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EDUCATION

Preparing Students for a Future in Fintech

The Role of Massachusetts Public Universities

by Eamon McCarthy Earls

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Executive Summary

Financial technology (fintech) is a term applied to diverse digital technology changes impacting banking, insurance, and other sectors of the finance industry. As a new and emerging field, technologically diverse fintech companies are gaining market share and changing the way business is conducted in traditional financial institutions, in an example of what Harvard Business School researcher Clayton Christensen has dubbed "disruptive innovation."[1] The Commonwealth of Massachusetts, including its major metro areas, Boston, Worcester, and Springfield, is already feeling the effects of the major changes brought by fintech. In November, 2018, the *Boston Business Journal* reported that only two industries in Boston have seen declines in headcount since the 2008 recession — finance and insurance.[2] According to a January 2018 *Financial Times* article, the area where finance overlaps technology is still rarely taught, even at top-tier graduate-level business schools.[3] If many leading business schools aren't yet getting it right, where should Massachusetts public universities find inspiration?

"Fintech is a new form of finance which has to be understood before it can be applied. If you don't understand these trends and new forms of finance, you're at a disadvantage," said Professor Mark Williams, executive-in-residence for finance at Boston University.[4]

There are some exemplars within higher education and beyond, with a few first movers beginning to address the need for fintech training and career development. These models can help public universities find innovative ways to adapt educational programs to better prepare business and computer science students for careers in fintech — or in existing financial enterprises redefined by new technology.

What is fintech? The scope and impact of new technology in finance

Fintech describes new technology aimed at improving and automating the delivery of financial services.[5] The term encompasses a wide variety of finance industry segments, such as crowdfunding, peer-to-peer lending, payments, data collection, cryptocurrency, credit scoring, cybersecurity for finance, thematic investing, algorithmic asset management, stock and bond investing, private securities transactions and more. New technologies compete with traditional finance models and change the internal processes of financial companies.[6] Financial companies that fail to adopt fintech innovations will see profit declines of 20 to 60 percent by 2025, according to McKinsey & Company.[7] But simply adopting new technology is not enough. According to Nadeem Shaikh, writing in *Harvard Business Review*, innovation — in essence, human capital and the application of new modes of thinking — will prove far more important to the future of finance rather than simply "bolting on" new technology.[8]

The changing face of the Massachusetts finance industry

Massachusetts plays an outsized role in the U.S. and international financial services market. The Executive Office of Labor and Workforce Development reported 220,637 people in the Commonwealth employed in finance across 17,574 establishments in June 2018.[9] More in-depth analysis from PricewaterhouseCoopers, published by the New England Council in 2017, found 174,072 people employed directly within financial services companies in 2015, amounting to a total employment contribution of 478,960 people. The three branches of finance most active in Massachusetts are insurance — the largest category of employment with 72,293 workers — banking, and asset management, the smallest category with only slightly more than 31,000 employees but with the highest average wages of over $300,000 annually, including administrators.[10]

Additionally, New England as a whole is a hub for fintech companies, which attracted up to $750 million in investment through early 2016, principally in the Greater Boston area.[11]

Fintech's impact, first felt in front-office data entry and accounts payable roles is beginning to ascend the skill ladder. Automated investment advice systems, also known as robo-advisors, are poised to threaten traditional investment advisors.[12] Boston-based consulting firm, Opimas, estimates that AI adoption could result in the loss of up to 90,000 asset management jobs globally by 2025, as human portfolio managers are challenged by the increasingly large data sets used to inform investments. Securities services, wealth management and sales and trading will also be affected by machine learning, perhaps resulting in smaller sales teams supported by complex cognitive analytics and advanced customer relationship management systems.[13]

Continued fintech innovation will likely impact the Massachusetts financial industry moving forward and could lead to reduced headcount at many firms. However, fintech also promises new opportunities within technology-side fintech vendors and traditional financial services organizations.

