Investigating the Global FinTech Talent Shortage

An Inter-Jurisdictional Review of Industry and Institution Response within London, New York City, and Toronto
EXECUTIVE SUMMARY

Recent reports by PricewaterhouseCoopers, KPMG, EY, and other industry-focused reports have identified technology as a key contributor to transforming the financial services industry. The Financial Technology (FinTech) industry, however, faces mounting concerns related to attracting and retaining highly skilled talent that is necessary to sustain and grow local finance industries. Specialized talent that combines financial and digital skills are required to develop innovative and cost-efficient FinTech solutions. This report examines the current challenges faced by industry, as well as the distinct skills that are lacking within the workforce. The report aims to inform post-secondary education institutions (PSEs) and the FinTech industry about strategies for reducing the talent shortage.

The report is a part of a larger research project led by various partners at Ryerson University. The project examines how the industry and PSEs can align with each other to address the talent shortage challenge. Through case studies of leading global FinTech hubs, namely London, New York, Singapore, and San Francisco, this report presents a series of recommendations that can be adopted to address Toronto’s own FinTech talent shortage. These recommendations are presented based on examining three categories of strategies of interventions: Education Interventions; Incubators and Extra-Curricular Events, and; Government and Policy interventions.

Key findings suggest that financial incentives for new graduate startup networks, immigration process reform, and mobilizing policy papers will directly address talent shortages in international hubs. London, New York, and Singapore demonstrated robust ecosystems that:

- Promoted Science, Technology, Engineering, Mathematics (STEM) fields in universities.
- Supported FinTech education with specialty programs, apprenticeships and sponsored work placements with industry organizations.
- Taught students specific skills for starting, growing and joining a startup.
- Introduced immigration process reform to make it easier for prospective entrepreneurs to enter and contribute to the growth of an ecosystem.

Toronto’s FinTech sector can greatly benefit from these findings. This report presents a total of 11 recommendations that, if adopted, would begin to address Toronto’s FinTech labour shortage. These recommendations should be validated and assessed by stakeholders within the industry and PSEs for suitability toward Toronto’s FinTech ecosystem. This report also recognizes the lack of peer-reviewed resources and acknowledges its reliance on reports written by private sector organizations.

The findings and strategies presented in this report are considered to be valuable as a foundation for addressing the global FinTech talent shortage.
In a recent survey conducted by PricewaterhouseCoopers on Global Banking and Capital Markets (BCM), a vast majority of CEOs (93%) identified technology changes to be a key contributor to transformation in the sector over the next five years (PwC, 2016). The financial services sector must be able to respond to this transformation and therefore, will require labour talent that combines strong financial and digital skills (PwC, 2016). Through this report, we explore the international financial technology (FinTech) industry to understand how industry and post-secondary education institutions have responded to the increasing talent shortage.

The research that is foundational to this report is threefold; first, the literature establishes the context of the growing FinTech talent shortage and examines the current challenges industry stakeholders are facing, as well as the distinct types of skills that are lacking within the workforce. Second, the research then turns to a jurisdictional scan of three significant FinTech hubs, namely: London, UK; New York City, USA; and Toronto, Canada. Each case study is explored for insights and best practices regarding the industry and institution’s response to the talent shortage. The responses have been categorized into three primary themes:

1. Education Interventions;
2. Incubators and Extra-Curricular Events, and;

Interventions. Additional insights have been drawn from secondary FinTech hubs including Singapore and San Francisco, USA. Finally, the research consolidates and reframes the discussion by acknowledging that multiple gaps exist within Toronto’s FinTech ecosystem, helping to identify a series of recommendations that could be explored or adopted by industry and post-secondary education institutions.

This report aims to inform post-secondary education institutions (PSE) and the FinTech industry communities of practice about potential strategies for reducing the FinTech talent shortage. Through this work, we will understand how the industry can fully integrate into PSEs and help inform the skills development of students/post-secondary to ensure they are well equipped to secure successful career outcomes. This report also contributes to a larger research project, led by various partners within Ryerson University, which examines how industry and universities can align with each other in responding to our fast-changing economy and talent needs.
INTRODUCTION TO FINTECH

KPMG defines FinTech as technology-based businesses that compete against, enable, and/or collaborate with financial institutions. This ranges from the creation of software processes that enable financial institutions to enhance their customer’s experience and streamline their operations, to providing opportunities for consumers to fulfill their financial needs (saving, investing, making payments). The sector encompasses 1) new start-ups and ventures (in FinTech); 2) the activities and investment in technology innovation from established financial services institutions as well as ICT/technology providers, and; 3) collaboration between these parties or ‘disruptive innovation’ by any of them individually. (Pollari, 2016).

The phrase “FinTech”, was first coined by a New York banker in 1972. While there is no widely accepted definition of what qualifies as FinTech, companies considered to belong to that sector provide services including payment options, online marketplace lending, mobile apps, financing, foreign exchange and remittances, investments, distributed ledger tech, digital currencies, mobile wallets, artificial intelligence and robotics in finance, crowdfunding, insurance, and wealth management. An expanded definition might include ancillary technology solutions targeted at financial services such as digital identity, biometrics, wearables, and technology to assist with Regulatory Compliance (RegTech) (Digital Finance Institute, 2016). As such, the financial services sector has become significantly impacted and influenced by emerging technology-enabled trends that support innovation.

