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Future of Regulation
Case studies

Contents

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About the Deloitte Center for Government Insights

The Deloitte Center for Government Insights shares inspiring stories of government innovation, looking at what's behind the adoption of new technologies and management practices. We produce cutting-edge research that guides public officials without burying them in jargon and minutiae, crystalizing essential insights in an easy-to-absorb format. Through research, forums, and immersive workshops, our goal is to provide public officials, policy professionals, and members of the media with fresh insights that advance an understanding of what is possible in government transformation.

Sweeping technological advancements are creating a sea change in today's regulatory environment, posing significant challenges for regulators who strive to maintain a balance between fostering innovation, protecting consumers, and addressing the potential unintended consequences of disruption.

What does the future hold?

Emerging technologies such as artificial intelligence (AI), machine learning, big data analytics, distributed ledger technology, and the Internet of Things (IoT), are disrupting traditional business models. In the wake of these developments, regulatory leaders are faced with a key challenge: how to best protect citizens, ensure fair markets, and enforce regulations, while allowing these new technologies and businesses to flourish?

Technology tools

Artificial Intelligence (AI)

Using AI to fight food poisoning

The Southern Nevada Health District (SNHD) oversees public health matters in Clark County. In 2014, SNHD conducted 35,855 food inspections on nearly 16,000 facilities, randomly selecting establishments for inspection. To improve its effectiveness, the health department has turned to AI applications.[1]

The department uses data from Twitter: An app employs geotagging and natural language processing to identify Twitter users reporting food poisoning and flag the restaurants they visited, generating a list of eateries for investigation.[2]

In an experiment conducted in Las Vegas, half of the city's food inspections were allotted randomly; the other half used the app. For three months, the system automatically scanned a daily average of 16,000 tweets by about 3,600 users. A thousand of these tweets could be linked to specific restaurants, with about 12 a day mentioning food poisoning. This was used to create a list of high-priority locations for inspection.[3]

SNHD analyzed the tweets with human-guided machine learning and an automated language model. The agency hired workers to scan sample tweets that then were fed into a model trained on 8,000 tweets to detect venues likely to pose public health hazards.

These *adaptive inspections*, based on machine learning, significantly outperformed random inspections: Adaptive inspection uncovered significantly more demerits, an average of nine versus six per inspection, and resulted in citations in 15 percent of inspections compared with 9 percent in the randomized selection. The researchers estimate that ifevery inspection were adaptive, it could result in 9,000 fewer food poisoning incidents and 557 fewer hospitalizations in the city each year.[4]

Identifying outlier behaviors among market participants at the SEC

Shortly after the onset of the financial crisis in 2008, the US Securities and Exchange Commission used analytics and machine learning to analyze 10-K filings to see if the crisis could have been predicted. The agency used text analytics in combination with natural language lrocessing (topic modeling) to identify the frequency of the mention of credit default swap (CDS) contracts, which protect buyers against certain financial risks. According to the SEC's analysis, the first mention of CDS contracts was made by three banks in 1998, and by 2004 more than 100 corporate issuers had mentioned their use. A huge increase in CDS disclosures came in 2009, after the crisis was in full swing.[5] While this analysis likely could not have predicted the financial crisis, the SEC is now using topic modeling and other cluster analysis techniques to produce groups of "like" documents and corporate disclosures that identify common and outlier behaviors among market participants. These analyses can identify latent trends in large amounts of unstructured financial information, some of which may warrant further scrutiny by enforcement or examination staff.[6]

Identifying fraud using AI

The Danish Business Authority, which aims to create predictable and responsible business conditions in Denmark, is using AI in experiments to identify fraud and highlight material errors in financial statements. The agency is using machine learning to conduct a comprehensive analysis of more than 230,000 financial statement filings it receives each year. Chief Advisor Niels-Peter Rønmos of Erhvervsstyrelsen, the Danish Business Authority, says with time and further experimentation, a significant improvement in regulatory efficiency may be achieved. The Danish regulator aims to be able to identify financial statement fraud and tax fraud more accurately and rapidly.[7]

Gauge public reaction

As part of the rulemaking process, government agencies are required to give the public a chance to make comments on proposed regulations. Each year, millions of people comment on pending rules and regulations, and agencies are required to consider "the relevant matter" in such public comments. But as technology advances, some individuals and organizations are using bots to post "fake" comments to amplify their positions. According to multiple researchers, more than one million of the 22 million comments the FCC received on its call to consider repealing net neutrality protections were from bots.[8]

To identify and combat such activity, the FCC is using analytics and AI. They contracted with FiscalNote, a government relationship management company,

to analyze all 22 million of the FCC net neutrality comments, using natural language processing techniques to cluster the comments into groups and analyze similarities in structure and word usage. Analysts discovered hundreds of thousands of comments with identical sentence and paragraph structure, using different words to communicate the same message.[9]

The next iteration is a tool called a "gravitas score," it's based on an analysis of decades of public comments. The score is based on a number of factors including comment length, a number of attachments, the complexity (or coarseness) of the language that is used, whether the author is an entity, key person, or ordinary individual, the number of cogent arguments expressed, and other cues that together serve as a proxy for sophistication.[10]

Agencies can build such analytical tools since they have historical information to validate the identified variables. Specifically, agencies have data from past rulemaking processes on which comments were considered good enough to warrant a substantive response. Many agencies will have "tagged" certain documents as worthy of deeper consideration. This information could be used to create a training set to build supervised machine-learning algorithms.[11]

As the use of bots to influence proposed rulemakings increases, regulators could benefit from incorporating data science and machine learning into the regulatory process to weed out bad actors and gauge public opinion accurately.

Georgia Government Transparency and Campaign Finance Commission: Increasing productivity
Cognitive automation can help regulators perform tasks at previously unattainable scale, speed, and volume. This allows for not only resource redistribution but also workforce optimization—allocating the right resources to the right tasks. For example, the Georgia Government Transparency and Campaign Finance Commission processes about 40,000 pages of campaign finance disclosures per month, many of them handwritten. After evaluating other alternatives, the commission opted for a solution that combines handwriting recognition software with crowdsourced human review to keep pace with the workload while ensuring quality.[12]

Technology tools

Analytics

The Monetary Authority of Singapore uses data analytics to detect suspicious transactions
The Monetary Authority of Singapore's (MAS) Data Analytics Group (DAG) develops algorithms that scan suspicious transaction reports and trading accounts to identify activity that warrants further attention. Various units formulate data management policies, manage data collection and quality, publish statistics, and work with other MAS departments to improve their data capabilities and conduct data analytics training programs. "The digitization of information and the harnessing of data from multiple platforms has created the opportunity to use data analytics to understand the economy and the financial system with a depth that was not possible before," explains Ravi Menon, MAS Managing Director. "Our new Data Analytics Group will work with the financial industry to sharpen the surveillance of risks, and with the various departments within MAS to transform the way we do our work." [13]

