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R²A

REGTECH FOR REGULATORS
ACCELERATOR

Financial Authorities in the Era of Data Abundance

RegTech for Regulators and SupTech Solutions

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August 2018

The RegTech for Regulators Accelerator (R^2A)

The RegTech for Regulators Accelerator (R^2A) partners with leading financial sector authorities to pioneer the next generation of tools and techniques for regulation, market supervision, and policy analysis. Accessing new datasets and analyzing available data more effectively allows financial authorities to establish a body of knowledge and evidence to drive smart policy reforms that promote financial inclusion and ensure financial stability, integrity, and consumer protection. R^2A accelerates these advances by helping authorities re-imagine how they collect and manage data, and by prototyping new solutions that strengthen their capabilities. Through R^2A, partner financial authorities seek to harness technology to improve the speed, quality, and comprehensiveness of information in support of targeted, risk-based decision-making.

Launched in October 2016, R^2A has already partnered with the Bangko Sentral ng Pilipinas (BSP) and the Mexican Comisión Nacional Bancaria y de Valores (CNBV) to develop and test next-generation prototypes that can serve as examples for other supervisors and regulators. R^2A also engages closely with technology innovators to create structured opportunities for them to propose solutions and collaborate with financial authorities in the design and testing of promising ideas.

Acknowledgements

BFA received valuable support and contributions from its stakeholders and partners in drafting this white paper. We would like to thank in particular our outstanding group of reviewers, in alphabetical order: Malika Anand, Dirk Broeders (De Nederlandsche Bank), Christopher Calabia (Bill & Melinda Gates Foundation), Nick Cook (Financial Conduct Authority), Denise Dias, Jon Frost (Bank for International Settlements), Matt Homer, Juan Carlos Izaguirre (CGAP), Ivo Jenik (CGAP), Rosita Najmi, (Bill & Melinda Gates Foundation), Paul Nelson (USAID), Jermy Prenio (Bank for International Settlements), Pia Bernadette Roman-Tayag (Bangko Sentral ng Pilipinas), and Bart van Liebergen. A special thank you to the team at BFA who have made R^2A a reality and to Daryl Collins and David Porteous, who paved the way for our work designing the BFA "solution creation" approach.

We would also like to thank the teams at Bangko Sentral ng Pilipinas (BSP) and Comision Nacional Bancaria y de Valores (CNBV) that collaborated in the R^2A process led by BSP Governor Nestor A. Espenilla Jr. and CNBV President Bernardo González Rosas.

We are grateful for the trust and guidance provided the Bill & Melinda Gates Foundation, Omidyar Network, and the U.S. Agency for International Development and in particular (in alphabetical order) Kwasi Donkor, Matthew Homer, Kabir Kumar, Abed Mutemi, Rosita Najmi, Paul Nelson, and Chris Page.

R^2A is sponsored by

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Executive summary

Digitization in the financial sector is driving product and service innovation at a furious pace, from the rapid adoption of mobile money in Africa to the viral spread of cryptocurrencies across the world. This rapid transformation stands in stark contrast to the comparatively slow adaptation of financial regulatory and supervisory processes to today's needs. In general, the information technology (IT) systems currently employed by financial authorities to capture, store, and render data from financial service providers (FSPs) and other sources were not designed for the latest generation of digital products, platforms, and providers that rely on Big Data. As these continue to proliferate across and within financial sectors, the capacity of existing data architectures to fully absorb and digest the data that digital financial services (DFS) generate is steadily diminishing.

Data overload threatens to undermine the efforts regulators and supervisors to fulfill their respective mandates. In the context of growing demands on financial authorities to pursue objectives beyond financial stability, such as the safeguarding consumer protection and guaranteeing financial market integrity, the limitations of existing data architectures are becoming ever more binding. Human-driven processing and antiquated technologies in data gathering, validation, storage, and analysis embed inefficiencies that erode analytical capabilities. Their prevalence can lead to lengthy delays in regulatory reporting, supervisory blind spots, and minefields of operational risks. As a result, supervisors may be too late in seeing signs of stress in the financial system or miss the underlying causes. They may also lack the evidence base upon which to craft appropriate policies and strategies that further competition, innovation, and inclusion.