A recent report by Ernst and Young (EY, 2016a), Capital Markets: Innovation and the FinTech Landscape, identified the following nine technology or technology-enabled trends that, individually or collectively, use innovation to address the challenges faced by the industry:

1. Cloud technology;
2. Process and service externalization;
3. Robotic Process Automation (RPA);
4. Advance Analytics;
5. Digital Transformation;
6. Blockchain;
7. Smart Contracts;
8. Artificial Intelligence (AI); and
9. Internet of Things (EY, 2016a).

The following diagram illustrates the interrelated nature and convergence of technology trends. ‘Cloud technology’ and ‘Process and service externalization’ are universal trends that could underpin any and all aspects of innovation. This diagram is not to scale, and does not depict all possible overlaps.

EY (2016a) stated that the greatest benefits in the near term will result from innovation based on Advanced Analytics, RPA, digital transformation, and externalization of processes and services. Blockchain and AI could present game-changing opportunities in the longer term.

The benefits of cloud technology are available today, but for many firms, deriving full value from widespread adoption will take some time (EY, 2016a).

The following graph illustrates the benefits trajectory of the above nine enabling technologies over the next 2, 3 to 5, and 5+ years.
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Understanding the FinTech Talent Shortage

Stakeholders have repeatedly expressed that attracting and retaining high quality talent is one of the most prevalent contemporary challenges faced by FinTech companies (Digital Finance Institute, 2016). International industry reports have recommended that the Government of Canada should intervene, invest, and provide more active support in closing the FinTech talent shortage and support the creation of co-working spaces that facilitate startup culture (Digital Finance Institute, 2016). Within the financial services sector, there is a growing realization that leveraging technology is critical to competitiveness: creating a sustainable advantage in distribution, efficiency of business processes, sales and marketing. This presents a systemic challenge, as current literature indicates that the shortage of technical talent is directly caused by the growing demand for diverse and increasingly complex software systems, and this demand is growing much faster than the educational capacity of current institutions (Digital Finance Institute, 2016).

Furthermore, one of the most challenging and underlying issues to address is whether a sufficient supply of graduates are interested and/or are pursuing education that will train them to work within digital technologies across the economy (Wolfe, 2016; Nordicity, 2012). In a foundational paper, How will the software talent shortage end?, Barr and Tessler (1997) explore the various reasons why young workers may not be attracted to developing their professional technical skills. These reasons include: the vast initial learning curve before they learn the necessary skills, knowledge, and behaviours at the beginning of their careers, are no longer available. These skilled workers who have the innate ability to generate new ideas, build businesses from scratch, and identify and acquire customers (EY, 2016b). Entrepreneurial talent is generally clustered in close proximity to global financial hubs, including London, UK and New York City, USA. In addition, entrepreneurial talent encompasses skilled workers who have the innate ability to generate new ideas, build businesses from scratch, and identify and acquire customers (EY, 2016b). Entrepreneurial talent is not as easily clustered in specific spatial areas, but rather includes a wide range of creative individuals that have strong leadership skills and enjoy professional risk-taking.

Regarding the talent pipeline, the greatest occurrence of FinTech talent shortage exists within the technical talent sector, as there are lower shares of science and technology graduates. Conversely, financial services and entrepreneurial talent are the strongest (EY, 2016b). Evidence suggests that the talent pipeline is drying up. As many junior-level transactional jobs are being moved offshore, the traditional ‘on the job training’ where young employees learn the necessary skills, knowledge, and behaviours at the beginning of their careers, are no longer available. These jobs are ripe for automation and could gradually disappear (Herbert, 2016). Building a sustainable talent pipeline requires strong and adaptive education systems at all levels of schooling, as well as resolving the current discrepancies between how skilled workers search for jobs and where employers are looking to hire (Herbert, 2016).

To maintain Canadian talent, post-secondary education institutions need to do more than simply produce a high volume of well-trained graduates; they must also introduce students to career opportunities within the financial technology sector at a much earlier stage of their education (Wolfe, 2016). The UK FinTech: On the Cutting Edge report, commissioned by the HM Treasury of the UK Government, discusses that FinTech ‘talent’ is comprised of two distinct factors: ‘Talent Availability’ and ‘Talent Pipeline’. Talent Availability refers to the current availability of technical, financial services, and entrepreneurial talent, whereas Talent Pipeline includes the future sources of talent of both domestic and foreign descent (EY, 2016b). Technical talent consists of Engineers, Software Developers, and Computer Programmers, all of whom are required to build and implement FinTech solutions (EY, 2016b). Areas that report high levels of technical talent are typically located near established technology hubs such as the City of San Francisco. Financial services talent includes individuals who have a keen understanding of financial markets, business models, and regulations (EY, 2016b). This type of talent is generally clustered in close proximity to global financial hubs, including London, UK and New York City, USA. In addition, entrepreneurial talent encompasses skilled workers who have the innate ability to generate new ideas, build businesses from scratch, and identify and acquire customers (EY, 2016b). Entrepreneurial talent is not as easily clustered in specific spatial areas, but rather includes a wide range of creative individuals that have strong leadership skills and enjoy professional risk-taking.

Since there has been a rapid expansion of innovative technology in the financial services sector, the sourcing of high quality talent within localized FinTech ecosystems has become a major international concern.
The majority of the resources used in this report were found through online research and publicly available documents including but not limited to: academic peer-reviewed literature, government (local, regional, and national) publications and white papers, university websites, financial sector reports, and leading industry program websites. The primary information used in this report relates to the FinTech sectors within three global cities: London, United Kingdom; New York, United States of America; and Toronto, Canada. Additional information regarding the growing FinTech sectors in San Francisco, United States of America; and Singapore were also referenced.