Using machine learning to fight fraud
The U.S. Securities and Exchange Commission (SEC) uses machine learning to identify patterns in the text of SEC filings. These patterns can be compared to past examination outcomes to find risks in investment manager filings. SEC staff say that these techniques are considered five times more effective than random selections at finding language that merits a referral to enforcement. For investment advisors, the SEC uses machine learning algorithms to predict the presence of idiosyncratic risks for each advisor.[14]

Technology tools

Internet of Things (IoT)

Michigan's Mcity Testbed
The state of Michigan—which produces more cars and trucks than any other state[15] —is taking a somewhat unique approach to testing autonomous vehicles as the technology develops. The Michigan Department of Transportation (MDOT), the University of Michigan, and the automotive industry are collaborating on a project called Mcity, a 32-acre test track in Ann Arbor, Michigan. The shared track is operated by the University of Michigan and is used by automakers and MDOT to experiment with autonomous and connected cars in a simulated environment. Mcity contains elements not typically found on other automotive test tracks, such as stoplights that broadcast information to vehicles, highway on-ramps, sidewalk crossings, a simulated tree canopy and overpass, vandalized traffic signs, and a mockup of downtown city blocks. With Mcity Michigan transportation officials are attempting to

create an enabling environment for the development of autonomous vehicles. "The public sector has a role in this," says Kirk Steudle, director of MDOT. "What we're trying to figure out is: How do we enable the technology to happen? It's growing, it's flourishing. How do we make sure the government is not in the way?"

The state of Michigan has also encouraged automakers to develop technology that lets vehicles and infrastructure communicate with each other. The state and other partners tested some of that technology for more than a year in Ann Arbor. About 2,800 cars, trucks, and buses took part in the pilot project, allowing them to get information from traffic lights, curve warning devices, and other IoT-enabled sensors along roadways. The city of Ann Arbor and the University of Michigan are now expanding the network of connected stoplights and roadside sensors.[16]

Augmented reality and virtual reality

Training the next generation of inspectors through virtual reality and augmented reality
Virtual reality and augmented reality (AR) can be used to acclimate inspectors to the environments they will work in. The US Department of Agriculture's Food Safety and Inspection Service (FSIS) uses virtual reality and augmented reality for training and recruitment purposes. The FSIS began transforming the traditional public health veterinary classroom course. It devised interactive solutions such as providing the opportunity to view an inspector's work setting in an engaging, highly-sensory manner using 360-degree virtual reality technology and media-rich, interactive classroom training environments.[17]

The division has also been facing retention issues since some inspectors and veterinarians simply couldn't handle the occasional meat cutting or hide removal tasks. In response, FSIS filmed plant processes such as examining an eviscerated animal. The videos along with VR headsets were sent to job fairs to show candidates what their work setting would look like. "About 20 to 25 percent of candidates said they would not work in a slaughter plant," says Dean Norman, the former distance learning manager of FSIS. "That's exactly the reaction we want. If you don't think you can do it, it is better to know now than after we have spent the money to train and relocate you."[18]

Technology tools

Digital technology

New York City's business atlas helps businesses decide location

They say the three most important things in real estate are "location, location, location." While a business may succeed or fail because of where it is, surprisingly, small businesses often choose their locations based on little more than gut instinct. According to one survey, 72 percent of small and mid-size businesses make decisions that way, and 90 percent say that data-based decisions are the sole preserve of big companies, due to the costs involved.[19] But if you want to start a business in New York City, City Hall has you covered. The city government offers a nifty tool called "Business Atlas" to help businesses research the economic conditions of neighborhoods where they might set up shop.[20]

The free, online portal shows a map with interactive data on demographics, density of restaurants, income, and even foot traffic. This helps businesses determine what type of shop would thrive in a particular area, or which area might best nurture a new idea.[21]

The tool combines business filing data from the Department of Consumer Affairs, sales tax data from the Department of Finance, demographic data from the census, and traffic data from Placemeter.[22] Although this information is publicly available, pulling files from each department, neighborhood by neighborhood, is a huge hassle. Some corporations dedicate entire offices to researching locations for new franchises. New York's tool allows small businesses to compete.

The Business Atlas can help entrepreneurs gain crucial knowledge before making a costly investment. Its

searchable data go as deep as percentage change in population, median income, existing businesses, new businesses, and taxable sales revenue. The atlas provides data on how many households have children, rent their apartments, or include people who work from home. It even provides real-time information on traffic.[23]

Speeding up regulatory approvals

Austria's Central Bank, Oesterreichische Nationalbank (OeNB), is working with the country's banking community to create a common software platform in an effort to implement a new regulatory reporting model. The initiative is based on greater integration of data within banks, as well as bridging the IT systems of the supervisory authority and the banking industry. The system is housed in a separate entity called the Austrian Reporting Services (AuRep), and is jointly owned by the seven largest Austrian banking groups—representing 87 percent of the market. This collaboration allows for cost-sharing of compliance, as well as standardization in data collection.[24]

AuRep takes an innovative approach to regulatory reporting, allowing Austrian banks to deliver micro-data in the form of single contracts, loans, or deposits to a common platform in a standardized format, known as "basic cubes." These cubes can then be enriched with additional attributes, enabling supervisors to aggregate and analyze data without increasing the administrative burden on data providers, such as banks. This approach facilitates the reusability of data and has reduced the cost of regulatory reporting in Austria by upwards of 30 percent.[25]

Blockchain

Singapore exploring use of blockchain in regulation

In November 2016, the Monetary Authority of Singapore (MAS) partnered with R3 —a Distributed Ledger Technology company, and a consortium of financial institutions to work on a proof-of-concept to conduct inter-bank payments using blockchain technology. In 2017, the MAS reported that the consortium developed prototypes of three different models for decentralized

inter-bank payment and settlements with liquidity savings mechanisms.[26]

The prototypes will be leveraged for two spin-off projects. The first project, led by the Singapore Exchange (SGX), aims to make the securities trading and settlement cycle more efficient. The second project focuses on conducting cross border payments using central bank digital currency.[27]

Technology tools

Crowdsourcing

Boston's HubHacks Permitting Challenge
The city of Boston had a backlog of requests for building permits, including permits for zoning, elevators, ducts, and plumbing. The backlog was causing construction delays, which resulted in increased costs and complaints about buildings. Upon taking office, Boston Mayor Marty Walsh made streamlining permits a top priority, with a goal of creating easier, faster permitting. The city launched the HubHacks Permitting Challenge, a hackathon co-hosted by the city's Department of Innovation and Technology and the Mayor's Office of New Urban Mechanics. Citizens, businesses, and the tech community were invited to reinvent the city's permitting process using a custom API.[28]

