Android, Inc. This purchase brought Google the Android technology and, perhaps more crucially, the software development team that had created it (Thomas 2010).

While Caribbean companies would be quite challenged to assemble the concentration of technology expertise needed to create the next Android, the region certainly has many broad areas of concern in which research, development, and innovation is needed. Many of these areas do not represent direct needs for new ICT products, but would be reliant on ICT as a means of providing effective execution of a broader solution.

For example, there is a need in the region for logistical improvements that can increase the productivity of the agricultural sector by ensuring products reach their market at the time of optimum ripeness, and in synchronization with projected market demand. Specialized planning software that could coordinate planting and harvest dates among small farmers across a broad area may be one important part of this solution, while another function might entail the enhancements to the scheduling processes of transportation and warehouses, and another might facilitate the coordination of microloans to various industry participants for the purpose of capital improvements. Each of these elements requires extensive investigation, design, testing, and ongoing improvements through iterative cycles of trial and error. Rather than attempt to have a single entity coordinate all these disparate projects, an approach built upon a startup ecosystem would entail the creation of many different small companies working in this space – both in cooperation and in competition. These efforts would be supplemented by basic research provided through the university system, and would also require investment in workforce training and supporting infrastructure – as well as capital investments in the startup companies themselves. With luck and patience, a viable suite of successful innovations would emerge that could help improve productivity in the agricultural sector, and, in so doing, help the broader economy to grow.

A. Accelerating a startup ecosystem

In 2014, with funding provided through a World Bank loan, the Government of Jamaica initiated a five year, USD 20 million programme called the "Youth Employment in the Digital and Animation Industries Project." This project encompasses two major elements: the provision of training in animation skills – discussed previously in this paper – and the creation of the Start-Up Jamaica technology hub to host a business accelerator programme, which will now be examined in some detail.

The idea of an accelerator grew out of the Silicon Valley ecosystem of venture capital-funded startup companies in the era that followed the bursting of the original dot com bubble. The first, and

most famous accelerator is called Y Combinator. Since Y Combinator was founded in 2005, over 170 accelerators have been founded on similar models around the globe (Lennon 2013). In recent years, Y Combinator's accelerator programme has funded over 700 companies, over 20 of which have eventually grown to have a valuation of over $100 million each. Some of the more famous Y Combinator companies include AirBnB, Dropbox, reddit, and Scribd (Altman 2014). With this kind of a track record, the allure of the accelerator model to Caribbean countries is clear.

The idea of an accelerator is similar in concept to a business incubator, which is a widely implemented model for nurturing the development of small businesses and helping them grow into larger firms. Accelerators and incubators both provide physical space, mentorship, and business community connections to young companies. An important part of the model entails the exchange of ideas and the development of strategic alliances among entrepreneurs working in close proximity to one another. Where accelerators differ from incubators is in the degree to which the accelerator model has been specifically developed as a pipeline for bringing large numbers of new, technology-focused startup companies into the venture capital ecosystem.

Typically, accelerators provide "seed stage" venture capital funding to participating companies. This is a relatively small investment, intended to help the company begin to get established. Accelerators invest in a large number of companies – commonly dozens – all starting at the same time, and take a slice of equity ownership in each of the startups that participate in the program. This "class" of participating startup companies then goes through the accelerator process, in which they work to develop their ideas into marketable products over a time period of three to six months. At the end of the period, these companies showcase their product in a "demo-day," in which they pitch themselves to angel investors and venture capitalists. These investors may then choose to provide further rounds of funding to attractive companies – and take further slices of equity – to help the growing businesses expand.

While most accelerators provide their services in exchange for a percentage of equity in the company, some government-sponsored accelerators, like Start-Up Chile – on which Start-Up Jamaica is modelled – do not take an equity stake in the company. In the case of Start-Up Jamaica, the project is partnering with Oasis500, a Jordanian venture capital company, which is providing each startup with $30,000 in seed capital – 50% of which is made up of in-kind contributions. In return, it is reported (Barnett 2014) that Oasis500 will be taking up to a 20% equity stake in each company. A 20% stake is quite high by accelerator standards (Y Combinator's standard package takes a 7% stake in company equity on a $120,000 investment), and this raises concerns. The high rate of equity required by the venture capitalist may be reflective of the exceptional level of risk perceived to be associated with the development of Caribbean startups. While this may reflect a market reality, it may not be a particularly good deal for the entrepreneurs involved.