Based on a comprehensive literature review of the FinTech talent shortage and the global strategies that have been employed in response to said shortage, the authors have developed a framework for investigation, comprised of three common categories of strategies/interventions, explained in this section.

**Education Interventions:** International post-secondary education institutions have taken multiple approaches towards increasing the interest and competency of students in FinTech-related skills. Universities and colleges are strongly considering the needs of industry – in regard to employable skills – to ensure that the education being delivered is directly assisting students in gaining the appropriate skills needed to find employment within the FinTech sector. Common university responses to the FinTech skill shortage, which are examined further in this report, include curriculum reviews, inclusion of STEM (Science, Technology, Engineering, and Mathematics) programming, FinTech specific MBA specializations, and various policy/white papers written by Ministries of Education and universities.

**Incubators and Extra-Curricular Events:** Post-secondary education institutions, government, and industry partners have responded to the FinTech talent shortage by financing and promoting various forms of programs and extra-curricular activities offered to students. These can include hackathons, mentorship programs, independent course offerings for specific skill enhancement, conferences, and both privately-funded and publicly-funded events. Additionally, recent trends in attracting and developing financial technology talent include the establishment of incubators and seed accelerator programs. These programs are meant to accelerate successful venture creation by providing specific incubation services, focused on education and mentoring, during an intensive program of limited duration (Cohen and Hochberg, 2014; Miller and Bound, 2011). This report discusses several incubator programs that have been created in an effort to grow the FinTech industry and reduce the current talent shortage. Each program’s format and purpose is diverse, differing greatly based on which sector finances the program. More specifically, universities have introduced progressive incubator programs and promotes them as a means to facilitate student entrepreneurship, provide industry with a direct connection to student start-up innovation and talent, and give recruitment agencies a way to identify employable talent (Pauwels et al., 2015).

**Government and Policy Interventions:** The rise of recent government and policy interventions have become a prominent response to closing the talent shortage within the FinTech sector. One of the biggest challenges facing the Canadian FinTech ecosystem is the lack of ability to engage with the government and to collaborate at a national level (Digital Finance Institute, 2016). Therefore, purpose-based interventions have been recommended and introduced to directly address the skills gap. These interventions include financial incentives for new graduate start-up networks, streamlined immigration processes meant to attract foreign talent, and various policy papers that illustrate the many opportunities that national, regional, and local governments could implement to support the FinTech sector.
GLOBAL TRENDS IN RESPONDING TO THE FINTECH TALENT SHORTAGE

In this section of the report, we provide an overview of three major cities – London, UK; New York City, US; and Toronto, Canada – to examine the contributions each has made towards lessening the talent shortage within their respective FinTech ecosystem. Understanding techniques used by global jurisdictions will provide a benchmark by which we can compare Toronto’s progress and potential in FinTech. This will also help identify where gaps currently exist and how industry, educational institutions, and levels of government can collaborate to produce well-equipped and suitable employees for the emerging FinTech sector.
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Since 2008, the United Kingdom (UK) has substantially grown the industry—representing £6.6 billion in revenue and £524 million in investment in 2015 (EY, 2016b). Further, the industry reported that 61,000 people were employed in FinTech-related positions in 2015, making up 5% of the total financial services employment sector (EY, 2016b). In 2016, technical talent accounted for the largest segment of UK FinTech employees (40%), followed by financial services experts (30%). Business development, corporate staff, and executive leadership made up the remaining 30% (EY, 2016b). Currently, London is the largest FinTech hub in the world by revenue, and second largest in employment as 72% of FinTech employees in the UK are based in the urban capital (London First, 2016; Mandel, et al., 2014).

This success is commonly attributed to the ecosystem’s closeness and connectedness to a giant financial services hub, comprised of 251 foreign banks and 588 foreign quoted companies (FinTech and the Evolving Landscape, 2016).

In 2016, an evaluation of the UK ecosystem’s productivity concluded that the average revenue per FinTech employee is £108,200, greater than global competitors based in New York City (98,300p ) and California (63,500p ) (EY, 2016b). Moreover, the London FinTech hub has grown in productivity due to many factors, including its consistent access to an international pool of talent, a strong demand and willingness to embrace new technology in the UK, access to capital to finance and support start-ups (helped by FinTech-supportive UK tax policies), and an adaptive regulatory environment provided by progressive regulators (London First, 2016).

Education Interventions

London has a high density of top ranked post-secondary education institutions, including four of the top thirty ranked universities of the world (World University Rankings, 2016). To strengthen the FinTech talent pipeline, many universities have promoted Science, Technology, Engineering, and Mathematics (STEM) as well as specific FinTech education within universities through specialist course programs, apprenticeships, and sponsored work placements (EY, 2016b). The UK has expressed similar support towards STEM education as the US, actively integrating web development and coding into curricula as part of national innovation programs (EY, 2016b). The national government has also expressed interest in extending participation in STEM classes to industry professionals, encouraging the current workforce to improve upon and expand their technical skills (EY, 2016b).