Examining the pipeline

Massachusetts has some of the most competitive school districts in the United States. That's the good news. But the specific educational attainments that could lead to fintech career choices and support higher-ed fintech coursework is not always in evidence. The Commonwealth does not offer or require financial literacy courses in high school, although various House bills have attempted to provide for their implementation.[14] Frameworks already in place like STEM (Science, Technology, Engineering and Math) or the creative thinking in STEAM (Science, Technology, Engineering, Art and Math), as imagined by the Rhode Island School of Design, both offer examples of how preparation for fintech could be

incorporated into elementary, middle and high schools.[15] For now, these frameworks offer the closest analogs for a fintech pathway from high school to college and help contribute some of the technical skills and design thinking increasingly needed in the financial services industry.

Fintech initiatives at other universities

Universities around the world are beginning to examine fintech preparedness and some are attempting to create coursework to fill the skills gap. Characteristically, the majority of university fintech programs in existence have focused on regulation, security considerations and understanding the impact of technology on the market. This high-level approach does not go into depth about individual technologies, leaving students to learn on the job or pursue additional elective coursework. To avoid teaching students the "wrong" version of fintech, which could leave them with out-of-date skills for a dynamic and rapidly changing field, public universities in Massachusetts must seek continual input from industry, where the change is occurring.

MBA programs in particular have hastened to offer fintech coursework. For example, Brandeis University in Waltham offers dedicated fintech degree paths for MS in Finance candidates. Over two years, students complete courses such as Python and Applications to Finance, Quantitative Investment Management, Predictive Analytics and FinTech in Corporate Innovation, Venture Capital and Entrepreneurial Finance, Computer Simulation and Risk, Corporate Financial Engineering and Technological Rivalry.[16] MIT's Sloan School of Management has adopted an interdisciplinary approach since the launch of its fintech ventures course in fall 2015. The course focuses on creating business models for fintech ventures, drawing on a combination of Sloan students, participants from MIT engineering and computer science and even attendees from Harvard Law School.[17]

Other prominent American business schools now offering fintech coursework include the University of Pennsylvania, Columbia, Stanford and Georgetown. In a series of 2017 Reuters interviews, academics who were charged with leading fintech programs said constructing syllabuses was challenging due to a lack of textbooks and professors with fintech knowledge. To overcome these challenges, many universities have begun to invite fintech executives who have more up-to-date knowledge to speak.[18]

Internationally, the University of Oxford Fintech Programme encompasses topics such as the future of money and markets, infrastructure and regtech, proptech, real estate innovation and financial innovation.[19] The Open University in the UK has taken a different approach giving students a broad overview of fintech and its origins, how these technologies are changing the business landscape, as well as regulatory and cybersecurity considerations.[20] Similarly, the Singapore Management University's Certificate in FinTech and Innovation emphasizes "design thinking" and financial regulation.[20]

To build additional relevant skills, many universities have begun to offer electives encompassing fintech topics. Examples include UC Berkeley's blockchain course. Offered on campus for students interested in understanding and developing blockchains, the course was retargeted in an online version for professionals interested in retraining or students at other universities not offering blockchain electives, for a Professional Certificate in Blockchain Fundamentals.[21]

Getting business and finance students on track for fintech

Public universities in Massachusetts can strive to offer coursework that gives a broad overview of fintech and regulation by examining in-demand skills as well as the pioneering efforts of early movers in academic fintech. For students, a key goal of fintech education is to develop the tools to think ahead of the curve. The Commonwealth's public universities cåan develop their own courses about how technological change plays out in markets.

