

IoT Workforce Development in NY

PLANA6941 - Urban Analytics and Human-Centered Decision Making
Columbia GSAPP
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Final Presentation
Fall 2021

Preface

The New York City Mayor’s Office of the Chief Technology Officer (MOCTO) worked in close partnership with Columbia University, Graduate School of Architecture, Planning and Preservation (GSAPP) instructor, André Corrêa d’Almeida, and challenged students to grapple with the demands to quantify workforce needs in the Internet of Things (IoT) ecosystem in New York City.

This report provides the methodologies and findings as a result of the almost three-month process, during which the team members explored the information about the state of the IoT workforce, needs of employers, and any skills gaps that exist in order for MOCTO to move forward with implementing a dashboard that tracks existing and emerging IoT-related skills needs.

Credits

The Human-Centered Decision Making Course’s New York City Team would like to thank our client, the New York City Mayor’s Office of the Chief Technology Officer (MOCTO) for their invaluable insights and guidance. We would also like to express appreciation for our instructor, André Corrêa d’Almeida, and his course, Urban Analytics and Human-Centered Decision Making of Fall 2021.

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Project Background: IoT Workforce Needs in NYC

“Internet of Things” (IoT) serves as an increasingly germane nomenclature, describing the interwoven network of objects and services that can gather and transmit data across a wireless network, without the need for human interaction. In New York City, entities have implemented IoT solutions through initial projects in both the private and public sector that automate networks for waste, water, and utility management; traffic and road safety through crowdsensing; intelligent transportation systems and smart mobility vehicular automation; real estate, such as Building Management Systems (BMS); smart grid solutions; algorithmic hiring and workforce management; and physical security, such as surveillance video, plate reading, face recognition, gunshot detection, crowd control, biohazard, and radiological contamination monitoring—the immense list is ever-expanding.¹

However, innovations in IoT networks have largely been domain-specific and disparate across sectors,² and such dynamics have informed the workforce needs for NYC’s IoT industry. In March 2021, MOCTO released “The New York City Internet of Things Strategy” that describes the landscape of IoT use across society, outlines the state of the New York City’s IoT ecosystem, and establishes a set of near-term actions essential for creating a healthy, cross-sector IoT ecosystem in New York City. Among the actions outlined is a commitment to research emerging IoT workforce needs in the NYC ecosystem, as stated:

“[The City will] work to explore local IoT workforce needs among employers, including those related to distinct IoT jobs and existing jobs in which IoT is a supplemental skill set, and identify ways to integrate appropriate IoT skills into City training opportunities³.”

1 <https://onlinelibrary-wiley-com.ezproxy.cul.columbia.edu/doi/pdf/10.1002/9781119456735.ch12>

2 Machina Research White Paper, (2016) Open Standards in IoT Deployments Would Accelerate Growth by 27% and Reduce Deployment Costs by 30%. May Published via Interdigital, 200 Bellevue Parkway, Suite 300, Wilmington, DE 19809.

3 https://www1.nyc.gov/assets/cto/downloads/iot-strategy/nyc_iot_strategy.pdf

Client

The Mayor’s Office of the Chief Technology Officer (MOCTO) is driven to ensure that technology is “inclusive, accessible, and human-centered”. In collaboration with city agencies, communities, startups and industry, as well as other cities, MOCTO strives for impact so that technology works equitably to make New York a fairer city.⁴

Along with the City’s Tech Talent Pipeline (NYC TTP), MOCTO has supported the implementation of IoT-related training programs that aim to develop a more competent and homegrown IoT workforce. And while the TTP conducts ongoing industry engagement to understand local tech training needs, up-to-date information about the state of the workforce, needs of employers, and skills gaps that exist has proved difficult to capture comprehensively.

Project Goal

This project aims to identify a solution in order to capture crucial data about emerging trends in IoT workforce needs and difficult-to-fill positions that require IoT-related skills through the implementation of a tool that automates analytics with evergreen data. The team sought to develop a method that complements the industry engagement work already in place and is feasibly replicable for the City to implement on an ongoing basis.



⁴ <https://www1.nyc.gov/assets/cto/#/collaboration>

Our Approach

Given the vast scope of industries, stakeholders, and workforce needs pertinent to IoT in New York, our research uses findings from the growing industry of property technology, commonly referred to as “Proptech.” In close examination of this one sector, we aim to provide for larger, systems-wide recommendations for improving the data availability and possible dashboard tool implementations on a broader scale, across industries.

Consequently, our research provides a preliminary prototype for a dashboard tool that uses one professional role in frequent demand from Proptech ventures. Proptech ventures. The process of identifying available datasets and designing a user-friendly tool provided an understanding of the opportunities and challenges confronting the City to better gain analytic insights. Thereby, this research offers an initial blueprint for strategies identified to better understand the existing and emerging IoT-related skills in demand.

The following sections in this report includes findings from a literature review of Proptech in NYC, as well as those from case studies of other municipalities’ initiatives for improved IoT workforce analytics and their efforts to quantify IoT or other tech skills needs. The qualitative analyses were put into dialogue with the team’s buildout of a dashboard prototype, based on the relative merits of precedent efforts.

Moreover, the report outlines the methodology, assumptions, and limitations regarding the dashboard prototype, of which the prospective implementation is explained in further detail. Finally, the report proposes recommendations for both improving the model of a workforce-needs dashboard tool, as well as those for engaging a systems approach that might provide for a more inclusive and equitable IoT ecosystem in NYC.

Contextual Research

Identified Challenges and Opportunities in NYC's IoT Ecosystem

An estimated 75 billion IoT devices will be connected by 2025, and demand for IoT jobs is rising exponentially.⁵ A recent survey of IoT industry employers found that 76% of respondents said they need more higher level IoT specialists and 80% felt they didn't have the skills needed to keep their IoT working as it is— 1/3 of respondents felt there was a major skills gap in readiness.⁶

However, the adoption of IoT has largely been decentralized, presenting real challenges in quantifying workforce needs. Smart city solutions have tended to be vendor-proprietary approaches, and consumers of private vendors currently drive the market force for IoT adoption.⁷ Competition for sales incentivizes vendors to provide interconnectivity among their respective goods and services, but can result in less than collaborative marketplace for interoperability among all IoT devices. Such a disjointed market can also pose barriers to effective IoT governance for privacy, ethical frameworks, and—of course—homegrown, equitable workforce development.

Despite the decentralization of the IoT ecosystem, attention to such an inherent nature of IoT is not one that pushes for an opposite “centralization”, such as to a governmental entity. While studies show that IoT deployment by city agencies can improve both speed and financial expenses related to disbursement, there are unmet opportunities related to the lack of a.) interoperability, b.) scalability, and c.) widely adopted IoT standards that would allow interconnectivity among various systems.⁸ Moreover, there is a reactive gap of how city agencies can be responsive to emerging technologies and opportunities—their delay is often attributed to bureaucratic barriers to innovation implementation, insufficient funding and/or capacity, and lack of technological infrastructure.⁹

⁵ <https://www.gartner.com/en/newsroom/press-releases/2018-11-07-gartner-identifies-top-10-strategic-iot-technologies-and-trends>

⁶ <https://www.forbes.com/sites/danielnewman/2019/07/30/return-on-iot-dealing-with-the-iot-skills-gap/?sh=5978aaba7091>

⁷ Ibid.