Updated in 2015, the Department for Business, Innovation, and Skills wrote a STEM policy paper entitled 2010 to 2015 Government Policy: Public Understanding of Science and Engineering (Department for Business Innovation and Skills, 2015). The paper was a response to the contemporary understanding that science and research are major contributors to national prosperity, and that the government has a significant role to play in ensuring the UK workforce is adequately equipped and skilled for employment. One outcome of this paper was to integrate STEM education into all schools (Department for Business Innovation and Skills, 2015). To achieve this, a UK-wide organization named STEMNET (Science, Technology, Engineering, and Mathematics Network) was established and financed by the Department of Business, Innovation, and Skills and the Department of Education to encourage students to enroll in STEM courses (Science, Technology, Engineering, and Mathematics Network, 2017). STEMNET is comprised of three primary programs:

1. STEM Ambassadors: 28,000 volunteers who support teachers to deliver STEM curriculum;
2. STEM Clubs Network: various clubs that inspire students to explore STEM subjects outside of their formal school curriculum; and
3. Schools STEM Advisory Network: 45 UK organizations that offer objective advice to schools pertaining to encouraging students to further their STEM education and employment (Science, Technology, Engineering, and Mathematics Network, 2017)

The Department for Business, Innovation, and Skills, in partnership with the UK Resource Centre, promotes the WISE Campaign (Women into Science and Engineering). This initiative is meant to directly inspire and encourage women to pursue science, technology, engineering, and mathematical careers by offering various scholarships, workshop resources, and professional opportunities including the prestigious Chief Scientific Officer’s WISE Fellowship Programme (WISE Campaign UK, 2017). Additionally, the ‘Your Life’ initiative, launched by the UK national government in 2014, includes a three-year STEM campaign to ensure the future UK workforce has the necessary skills to succeed in the expanding technology industries (Your Life - STEM Skills Gap, 2017). This campaign collaborates with businesses and institutions to create more than 2,000 jobs and apprenticeships, seeking to increase the number of young people enrolled in STEM education by 50% by 2018 (Bateman, 2014). ‘Your Life’ offers education institutions career-focused STEM curriculum teaching resources and engagement activities meant to bring industry into the classroom and encouraging employers to recruit and retain future talent (Your Life - STEM Skills Gap, 2017).

London, United Kingdom

Considered the global leader in FinTech, London has excelled in curating a robust and interdisciplinary ecosystem that attracts and retains talent.

Despite recent threats to the industry relating to the contemporary Brexit political landscape, the UK government has remained strongly in favour of expanding and nurturing the FinTech industry (London First, 2016). Conversely, industry leaders have expressed concerns that the FinTech skills shortage will likely grow in the coming future as technical talent from the European Union (EU) will choose to stay within EU borders in order to avoid the associated expenses and difficulty of visa applications to work in the UK (London First, 2016). While current trends demonstrate stable productivity and growth of UK FinTech, the ecosystem faces a persistent talent shortage. Recent research suggests the UK will need to fill 768,000 new technology jobs by the year 2020, and this demand will require training approximately 2.3 million skilled workers (O2). London is experiencing a shortage of talented technical talent, including coders, web developers, product managers, and data scientists (Roya, 2014). The 2014 Scale Up Report: On UK Economic Growth, concluded that the challenges associated with recruiting skilled technical talent is first in order of why companies cannot scale up in the UK (Coutu, 2014). To address this challenge, many private financial technology firms have begun investing in the recruitment of foreign talent (Coutu, 2014). The Organisation for Economic Co-operation and Development (OECD) regards the UK as one of the most flexible labour markets in the developed world (Portes, 2013). This disruption of free movement and mobility could have significant implications for the talent pipeline and talent availability – potentially compromising London’s leadership position as the global hub for FinTech.
In light of the talent shortage in the technology sector, the UK government has undertaken specific steps towards improving education curricula to align more closely with the needs of industry employers. In 2013, the Department of Education conducted a national review of ICT (Information and Communications Technology) curriculum to improve the education of students. The review modified the ICT curriculum by requiring outstanding but reviewed new course material related to computer science and computer programming (EY, 2016b). Additionally, the Department for Business, Innovation, and Skills undertook the Shadbolt Review in 2015, following the publication of the Government’s Science and Innovation Strategy in 2014. This was meant to gain a deeper understanding of how the current accreditation process for computer science degrees could be reformed and adapted to improve the employability of ICT graduates (Shadbolt, 2016). The review was conducted through: 1) evaluating the data collected by the Higher Education Statistics Agency to establish figures pertaining to graduate employment in the technology workforce, and; 2) consulting with stakeholders to understand current supply and demand in the industry, measuring the skills gap, and gathering insights on the accreditation process (Shadbolt, 2016). The final report developed after the review presented ten recommendations for national government, including ensuring graduates’ foundational knowledge and the ability to adapt, improving graduates’ softer and work readiness skills, developing a clearer view of the requirements of start-up technology companies, and fostering scanning for future demand for skills (Shadbolt, 2016).

Incubators and Extra-Curricular Events

To attract and grow the skills of available talent within the UK FinTech ecosystem, multiple institutions and organizations have developed FinTech-related programs and events.

Tech City UK, a publicly funded organization established in 2010 to accelerate the growth of the UK digital economy, directly supports the FinTech ecosystem by responding to the sector’s need for skills through various programs (Tech city about us ). In 2014, the organization launched the Digital Business Academy, an online education program that teaches participants specific skills in starting, growing or joining a technology business (EY, 2016b). To ensure relevancy and establish credibility, the online program was developed in partnership with University College London and Cambridge University (EY, 2016b). The program covered all of which are free and can be taken separately or together as a complete module. The courses include: Size Up Your Idea, Set Up a Digital Business, Develop and Manage a Digital Product, Make a Marketing Plan, Build a Brand, Understanding Digital Marketing Channels, Run a Digital Marketing Campaign, Master Finance for your Business, How to Track Performance in Early Stage Start-ups, How to Manage Customers, and How to Use Social Media for Business (Tech City about us - Digital Business Academy, 2017). Similarly, the ELITE Programme, established in 2014 by the London Stock Exchange Group, works in collaboration with Imperial College Business School to provide the Shadbolt Review in 2015. Additionally, the Shadbolt Review in 2015 recommended that the UK government establish a clearer view of the requirements of start-up technology companies, and fostering scanning for future demand for skills (Shadbolt, 2016).
New York City, United States of America