As a result of HubHacks, the city designed a new permitting system with a better customer experience, based on user feedback. It lets users apply for multiple permits at once, organizes permits by project, and allows for multiple contacts on each application. The effort has yielded significant results. In the first year since making the improvements, the Boston Inspectional Services Department issued 12,500 more permits than in the previous year. The average review time for long-form permits was cut by five days, or 20 percent. Permits are now issued on time 75 percent of the time. And the building complaint backlog plummeted from 3,500 to 212.[29]

The crowd helps Boston augment food safety inspection process
Historically, the city of Boston's food safety process relied on random selections of restaurants for further scrutiny. The city thought there was a better way to do targeting. Its data portal hosts public data on restaurant food safety inspections as well as many other aspects of city life.[30] To better target restaurants in need of regulatory attention, the city partnered with Yelp and Harvard Business School to sponsor an open competition to develop an algorithm that could predict health code violations. More than 700 contestants participated, using restaurant inspection data and years of Yelp reviews.[31]

While participants analyzed the reviews, looking for common words and phrases, Harvard economists evaluated the submissions against the city's actual inspection reports.[32] The verdict: The winning algorithm could make inspectors 30 to 50 percent more productive in finding violations.[33]

Business tools

Customer experience toolkit

Ohio modernizing business gateway
When the State of Ohio decided to modernize its business gateway, the team started by examining the pain points that business users faced. The state employed interviews, focus groups and a survey to investigate users' needs. The analysis identified five clusters of end users based on their priorities and their satisfaction with the current gateway.

For instance, a cluster called 'Corporate Employees' comprised people who worked for companies with a larger geographic footprint. These users were mostly satisfied with the business gateway, but they wanted functional tweaks, such as easy password resets and log-ins, confirmation mailers for saving and uploading data, and the ability to create customized alerts. They were focused on making sure their company complied with state rules and regulations.

Another cluster, called 'Aspiring Entrepreneurs,' consisted of young, educated and tech savvy entrepreneurs. Their needs were completely different. They wanted relevant resources, step-by-step guidance for navigating the gateway and a dynamic help function to address their problems. They were more interested in using state services that could streamline their interactions and enable them to realize their dream of starting a business.

After going through this detailed need analysis, the state incorporated the needs of each of the five clusters into a revamped gateway.[34]

Business tools

Design thinking

New Zealand Better for Business Program

New Zealand routinely scores near the top of the World Bank's Doing Business study, and for good reason. The nation is deliberately reshaping its government to prioritize customer service. Extensive research underpins the transformation. Surveys found many businesses appreciated the service of individual agencies. However, the system too often required restarting from scratch elsewhere.[35] Reformers used design thinking principles to identify common pain points across businesses and set to work.

First, the Ministry of Business, Innovation, and Employment instigated the Result 9: Better for Business program. The program is supported by seven other agencies including ACC, Callaghan Innovation, Inland Revenue, New Zealand Customs Service, NZ Trade and Enterprise, Ministry for Primary Industries, and Statistics NZ.[36] Their goal: to reduce the business costs of dealing with government by 25 percent and to match key performance indicators of private sector firms by 2020. To date the costs of compliance have been reduced by 7 percent.

R-9 helped spearhead over 80 initiatives. Their R-9 accelerator program unleashed teams of experts— each including an entrepreneur—to simplify business's experience with government. This often required joining up unconnected services.

Join up Government Services

"Join up" is just Kiwi for collaboration. For example, the ACC, GST, and Inland Revenue all now accept R-9's single registration numbers for business, potentially sparing companies multiple ID numbers. Soon, data from one agency database may update across government, so that a business changing a name need only inform one agency. Joined services don't just combine duplicate processes and share data. They coordinate tasks, aligning them to a user's needs. That's how the new "single trade window" turns "arrive at a New Zealand Port" into one online process, not a series of agency checklists. Shipping lines can now securely submit the cargo information required by entities like Customs, Maritime New Zealand, and the Ministry of Health.[37]

Simplification

Obeying the law shouldn't be confusing. While applying for building permits (or "consents") 41 percent of New Zealand's applicants mess up their paperwork, causing costly delays.[38] In response, R-9's accelerator team created Vizbot, an application that town councils can incorporate into their websites. Vizbot walks contractors through applications, then tracks the application's journey across desks like a Fed-Ex package through a warehouse. The program even shows notes officials make during processing, so the architect can see that a deck may violate zoning laws well before snail mail delivers the verdict.

Prioritize Digital

A bias for simplicity often means a bias for the web. A similar effort to Vizbot transformed the Intellectual Property Office of New Zealand (IPONZ) into the world's first 100 percent online IP office.[39] Businesses can file patent applications, monitor their case progression, and update their contact details online. A single 'inbox' tracks a case—which both businesses and IPONZ staff can view.[40] The shared window on decisions makes the process transparent and predictable for business, while reducing transaction costs.[41] With more time to examine IP rather than administrate, IPONZ employees are responding quickly and more accurately. Over 98 percent of applications received a response within 15 working days and 99 percent of decisions to grant or deny IP were upheld.[42]

A Strategy of Testing

There is no silver bullet. Redesigning government requires beta testing, consultations with stakeholders, and user feedback. So R-9's leaders advance together with users. And the costs of dealing with government had been reduced by seven percent as of December 2016.[43] The median annual time SMEs spent within their business meeting their tax obligations was 27 hours, a 25 percent reduction compared to 2013.[44] Construction agents using Vizbot reported a 30 percent reduction in time spent.[45] The Trade Single Window has processed more than 1.7 million inward transactions, getting ships turned around faster.[46] Reorganizing around customers not only increases satisfaction, but it turns out to speed an economy forward.

Business tools

Nudges

Reducing child road deaths in the United Kingdom
In 2000, the UK's Department for Transport (DfT) set targets to reduce the number of people killed or seriously injured on roads by 50 per cent for children and by 40 percent overall by 2010. To achieve these ambitious targets, the department developed a three-pronged strategy (engineering. enforcement, and education) that combined traditional approaches such as regulation and enforcement with efforts to educate and Influence the behaviors of road users.

The education element included a campaign called THINK! that sought to educate road users about road safety issues. To inform their strategy for THINK!. DfT analyzed the causes of road deaths and serious injuries, the characteristics of the drivers who caused them and their beliefs and motivations. Based on these insights, DfT commissioned advertisements to educate and influence the behaviors of particular groups of individuals.