⁸ Ibid.

⁹ Ibid.

Instead, private and public organizations must collaborate extensively to determine and act on the opportunities presented by automation. Discussions among the relevant leaders in NYC have signaled the need for new policies and IoT governance, particularly to improve municipal data collection programs and infrastructure for data-sharing and transparency about city projects.¹ Moreover, such engagement can better safeguard employment prospects of New Yorkers from massive changes from a rapidly automating market and the effect it will have on job demand, security, and quality.

And while change is expected for both white-collar and blue-collar roles, the implications from automation to the access low-to-medium skilled laborers have to jobs are projected to be worse and bring about significant community shifts.² Findings from the Center for an Urban Future highlight that workers of color in New York City are overrepresented in highly automatable jobs, based on the technology that exists today, and calls for a growing need for “substantial investments in upskilling and lifelong learning in order to ensure an inclusive recovery.”³ According to the study, “among occupations that are the most highly automatable using technology that exists today, 76 percent of jobs are held by Black, Hispanic, and Asian New Yorkers, even though they make up just 57 percent of the city’s total workforce,” and Hispanic, younger, and male New Yorkers were found to be most vulnerable to employment displacement.⁴

Particularly in such a divergent and shifting landscape, this vulnerability to inequitable job displacement is also met with rising trends of job creation—demands that are often being unmet. Such dynamics necessitate an equitable and strategic decisions of IoT stakeholders to be made towards making NYC a city that cultivates homegrown IoT workforce, as well as one that is less susceptible to automation shocks through efforts to improve coordination.¹⁴

10 <https://cities-today.com/new-york-gears-up-for-iot-growth-with-new-strategy/>

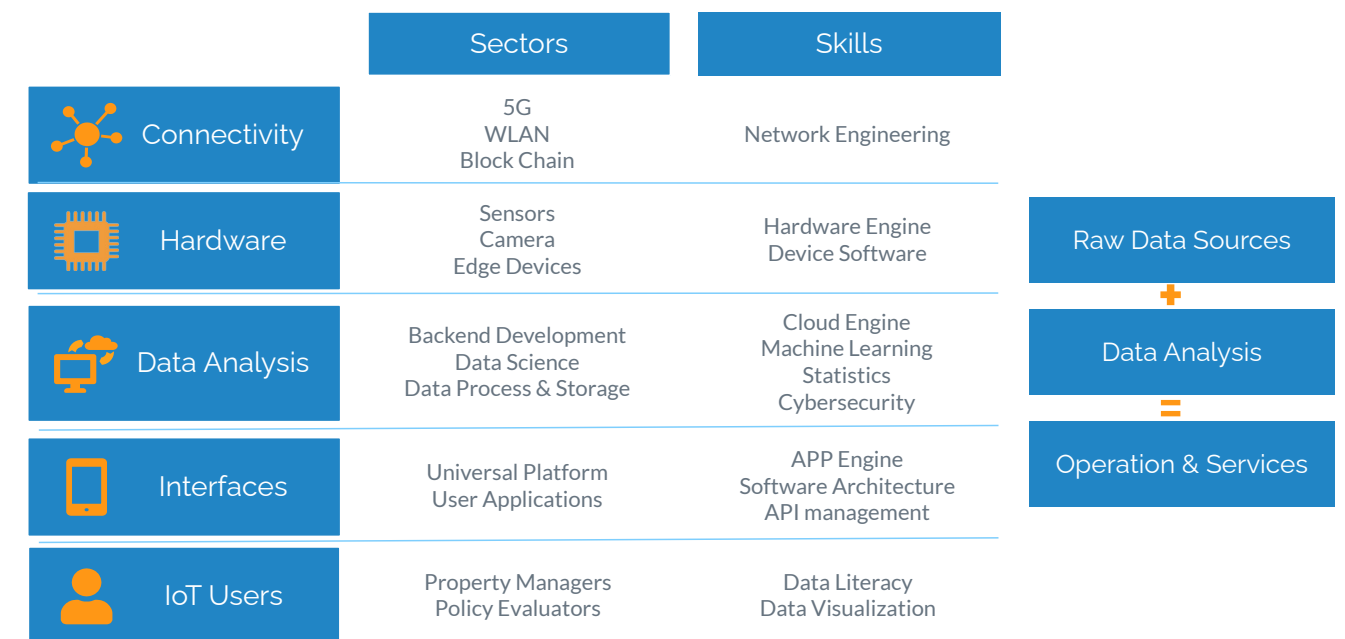
11 https://ainowinstitute.org/AI_Now_2019_Report.pdf

12 <https://nycfuture.org/research/automation-and-equitable-recovery>

13 Ibid

14 <https://www.bruegel.org/wp-content/uploads/2018/07/Impact-of-AI-Petrouopoulos.pdf>

Overview of Internet of Things (IoT)

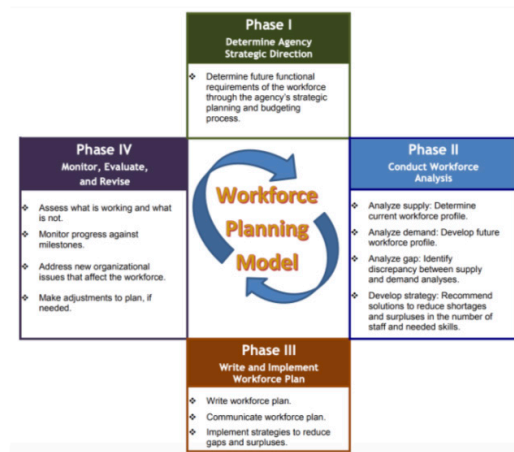


Case Studies: Existing Municipal IoT Workforce Development

Other municipalities undertaking workforce sensing have established robust strategies, goals, and processes to facilitate the identification of needed skills. Partnerships across the entire ecosystem – including the relevant industry, education, and government agencies – are critical to successfully identifying workforce needs and deploying relevant programming to fill skill gaps.

We have identified three existing municipal IoT workforce development benchmarks that are relevant to our project which helped us to investigate the key points when developing the IoT workforce development dashboard.

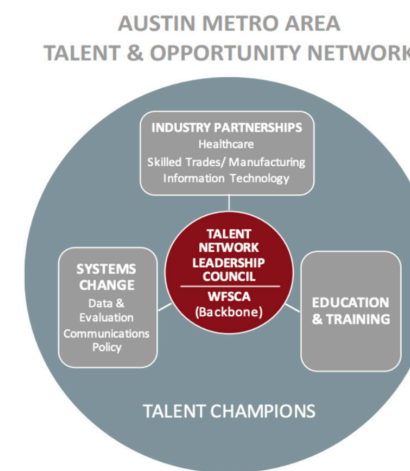
1. Holistic Approach: Texas State Auditor’s Office Report



Workforce planning guide by Texas State Auditor’s Office conducts both supply and demand analysis which is important to understand where the workforce is at and illuminate gaps in the current workforce. Supply analysis focuses on understanding the agency’s existing workforce and comparing that to how it may look over time due to various factors, including retirements and the economy. Demand analysis identifies the future workforce necessary to carry out an agency’s mission. This step should focus on the work the agency must perform and on the staff necessary to perform that work.