New York City continues to be a strong contender as one of the world’s leading FinTech ecosystems. In 2016, the sector reported a market size worth $6,635,920,000 USD (EY, 2016b). Nearly $1 billion was invested specifically in FinTech in 2014 (Accenture, 2014). Arguably, FinTech was first introduced to the New York financial services landscape in 1981 when Michael Bloomberg launched Bloomberg LP, realizing that financial institutions would pay for innovative technology-based solutions (Accenture, 2014). The ecosystem has since matured into a productive industry, reporting a 21% increase in financial technology employment since 2006; close to double the national average of 12% (Partnership for New York City, 2014). The success in the US in cultivating FinTech hubs, such as New York City, are attributed to the city’s position as a leading global financial centre, its close proximity to large customer base of financial products, and the openness of banks and capital market firms toward the benefits of FinTech. In addition, it has an existing financial technology workforce and a flourishing venture capital network (Strategy&, 2015). New York City’s success is also due to its closeness to vast and established financial market expertise, networks of first-generation entrepreneurs, and a stable pipeline of technical and innovative talent that is attracted to FinTech employment (EY, 2016; Accenture, 2014).

In December 2012, Start Up City: Growing New York City’s Entrepreneurial Ecosystem for All, reported that New York City’s Innovation Economy, where researchers argued that universities in New York City have not adequately partnered with local industry in the financial technology sector (Centre for an Urban Future, 2009). The report concluded that the city is far behind competing regions in this regard, and that the City of New York was experiencing a significant missed opportunity for economic development and employment growth (Centre for an Urban Future, 2009). By 2014, New York City reported 150,000 existing technology jobs, and many industry leaders were encouraging the emergence of more technical skilled graduates from local universities (Accenture, 2014). As reported in 2016, 57,000 of these positions were specifically related to the FinTech ecosystem (EY, 2016b). Many industry leaders were encouraging the emergence of more technical skilled graduates from local universities (Accenture, 2014). As reported in 2016, 57,000 of these positions were specifically related to the FinTech ecosystem (EY, 2016b).

Education Interventions

New York City has taken an emerging lead in university-industry collaboration and engagement with the FinTech sector (EY, 2016b).

Michael Bloomberg launched ‘Applied Sciences NYC’ in 2010, a program meant to address the technology talent shortage by funding and creating world-class science and engineering campuses throughout New York City (Accenture, 2014). This initiative seeks to expand the talent capacity within the applied sciences and FinTech industry, maintaining New York City’s global competitiveness as a revenue-generating and employment leader (Applied Sciences NYC, 2016). To encourage local universities to embrace this initiative, the local government of New York City offered City-owned land, seed investment, and the full support of their administration throughout implementation (Applied Sciences NYC, 2016). Recently, the New York University (NYU) Stern School of Business announced the introduction of a FinTech specialisation within the Master of Business Administration (MBA) program (NYU Stern - FinTech, 2016). NYU Stern is the first post-secondary institution to integrate a FinTech specialization into course curricula, and encourages enrollment of professionals interested in investment banking, international finance, social entrepreneurship, sales and trading, information technology, and product management (Pulcini, 2017). The course offerings have been designed to fluctuate and evolve as the financial technology advances globally, however core courses include: FinTech Analytics, Financial Information Systems, Robo Advisors and Systematic Trading, Dealing with Data, Risk Management for FinTech, Application in Entrepreneurial Finance, FinTech Personal Finance and Payments, and lastly, Digital Currencies, Blockchains, and the Financial Services Industry (NYU Stern - FinTech, 2016). Following the program’s inception, NYU Stern hosted its first FinTech conference to promote discussion and collaboration between researchers, business practitioners, alumni, and students (FinTech - NYU MBA Conference, 2016).

Incubators and Extra-Curricular Events

To attract FinTech talent to New York City, the industry introduced and invested efforts into multiple incubator programs. Notably, the FinTech Innovation Lab was designed to help emerging FinTech entrepreneurs engage with industry leaders (FinTech Innovation Lab, n.d.; Strategy&, 2015). This mentoring program teaches participants the customer issues which are a concern to financial institutions; raising millions of dollars in financing to launch start-ups and has successfully had one start-up acquired for $175 million USD in 2014 (Accenture, 2014). Cornell University launched a FinTech incubator program in 2014 for recent PhD students interested in starting a technology company in New York City (EY, 2016b). Once accepted into the program, participants receive a package of $175,000 USD for their salary, housing allowance, research budget, and access to workspace, technology, and equipment (Runway Startup Postdocs, 2017). The program begins with a four-week intensive business and entrepreneurship curriculum, followed by opportunities to create start-up strategies with other Master of Business Administration, Engineer, and Law students (Runway Startup Postdocs, 2017). Additionally, Startupbootcamp Fintech – a leading accelerator focused on financial innovation – offered participants seed funding, office space, and mentorship with a vast network of industry partners and local FinTech companies (FinTech New York, n.d.).
To keep the industry connected and competitive, Empire Startups – a community of FinTech entrepreneurs and innovators – hosts meetups, open mic night, workshops, webinars, panel discussions, as well as summits for entrepreneurs to share knowledge, learn from FinTech experts, and bridge the gap between emerging talent and the established investment community (NY FinTech Meetups, 2017). The group also organizes an annual conference that encourages attendees to discuss new trends within FinTech, connect service providers to startups, and offers a range of diverse and compelling keynote speakers, panels, and demonstrations from leading industry leaders (New York 2017 - Empire FinTech Conference, 2017).