One example was the "Lucky" advertisement, which targeted drivers who drive above the 30 mph limit on urban and residential roads. Many of these drivers were not convinced that driving at 40 mph was more dangerous than 30 mph, and thought of themselves as good drivers. They did not respond to threats of imprisonment because they could not imagine themselves ever becoming a convicted felon. Focus groups, however, found that this group of drivers would find it hard to cope with the guilt of killing a child.

The resulting TV advertisement, shown at times when many people in the target demographic would be watching, featured an eight-year-old girl who has been hit by a car, talking directly to the audience about the consequences of being hit at 30 mph (which carries an 80 percent chance of survival) versus 40 mph (with an 80 percent chance of being killed), and showed the level of injuries sustained in each case.

The campaign along with engineering and enforcement measures, produced real improvements in road safety targets, with a 59 percent reduction in child deaths and serious injuries. DfT estimates that for every £1 spent on THINK!, £9.36 of public money was saved.[47]

Using nudges to collect employer health tax
In the Canadian province of Ontario, every year, employers are required to file and pay an Employer Health Tax (EHT), a payroll tax on health services provided to both current and former employees. In 2014, the government of Ontario was struggling with a number of businesses filing their EHTs delinquently;[48] more than 7,000 employers filed their returns late that year. So the government turned to the behavioral sciences for help.

To assist employers who were running late on filing, Ontario tested new messaging that tweaked their collection letters to focus on *where* participants could file a return, directing them to websites and the mailing addresses to service centers. Participants also received detailed instructions on how to go about filing the EHT return and a deadline for *when* the filing was needed. Compared to the control group that received the standard delinquent message, the employers using this approach increased their filings by 13 percent (53 percent vs. 46.9 percent). Through a single nudge, Ontario was able to significantly increase the compliance of its businesses.[49]

Principles

Adaptive regulation: Shift from "regulate and forget" to a responsive, iterative approach

Finland reforms its transportation regulation

Finnish officials recognized the need to reform their transport regulations to support their vision of Mobility-as-a-Service (MaaS), which considers transportation as an integrated system of different services. "We have to look at the transport system as one entity, with no borders and the ability to share data on payments, tickets, and location," says Anne Berner, Finland's minister of transport and communication.

Hence, the country decided not to reform or revise separate laws on taxis, public transport, roads, or the transport of goods but instead to create a new integrated transportation code. "We decided to remove those old laws and create a new transport code that incorporates all transport modes into one piece of legislation, to be technology-neutral, and to create the same level playing field for different transport modes," Berner says. The aim is to deregulate existing transport while building the foundations for MaaS.[50]

Denmark's agile regulation for new business models

As part of Denmark's strategy for digital growth, the Danish government is creating an enabling regulatory environment for new business models to thrive. As of July 1 2018, it will be mandatory for Danish agencies to assess whether commercial regulation is agile based on the following five principles.[51]

01. **Facilitates the integration of new business models:** New regulation will be assessed to determine whether it supports new business models including creating testing facilities.

02. **Technology neutral:** Whether new regulation is technology neutral by avoiding setting specific technology requirements.

03. **More simple and purposive approach:** A clear focus on purpose instead of process requirements can encourage companies to innovate.

04. **Holistic approach:** Authorities should ensure that new regulation considers any interaction with other regulatory areas which could impact companies' use of new technologies and business models.

05. **Ensure user-friendly digitalization:** Where relevant, new regulation should contain a description of how commercial digital solutions can be made user-friendly

These principles are included in the Ministry of Justice's legal quality guidelines.[52] Apart from these five principles, Denmark's agile regulation approach includes these three initiatives:[53]

• **A single, cross-ministerial point of entry** for companies to clarify whether their digital solutions based on emerging technologies fall within the existing regulation framework

• **Check-ups on regulation in neighboring countries** to study whether the existing commercial regulation is outdated and should be modified with regard to digital development.

• **Better opportunities for tests** of new business models in a range of areas such as mobility, construction, financial services, the consumer field and health.

US guidance for vehicle safety

The National Highway Traffic Safety Administration's (NHTSA) 2016 Federal Automated Vehicles Policy offers a good example of adaptive and iterative approach. By taking an iterative approach in designing policy for autonomous vehicles, the NHTSA responded to new data and technologies to make significant revisions in its revised policy titled A Vision for Safety 2.0. Released in September 2017, NHTSA's revised policy clarified that guidance is voluntary and that entities do not need to wait to test their automated driving systems. It also removed the elements of registration and certification from its safety assessment letter as both were already subject to state government regulations. The guidance also urged states not to codify the voluntary guidance as some states tried to do with its 2016 guidance.[54] The guidelines are designed to make the department's regulatory process more nimble, encourage new entrants and ideas, and "remove barriers to innovation."[55] They also help to identify good practices and new practices.

Principles

Regulatory sandboxes: Create environments to prototype new approaches

Sandbox approach by Canadian Securities Administrators

The Canadian Securities Administrators (CSA) launched a regulatory sandbox that provides time-limited relaxation from certain regulatory requirements placed on startups.[56] "The objective of this initiative is to facilitate the ability of those businesses to use innovative products, services, and applications all across Canada, while ensuring appropriate investor protection," says Louis Morisset, CSA chair and president and CEO of the Autorité des Marchés Financiers.[57] Impak Finance, for instance, became the first company ever to legally raise $1 million via a cryptocurrency crowdsale in the Americas.[58] As part of the CSA sandbox, it was exempted from registering as a security dealer and providing a prospectus. Impak will be allowed to remain in the sandbox for two years.[59]

The US Department of Transportation's sandbox for Unmanned Aerial Systems

The US is piloting a sandbox approach for unmanned aerial systems. The Department of Transportation and the Federal Aviation Administration have chosen 10 public-private partnerships to test unmanned aerial systems.[60] "The pilot programs will test the safe operation of drones in a variety of conditions currently forbidden. These include operations over the heads of people, beyond the line of sight and at night," says Elaine Chao, Secretary, Department of Transportation "Instead of a dictate from Washington, this program takes another approach. It allows interested communities to test drones in ways that they're comfortable with."[61]

The UK Financial Conduct Authority's regulatory sandbox

The United Kingdom has been a pioneer in the use of accelerators and sandboxes as part of the regulatory process. Its Financial Conduct Authority (FCA), as part of its broader Project Innovate, launched the first fintech regulatory sandbox in June 2016. This sandbox allows businesses to test innovative products and services in a safe, live environment, with the appropriate consumer safeguards, and, when appropriate, is exempt from some regulatory environments.[62] After its first year of operation, 90 percent of firms that completed testing in its first cohort were continuing toward a wider market launch, and more than 40 percent received investment during or following their sandbox tests.