2. Prioritizing Partnerships:

The Austin Metro Area Master Community Workforce Plan



The Austin Metro Area Master Community Workforce Plan lays out a common agenda and establishes a framework for collaboration to coordinate the efforts of the region’s workforce development organizations and educational institutions. It lays out an ambitious agenda for collaboration and coordination to address one of the region’s most persistent challenges. It emphasizes that many organizations should be involved in the regional workforce system to come together around a common vision and goal.

Centralizing this input function by industry can be an effective means of engaging employers more fully and obtaining the level of input needed to align programs to employers’ needs. This approach allows employers to engage through a single platform that shares their input across the network of training providers. This also allows training providers to better coordinate their response to employer input.

Although these benchmarks are broader (e.g. regional and/or multiple industries) or relevant to internal workforce planning, they provide important lessons to build the system needed to support IoT workforce development. However, when you look across the whole IoT, there are a lot of parallels in looking across industries.

Domain of Study: PropTech

Considering the diversity of workforce needs within one domain of IoT-related industries, our team has focused on property technology, or PropTech, as a case study to reach the project objective to conceptualize a framework in quantifying workforce needs. PropTech is particularly interesting as a model, as it consolidates stakeholders from deeply rooted, and thus often manually operated—networks in the real estate industry with the emergence of digitizing startups, accelerators, and non-profit/governmental facilitators. Similar to other tech subsectors, PropTech is helped by member networks where ideas, pathways, and opportunities are built. Other advantages of narrowing the study area to Proptech include the following:

Inherently IoT: PropTech combines software and hard infrastructure through the use of technologies that connect and exchange data with for communicative and iterative processes.

Locational advantages: PropTech in New York City is regarded as having the edge over other cities proptech due to the wealth of capital, expertise, and mentorship opportunities that exist in its real estate industry.

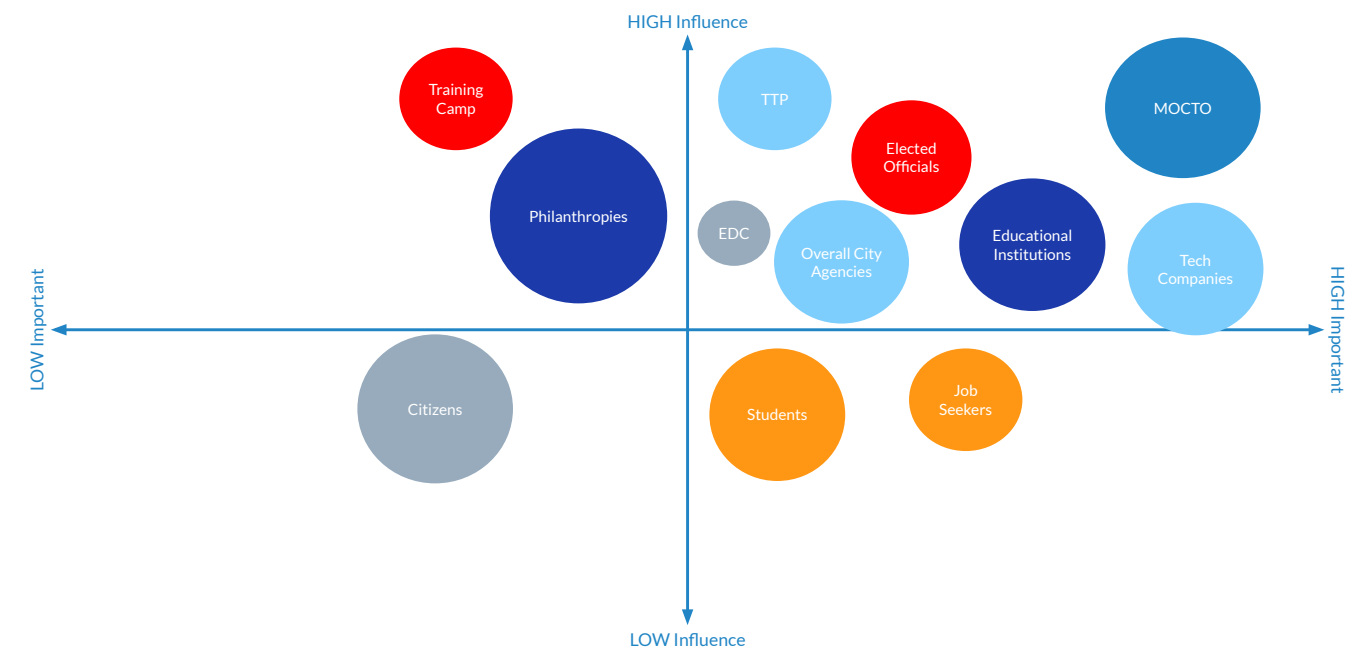
Insular and budding industry: allows us to isolate the larger universe of IoT into a smaller, workable case study for the experimentation of a dashboard.

Market backing: has the support of EDC and TTP which increases the possibility of cross-organization collaboration.

Private sector incentive: Non-profit organizations are able to leverage their resources (innovation and assets) to connect with the private sector in exchange for technological advances (building technology) within real estate that further such organization’s growth and development objectives. It is already happening in small cases (e.g., Class A office buildings).

Marked workforce needs: IoT jobs within proptech have been identified and stakeholders (i.e., EDC) have indicated those that they are looking to engage with and improve upon.







Stakeholder Matrix



The Value Proposition of PropTech

PropTech IoT Taskforce



Products and Services  Connect MOCTO and EDC through their shared mission for diversity in the workforce Identification of specific jobs within PropTech IoT with a clear demand for training opportunities Access to an industry with already-established and growing private-public connection	Gain Creators  Private sector incentive to collaborate Cross-agency engagement with MOCTO and EDC	Desired Gains  Better understanding of IoT workforce needs Increased access to private sector resources (i.e., data) Equitable outcomes in workforce development	Job to be Done for MOCTO  Partner with city agencies to build digital services Engage with startups and industries on workforce need Keep NYC competitive
	Pain Relievers  Taps into a city incentive for the private sector Create systematic, not random, approach to workforce	Current Pains  Analog system of data collection of workforce needs Lack of central entity that aggregates workforce data Lack of private sector incentive to collaborate	

Background of PropTech

A brief background of proptech delineates a modern history of growing data availability since the turn of the 21st Century that enabled more finance-grounded quantitative modeling, and valuation software and property and portfolio management systems became computer and technology based. The Internet of Things (IoT) allowed such innovations in Maintenance Management and control of hardware, as they permit objects to be measured (information provision) but also sensed and/or controlled remotely across the existing network infrastructure, creating opportunities to adjust or turn systems on or off remotely.

Today, proptech is broadly defined by the application of information technology and platform economics to real estate markets, often attributed to four key areas of activity:

1. Smart real estate;
2. Real estate “FinTech,” for the trading, valuation, transactions of real estate asset ownership;
3. The real estate “shared economy”, which describes technology-based platforms which facilitate the use of real estate assets; and
4. Data digitization and data analytics—the nuts and bolts of IoT.