As a participating TechHire community, the New York City local government launched the ‘NYC Tech Talent Pipeline’ program to better prepare students for careers in the technology sector (Accenture, 2014). This novel program is supported by a $10 million industry partnership and seeks to train and deliver quality talent to New York businesses, particularly FinTech companies. Recent advancements in the state program include connecting over 100 college students within the University of New York (CUNY) system to paid internships at FinTech technology companies. This was accomplished through various programs including: CUNY Tech Prep, TTP Residency @ Queens College, and the Brooklyn Tech Triangle Internship Program (Accenture, 2014).

In 2013, the state government of New York launched ‘START-UP NYC’ to accelerate entrepreneurial job creation (EY, 2016b). The initiative partners with local universities to attract global start-ups, venture capital, new business, and investment (EY, 2016b). START-UP NY offers ten years of tax-free operations for new or existing businesses that are located near eligible universities and colleges (START-UP NY: New York State, n.d.), with the hopes that through partnerships with higher education institutions, businesses will have access to advanced research laboratories and students will have access to industry experts (Governor Cuomo…, 2014).
Singapore

The FinTech ecosystem within Singapore has grown significantly over the last decade. In 2016, the local industry reported a market size of $0.6 billion and £44 million of investment (EY, 2016b). Further, Singapore ranks second in talent pipeline due to world-class access to foreign talent and a supportive immigration regime, resulting in over 7,000 employees who work specifically in FinTech (EY, 2016b). This growing ecosystem and consistent talent pipeline is attributed to the progressive Monetary Authority of Singapore (MAS), which has established a dedicated team for creating public/private partnerships for FinTech. MAS committed $225 million of public sector funds toward developing a Smart Financial Centre to facilitate connections between financial institutions and universities (Digital Finance Institute, 2016; EY, 2016; KPMG, 2017). MAS has publicly recognized the need to attract top talent in hopes of filling demand and growing the industry, as well as acknowledging the difficulty of recruiting and retaining the right talent (Boon, 2016). In response, Singapore has created the most supportive immigration regime to promote foreign talent, including lessening the steps required to process skilled worker VISAs, creating longer term residency options, and removing quotas that restrict the inflow of foreign skilled workers (EY, 2016b). Moreover, MAS has taken additional steps towards attracting foreign talent including the development of a regulatory sandbox, introduction of a fund to facilitate collaboration between FinTech companies and financial institutions, and launching a major international FinTech conference (KPMG, 2017).

San Francisco, United States of America

Within the United States, San Francisco is a recognized leader in FinTech investment, employment, and ecosystem connectedness. In 2015, the California FinTech workforce reached 74,000 people – the majority of which worked directly in the city of San Francisco (EY, 2016b). The maturity of the ecosystem is commonly attributed to the close community of entrepreneurial talent, plethora of financial and technology institutions, and the culture of progressive and forward-thinking employees attracted to San Francisco startups (Australian Trade and Investment Commission, 2017; EY, 2016b). FinTech investment in San Francisco equaled $3.7 billion USD in 2015 (KPMG, 2017), and the region accounted for 34.4% of equity capital invested in online lending (Pitchbook, 2016).

San Francisco attracts high quality FinTech talent due to its close proximity to internationally renowned post-secondary education institutions. University of California – Berkeley’s Master of Business Administration program includes multiple courses that prepare students for the FinTech industry including: Introduction to Management of Technology, Innovation Strategies for Emerging Technologies, Strategy for the Information Technology Firm, and Opportunity Recognition: Technology and Entrepreneurship in Silicon Valley (University of California Berkeley, 2017). Further, the StartX Accelerator was launched in partnership with Stanford University in 2014, seeking to support and develop the university’s top entrepreneurs through customized education programs and access to unlimited financing (EY, 2016b). StartX accepts applicants from multiple sectors and is not solely focused on FinTech; the program is also dedicated to connecting the accelerator community with over 200 compatible experts, and promises to offer unconventional and tailored education to meet the career needs of each participant (StartX, n.d.).

In 2015, Draper University and Hero City partnered to create the FinTech Connection incubator program (EY, 2016b). This invite-only initiative complements Draper University’s unconventional approach toward business education, and seeks to align emerging technical talent with leading financial institutions (Draper FinTech Connection, n.d.). Similarly, San Francisco-based bank, Wells Fargo, launched an in-house startup accelerator program directly focusing on startups and talent with innovative ideas to reinvent and progress the financial services sector (Wells Fargo Startup Accelerator, 2017). At the state level, California initiated a STEM task force to improve teaching and access to STEM-related courses and careers for primary and high school students (EY, 2016b). The task force was created to specifically address the following key areas in STEM education:

1. Curriculum and Instructional Practices: review current STEM education and identify how it can be improved to engage more students;
2. Resources: identify existing STEM resources and recommend the creation of new relevant resources for dissemination;
3. Professional Learning: recommend professional learning opportunities to educators and teachers of STEM courses;
4. Student Testing: recommend state and local level STEM assessments to measure applied learning and identify what constitutes high quality STEM education; and
5. Community and Business Partnerships: review how partnerships with the greater community and industry can support and engage students in STEM education (STEM Task Force, 2016).
Despite not being recognized as a global hub, Canada has recently experienced record high investment and revenue in the FinTech industry (KPMG, 2017). Currently retaining approximately 60,000 FinTech employees (Toronto Financial Services Alliance, n.d.), Canada clearly demonstrates that it has the necessary characteristics in becoming a global FinTech cluster. This includes: a stable banking system, leading universities, and a growing community of financial innovators who are releasing technology solutions to the market (Digital Finance Institute, 2016).