The FCA released a report on what it learned from its first year. Some key lessons include:

- **Reduced time to market.** Access to the regulatory expertise the sandbox offers reduced the time and cost of getting innovative ideas to market.
- **Facilitated investor funding.** The feedback received from participating firms indicated that investors can be reluctant to work with companies not yet authorized by FCA due to regulatory uncertainty.
- **Product and market testing.** Many firms in the sandbox used the platform to assess the consumer traction and viability of their business models. Testing in the live environment helped businesses understand consumers' reception to new pricing strategies or new technologies. This enabled them to constantly iterate on the business model.[63]
- **Testing viability of underlying technology.** The FCA conducted technology and cybersecurity reviews of the firms when setting up the sandboxes. This allowed the firms to test the viability of their underlying technology and build in appropriate measures to minimize cyber risk.[64]
- **Better consumer safeguards.** Working closely with the FCA encouraged fintech startups to develop business models that mitigated risks for consumers. For example, all firms testing the use of digital currency for payment transfers were required to guarantee the funds being transferred and pay full refunds if they were lost in transfer.[65]
- **Reduced challenges in data sharing.** For a few firms, their business model relied on obtaining users' transactional data on loans, credit cards, current accounts, and pension balances from other financial institutions. Without a formal mechanism for data sharing in place, it was difficult for such firms to directly approach institutions.

Bank of England's accelerator

The Bank of England—UK's central bank—launched a fintech accelerator project in 2016 to gain familiarity with fintech innovations relevant to central banking, and give firms the opportunity to work with them to understand and demonstrate how their solutions could be relevant for policy makers and regulators.

In one accelerator project, the Bank of England collaborated with Anomali, developer of the ThreatStream platform, to explore solutions for responding to cyber threats. In another project, it worked with MindBridge Analytics to prove the value of AI in detecting anomalies in financial transactions and reports.[66]

Office of Gas and Electricity Markets (Ofgem), UK regulatory sandbox

Office of Gas and Electricity Markets (Ofgem) launched a regulatory sandbox known as Innovation Link. It supported 22 innovators through its fast, frank feedback service. The service helps innovators identify how their business can work under existing regulations. The regulators' other service in the sandbox enables innovators to try and pilot products and services which are not supported by existing business models. So far, it has granted access to three businesses. One of those businesses offers a blockchain-based trading platform that encourages residents to source energy from renewable energy producers and trade the energy with neighbors to reduce energy consumption and cost.[67]

Swiss banking regulations aligned to new business models

Sandboxes are often used to test new regulatory approaches. The Swiss Federal Council amended the definition of "acting on a commercial basis"—which requires a banking license—to allow businesses in the early stage of development to experiment without being subject to the cumbersome burden of regulatory supervision. The amended rules allow businesses to accept deposits from the public for up to $1.04 million, regardless of the number of depositors, without requiring a banking license. This creates a regulatory sandbox that can help businesses grow rapidly and experiment with new funding approaches, such as crowdfunding.[68]

Singapore's autonomous vehicle test centre

In the eastern hemisphere, Singapore has been testing autonomous vehicles. The Land Transport Authority (LTA), the Nanyang Technological University, and the JTC corporation collaborated to develop an autonomous vehicle (AV) test center.[69]

The test center, spread over 2 hectares, is designed to test communication, interaction, and routing of vehicles with each other. The facility brings together different elements of transport systems including road networks, traffic infrastructure, and traffic rules and regulations. Since Singapore receives heavy rainfall almost every year, the site also offers the facility of rain simulation and flood zone to test AVs under different extreme weather conditions.[70]

The LTA has installed a network of CCTV cameras to monitor the progress of testing. The real-time footage of CCTV cameras is stored at LTA's intelligent transport system center for further analysis to assess the readiness of AVs on Singapore's public roads.[71]

Principles

Outcome-based regulation: Focus on results and performance rather than form

Australia's guidelines for autonomous vehicles

Australia has developed performance-based guidelines for autonomous vehicles. "Guidelines are preferable to legislation as they allow the flexibility to be quickly amended and updated, if required," states a policy paper by Australia's National Transport Commission (NTC). The paper goes on to say that regulations for automated vehicles should be "proportionate, performance-based, and regularly reviewed."[72]

Paul Retter, NTC chief executive, believes multiple issues should be addressed before making autonomous vehicle a reality on the road. "Our focus is on ensuring the regulatory system remains flexible enough to accommodate evolving technologies as they come to market while always prioritizing public safety," says Retter.

Industry stakeholders also are evaluating performance-based standards. The Australian Automobile Association suggests that standards for automated vehicles should be performance-based and technology-agnostic, and that the responsible parties and processes for certifying vehicle modifications should be clearly identified and unambiguous.[73]

Principles

Risk-weighted regulation: Shift from one-size-fits-all regulation to a data-driven, segmented approach

The FDA's Pre-Cert process

For certain digital health products, the FDA already uses risk-based approaches that balance potential risks with patient benefits.

As part of its Digital Health Innovation Action Plan, the FDA created a Pre-Cert pilot program for eligible digital health developers that demonstrate a culture of quality and organizational excellence based on objective criteria—for example, excelling in software design, development, and testing. The pilot intends to look "first at the software developer or digital health technology developer, not the product."[74]

The idea behind this is to allow the FDA to accelerate time to market for lower-risk health products and focus its resources on those posing greater potential risks to patients. Pre-certified developers could market lower-risk devices without additional FDA review, or with a simpler premarket review.

But precertification is just one part of the model; the FDA intends to monitor the performance of these companies continuously, with real-world data. Scorecards and corresponding Pre-Cert levels could go up or down based on performance and effectiveness data. If scores fall below a defined threshold, the organization might lose certain benefits, such as expedited reviews for less-risky products or eligibility for Pre-Cert status until it can resolve any product issues through a new assessment.[75]

New York City's Targeted Building Inspections

For decades, the New York City Department of Buildings focused on complaints when deciding which properties to inspect for unsafe conditions and structural hazards. This made sense.

The problem was, in 2011, the city received almost 25,000 complaints about just one type of problem, illegal conversions, and had only 200 inspectors to cover the workload. These illegal conversions, in which landlords would divide apartments into smaller units to accommodate more people than the apartment was zoned for, were disasters waiting to happen. Dozens of people might occupy a space intended for five, generating issues in terms of fire safety, crime, and public health.