In addition, Massachusetts public universities can begin a process of examining their elective coursework across disciplines, identifying areas of opportunity for business students to gain further fintech-related skills. University administrators could consider expanding some elective course opportunities, setting up new tracks for business majors or developing certificate programs for business students to package their additional course experiences for potential employers. New paths might incorporate introductory courses for computer science or data science topics such as scraping, cleaning, managing and processing data. Additionally, a training ecosystem with major technology vendors could expose business students to distributed systems management (the process of putting computer workloads into major cloud systems like Amazon AWS, Microsoft Azure or Google Cloud), advanced customer relationship management (CRM), enterprise resource planning (ERP), business intelligence and no-code application development software systems like Salesforce Essentials or Microsoft Dynamics. With the example of leading graduate business programs at MIT and Brandeis in mind, Massachusetts public universities might also consider building in more forecasting and analytics training at the undergraduate and graduate level.

"You need to have people with [an awareness of] software development, Python, C++ and the ability to have strong math skills. Fintech's much more quantitatively inclined," said Professor Williams, who spearheaded the creation of Boston University's new IS 815 Fintech Revolution course.[22]

For students on a finance or fintech path, the Python programming language is currently in widespread use for advanced analysis. In fact, it is a prerequisite for Brandeis'

graduate course in Machine Learning and Data Analysis for Business and Finance.[23] The popularity of software languages can change over time, but advanced mathematical knowledge related to statistics, algorithms, linear algebra and ordinary differential equations may be even more relevant for machine learning longer term.[24]

"We find that it's not enough to teach the theoretical; we need to incorporate technological expertise. Technical analysis is one example. We are now requiring students to get proficient in statistical packages like R if they're going to do any sort of modeling. The biggest change we're in the process of making because of fintech is for [new abilities]. We find that as our students are hitting the job market, the questions that employers are asking them [are different]. They end up in finance companies doing technology heavy jobs," said Dean Arindam Bandopadhyaya, head of the UMASS Boston College of Management.

In fact, UMASS Boston is even changing the skills it teaches to PhD students. "The biggest curriculum reform we're thinking of is at the PhD, because the traditional PhD finance curriculum is coming under attack. It used to be based on basic micro-, macro- and corporate finance. Now we think the basic core curriculum needs to be technically oriented with finance built on top of that," he added.[25]

Dean Chris Pilsner of UMASS Amherst's Isenberg School of Management indicated similar growing interest in AI and machine learning. "Isenberg students will benefit from our faculty's thought leadership with a new concentration in fintech for undergraduate students, which has a tentative launch targeted for fall 2019. A graduate-level program in financial data analysis is also under consideration. The curriculum of these programs would explore machine learning, AI, advanced data analytics, as well as peer to peer lending." In addition, Professor Hossein Kazemi has spearheaded Isenberg's fintech focus, curating the 2017 CISDM conference for machine learning in finance and co-launching the Journal of Financial Data Science.[26]

However, the response to fintech has been mixed. According to Dean Susan Dargan, Framingham State University's business program has remained primarily focused on more traditional financial topics, with the exception of Microsoft Excel online, which is required for courses like FINA 248.[27] Because fintech companies or fintech operations in major financial enterprises are often structured around lengthy software projects, project management skills are in high demand among Massachusetts employers. In fact, the Project Management Institute projects a 33 percent increase in project-oriented roles by 2027, bringing the nationwide total of such job paths to 8.8 million.[29] Currently, UMASS Boston, UMASS Lowell and UMASS Online offer project management coursework.[29] However, these courses are only offered to continuing education students and might be good candidates to extend to the general student population, and business majors in particular. For students on an accounting path, particularly those pursuing MS Accounting degrees, Massachusetts public universities could consider establishing a certificate program like one offered at NYU's Stern School of Business or adding a course about advanced valuation methods needed to help assess intellectual property and intangible asset technology businesses such as those in fintech.[30]

"Particularly the way we teach asset valuation has shifted. Earlier on our focus in undergraduate and graduate curriculum was more on the fundamental analysis of balance sheets and deciding under- or over-valuation. We have introduced more technical indicators in our theoretical discussions and practical analysis in labs. Students are using technology to analyze market data and sense momentum, floors and ceilings for price," said Dean Bandopadhyaya.[31]

Nurturing fintech skills in computer science students

While business students may feel the impacts of fintech growth most directly in their chosen field, computer science students at Massachusetts public universities may find themselves working for companies providing fintech software or within existing financial services companies doing software design, development and configuration.