Proptech is often regarded as a field of real-estate/hardware/software “as-a-service,” for which innovation is driven by identified customer demand. In turn, an understanding of the market demands is critical for a better framework of conceptualizing the effort to quantify workforce needs in proptech.

Recent years have seen new platform-based marketplaces connecting a broad network of market participants, such as buyers and sellers, tenants and landlords, lenders and borrowers, and investors and fund managers. Delivering transactional efficiencies as well as the collection and aggregation of data for the benefit of users. Lending platforms have experienced the largest level of adoption to date, with 63% of Commercial Real Estate(CRE) firms having used an online lending marketplace for a recent transaction and 79% planning to increase use in the future.¹⁵

Workforce Needs in PropTech

According to an article by CMP, three-quarters of CRE leaders said automation will eliminate jobs, but almost as many said that it will introduce new types of jobs within the industry and 67% said that positions will shift toward higher value-add tasks. Also, 89% of CRE executives said that significant consolidation is needed for PropTech to more effectively deliver on the needs of the CRE industry.

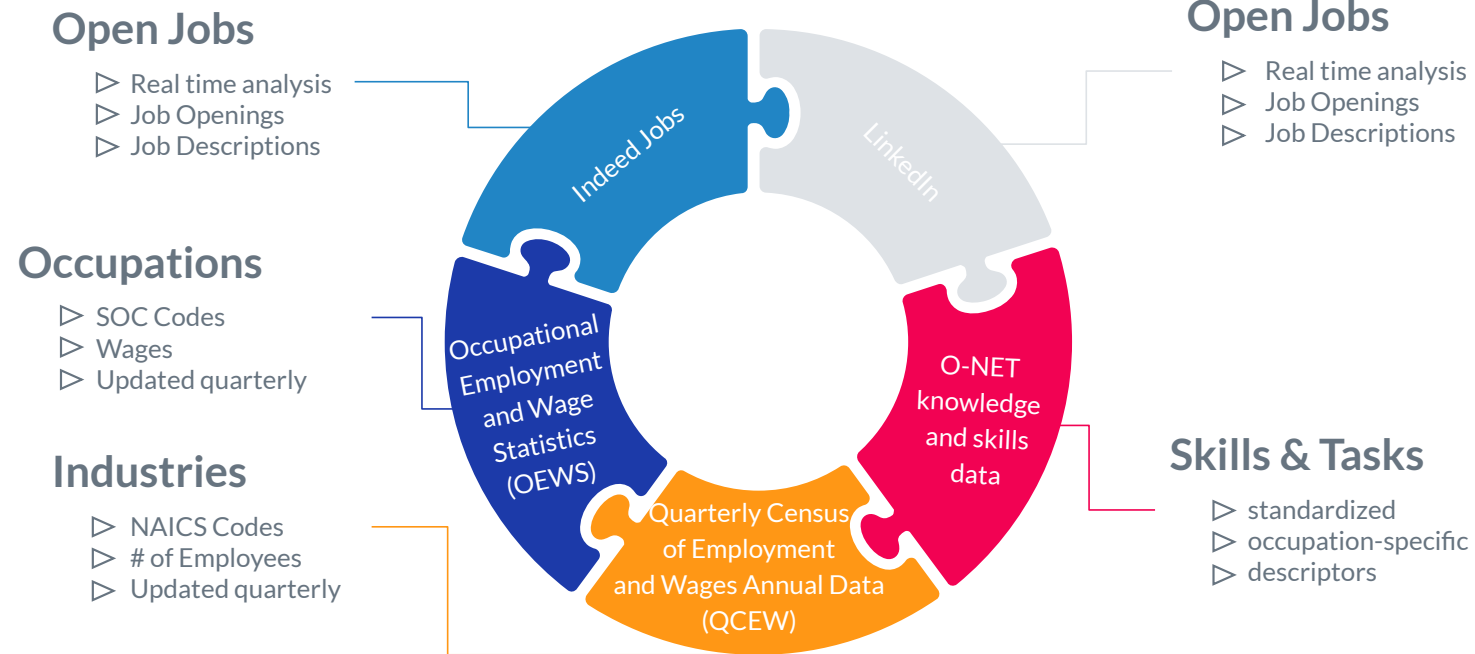
Furthermore, PropTech is a global phenomenon. According to PropTech 2020: the future of real estate report by University of Oxford, United States is a global property and PropTech powerhouse. New York City and San Francisco represent the nation’s two major tech hubs and both cities are enjoying generous amounts of private investment and interest, both domestic and foreign.

¹⁵ <https://www.mpamag.com/ca/news/general/proptech-has-reached-critical-mass-according-to-new-report/285879>

¹⁶ Ibid

Proposal: Dashboard Prototype

Current Data Availability



Assumptions

Given the complexity of the IoT ecosystem, especially the difference of skill and occupation definitions in different aspects in the current IoT industry, we decided to drill down as narrowly as possible to make this dashboard as practical as possible. We first identify the NAICS codes that are relevant to PropTech, the target industry that employs IoT. Then we identify the SOC codes of jobs that would be applicable to each of those NAICS codes. And from that we build a road map of skill identification from existing skill and occupation code to occupations demanded by IoT companies in the real world.

We picked a middle-skills job common in PropTech, Computer Support Specialist (SOC 15-1230), which we believe is widely needed by the IoT companies in the process of literature review and data collection. And we used this occupation to create a prototype of the dashboard.

Methodology

Like the methodology applied in the Brookings Institute study on the green economy's impact on jobs, we are planning to use a similar methodology as it provides a rigorous way of translating specific definitions to specific NAICS codes to estimate jobs needs. The North American Industry Classification System (NAICS) is the standard used by Federal statistical agencies in classifying business establishments for the purpose of collecting, analyzing, and publishing statistical data related to the U.S. business economy. Combined with the NAICS code, we hope to identify the skills more accurately to narrow down to soft skills, which we believe soft skills are often more important than industry-specific skills.

Two main sources have been identified QCEW AND OWES both are from the NY State Department of Labor, and both are accessible from APIs which means incorporating these sources into a dashboard will be possible. The Data sources are job postings that were scraped from LinkedIn and skills data from ONET.

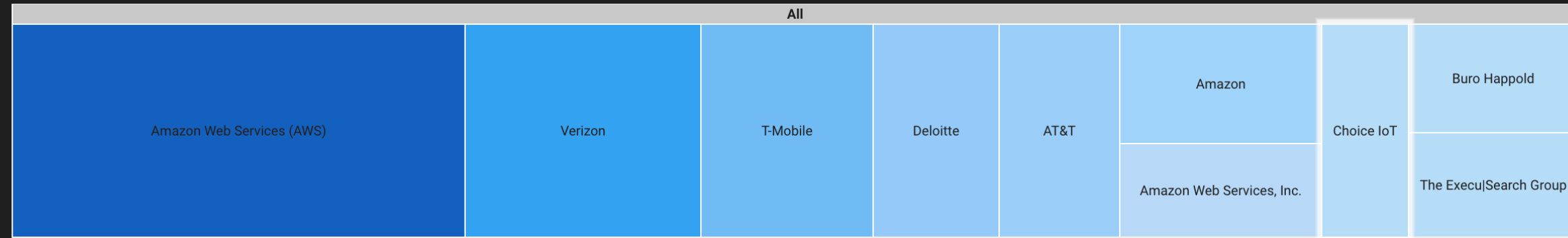
Workforce Training Programs in NYC

TYPE OF PROGRAM	NUMBER OF PROGRAMS	LOCATIONS
Basic Computer/Digital Literacy	101	170
Introduction to a Specific Tech Skill or Technology	114	127
Career-Oriented Training for Entry-Level Jobs in Tech	90	93
Total, basic/intro/entry-level	305	390
Career-Oriented Training for Mid-level Jobs in Tech	40	50
In-depth Career-Oriented Training for Jobs Requiring Advanced Coding and/or Engineering Skills	29	32
Total, mid-level and advanced	69	82