In response, the Mayor's Office of Data Analytics, a crew of scientifically minded problem solvers led by Michael Flowers, was able to radically improve inspection efficiency by using predictive analytics. "When we prioritize the complaint list, we're reducing our time to respond to the most dangerous places, in effect reducing the number of days that residents are living at risk," Flowers says.[76]

Crucially, Flowers's data science team didn't create a fancy algorithm sitting in isolation at their desks at City Hall—they built their predictive data model with the help of building inspectors who'd been in the field for years. "The field inspectors were like, 'Yeah, I know which places are dumps in this neighborhood, because I've been working this beat for so long,'" Flowers says. "So we injected that employee experience into the data and fed that into a risk filter." The result was a triaged list of properties for inspection.

The results were staggering. Previously only 13 percent of complaints had ended up requiring vacate orders. After Flowers's team filtered out the number of false positives, the share of complaints leading to vacate orders escalated to 70 percent.[77] "We didn't reengineer anything," Flowers says.[78]

In this case, the city didn't gather any data it didn't have before. It simply started making better decisions by using modern methods of data analysis. The results were impressive. The city found, for instance, that improved building inspections lowered risks for firefighters, since fires in illegal conversions were 15 times more likely than other fires to result in injury or death for firefighters.[79] "It's very, very clear that if the buildings department doesn't do its job, it's felt downstream by the fire department," he explains.[80] Thanks in no small part to this analytics-driven approach, in June 2015, New York City experienced zero fire deaths for the first time since 1916.[81]

Principles

Collaborative regulation: Align regulation nationally and internationally by engaging a broader set of players across the ecosystem

Internet governance and multi-stakeholder engagement

In certain instances, regulators can benefit from working directly with businesses, innovators, and other players to define rules for emerging technologies. For example, the internet's decentralized, global structure defied regulatory logic and demanded a new framework to address its revolutionary nature.

In 1997, after considering various regulatory approaches to internet governance, the Clinton Administration released a set of principles called *The framework for global electronic commerce* to guide the development of digital communications technologies. The *framework* outlined a number of general principles to guide the government's treatment of cyberspace and forestall aggressive regulatory action. Among these:

- The private sector should lead.
- Governments should avoid undue restrictions on electronic commerce.
- Where governmental involvement is needed, its aim should be to support and enforce a predictable, consistent, and simple legal environment for commerce.
- Governments should recognize the internet's unique qualities.
- Electronic commerce through the internet should be facilitated globally.[82]

Taken together, these principles establish a *de facto* regulatory structure that sidesteps the traditional process for promulgating new rules in favor of a system of co-regulation and multi-stakeholder engagements. Such systems can help induce constructive dialogue among various stakeholders who might otherwise be less amenable to compromise.

Collaboration of financial regulatory institutions in the UK

The Financial Conduct Authorities (FCA) in the UK and Bank of England are collaborating on a technology solution that could help financial institutions report more easily and improve the quality of information. Both regulators jointly held a TechSprint in November 2017 to find a technology solution to link regulation, compliance procedures, firms' policies and standards together with companies' transactional applications and databases.[83] The sprint helped develop a proof of concept that could turn reporting rules into a language that is readable by machines so it removes the need for human interpretation. The machines could assess the information required based on rules and then pull the same information from a firm's databases to automate the process of compliance.[84]

Data sharing in the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP)

One way to enable cross-border data sharing is to incorporate this into trade agreements. One example is the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).[85] The multi-nation agreement, signed in March 2018, covers 11 countries including Australia, Singapore and Japan.[86] The agreement tries to balance the data sharing restrictions with trade considerations. The agreement states that *"Each Party shall allow the cross-border transfer of information by electronic means, including personal information, when this activity is for the conduct of the business."* It also can minimize any barriers relating to the location of computing facilities as a pre-requisite to conduct business, i.e. a CPTPP signatory country cannot put a condition of locating computing facilities in its country as a pre-requite to conduct business. [87]

Endnotes

1. Adam Sadilek, et al., "Deploying nEmesis: Preventing foodborne illness by data mining social media," www.cs.rochester.edu/~sadilek/publications/Sadilek,%20Kautz,%20et%20al.%20Deploying%20nEmesis.pdf. **View in article**

2. Adam Sadilek, et al., "Deploying nEmesis: Preventing foodborne illness by data mining social media," www.cs.rochester.edu/~sadilek/publications/Sadilek,%20Kautz,%20et%20al.%20Deploying%20nEmesis.pdf.

3. University of Rochester, "App helps fight food poisoning in Las Vegas with machine learning," March 7, 2016, www.hajim.rochester.edu/news/2016-03-09_app_tracks_food_poisoning.html.

4. Adam Sadilek et al., "Deploying nEmesis, 2016, https://dl.acm.org/citation.cfm?id=3016466

5. Securities and Exchange Commission, "The Role of Big Data, Machine Learning, and AI in Assessing Risks: a Regulatory Perspective," https://www.sec.gov/news/speech/bauguess-big-data-ai, accessed May 29, 2018

6. ibid

7. XBRL: The Business Reporting Standard, "AI to boost regulator in Denmark?", Feb. 17, 2017, https://www.xbrl.org/news/ai-to-boost-regulator-in-denmark/, accessed Feb. 8, 2018.

8. RealClear Policy, "The FCC Should Embrace Artificial Intelligence," Sept. 14, 2017, https://www.realclearpolicy.com/articles/2017/09/14/the_fcc_should_embrace_artificial_intelligence_110355.html, accessed Feb. 9, 2018.

9. Issie Lapowsky, "How Bots Broke the FCC's Public Comment System," *Wired*, Nov. 28, 2017, https://www.wired.com/story/bots-broke-fcc-public-comment-system/,.

10. Michael A. Livermore, Vladimir Eidelman, and Brian Grom, "Computationally Assisted Regulatory Participation (93:3)," *Notre Dame Law Review*, March 2018, pp. 1019, https://scholarship.law.nd.edu/cgi/viewcontent.cgi?article=4771&context=ndlr

11. Michael A. Livermore, Vladimir Eidelman, and Brian Grom, "Computationally Assisted Regulatory Participation (93:3)," *Notre Dame Law Review*, March 2018, pp. 1022, https://scholarship.law.nd.edu/cgi/viewcontent.cgi?article=4771&context=ndlr

12. Richard W. Walker, "Georgia solves campaign finance data challenge via OCR," *InformationWeek*, April 15, 2014, www.informationweek.com/government/cloud-computing/georgia-solves-campaign-finance-data-challenge-via-ocr/d/d-id/120447.

13. Monetary Authority of Singapore, "MAS Sets Up Data Analytics Group," Feb. 13, 2017, http://www.mas.gov.sg/News-and-Publications/Media-Releases/2017/MAS-Sets-up-Data-Analytics-Group.aspx, accessed Feb. 8, 2018.

14. Financial Stability Board, "Artificial Intelligence and Machine Learning in Financial Services," Nov. 1, 2017, http://www.fsb.org/wp-content/uploads/P011117.pdf, accessed Feb. 8, 2018.