New solutions are emerging to help financial authorities upgrade the speed and capabilities of their systems and allow them to turn the data tide in their favor. These technologies include application programming interfaces (APIs), artificial intelligence (AI), machine learning (ML), machine reading (MR), distributed ledger technologies (DLT), biometrics, natural language processing (NLP), Big Data analytics, smart contracts, cloud computing, cryptography, and others. These new tools promise the power to automate or accelerate manual processes, and to generate far better insights that might otherwise escape or exceed human capabilities.

Technology solutions for regulators (RegTech for Regulators or "RegTech^2") and supervisors ("SupTech") enhance the capabilities of financial authorities to meet the challenges posed by digitization and globalization of the marketplace as well as the expansion of their mandates. They lend themselves especially well to the implementation of data-intensive, risk-based supervision. They do so by furnishing authorities with tools that can capture larger and richer datasets from more varied sources, automate and accelerate administrative procedures, and extract deeper meaning from their data than was hitherto possible.

This potential is already being unlocked. R^{2}A prototypes for financial authorities in Mexico, Nigeria, and the Philippines – outlined in this paper – demonstrate how RegTech^2 and SupTech help to ensure financial stability, fight financial crime, and promote good market conduct, competition, financial inclusion, and innovation. The adoption of RegTech^2 and SupTech can also have positive spillovers on market efficiency, consumer welfare, and governance. These stem from their potential to lower transaction costs for individuals and firms seeking to enter the financial service market, as well as their ability to reduce information asymmetries between regulator, providers, and consumers. In short, the embrace of the innovative solutions outlined in this white paper show that regulators and supervisors can themselves leverage and stimulate – rather than be threatened by – the innovation unfolding in their sectors and ensure that it contributes to resilient, fair, and secure financial systems that contribute to social and economic development.

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Introduction

In the past decade, financial service providers (FSPs) have successfully transformed their business models to satisfy a growing base of "digital-first" customers, and developed accessible products geared toward mass markets. Many FSPs have invested in new information technology (IT) infrastructure, re-engineered their data architectures, and sharpened their analytical tools to lower costs and deliver solutions that suit the needs of diverse customer groups. In doing so, they are taking advantage of new opportunities and efficiency gains made possible by improved connectivity, the growth in computing power, and the application of artificial intelligence (AI) and Big Data.

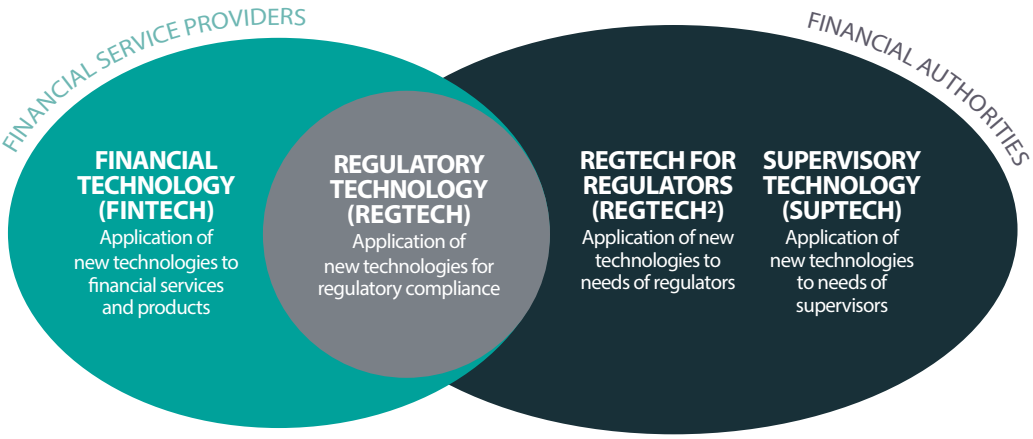
The digitization of finance is generating a wealth of new data about financial ecosystems and their users. Properly mined with technologies such as machine learning (ML), these growing reservoirs of data are revealing previously hidden patterns of consumer behavior and financial activity. The resulting insights and predictions are dramatically improving the accuracy and efficiency of processes such as loan approval, risk assessment, and fraud investigation.[1] Distributed ledger technology, natural language processing, cognitive computing and other applications are further shaking up large swathes of finance, from asset and credit risk management to fraud prevention.