Source: Center for an Urban Future, Plugging In: Building Nyc's Tech Education & Training Ecosystem, Feb 2020

IoT Skills: Support Associate in Real Estate

Industry Overview



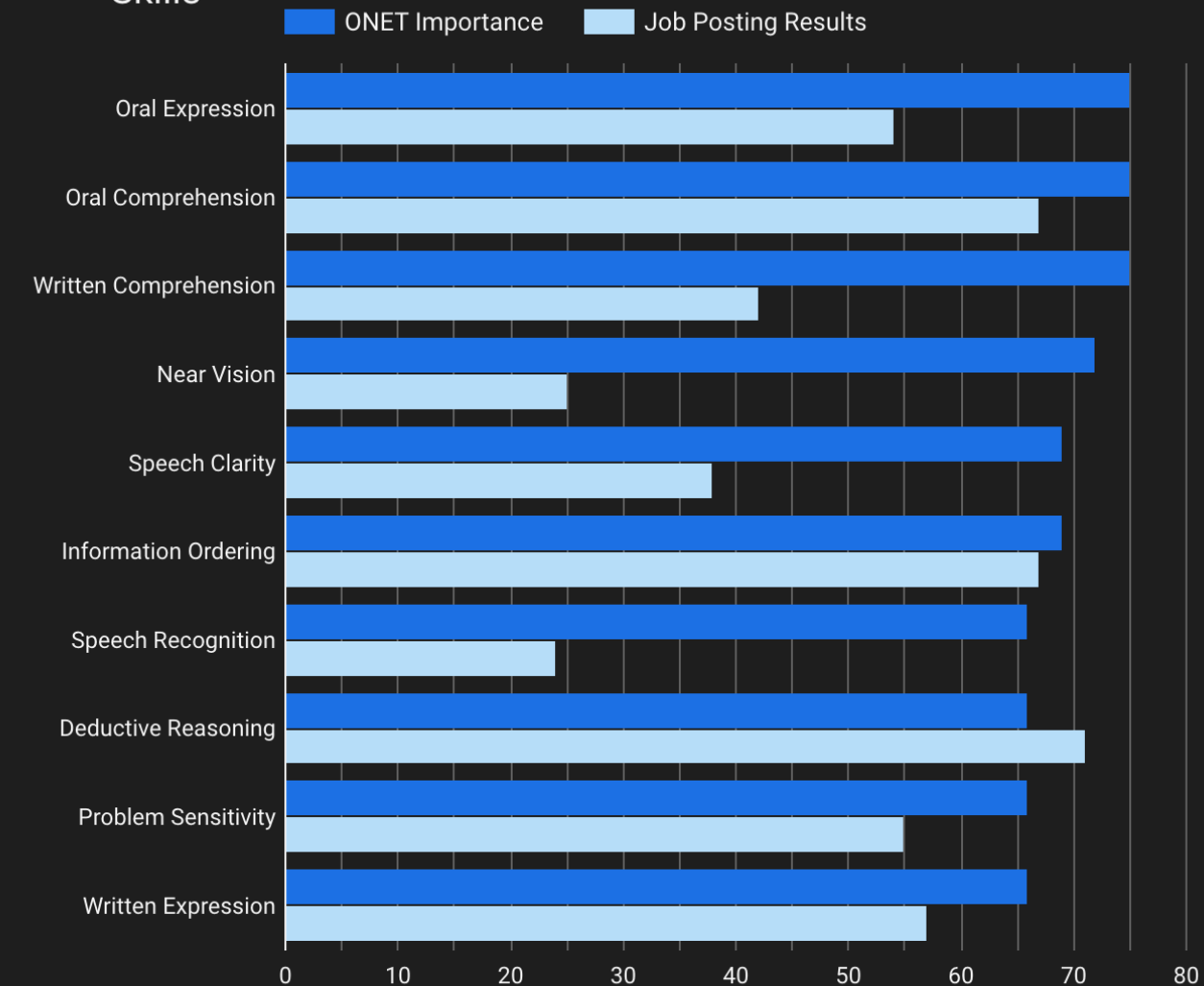
The dashboard is designed to include three parts, the Industry Overview, Job Demand Overview and the Skills. The Industry Overview section shows the top ten employers of Computer Support Specialists in the Prop Tech industry. The job demand section includes the varied job titles related to Computer Support Specialists and lists the employer and counts of each job title. The Skill section compares the demand for skills reflected in the job description to the required skills as identified from ONET.

Job Demand Overview

	Job Title	Companies	Record C...
1.	Sr. IoT Architect	Amazon Web Services (AW...	63
2.	Principal IoT Architect	Amazon Web Services (AW...	45
3.	Principal Partner Solutions Leader	Amazon	42
4.	Manager of 5G Strategy	Verizon	35
5.	Sr. Business Development Manager - ...	T-Mobile	34
6.	Senior Consultant IoT	AT&T	34
7.	Head of Technology- 5G Disruption	Verizon	33
8.	Business Development Manager	Choice IoT	33
9.	Graduate Smart IoT/BMS Engineer, Ne...	Buro Happold	33
10.	Vice President of Engineering	The Execu Search Group	32
11.	IoT Business Development Manager A...	HSB - Hartford Steam Boiler	32
12.	Sr. Business Development Manager - ...	T-Mobile	31
13.	VP of Engineering	Harnham	24
14.	Associate Technology Director	frog	23
15.	Engineering Program Manager - IoT - ...	CrowdStrike	22

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Skills



The dashboard prototype is a mockup for the final product. It is a starting point for IoT industry workforce analysis that is more comprehensive and insightful. It is a snapshot of the supply and demand in the job market at the current moment. In the future, the dashboard should track the development of the job markets consistently, based on robust data and more rigorously defined skill standards.