Caribbean entrepreneurs will be faced with an even greater difficulty than sharing their equity: a significant feature of the venture capital-funded startup model is that the rate of attrition is typically very high. In the United States, for example – only 12% of seed-funded startup companies obtain a first round of "Series A" funding, with only 4% making it through to a "Series B" round of funding. In Europe, only 1.5% of companies make it to a Series B round of funding (Hernandez & Piron 2014). A large proportion of companies can be expected to go out of business as funding runs out, and a somewhat smaller proportion can be expected to be purchased at a fairly low valuation by a larger company – the so called "aqui-hire" scenario, in which a larger company buys a smaller company as a means of obtaining its development talent. A lucky few companies may be able to make an "exit" though an IPO or through a high-value acquisition. Still others will manage to sustain themselves for a long time as small companies with limited growth. This last category is often considered a failure from the venture capitalist perspective, but, if the broader goal is the creation of a sustainable ICT industry that can service local needs, the establishment of stable, small companies can be viewed in a more positive light.

Nonetheless, the accelerator model is built around the goal of creating high-growth companies. To that end, it aims to significantly reduce attrition at the early stages of the company development process, through the strength of the business mentoring program and by cultivating ties between accelerator graduates and the broader community of investors and potential customers. One of the goals of the Start-Up Jamaica project is to foster the development a network of Caribbean-based high-net-worth-individuals to act as angel investors to the burgeoning startup community. Start-Up Jamaica hopes to use this network to achieve its projection that 33% of its participating companies will obtain a first round of funding (World Bank 2014).

A funding rate of 33% is perhaps optimistic, but it would be in line with averages for accelerator performance on a global level. However, these averages are inflated by a few very highly performing "elite" accelerators, such as Y Combinator – and there are a large number of accelerators in the world with far less impressive results. Some have questioned whether the global trend in the establishment of accelerators is a bubble, and consider that the glut of accelerators – and of associated seed-stage startups – is likely to result in a lower quality standard of business mentorship, and strain the availability of later-stage funding from venture capital pools (Lennon, 2013).

B. Managing the cost of failure

As an outgrowth of the high-risk, high-reward nature of the technology industry, the culture of Silicon Valley has a developed a reputation for embracing failure. For an individual, participation in a failed startup can be held up as a badge of honour because it is viewed as a formative experience and is indicative of a willingness accepting risk in the pursuit of potentially very high returns. "In the startup world, *failure* is almost synonymous with *learning experience*," startup company founder Erica Zidel told Inc. Magazine. "Being a founder who has failed before signals to the community that, one, you've done this before, and, two, you've gathered information on what doesn't work and are better armed to create something that does." (Markowitz 2012)

This attitude is widely propagated among boosters of high-tech startup culture, though, to an extent, the limited consequence of failure is more common in legend than in practice. Geoff Lewis, a partner at a Silicon Valley venture capital firm, suggests that there is an advantage to the investor class in promoting this trope. "Since the vast majority of a venture-capital fund's returns come from one or two big hits, it's a truism that most companies in any given investor's portfolio will fail. So there's a sense in which playing down the trauma of real failure to entrepreneurs can be good for business." (Lewis 2014)

In as much as failure appears to be a fundamental aspect of venture capital-based startup ecosystems, it is important that those seeking to develop the accelerator model in the Caribbean take steps to ensure that participants in startup companies which do not succeed are still able to benefit from the process. For those entrepreneurs that do not prosper in the attempt to create a startup business – and this will be most of them – there may a significant price paid in terms of reputation, opportunity cost, sweat equity, personal financial investment, and social stability. It is hoped that the value of the learning experience and networking benefits will outweigh these personal costs of failure, but this is not guaranteed, and one could speculate that the adverse impact of these costs is likely to be relatively higher in a developing country context than it would be in a wealthy country.