Ontario contains one of the largest information technology clusters in North America, including 13,000 tech companies that are primarily based in Toronto (Australian Trade and Investment Commission, 2017). Moreover, Toronto is one of the largest employers within the financial services sector, recently reporting 350,000 employees (University of Toronto, n.d.).

Local Toronto universities and education institutions have responded to the FinTech talent shortage through developing and training highly skilled new graduate students.

The combination of Ryerson University, University of Toronto, and York University contributes significantly to Toronto’s technology community, reporting a total of 2,559 full time students enrolled in computer science degree programs in 2012 (Tech Toronto, 2016). To align with the progressive technology industry, Ryerson University has introduced a Master of Business Administration in the Management of Technology and Innovation program. This program marries business practicality with technology, seeking to better equip students to understand and communicate technical processes.

Education Interventions

The combination of Ryerson University, University of Toronto, and York University contribute significantly to Toronto’s technology community, reporting a total of 2,559 full time students enrolled in computer science degree programs in 2012 (Tech Toronto, 2016). To align with the progressive technology industry, Ryerson University has introduced a Master of Business Administration in the Management of Technology and Innovation program. This program marries business practicality with technology, seeking to better equip students to understand and communicate technical processes.

(First author, 2017). Students enrolled in the program are offered many courses that are directly related to the FinTech industry, including: Global Markets and Tech Trends and Research and Communication for Business Startups (Ryerson University, 2017). Comparably, the University of Toronto Rotman School of Management launched a specialization for Innovation and Entrepreneurship within the Master of Business Administration program. This specialization directly speaks to the process of launching an entrepreneurial venture as well as managing and financing a technology-driven business (Rotman School of Management, 2017). Relevant courses to the FinTech industry include: Economics of Innovation and Intellectual Property, Business Strategy by Firms Based in Emerging Market Economies, and Creative Destruction Lab Course (Rotman School of Business, 2017).

Relating to high school students, the City of Toronto Startup Ecosystem Strategy identified a need to partner with business incubators and the Toronto school boards to share programming and startup success stories (Tech Toronto, 2016; City of Toronto, 2015). This recommendation seeks to inspire more students to become interested in STEM fields for their post secondary education, and to continue a career within the emerging technology sectors (Tech Toronto, 2016; Digital Finance Institute, 2016). Furthermore, the Toronto FinTech ecosystem has created a demand for private computer programming schools which offer opportunities for individuals to enhance their technical skill. Lighthouse Labs and Bitmaker Labs are examples of such schools, both seeking to transform the way technical education is delivered and to produce higher quality talent for the Toronto ecosystem (Tech Toronto, 2016).
The growth of FinTech in Toronto has been attributed to the vast diversity of incubator programs that attract, grow, and retain technical talent to the city (City of Toronto, 2015). Specifically, Toronto boasts a strong network of university-based incubators, the Province of Ontario created a publicly funded program – Ontario Network of Entrepreneurs (ONE) – which includes the Ontario Centres of Excellence’s Campus-Linked Accelerator Program (Tech Toronto, 2016; Campus-Linked Accelerators, 2017). This initiative provides funding to post-secondary institutions for creating and sustaining a culture of entrepreneurship among students. Funding is also used to connect education institutions with investors, stakeholders, and the greater technology industry (Campus-Linked Accelerators, 2017). As of 2016, 24 out of 37 of the Campus-Linked Accelerators were located in the Greater Toronto Area (Tech Toronto, 2016). The Digital Media Zone (DMZ), launched by Ryerson University as part of the Campus-Linked Accelerator initiative, is currently the leading university-based incubator for tech companies in Canada and in North America (Digital Finance Institute, 2016; About- The DMZ, 2017). The DMZ fosters a culture of innovation and entrepreneurship by connecting students and startups to industry experts. Since 2010, the accelerator has graduated 276 startups, raised $283 million CAD in seed investment, and generated more than 2,600 jobs in the technology sector (About- The DMZ, 2017). Comparably, the University of Toronto launched the Creative Destruction Lab that has a nine-month program for scaling up technology startups through the mentorship of industry leaders and established corporations (Program - Creative Destruction Lab, n.d.). The University of Toronto announced that they will partner with RBC to launch ‘ONRamp’ – the university’s second incubator program dedicated to growing the technology ecosystem and workforce (Galan, 2015). These accelerator programs encourage highly skilled talent to relocate to Toronto and launch their startups within the local technology ecosystem. Other notable FinTech related incubators within Toronto include Incubes, OneEleven, HIGHLINE, Brightpark Ventures, Multiplicity, DRIVEN Accelerator Group, and the MaRS Discovery District FinTech Cluster (Tech Toronto, 2016; KPMG, 2017; City of Toronto, 2015; Digital Finance Institute, 2016).