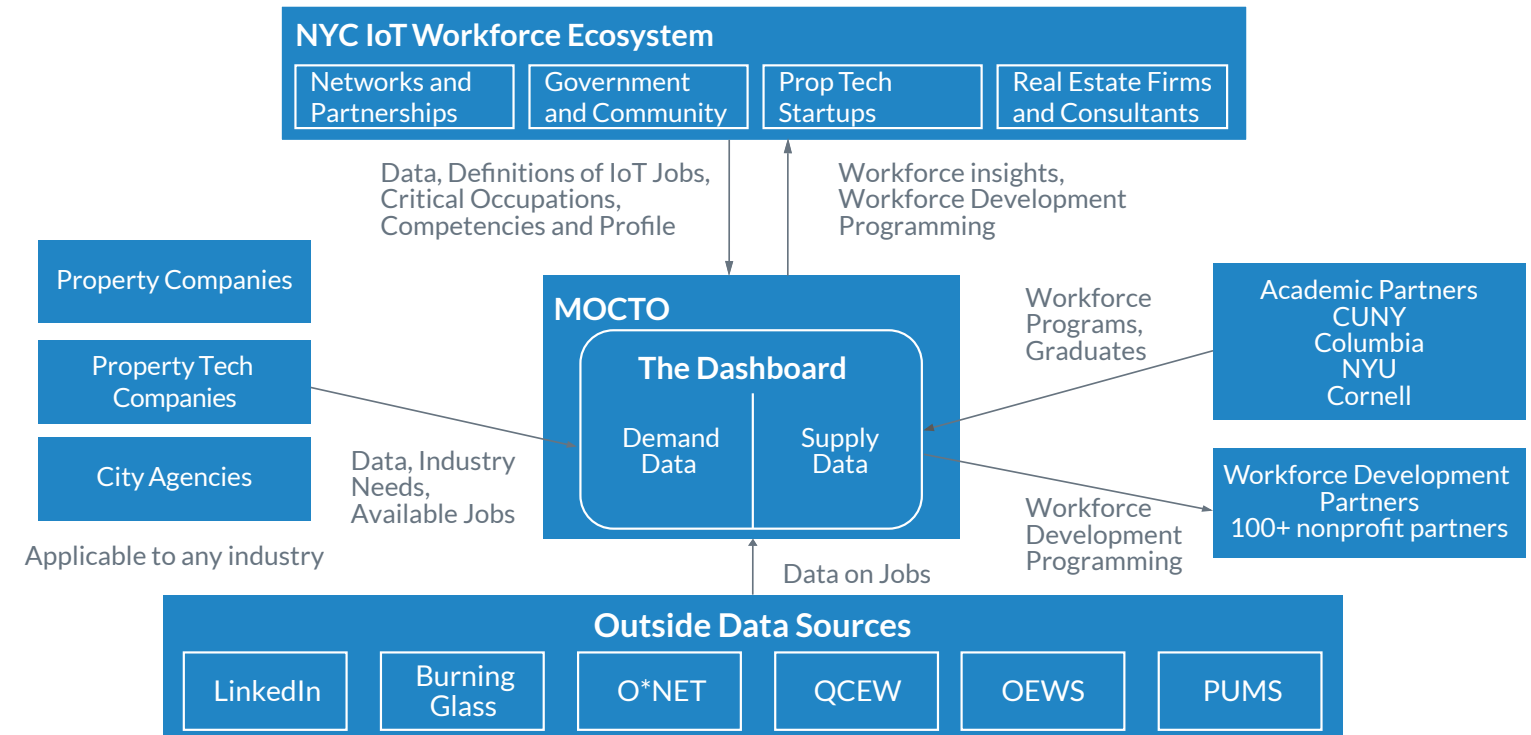
Sources: LinkedIn, ONET

Conclusion: A Systems Approach
Needed to Achieve IoT Goals

In the NYC Internet of Things strategy, MOCTO set a goal to “work to explore local IoT workforce needs among employers...and identify ways to integrate appropriate IoT skills into City training opportunities.” Further, MOCTO hopes to “work across agencies to identify opportunities to support local hiring for City IoT work.” However, the identification of relevant data and building a dashboard is insufficient to identify NYC IoT workforce needs and to achieve the goals set forth in the NYC IoT strategy – especially with the data limitations identified above. Instead, MOCTO needs to establish a more robust framework for identifying workforce needs for IoT.

As a result, we recommend MOCTO engage in a broader “system” approach to identify IoT workforce needs in NYC and achieve MOCTO’s workforce development goals. The dashboard is just a small component of identifying IoT workforce development needs and developing programming to meet those needs. Instead, MOCTO should engage with a network of industry, government, and community partners to identify key trends, jobs, and establish competencies in critical occupations.

The benefits of a systems approach are clear. First, it will enable MOCTO to better identify IoT workforce needs by engaging directly with industry partners to understand their perspective on the current state of the workforce. Second, it will assist MOCTO in overcoming the data challenges described above. Third, it will enable MOCTO and the NYC government to receive continuous feedback on industry trends and proposed policy and programming to support IoT workforce development needs. Finally, it will enable MOCTO to identify partners to develop and implement the programming needed to close skill gaps in the NYC IoT workforce.



The figure above provides an overview of a potential systems approach to IoT workforce development in NYC, with a specific emphasis on Prop Tech. MOCTO sits in the middle, convening stakeholders from across the city and ecosystem; the dashboard is also represented here as the lynch-pin of identifying and tracking IoT workforce development in NYC. On the left are Prop Tech-specific stakeholders, who provide “demand data” on workforce needs in NYC. On the right are academic partners and workforce development partners, who provide “supply data” on currently available trainings and skills-development programming. The top represents a broad swath of stakeholders who provide input on industry trends, workforce needs, and a general understanding of the current situation in NYC. Across the bottom are outside data sources which can augment all of the information – both qualitative and quantitative – provided by IoT ecosystem stakeholders. (Please note: some stakeholders may play multiple roles within the ecosystem; for example, city agencies are both a demander of IoT skills and a supplier of workforce development programming).

Recommended Engagement

Below are three recommendations MOCTO should consider to implement a systems approach to IoT workforce development in NYC.

1) Develop an (informal) adviser network of Prop Tech stakeholders to inform MOCTO's workforce development efforts.

2) Leverage the adviser network to develop a baseline workforce profile for IoT jobs.

3) Utilize data collaboratives with Prop Tech stakeholders to improve IoT workforce data and analysis.

Recommendation 1: Develop an (informal) adviser network of Prop Tech stakeholders to inform MOCTO's workforce development efforts.

The NYC Internet of Things Strategy identified that “there is opportunity in NYC to conduct further engagement with industry stakeholders to better understand their needs in this regard, and to work to connect local talent to meet them” in order to meet unmet workforce needs for IoT-related skills. MOCTO can best meet this need by cultivating an adviser network of relevant PropTech stakeholders. Such a network would enable MOCTO to centralize engagement with the IoT industry and other relevant stakeholders, access insight into workforce needs and relevant data, and coordinate workforce development efforts across the city. While this network could start informally and draw on existing networks (such as The GRID), the successful utilization of such a network to advance PropTech workforce development could establish a platform MOCTO could apply to IoT and/or technology workforce development across the city. Specifically, MOCTO should consider engaging stakeholders from the following groups as part of their Prop Tech Adviser Network:

Industry Group	Description and Relevance	Potential MOCTO Partner
Networks and Partnerships	Networks offer MOCTO connections into established engagements within the industry at large as well as tested platforms for workforce mobilization efforts.	<ul style="list-style-type: none"> • The GRID • NYC Tech Talent Pipeline
Government and Community	Government and community advisers pursue IoT initiatives, sometimes without private sector inputs. Piloting programs have been created specifically for PropTech endeavors (i.e., PropTech Piloting Program) through municipal agencies that share similar local workforce development assessment goals to MOCTO. Engaging with these agencies would provide MOCTO access to public-private pipelines that it may previously have found difficulties collaborating with.	<ul style="list-style-type: none"> • NYC Housing Authority • NYC Economic Development Corporation • NYC Housing Preservation and Development • NYC Department of Citywide Administrative Services
Academia and Institutions	Local academic institutions and think tanks survey New York's growing tech ecosystem and its workforce needs. They can inform both MOCTO's efforts to fill skills gaps in workforce development and PropTech integration efforts undertaken by other public and private stakeholders.	<ul style="list-style-type: none"> • City University of New York • Columbia University • Cornell University • Center for an Urban Future
PropTech Startups	PropTech startup companies are solicited by city agencies and their contracted private consultants for work provisions in PropTech endeavors. MOCTO can look to them as the primary identifiers of PropTech demands in the IoT ecosystem.	<ul style="list-style-type: none"> • Calm • Hq0 • Mapped • Building Engines
Real Estate Firms and Consultants	Real estate consultants are hired by city agencies to identify and vet potential PropTech solutions in municipal infrastructure. From them, MOCTO is able to identify specific vendors who can offer specific metrics of their workforce needs.	<ul style="list-style-type: none"> • JLL Technologies • Deloitte Insights

Recommendation 2: Leverage the adviser network to develop a baseline workforce profile for IoT jobs.

Industry feedback will be essential to identifying the current gaps in occupations and skills related to IoT in the Prop Tech industry. Identifying the critical occupations and required knowledge, skills, and abilities for each position will enable MOCTO to narrow their efforts to where they can have the largest impact on advancing IoT workforce development in New York City. Further, the narrowing of focus and the development of a qualitative occupation profile will enhance MOCTO's data analytics efforts. More detailed information and industry insight about these roles can refine the algorithms used to generate the IoT workforce development dashboard. Finally, a baseline set of occupational profiles will enable MOCTO to measure the progress of their efforts by comparing current industry needs and available training to the baseline profiles on a regular basis.

Alignment across ecosystem partners on the definition of IoT and relevant jobs and skills will be essential to achieving MOCTO's workforce development goals. Most importantly, alignment on the critical occupations and needed competencies will ensure that all of MOCTO's industry partners are directing their efforts toward the same desired outcome – instead of disparately pursuing goals that may be at odds with each other.

Specifically, MOCTO should work with the adviser network to:

- Identify the three to five most critical occupations in PropTech that will be impacted and/or require IoT skills. These profiles should consider the occupations across building management, real estate development, technology and sensor development, city regulatory agencies, and any other positions within the industry that face the most significant need. These occupations will be the target of concerted workforce development programs.
- Define competencies, relevant knowledge, skills, and abilities for each critical occupation. Once the occupations have been identified, MOCTO should work with the adviser network to create profiles that include skills standards and

competencies for each position. These profiles should resemble “strawman” job descriptions, and include the requisite knowledge, skills, and abilities the industry believes each occupation requires. Industry feedback can be supplemented with the initial analysis of O*NET data discussed above. Additionally, the development of these profiles present an excellent opportunity to define what entry-level workers should be able to do in each position, identify the current pathways to these positions, and challenge the assumptions of what skills are truly needed for each position.

- Align critical occupations to existing training opportunities and share findings across the Prop Tech / IoT ecosystem. MOCTO should identify and cross-walk currently available training programs to the critical occupations and required competencies once they have been identified. This will provide insight on the current state of IoT workforce development programming in NYC, how the availability of current training programming aligns to specific industry needs, and identify initial opportunities for IoT workforce development programming. Once the profiles and crosswalk have been completed, MOCTO should socialize the findings across the PropTech and IoT ecosystem in New York City; this will enable MOCTO to receive additional feedback and refinements to the profiles, as well as empower the ecosystem to undertake their own efforts to develop the requisite IoT workforce skills.

Recommendation 3: Utilize data collaboratives with Prop Tech stakeholders to improve IoT workforce data and analysis.

Industry stakeholders will be an important and critical source of data for MOCTO's IoT workforce development needs dashboard. As discussed above, there is limited publicly available data specific to IoT workforce development needs. When and where possible, MOCTO should seek to access industry data and expertise to enhance the quantitative analysis of NYC's IoT workforce needs. Further, these efforts could support efforts to centralize IoT workforce development data across various stakeholders and partners, remedying a central challenge facing workforce development efforts across the city and country. Data collaboratives present an excellent way for MOCTO to collaborate with industry and help each stakeholder

advance their individual goals in a collective manner.

Specifically, MOCTO should consider the following data collaboratives to enhance the access and analysis of IoT workforce data:

Data Cooperatives

• What it is: Various stakeholders group together to create “data pools” with shared data resources. Data pools would enable every stakeholder to find additional value in their data (by linking it to others data) and work from a “single source of truth.” Data cooperatives have also proven effective at democratizing data analysis by rebalancing the asymmetric relationship between data subjects and data users. It also eases the maintenance burden by pooling resources, though it would require shared data standards.

• How it can be used: MOCTO could centralize IoT workforce information, including occupation profiles, workforce data, and currently available training. It could also collect and aggregate information on open needs and hiring trends for the critical occupations discussed above.

Prizes and Challenges

• What it is: Data is made available to qualified applicants who then compete to develop new applications and/or innovative uses of said data. The challenge organizer provides a prize to the winning solution (for example, Netflix offered \$1 million in a challenge to improve their recommendation algorithm).

• How it can be used: Prizes and challenges have proven effective ways for government agencies to spur innovation and harness the private sector’s technical abilities and additional sources of data. In this case, MOCTO could seek to leverage the expertise of the PropTech start-up community to innovatively track IoT workforce development needs.

Research Partnerships

• What it is: Data is made available to academic institutions in order to advance analysis of consumer behavior and/or social trends. These collaboratives enable academics to conduct rigorous research into the effectiveness of certain policies.

• How it can be used: MOCTO can make data related to IoT workforce needs and workforce development programs in NYC available to academic partners. This would enable the research partners to evaluate the efficacy and impact of IoT workforce development trainings and programming. MOCTO can use the evaluations of its training to adjust policy and programming as necessary.

Proposed Engagement Strategies

Data Cooperatives	Prizes and Challenges	Research Partnerships
<p>What is it: Stakeholders group together to create “data pools” with shared data resources</p> <p>How it can be used: Centralize IoT specific information, including occupation profiles, workforce data, and training information</p> <p>Relevant stakeholders:</p> <ul style="list-style-type: none">• EDC• Workforce development partners	<p>What is it: MOCTO makes data available to qualified applicants that compete to develop new apps / innovative uses</p> <p>How it can be used: Leverage private sector skills and data to develop deeper workforce insights</p> <p>Relevant stakeholders:</p> <ul style="list-style-type: none">• EDC• Prop Tech companies	<p>What is it: MOCTO shares data with academic partners to analyze consumer behavior / social trends</p> <p>How it can be used: Evaluate the efficacy and impact of IoT workforce development trainings and programming</p> <p>Relevant stakeholders:</p> <ul style="list-style-type: none">• CUNY• Workforce development partners

Looking Ahead

The recommendations describe how MOCTO can leverage a systems approach to achieve near-term goals related to IoT workforce development. Specifically, the recommendations focused on how MOCTO should work with industry partners to improve the data available for the IoT workforce development dashboard.