Helping entrepreneurs to gracefully manage failure may be an important means of increasing the chances that these individuals would be willing to take the risk of making another attempt at building a startup. In general, Caribbean countries should tread carefully when implementing venture capital-based models of business development, which are structurally designed to provide great fortunes to a few of the most successful, while leaving the other participants with little accumulated capital to show for it. The startup ecosystem embodied by the Silicon Valley model is one of high-

risk, high-reward, and is not necessarily suited for an economic environment where vulnerability to risk is already quite high. Therefore, it is worth examining how the accelerator model could be adapted to reduce risk to the young entrepreneurs – perhaps by ensuring that there is some means for all programme participants to share in equity produced by the highest fliers.

More broadly, it may prove wiser to shift the business development model away from one that is designed to foster small numbers of high-growth companies that compete on a global scale, and focus instead on developing sustainable, medium-sized enterprises aimed at servicing the ICT needs of the Caribbean region. Greater stability and enhanced resilience can come by building a core of companies that pursue organic growth, rather than venture capital, and which focus on doing the less glamorous, but necessary, ICT tasks needed to support regional companies and governments. These tasks include basic web development, e-commerce and e-government installations, and building enterprise software applications used in the operations of regional industries, such as hotels, shipping operations, and call centres.

C. Industry focus: Mobile applications development

The accelerator model has been promoted specifically in consideration with the establishment of a mobile applications development industry (World Bank 2014). The development of smartphone applications is widely seen as a potential growth opportunity for the region's ICT industry. In addition to the Government of Jamaica, the Government of Dominica, The Caribbean Development Bank, and CANTO have all sponsored efforts to help build workforce capacity in this area. The region is rich with "build an app" contests aimed at encouraging young people to learn mobile apps development.

At first glance, the "app economy," as it is called, seems to be well-matched to the Caribbean region. Apps can be developed with relatively little upfront investment, by individuals or small companies, and can be sold to a global audience through Apple's iPhone App Store, or Android's Google Play – the problems of small size and geographic remoteness that are endemic to the region's island states are not an impediment to participation in this industry. Moreover, the market appears to be growing rapidly in the Caribbean – and around the world – as older mobile phones are retired and replaced by new smart phones with broader capabilities.

Unfortunately, for the above reasons and others, the global market for consumer smart phone applications has matured quickly and is now extremely competitive. In the early days of app development, stories were common of small software development shops that made a fortune by releasing a hit app for the iPhone. That may have been possible in the early days of smart phones, when there were relatively few apps to choose from. Since that time, apps have proliferated to the point where an average of 550 new apps are being added to the App Store every day (Murph 2014), and app developers face a huge problem in achieving "discoverability" for their creations. Simply put, there are so many apps currently available that it is very difficult for any single app to stand out among them to be able to reach a sizable audience.

As a result of this glut of software, there has also been a "race to the bottom" in app pricing, resulting in a situation where 90% of the apps on the iPhone are made available for free (Gordon 2013), and developers must make money by finding ancillary revenues, selling advertising, or by selling premium features to a small segment of their user base. Achieving the critical mass of app installations required to make viable businesses out of any of these models can cost hundreds of thousands of US dollars, or more, in development and marketing expenses. Increasingly, sizable revenues are accruing to only the very upper crust of the apps industry, and the most popular apps are published by large, established companies with extensive resources, rather than by the type of small software development shops one might find in the Caribbean. Thus, given the difficulties of

effectively competing in this field, a strategy of pursuing app development for the consumer market may not be the best use of the region's limited pool of software development skills.

On the other hand, there may be better opportunities in mobile development for governments and enterprises, and public policy should be used to encourage the mobile development industry along those lines. For example, a regional app store specializing in e-government apps could enable Caribbean app developers to sell their software to Ministries in various participating countries. This would help to build the local ICT industry while enabling governments to make use of tools developed and customized to meet their needs. Similar efforts could be made to promote Caribbean-built apps for business operations in the private sector, supporting industries that require a high level of localized customization, such as tourism and agriculture.

IV. Estonia: A small country with large technology footprint

One country that has been a global leader in mobile applications development for e-government, among other sectors, is the Eastern European country of Estonia. Estonia, a former Soviet Republic, is comparable in population size and GDP to Trinidad and Tobago. According to World Bank figures, Estonia exported almost USD 1.5 billion worth of ICT services in 2012, a value almost five times the size of Jamaica's ICT exports for that year.