To grow interest in the FinTech sector and attract a highly skilled workforce to the Toronto ecosystem, various conferences and events have been organized by stakeholders. The 2017 CONNECT IT conference was held at the MaRS Discovery District in partnership with local universities, namely Ryerson University, University of Toronto, University of Ontario Institute of Technology, and York University (Connect IT Conference, 2017). The conference heavily focused on bridging the gap between students and the industry, offering various speaker panels, a technology firm fair, networking sessions, and a case competition (Connect IT Conference, 2017). Further, Empire Startups hosted an annual FinTech conference in Toronto (Empire FinTech Conference, 2017) meant to build relationships within key players in the FinTech ecosystem and to create opportunities for emerging talent (Toronto 2017 - Empire FinTech Conference, 2017). The Express Entry System, introduced in 2013, requires employers to submit a Labour Market Impact Assessment to demonstrate why they were unable to fill the position with a Canadian employee (Tech Toronto, 2016). Foreign talent recruitment processes can take upwards of six months, making Canada less attractive for highly skilled talent, and thus, contributing to the growing skills shortage (Tech Toronto, 2016). The current immigration procedure presents a significant challenge for technology companies that are in desperate need of technical talent. Recently, a Toronto start-up stated that Canada needs to fill 18,200 information technology positions by 2019, and this will not be accomplished if the immigration process is not accelerated or improved upon (Tech Toronto, 2016).

In June 2016, the government of Ontario responded to the growing technical talent shortage by releasing the report Building the Workforce of Tomorrow: A Shared Responsibility. The report presents several recommendations that are directly applicable to the FinTech sector, namely: ‘Building stronger partnerships between educators and employers’ [through the development of a new Planning and Partnership Table], ‘Promoting both traditional and nontraditional career paths’ [increase student exposure to arts, science, technology, skilled trades, and entrepreneurship careers], and ‘Closing gaps in skills and competencies’ [developing training programs for underrepresented groups and identifying new ways to teach students relevant technical skills] (Government of Ontario, 2016).

At a national level, the Government of Canada has released the federal budget plan for 2017, entitled “Building a Strong Middle Class” (http://www.budget.gc.ca/2017/docs/plan/toc-tdm-en.html).

**GAP ANALYSIS**

Upon consideration of the global industry and institutional responses to the FinTech talent shortage, this research identified a series of gaps within the Toronto region’s FinTech ecosystem. To amend inconsistencies and build upon internationally demonstrated opportunities in developing and attracting high quality talent, this report presents the following recommendations for strengthening Toronto’s position as a global leader in FinTech.

**Education Intervention Recommendations**

1. Toronto universities should introduce a FinTech specialization or more clearly integrate FinTech-specific content within existing Master of Business Administration (MBA) programs.

2. Toronto universities should undertake a curriculum review of current STEM-related education in order to identify gaps and inconsistencies in content. As well, there is a need to increase relevancy to be consistent with current financial services processes.

3. Toronto stakeholders should establish a STEM task force that is mandated to develop teaching material and resources to improve education, foster a STEM education network, and organize STEM promotion campaigns.

4. Toronto governments and universities should prioritize and incentivize the establishment of productive connections between industry and university institutions.

5. Toronto stakeholders should develop and disseminate online education programs that are designed to teach members about FinTech related skills. These courses should be appropriate for both adult learners and current students, and could potentially be recognized as a credible career-enhancing certificate.

6. Toronto stakeholders should establish FinTech-specific incubator programs, as well as integrating more financial content into current technology incubator programs.

7. Toronto stakeholders should determine a central ‘voice’ for the local FinTech ecosystem, ensuring the identified leading organization is vibrant, relevant, and is committed to actively growing the industry. The organization should recommends and host civic FinTech hackathons, as well as promoting national and/or regional career and networking fairs for students.

8. Toronto stakeholders should design programs for primary and high school students that is targeted at fostering an early interest in pursuing a FinTech-related career.
CONCLUSION

This report is an investigation of industry and post-secondary education institutions’ response towards the current FinTech talent shortage.

The findings provide an overview of how global FinTech hubs are innovating and leveraging expertise to attract and train high quality talent, revealing multiple opportunities for improvement for the Toronto region. To analyze each case study, the authors categorized the multiple response strategies into three major themes:

1. Education Interventions,
2. Incubators and Extra-Curricular Events; and

Within Education Interventions, the findings demonstrate how post-secondary institutions have taken progressive steps toward enhancing the technical skills of students. Noteworthy strategies included curriculum reviews, promotion of STEM-related education, and the integration of FinTech into MBA programs. The second theme, Incubators and Extra Curricular Events, outlines how FinTech stakeholders have developed skill enhancement programs for post-secondary students, adult learners, and startup entrepreneurs. Multiple programs aimed at growing local technical and financial talent, and encouraged students to pursue FinTech-related careers. These programs include: hackathons, startup accelerators, independent course offerings, and industry/university conferences. The last theme addressed Government and Policy Interventions.

Notable case study strategies included financial incentives for new graduate startup networks, immigration process reform, and mobilizing policy papers directly addressing the chronic skill shortage.

As FinTech is a relatively new phenomenon, and the talent shortage is only beginning to gain international response and interest, limitations to this research include a lack of peer-reviewed sources and a heavy reliance on recent reports that were written by private sector companies. This research offers multiple recommendations towards the improvement of the Toronto FinTech ecosystem and pinpoints particular opportunities local stakeholders could adopt in order to attract and develop high quality FinTech talent.

To validate the recommendations, involved stakeholders (industry and post-secondary institutions) should conduct a rigorous assessment of each and provide feedback regarding the suitability towards the Toronto FinTech ecosystem.

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REFERENCES


74. University of Toronto. (n.d.) Search for the Academic Director, Banting and Best Centre for Innovation and Entrepreneurship http://memosprovost.utoronto.ca/search-for-the-academic-director-banting-and-best-centre-for-innovation-and-entrepreneurship/