However, as fintech becomes a growing focus for some computer science students, the skill sets required may begin to resemble the "soft skills" already widely taught in business programs. Whether working in tightly integrated teams at small companies or large enterprises, computer science graduates will need to transcend the technical aspects of their fields for successful collaboration — or to pitch their fintech innovation ideas to investors and buyers. Only a handful of North American universities require computer science students to take communications classes. Fewer still focus on interpersonal as well as written and oral communication. UMASS Amherst, for instance, requires Junior Year Writing for computer science majors, but could borrow concepts from the University of Toronto's Communication Skills for Computer Scientists course.[32]

Computer science departments at Massachusetts public universities can work toward greater integration with business departments. Like business schools, these programs could create specific tracks for fintech and count some business coursework toward the computer science degree, such as introductory courses in finance and accounting. Examples of coursework that could be offered for a fintech track might include a look at financial regulation around the world, examining the wide-reaching effects of the European Union's General Data Protection Regulation or California's Consumer Privacy Act of 2018.[33]

Upwards of 60 percent of information technology professionals indicate that the majority of their apps run on cloud

infrastructure. UMASS Amherst has already made efforts to prepare public university students with cloud skills — for fintech and other business uses — with its elective CS590CC: Cloud Computing, which covers Microsoft Azure, OpenStack, Google AppEngine and Amazon EC2.[34] A fintech track could incorporate coursework from the UMASS Amherst Security and Privacy Track, which includes topics such as cryptography and digital forensics. Along with training graduates for cybersecurity careers, which often overlap with the security demands of fintech, the Security and Privacy Track serves as a model for future coursework expansion for smaller state university computer science departments.

Conclusion

Because of the centrality of the financial services and technology industries in Massachusetts, our public universities are in a unique position to play a lead role in developing programs that give graduates a competitive edge in the new age of fintech. Some Massachusetts public universities have already made progress toward preparing their business and computer science students for careers in fintech companies, as well as in traditional financial enterprises redefined by changing technology. However, others are just getting started. Overall, additional preparation is needed throughout the state's public university system.

Academic leaders can begin — or expand — a process of assessing current coursework and degree paths, potentially creating new prerequisites or entirely new avenues to degree completion for business and computer science students. By working to understand shifts in the market brought on by fintech and their implications for job skills demand, public universities can endeavor to better prepare undergraduate and graduate students for the future and strengthen one of the core industries of Massachusetts.

Recommendations

1. To ensure the efficient and effective transmission of information from industry, public universities could create a statewide advisory board to advise on the evolution of fintech that includes industry professionals, experts and public university and community college personnel to examine relevant course offerings, professional certifications, tracks within relevant degree programs and aligning those offerings. Massachusetts public colleges and universities should:
   - Expand coursework and related electives to include fintech topics, including in machine learning, data analysis, and fintech in traditional business/finance disciplines.
   - Establish professional certification programs for individuals wishing to continue their education and adapt to the changing role of fintech in finance and business.
   - Create new tracks within established business and computer finance degree programs to integrate fintech topics and skills into students' educational experience.
   - Plan opportunities for interdisciplinary experiences for business, computer science, engineering, and other degree candidates to develop a robust set of skills needed for fintech-related jobs.
2. Any higher education institution, public or private, should seek input from industry representatives on skills needed for the workforce and how fintech is changing the finance industry.

Finally, though outside the bounds of this current paper, Massachusetts vocational high schools would do well to explore the development of course offering and programs on fintech in order to ensure that Massachusetts students are well-prepared for the future.

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Pioneer Institute is an independent, non-partisan, privately funded research organization that seeks to improve the quality of life in Massachusetts through civic discourse and intellectually rigorous, data-driven public policy solutions based on free market principles, individual liberty and responsibility, and the ideal of effective, limited and accountable government.

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