Like India, Estonia has an ingrained cultural appreciation for mathematics and science. It has been able to develop this predisposition into a highly skilled workforce that supports an active startup scene. However, Estonia also has some of the lowest wages in Europe and, again like India, a high rate of poverty. The Caribbean can look to Estonia as an example of a small country that has successfully built a world-renowned ICT industry, and as an indication that even generally successful ICT development strategies have their limitations.

A. Investment in education

A highly skilled workforce has been vital to the success of Estonia's ICT sector. One of the foundational efforts in developing this workforce began in 1996, with a programme called Tiger Leap that focused on bringing computers into schools and teaching students how to use them. The pupils introduced to ICT through Tiger Leap have since come up through university and are forming the backbone of Estonia's knowledge-based workforce.

In contrast to Estonia's relatively early national effort, the efforts of Caribbean countries to bring computers into schools were fairly uneven during that era; there were a number of pilot projects that never extended to a national scale, or which provided very limited numbers of computers to each school, or which relied on second-hand computers that quickly became obsolete (Phillip 2014).

Perhaps the most successful national effort to place computers into Caribbean schools was in Barbados; the country's Education Sector Enhancement Program began in 1998, and focused on providing schools with adequate quantities of ICT equipment to enable the effective integration of Information Technology into the Caribbean (Phillip 2014). Perhaps Barbados' status as a regional

leader in ICT today is partly reflective of the payoff from this strategic investment in building human capital.

As a result of their country's educational focus, Estonian software developers have benefited from a depth and length of exposure to technology during their formative years that is reflected in the strong reputation they have earned in their field. The value of this experience is not something easily replicated through the high-intensity vocational ICT training schools that are promoted in conjunction with offshore development efforts in the Caribbean and elsewhere. Those methods can build a workforce equipped to perform fairly standardized work in a narrow set of technologies, but which is less suitable for cutting-edge development that requires a high level of innovation. Estonia, on the other hand, has learned that the best technologists start building experience early, and is now starting to teach computer programming to children when they enter school at the age of seven (Mansel 2013.)

The Caribbean could benefit also from a more focused effort to teach programming to children at secondary, if not primary, level. Currently, the technology curricula offered at the secondary level by the Caribbean Examinations Council (CXC) are focused on information technology skills, rather than computer science, and it is reported that both students and teachers have shied away from the programming-related elements of the curriculum (Gay 2011). This is unfortunate because, while IT training can teach students how to make good use of existing technology, it is computer science skills – particularly programming – that enables the innovative development and application of new technologies. While programming is a skill that many students find difficult, to some it comes almost naturally. Thus, there is a great potential benefit if those students who have an aptitude for computer science are identified early, and are provided the instruction and resources they need to gain an early footing towards mastery of the subject.

B. Government as an ICT customer

Like its Nordic neighbours in the Baltic region, Estonia's government plays an active role in promoting industrial development, and the government has made numerous interventions to promote the growth of the ICT industry. Significant among these interventions has been the government's early and continuous promotion of e-government.

For example, the Government of Estonia changed all of its cabinet meetings to paperless sessions using a web-based document system in August of 2000 (Duta 2006). Nearly fifteen years later, many countries around the world – and especially in the Caribbean – have yet to implement such a system. Estonia is also one of very few countries in the world that enable citizens to vote in elections over the internet, and, in 2013, 95% of tax declarations were filed electronically, in a process that typically takes five minutes (E-Estonia 2014). The e-government effort has also lead to a high level of government transparency, which reduces perceptions of corruption, and has helped to spur entrepreneurship by making the on-line process for starting a new business relatively quick and painless.

"The e-government wave has fostered innovation and growth of the private sector through private-public partnerships," writes INSTEAD's Soumitra Dutta. "Although the nascent state would not have been able to achieve its objectives without the help of private firms, government orders have stimulated the sector and contributed to the offer of innovative solutions." The Estonian government has not only acted as a valued customer for the country's ICT businesses, it has also helped to develop a population that displays a high level of willingness to embrace new digital technology, which has been important in creating a user-base for new Estonian technology products (Duta 2006).

The Caribbean is home to many national governments with extensive e-government needs. Ideally, these governments could look to Estonia's experience in using e-government procurement as

14

a means of supporting the regional ICT industry. The presence of so many potential customers in the region should be a boon to Caribbean developers of e-government software and services.