15. Michigan Economic Development Corp., https://www.michiganbusiness.org/automotive-industry-office/, accessed March 5, 2018

16. Daniel C. Vock, "Who's in the Driver's Seat for Regulating Autonomous Vehicles?" *FutureStructure*, March 1, 2016, http://www.govtech.com/fs/Whos-in-the-Drivers-Seat-for-Regulating-Autonomous-Vehicles.html

17. Food Safety Inspection Services, "2019 President's Budget," p.22, accessed June 1 2018, https://www.obpa.usda.gov/22fsis2019notes.pdf

18. Erin Brereton, "Virtual Reality Helps FEMA, VA Bring Their Missions to Life," *FedTech*, July 27, 2017, https://fedtechmagazine.com/article/2017/07/virtual-reality-helps-fema-va-bring-their-missions-life

19. Ryan McChrystal, "Lacking insight, SMEs' leaders rely on gut instinct," Elite Business, November 11, 2014, http://elitebusinessmagazine.co.uk/sales-marketing/item/lacking-insight-smes-leaders-rely-on-gut-instinct

20. Phyllis Furman, "Map this! New city tech tool lets small businesses compete with the big guys by dishing data," New York Daily News, December 26, 2013, http://www.nydailynews.com/new-york/map-new-city-tech-tool-lets-small-businesses-compete-big-guys-dishing-data-article-1.1559044#commentpostform

21. ibid

22. Miranda Neubauer, "With Business Atlas, NYC analytics office looks to 2014," TechPresident, January 2, 2014, http://techpresident.com/news/24635/business-atlas-nyc-analytics-office-looks-2014

23. Jill Krasny, "NYC data tool gives small business an edge," *Inc.com*, December 27, 2013, http://www.inc.com/jill-krasny/nyc-business-atlas-helps-small-businesses.html

24. TransAtlantic Policy Working Group Fintech, "The Future of RegTech for Regulators," June 2017, https://www.innovatefinance.com/wp-content/uploads/2017/06/tpwg-regtech-paper-digital.pdf

25. Ibid.

26. Monetary Authority of Singapore and Deloitte, "The future is here: Project Ubin: SGD on Distributed Ledger," 2017, pp. 12, https://www2.deloitte.com/content/dam/Deloitte/sg/Documents/financial-services/sg-fsi-project-ubin-report.pdf

27. Monetary Authority of Singapore, "Project Ubin: Central Bank Digital Money using Distributed Ledger Technology," http://www.mas.gov.sg/Singapore-Financial-Centre/Smart-Financial-Centre/Project-Ubin.aspx, accessed May 30, 2018

28. DevPost, "HubHacks: Boston's Civic Hackathon," https://hubhacks.devpost.com/, accessed Feb. 16, 2018.

29. Alex Lawrence, "How Boston is Making Permitting and Licensing Easier," Data-Smart City Solutions, Jan. 20, 2015, https://datasmart.ash.harvard.edu/news/article/how-boston-is-making-permitting-and-licensing-easier-621, accessed Feb. 16, 2018.

30. City of Boston, "Data portal," https://data.cityofboston.gov/, accessed May 29, 2018

31. Laura Adler, "What can Boston restaurant inspectors learn from Yelp reviews?" *Digital Communities*, May 26, 2015, www.govtech.com/dc/articles/What-Can-Boston-Restaurant-Inspectors-Learn-from-Yelp-Reviews.html.

32. Peter Bull, Isaac Slavitt, and Greg Lipstein, "Harnessing the power of the crowd to increase capacity for data science in the social sector," 2016 ICML Workshop on #Data4Good, June 24, 2016, https://arxiv.org/pdf/1606.07781.pdf.

33. DrivenData, "Keeping it fresh: Predict restaurant inspections," www.drivendata.org/competitions/5/leaderboard/eval/, accessed October 9, 2016.

34. Deloitte Digital, "Ohio Business Gateway: Steering Committee Meeting," October 9, 2015, http://business.ohio.gov/gatewaymodernization/OBGSteeringCommittee_100915.pdf

35. "BPS Result 9 – Improving Business' Interactions with Government" Stephen Joyce, Cabinet Committee on State Sector Reform and Expenditure Reform, http://www.mbie.govt.nz/info-services/business/better-for-business/documents-image-library/bps-result-9-improving-business-interactions-with-government.pdf

36. Ministry of Business, Innovation and Employment Website www.mbie.govt.nz , accessed on March 18, 2016

37. Trade Single Window Website, www.tsw.govt.nz, accessed February 21, 2016.

38. 25,000 out of 60,000 applications. "About," Vizbot. http://www.vizbot.co.nz/about/, accessed February 21, 2016.

39. State Service Commission, "Better Public Services Result 9 - Case Study: IPONZ: delivering better public services through business transformation." February 20 2014 http://www.ssc.govt.nz/bps-result9-cs3

40. Institute of Public Administration, NZ "Project Compass' Points IPONZ in the Right Direction" *Public Sector Journal*, April 2014 https://www.ipanz.org.nz/Category?Action=View&Category_id=225

41. ibid

42. IPONZ, "Annual Report for the Year Ending 30 June 2014," 2014, http://www.iponz.govt.nz/cms/pdf-library/iponz/annual-reports/IPONZ%20Annual%20Report%202014.pdf

43. State Service Commission, "Interaction With Government" last updated August 8, 2017, http://www.ssc.govt.nz/bps-improving-interaction-government

44. Inland Revenue, "Better for customers: SMEs' compliance costs in 2016," November 2016, pp. 1, https://www.ird.govt.nz/resources/b/6/b6c8237c-9646-4cd2-bbdb-f73383842ce1/sme-compliance-costs-2016-full-report.pdf

45. "R9 Acceleratot – Vizbot," posted by Ministry of Business, Innovation and Employment on July 22, 2015 https://www.youtube.com/watch?v=-klx9n37x3s

46. MBIE, "What We've Done", last updated December 24, 2015 http://www.mbie.govt.nz/info-services/business/better-for-business/what-weve-done

47. Nick Docherty, Rebecca Harris, Will Hodge, and Jane Dorset, "How One Word Helped Saved a Thousand Lives", 2010, United Kingdom Department for Transport,

48. OECD Publishing, "Behavioral Insights and Public Policy: Lessons from around the world," March 2017, pp. 332, http://www.keepeek.com/Digital-Asset-Management/oecd/governance/behavioural-insights-and-public-policy_9789264270480-en#page1

49. ibid

50. "Leading Finland's Transport Revolution," *ITS International*, June 2017, http://www.itsinternational.com/sections/comment-interview/interviews/leading-finlands-transport-revolution/.