However, the benefits of a systems approach do not stop there. A systems approach will have significant benefits to MOCTO and help advance their IoT workforce development goals. Specifically, an adviser network and systems will approach will enable MOCTO to:

- Identify implementation partners for workforce development programming. The systems approach will include workforce development partners from the beginning, helping MOCTO to identify and implement opportunities for additional trainings.
- Solicit feedback on potential IoT policy and programming. An adviser network will enable MOCTO – and the NYC government more broadly – to readily solicit feedback from industry partners on potential policy and programming related to IoT. This will enhance efforts of New York City to develop a robust IoT industry.
- Establish a model they can use for industry engagement across IoT workforce development (and potentially technology more broadly). The recommendations of this report have been specific to the Prop Tech industry. However, should this model prove successful, MOCTO will be well positioned to expand their efforts to include the entirety of the IoT industry. Further, it could present a template for a formal task force to integrate and align workforce development efforts across the technology industry in NYC.

Overall, a systems approach will augment MOCTO's efforts to build an IoT workforce development dashboard and enable it to achieve the workforce development goals set forth in the NYC IoT strategy.

Systems Approach to IoT Workforce Development

Why a Systems Approach...

MOCTO will be able to...

- Identify IoT workforce needs
- Remain informed about industry trends
- Receive feedback on proposed programs from industry and other interrelated stakeholders

Implementation

Recommendation 1:

Develop (informal) adviser network of PropTech stakeholders to inform IoT policy

Recommendation 2:

Leverage adviser network to develop baseline workforce profile

Recommendation 3:

Utilize data collaboratives to improve IoT workforce data and analysis

A systems approach will go beyond the dashboard to enable MOCTO to achieve their IoT workforce development goals

References

AI Now (2019). 2019 Report. From https://ainowinstitute.org/AI_Now_2019_Report.pdf.

Dvorkin, E., Shaviro, C., & Gallagher L. (2021). Upskilling for an Equitable Recovery: Hardest-Hit New Yorkers Most Vulnerable to Automation. From <https://nycfuture.org/research/automation-and-equitable-recovery>.

Greene, K. (2020). PropTech has reached critical mass, according to new report. From <https://www.mpamag.com/ca/news/general/proptech-has-reached-critical-mass-according-to-new-report/285879>.

Machina Research White Paper (2016). Open Standards in IoT Deployments Would Accelerate Growth by 27% and Reduce Deployment Costs by 30%. From https://www.interdigital.com/white_papers/Machina_2016_SmartCities.

Minoli, D., & Occhiogrosso, B. (2018). Internet of things applications for smart cities (Vol. 12). From <https://onlinelibrary-wiley-com.ezproxy.cul.columbia.edu/doi/pdf/10.1002/9781119456735.ch12>.

New York City Mayor's Office of the Chief Technology Officer (2021). IoT Strategy: The New York City Internet of Things Strategy. From https://www1.nyc.gov/assets/cto/downloads/iot-strategy/nyc_iot_strategy.pdf.

Newman, D. (2019). Return On IoT: Dealing With The IoT Skills Gap. From <https://www.forbes.com/sites/danielnewman/2019/07/30/return-on-iot-dealing-with-the-iot-skills-gap/?sh=5978aaba7091>.

Nimbio Gate Entry System (2021). PropTech and Access Control. From <https://nimbio.com/proptech-and-access-control/>

Omale, G. (2018). Gartner Identifies Top 10 Strategic IoT Technologies and Trends. From <https://www.gartner.com/en/newsroom/press-releases/2018-11-07-gartner-identifies-top-10-strategic-iot-technologies-and-trends>.

On Collaboration (2021). New York City Mayor's Office of the Chief Technology Officer (2021). From <https://www1.nyc.gov/assets/cto/#/collaboration>.

Petropoulos, G. (2018). The impact of artificial intelligence on employment. Praise for Work in the Digital Age, 119. From <https://www.bruegel.org/wp-content/uploads/2018107/Impact-of-AI-Petrouopoulos.pdf>.

Rothwell, J., Grueber, M., Horowitz, M., & Muro, M. (2011). Methodological Appendix for Sizing the Clean Economy: A National and Regional Green Jobs Assessment. From https://www.brookings.edu/wp-content/uploads/2016/06/0713_clean_economy_appendix.pdf

The State of Texas State Auditor's Office (2017). Workforce Planning Guide, Report No. 17-708. From <https://sao.texas.gov/Reports/Main/17-708.pdf>

University of Oxford Said Business School Oxford Future of Real Estate Initiative (2020). PropTech 2020: the future of real estate. From <https://www.sbs.ox.ac.uk/sites/default/files/2020-02/proptech2020.pdf>.

US Department of Labor (2014). Workforce Innovation and Opportunity Act: Strategic Workforce Development Plan for the Capital Region. From <https://www.seta.net/app/uploads/2012/07/apital-Region-Strategic-Workforce-Development-Plan-2017-2020.pdf>

Workforce Solutions Capital Area (201). Austin Metro Area Community Workforce Plan 2017. From <https://www.wfscapitalarea.com/reports-insights/strategic-plans/austin-metro-area-community-workforce-plan-2017/>

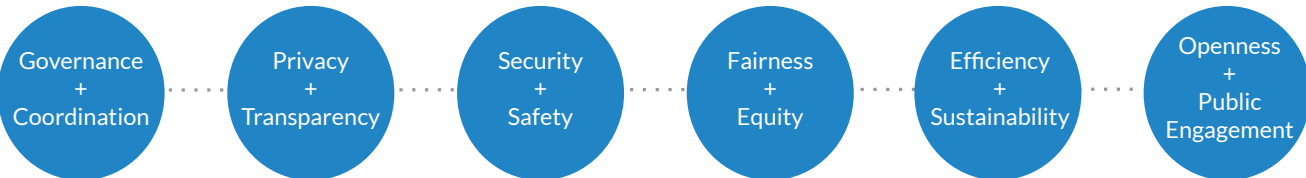
Wray, S. (2021). New York gears up for IoT growth with new strategy. From <https://cities-today.com/new-york-gears-up-for-iot-growth-with-new-strategy/>.

Appendix

Overview of Internet of Things (IoT) Strategy Report

The Internet of Things (IoT) is a network of interconnected, internet-connected objects that can gather and transmit data without the need for human interaction across a wireless network.

Key Principles of the NYC IoT Strategy




Opportunities and Takeaways

- Importance of effective and strong partnerships with private sector
- Tech workforce is struggling with equality and diversity

SWOT Analysis for Building Taskforce

<p>Strength</p> <ul style="list-style-type: none"> • Creating a global network of IoT • Flexibility on data sharing • Addressing gaps • Funding 		<p>Weakness</p> <ul style="list-style-type: none"> • Not being able to get everyone in stakeholder engagement • Lack of local voices • Elected officials support 	
<p>Opportunities</p> <ul style="list-style-type: none"> • Scholarships to educational institutions • More flexibility on skills requirement • Addressing SGDs 		<p>Threats</p> <ul style="list-style-type: none"> • Time • Addressing Inequality and lack of diversity 	



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