Unfortunately, this possibility is largely precluded by the donor-based funding mechanism that fiscally constrained governments so often rely upon to support e-government initiatives in the region. As Senator The Honourable Darcy Boyce, of Barbados, explained at a forum on E-Governance in Port of Spain, Trinidad and Tobago in May of 2014, in cases where work is being funded by international agencies, such as the World Bank, countries must use open procurement rules and there can be no weighting that allows any favouritism to local or regional providers in purchasing e-government products. As a result, small, regional companies find it difficult to compete with multinationals, and are not able to take advantage of these government contracts as potential opportunities to grow their business and, by extension, the regional ICT industry (Boyce 2014).

C. Government as a venture capital partner

The Government of Estonia also takes an active role in promoting the growth of Estonian companies competing in the private sector. The Estonian Development Fund and Enterprise Estonia are government-sponsored entities that provide mentorship, marketing assistance, and direct financial aid to private sector startup companies.

The Estonian Development Fund has an investment arm, SmartCap, which operates two early stage venture capital funds that invest in Estonia-registered companies. These investments are always made in partnership with a private sector co-investor, on equal terms. According to the SmartCap website, having a "[p]rivate sector co-investor confirms that our investment conditions and valuation are market-based. A fitting co-investor adds value to the company. We want to ensure that the company has an access to a wide and relevant network." (SmartCap 2014)

In spite of this market-based partnership, the Estonian government has come under criticism for investing taxpayer money in startup technology companies, at a time when many Estonians remain poor. One blogger, who writes anonymously and has a broad following in the Estonian startup scene, has said "Estonia receives a massive amount of EU funding (more than 18% of the 2012 budget), and I think they've chosen to spend too much of it on risky startup companies and startup incubators. It reminds me of the .com days in the US in the late 90's, when there was too much money chasing too few good ideas. The difference is that in Estonia, the money is coming from taxpayers and not private investors.... In one case, a company set up in both Estonia and the UK at the same time, in order to take advantage of taxpayer-funded support intended for companies in each region." (Biggs 2013)

This criticism is illustrative of the negative reactions that Caribbean governments might face if they were to directly fund investments in startup companies. For example, one of the projects the Estonian government supported was the development of a social network for pet owners (Biggs 2013). It is difficult to see how investing in a project like that would generate positive externalities for the Caribbean public, and so it's difficult to imagine that the Caribbean public would look kindly on officials for making such an investment.

That said, a 2010 study of over 22,700 startup companies around the world indicated that there was a positive relationship between moderate participation of government-sponsored venture capital funds, and the ultimate success of startup companies. This relationship became negative, however, when governments played an excessive role in capitalizing startup companies, in this case defined as providing more than 33% of funding (Brander et. al. 2010). There may be an opportunity here for Caribbean governments to have a beneficial impact on business survival with investments provided through national and regional development banks and, in the case of Trinidad and Tobago, the sovereign wealth fund. It would be better, however, if leadership in this area were to come from the private sector.

D. Startup drain: the problem of high-growth companies in small countries

The most famous technology product to come out of Estonia is Skype, the widely used internet telephony software. The company employs over 500 people there, with exports valued at over €32 a year. That sounds like a lot of money, but consider that the company, now a division of Microsoft, was valued in 2011 at $8.5 billion (Aasmae 2013). Skype had actually been founded and funded by non-Estonians, and the official headquarters was in the tax haven of Luxembourg. As Soumitra Dutta describes it, "[a]lthough Estonian developers wrote Skype's basic code, only a fraction of the Skype bonanza went into Estonian pockets." (Dutta 2006). This is a lesson that, even in the case of a smash success like Skype, small host countries may see the bulk of capital returns accruing to their foreign partners.

The Skype experience is reflective of a chronic problem with the startup scene in Estonia: successful companies have a tendency to move to larger countries with deeper markets, more funding opportunities, and bigger talent pools. Low labour costs mean that Estonian development teams continue to be engaged, but business operations are moved elsewhere. One Estonian startup, GrabCAD – frequently referred to as "Facebook for Engineers" – was recently acquired for USD $100 million... but only after it had moved its base of operations to the United States. Another example is Fits.me, a growing company that services on-line clothing retailers, which was founded by Estonians with Estonian venture capital and taxpayer-funded enterprise development money. The company continues to do product development in Estonia, but is now headquartered in the United Kingdom.