51. Ministry of Industry, Business and Financial Affairs, "Strategy for Denmark's Digital Growth," January 2018, pp.52, https://em.dk/english/~/media/files/2018/digital-growth-strategy-report_uk_web.ashx?la=en

52. ibid

53. ibid

54. Marc Scribner, "NHTSA Releases Improved Federal Automated Driving System Guidance," *Competitive Enterprise Institute*, https://cei.org/blog/nhtsa-releases-improved-federal-automated-driving-system-guidance

55. Sarah Holder, "Feds to Self-Driving Car Makers: Regulate Yourself," *City Lab*, September 15, 2017, https://www.citylab.com/transportation/2017/09/feds-to-self-driving-car-makers-regulate-yourself/539829/

56. Canadian Security Administrators, "CSA Regulatory Sandbox," https://www.securities-administrators.ca/industry_resources.aspx?id=1588,

57. Cision, "The Canadian Securities Administrators Launches a Regulatory Sandbox Initiative," February 23, 2017, https://www.newswire.ca/news-releases/the-canadian-securities-administrators-launches-a-regulatory-sandbox-initiative-614619474.html

58. Cision, "1st Legal ICO in the Americas: Impak Coin Raises Over $1M Up-to-Date for Social Good," September 5, 2017, https://www.newswire.ca/news-releases/1st-legal-ico-in-the-americas---impak-coin-raises-over-1m-up-to-date-for-social-good-642725773.html.

59. Jack Coles, Peter Reeves and Georgina Willcock, "Regulator in Quebec Accepts ICO into Regulatory Sandbox," *Lexology*, September 19, 2017, https://www.lexology.com/library/detail.aspx?g=ee27af77-82b2-458d-aa60-d78250ac42d6.

60. Aaron Boyd, "10 Drone Programs Get Federal OK To Break The Rules," *NextGov*, May 9, 2017, https://www.nextgov.com/emerging-tech/2018/05/10-drone-programs-get-federal-ok-break-rules/148098/

61. Ibid

62. United Kingdom Financial Conduct Authority, "Regulatory Sandbox," November 5, 2015, https://www.fca.org.uk/firms/regulatory-sandbox.

63. Financial Conduct Authority, "Regulatory Sandbox Lessons Learned Report," October 2017, pp. 5-6, https://www.fca.org.uk/publication/research-and-data/regulatory-sandbox-lessons-learned-report.pdf.

64. Ibid.

65. Ibid, p. 11.

66. Speech by Andrew Hauser, executive director, banking, payments and financial Resilience, Bank of England, "The Bank of England's FinTech Accelerator: what have we done and what have we learned?," Oct. 6, 2017, https://www.bankofengland.co.uk/-/media/boe/files/speech/2017/the-boes-fintech-accelerator-what-have-we-done-and-what-have-we-learnedpdf?la=en&hash=F4068A80F87E00D783B96C0157D4B4FE10A9AA52, accessed Feb. 21, 2018.

67. Ofgem, "The Innovation Link," https://www.ofgem.gov.uk/about-us/how-we-engage/innovation-link, accessed, May 11, 2018

68. Peter Hsu, "Rashid Bahr, "Switzerland: Fintech rules based," *International Financial Law Review*, August 24, 2017 http://www.iflr.com/Article/3745366/Switzerland-Fintech-rules-eased.html

69. Land Transport Authority, " NTU, LTA and JTC Unveil Singapore's First Autonomous Vehicle Test Centre," November 22, 2017, https://www.lta.gov.sg/apps/news/page.aspx?c=2&id=10ceddae-472a-4920-8d4c-e73babfcecb0

70. ibid

71. ibid

72. National Transport Commission Australia, *Regulatory Reforms for Automated Vehicles*, November 2016, pp. 22, 29, https://www.ntc.gov.au/Media/Reports/(32685218-7895-0E7C-ECF6-551177684E27).pdf.

73. National Transportation Commission Australia, "Would You Travel in an Automated Vehicle?" May 4, 2018, https://www.ntc.gov.au/about-ntc/news/media-releases/would-you-travel-in-an-automated-vehicle/.

74. Food and Drug Administration, "Digital Action Plan," https://www.fda.gov/downloads/MedicalDevices/DigitalHealth/UCM568735.pdf.

75. Byler, et al, "Reimagining Digital Health Regulation: An Agile Model for Regulating Software in Health Care," p. 13.

76. Michael Flowers, "Chapter 15. Beyond open data: The data-driven city," *Beyond Transparency: 2013 Code for America*, October 16, 2013, http://beyondtransparency.org/chapters/part-4/beyond-open-data-the-data-driven-city/.

77. Alex Howard, "Predictive data analytics is saving lives and taxpayer dollars in New York City," *O'Reilly Radar*, June 26, 2012, http://radar.oreilly.com/2012/06/predictive-data-analytics-big-data-nyc.html.

78. Author interview with Michael Flowers, December 11, 2014.

79. Viktor Schönberger and Kenneth Cukier, "Big data in the Big Apple," *Slate*, March 6, 2013, www.slate.com/articles/technology/future_tense/2013/03/big_data_excerpt_how_mike_flowers_revolutionized_new_york_s_building_inspections.html.

80. Flowers interview.

81. FDNY Foundation, "FDNY records first month with zero fire-related deaths in department history," July 5, 2015, www.fdnyfoundation.org/fdny-records-first-month-with-zero-fire-related-deaths-in-department-history/.

82. The White House, "The Framework for Global Electronic Commerce," https://clintonwhitehouse4.archives.gov/WH/New/Commerce/.

83. Financial Conduct Authority, "Model driven machine executable regulatory reporting," November 1, 2017, https://www.fca.org.uk/firms/our-work-programme/model-driven-machine-executable-regulatory-reporting

84. Financial Conduct Authority, "Call for Input: Using technology to achieve smarter regulatory reporting," February 2018, https://www.fca.org.uk/publication/call-for-input/call-for-input-smarter-regulatory-reporting.pdf

85. Ron Cheng, "Open E-Commerce Data Flows in the New Non-US TPP," March 14, 2018, *Forbes*, https://www.forbes.com/sites/roncheng/2018/03/14/open-e-commerce-data-flows-in-the-new-non-us-tpp/#7fdb96d1663e

86. Mathew P. Goodman, "From TPP to CPTPP," March 8, 2018, Center for Strategic & International Studies, https://www.csis.org/analysis/tpp-cptpp

87. New Zealand Foreign Affairs and Trade, "Electronic Commerce," pp.7, https://www.mfat.govt.nz/assets/Trans-Pacific-Partnership/Text/14.-Electronic-Commerce-Chapter.pdf, accessed May 31, 2018

Deloitte.