One might speculate that any successful startup ecosystem in the Caribbean would have to contend with a similar difficulty: the most highly successful businesses are liable to depart the region for greater opportunities in larger markets. This is parallel to the region's existing problem of brain-drain, though perhaps worse: instead losing its trained professionals, the Caribbean would be losing multi-million dollar, high-growth companies.

"Startup drain" would be especially frustrating to the execution of a venture capital-backed startup strategy, which relies on the wealth generated by a very successful few to cover the costs incurred by the large number of failed companies. If the wealth generated by the most successful companies ends up leaving the region, Caribbean economies will be left having endured the cost of the failures, with little to show for it on the positive side of the balance sheet. As such, it is important to consider, in the early stages, how it can be ensured that potentially successful Caribbean startups will maintain a tight connection to the region as they grow into global companies. One possible means of this is ensuring that they have a solid grounding in a regional customer base. As an example of this, we will examine the potential for the big data analysis industry in the Caribbean, especially in light of the advantages that industry might gain by focusing on issues of regional importance.

E. Industry focus: Big data

Valerie Mercer-Blackman and Sarosh R. Khan, of the Inter-American Development Bank, have identified the emerging field of "Big Data" as a potential focal point for innovative development in Trinidad and Tobago. Mercer-Blackman and Khan describe this field, "Big data is a popular term used to describe the exponential growth and availability of data for analysis. Much of these data are in unstructured formats but contain potentially extremely useful information if mined properly. Big data methodologies are designed to innovatively use existing computing technologies to extract this information." They suggest the establishment of a "Big Data Think Tank" in affiliation with the University of the West Indies, to recruit top performing students to study the latest in data analysis

methods, and that graduates of this program could help to establish a startup ecosystem focused around providing these services to a global market (Mercer-Blackman and Khan 2014).

This is a forward thinking proposal, but it would have to navigate some significant drawbacks. The first is that the Caribbean is a relatively data poor region, and has a low number of potential customers with the large data sets needed to support an incipient local industry. Without an established regional customer base, big data startups would have to sell their services primarily to customers in more developed markets, where the primary competitive advantage would be an ability to offer services at low cost – a market position that will be difficult to sustain as competition matures. A lack of ties to customers in the Caribbean would also contribute to the risk that the most successful companies in the big data industry may decide to move operations out of the region, to be closer to their customers.

A second concern is that, even if a few of Trinidad and Tobago's best and brightest technology minds found lucrative work exporting their big data services to global customers, this would not necessarily bring much in the way of value to the Caribbean economy. Though some foreign exchange would be gained, few additional jobs would be created outside of those engaged directly with the provision of big data analysis services. It would be better if this rare and valuable ICT talent could be put to work solving Caribbean problems and supporting Caribbean industries.

Thus, it is important that initiatives of this type consider how their efforts can be used to promote broader growth and the achievement of development goals. For example, the proposed "Big Data Think Tank" could partner with new startups that specialize in developing and installing networks of automated, remotely monitored, soil data collection sensors used for the early detection of landslides. By monitoring the "big data" provided by these sensor systems, combined with weather and seismic information, analysts could enable the development of new models of landslide prediction.

This type of partnership would bring several advantages. First, there are social and economic benefits to mitigating landslide risk, a common concern to countries of the region. Second, it creates a new category of jobs in the field of data collection for landslide monitoring. Third, it creates new, regionally-based customers for the data analysis industry. Fourth, it creates a niche in which the region's data analysts can cultivate specialized expertise, enabling the development of systems for landslide risk management that represent potentially high-value export products.

Landslide detection just is one possible vertical market that could be developed in conjunction with the establishment of a Caribbean big data analysis industry. Ideally, a diversified customer base for data analysis could be fostered within the region, which would support the development of niche service products for export to parts of the world with similar needs. This may include sectors such as tropical agriculture, tourism promotion, mosquito control, geothermal exploration, water resource management, and environmental monitoring.

V. Conclusion

The ICT industry, and the capabilities it supports, have the potential to strengthen economic and social development in the Caribbean region by providing well-paying jobs, increased efficiency in the public and the private sectors, new export opportunities, improved access to e-commerce and e-government services, enhanced disaster resilience, better support for the vulnerable, and platforms for civic engagement, socialization and entertainment. However it is also possible that global pressures in the ICT arena could result in a situation where information services are produced as a low-margin commodity, and the work of the region's best minds is reserved to benefit companies in other lands.

India, Silicon Valley, and Estonia each present models of ICT development that have benefits and drawbacks when considered in a Caribbean context. India has pioneered the offshoring model, demonstrating that jobs can be created in developing countries by performing outsourced work for companies in the global North. The Caribbean, however, lacks India's ability to scale and will find it difficult to compete with India for large customers; the region may have better luck with boutique business process outsourcing, aimed at providing more specialized services to smaller customers – including customers in the Caribbean region itself. The region is also under-equipped in terms of workforce ICT skills, and so cannot afford to have a too-high proportion of those skills sidelined by jobs intended primarily to create value for overseas customers. Ultimately, the greatest multiplier effect that a robust information technology sector can provide to the region is not as a source of exports, nor even as a provider of employment, but as a platform to strengthen Caribbean industries, address Caribbean problems, and support Caribbean development goals.

Silicon Valley represents a highly innovative model, but the framework of venture capital funding which it represents is reliant upon a level of risk taking that is inappropriate for a context as vulnerable as the Caribbean. The world of venture capital-funded high-growth companies has a certain glamour, but the Caribbean should opt instead for more egalitarian business models that focus on organic growth. While an innovative startup culture can play a role providing a research and development function focused on issues confronting the region, this value is reduced if too much emphasis is placed on creating products for external markets. It would be better to first focus on developing products that can succeed in supporting the needs of regional customers, with only the most successful of these products then considered as opportunities for export. Further, the drive for innovation should be balanced with the even greater need to make effective use of technology options that already exist, to meet the day-to-day ICT needs of the region.

The lesson from Estonia is that governments can play an important role in supporting the development of the ICT industry, foremost by being good customers to the region's ICT businesses. The many governments of the Caribbean region represent a large number of potential customers, but their ability to hire regional companies is often precluded when e-government work is funded by international donors that require contracts to be open to worldwide competition, without any preference given to regional companies. This is an issue that needs resolution, because the use of development money is foreclosing a very real opportunity for strengthening the development of a vital sector of the economy.

Estonia has also illustrated the problem of "startup drain," in which high-flying startups from small countries are lost to bigger markets. The small countries of the Caribbean are at risk of this as well, which is one reason they cannot afford to restrict their ICT industries to functioning primarily at a national level. Caribbean companies will find it hard to grow if they are limited to small national markets and small pools of ICT talent. They would do better to take a broader view – to sell their products to a regional market and draw from a larger, regional pool of ICT talent. Moreover, a regionally diversified customer base will increase companies' resilience in the face of economic downturn or to the impact of a natural disaster.

Finally, it should be noted that the successes of India, Silicon Valley, and Estonia have all been predicated on a high level of ICT capacity in the workforce. The Caribbean region got off to a late start in providing technology education in its school systems, and has widespread skill shortages as a result. Improving technology skills in the workforce will need to be assigned a priority – not just among workers in the ICT industry, but also among workers in other industries who interact with technology every day, and who form the potential user base for Caribbean ICT products.

A third sector of the workforce that requires a deeper understanding of ICT issues is management – the leadership level. The region's leaders must come to understand the value of technology as a great enabler that can empower Caribbean industries, governments, and citizens achieve a higher potential – and they must also understand its limitations. Only then will the countries of the region be able to develop a unified, strategic vision that can guide wise policy choices to support the Caribbean's information and communications technology industry.

Bibliography

Altman, Sam (2014). "YC Portfolio Stats." Y Combinator Posthaven, June 16. http://blog.ycombinator.com/yc-portfolio-stats

Arledge, Susan (2010). "Jamaica: Grabbing a Piece of the Call Centre Business." Nearshore Americas. http://www.arledgepartners.com/JamaicawantsaPortionoftheCallCenterBusiness.pdf

Biggs, John (2013). "Meet DotEEBubble, The Mysterious Estonian Starup Critic Who Throws Cold Water On Government-Backed Ventures." Tech Crunch, June 17. http://techcrunch.com/2013/06/17/meet-doteebubble-the-mysterious-estonian-start-up-critic-who-throws-cold-water-on-government-backed-ventures/

Bresnahan, T., Gambardella, A., & Saxenian, A. (2001). 'Old economy'inputs for 'new economy'outcomes: cluster formation in the new Silicon Valleys.Industrial and corporate change, 10(4), 835-860.

The Business Year (2014). "Ringing the Changes." http://www.thebusinessyear.com/publication/article/38/3913/dominican-republic-2014/ringing-the-changes

Boyce, Darcy (2014). In panel discussion at *Caribbean Stakeholders' Meeting: The Importance of ICTs and their Impact on Regional Development.* May 25. Port of Spain.

Burnett, Verne (2014). "US Software firm eyes Trinidadian developers." Trinidad and Tobago Newsday, September 25.

Cummings, Mark (2004). "CIT offers more training." Jamaica Observer. January 21.

Dutta, S. (2006). Estonia: A Sustainable Success in Networked Readiness?.The global information technology report, 2007, 81-90.

Heeks, R. B. (1999) "Software Strategies in Developing Countries." Communications of The ACM - CACM , vol. 42, no. 6, pp. 15-20, 1999.

Gay, Glenda (2011.) "A Place for Programming." The Caribbean Examiner, October. pp. 31-45.

Gereffi, Gary & Fernandez-Stark, Karina (2010). The Offshore Services Global Value Chain. Center of Globalization, Governance & Competitiveness, Duke University, Durham, North Carolina, USA.

Gill, Arley (2011). Remarks at the opening ceremony of the ICT Center for Excellence and Innovation. April 17. St. Georges, Grenada. http://spiceislander.com/?p=4642

Gordon, Mary Ellen (2013). "The History of App Pricing, and Why Most Apps are Free." Flurry, July 18. http://www.flurry.com/bid/99013/The-History-of-App-Pricing-And-Why-Most-Apps-Are-Free

E-Estonia (2014) e-Tax. https://e-estonia.com/component/e-tax/ Accessed December 16.

Lennon, Mark (2013). "The Startup Accelerator Trend is Finally Slowing Down". TechCrunch. http://techcrunch.com/2013/11/19/the-startup-accelerator-trend-is-finally-slowing-down/

Lewis, Geoff (2014). "Failure porn: There's too much celebration of failure and not enough fear." Washington Post. December 4. http://www.washingtonpost.com/opinions/failure-porn-theres-too-much-celebration-of-failure-and-too-little-fear/2014/12/04/6bc15816-73ec-11e4-a5b2-e1217af6b33d_story.html?hpid=z3

Mansel, Tim (2013). "How Estonia became E-stonia." BBC News, May 13. http://www.bbc.com/news/business-22317297

Murph, Darren (2014). "Six years in, the mobile app market is already mature." BGR, August 28. http://bgr.com/2014/08/28/app-store-evolution-analysis/

Pandey, A., Aggarwal, A., Devane, R., & Kuznetsov, Y. (2004). "India's transformation to knowledge-based economy–evolving role of the Indian diaspora." Draft. World Bank, Washington, DC.

Phillip, Gerard (2011). "IT Initiatives in Caribbean Schools." The Caribbean Examiner, October. pp. 36-42.

Richardson, Julian (2012). "For Xerox, Jamaica key for outsourcing business." Jamaica Observer, December 19. http://www.jamaicaobserver.com/business/For-Xerox--Jamaica-key-for-outsourcing-business_13239877

Thomas, Owen (2010). "Google exec: Android was 'best deal ever'". Venture Beat. October 27. http://venturebeat.com/2010/10/27/google-exec-android-was-best-deal-ever/

Thompson, Rhonda (2012). "Staff being let go at NCO." Nation News, May 4. http://www.nationnews.com/nationnews/news/34804/staff-nco

Wresch, W., & Fraser, S. (2012). ICT–enabled market freedoms and their impacts in developing countries: Opportunities, frustrations, and surprises. Information Technology for Development, 18(1), 76-86.

World Bank (2014), Jamaica - Youth Employment in Digital and Animation Industries Project. Washington, DC: World Bank Group. http://documents.worldbank.org/curated/en/2014/06/19755382/jamaica-youth-employment-digital-animation-industries-project