The need to contain burgeoning compliance costs and rising legal and reputational risks has been another impetus for FSPs to embrace innovative technological solutions to their regulatory challenges. Fines for compliance lapses have continued to mount after the terrorist attacks of September 11, 2001 and the global financial crisis. FSPs have massively expanded their compliance departments in recent years.[2] In response, many are turning to new regulatory technologies ("RegTech") to ease the regulatory burden and streamline reporting processes.

The rapid growth and development of financial technology ("Fintech") and RegTech is widening the technological divide between innovative FSPs and their regulators and supervisors. Established approaches to regulation and supervision are becoming outmoded amid the proliferation of new Fintech products, platforms, and providers. The data architectures of financial authorities that were built around relatively low-frequency, low-volume supply-side data (i.e., data that FSPs report periodically to comply with regulatory requirements) are having difficulty absorbing the flood of regulatory data unleashed by digitization. Established tools such as Excel spreadsheets struggle to run the complex risk models needed to adequately assess the health of the financial sector. As digital financial flows become faster and penetrate ever deeper into all areas of economic life, the timeliness of regulatory reporting and analysis will have a greater bearing on the authorities' ability to contain systemic risks. Likewise, as customers continue to embrace digital financial services (DFS) with alacrity, any undue delay in updating supervisory approaches risks creating gaps in consumer protection.

To plug potential gaps in oversight and keep up with market developments, financial authorities are turning to the same innovative technologies that are transforming the financial industry. New technologies for regulators ("RegTech for Regulators" or "RegTech^2," as opposed to RegTech for FSPs), and supervisors ("SupTech") enable financial authorities to handle more data and extract new, richer, and timelier insights. RegTech^2 and SupTech can help them to comply with their mandates, while accommodating new players under their purview and meeting the evolving needs of consumers.

Figure 1: Overlapping worlds of tech



While acknowledging that there are risks and challenges to adopting any new technology, this white paper argues that RegTech^2/SupTech's potential to increase access to financial services and consumer protection, improve financial stability and integrity, and create a more supportive regulatory environment for innovation is immense. If realized, this potential can benefit financial authorities, consumers, and FSPs alike.

The first section lays out the challenges that financial authorities face in safeguarding the soundness of their financial systems given the growing demands on their mandates, the evolving nature of financial services, and the pressures of digital financial globalization. The second section highlights some of the benefits that such an approach can deliver. The third section looks at use-cases of RegTech^2/SupTech, both real and possible. The fourth section examines potential risks surrounding these technologies together with the challenges authorities might face in implementation. Finally, the fifth section offers some examples of current efforts to deploy RegTech^2/SupTech applications in Mexico, Nigeria, and the Philippines.

1 Emerging Challenges Facing Financial Authorities

1.1 An expanded, increasingly digital regulatory and supervisory remit

The frenetic growth of DFS and the cross-border, cross-sector reach of many digital platforms and instruments have wrought new challenges for financial sector regulators and supervisors. The latter are particularly concerned about their capacity to oversee burgeoning Fintech industries with the current processes and tools at their disposal, as revealed in surveys and through engagements under the RegTech for Regulators Accelerator (R^2A) initiative.[3]

The digital financial industry has grown prodigiously over the past three decades, especially in economies where mobile money has taken off.[4] In Kenya, for example, the value of mobile money transactions increased from 7 percent of gross domestic product (GDP) in 2007 to nearly 50 percent in the decade to 2017 thanks in large part to the ubiquity of mobile phones and improved connectivity.[5] Financial authorities in Africa, Asia, and Latin America have licensed hundreds of new digital FSPs in recent years, thereby expanding the supply of formal financial services and supporting innovation.[6]

This wave of technology-driven innovation is expanding financial access for consumers at "the bottom of the pyramid," bringing hundreds of millions of first-time users into the formal financial system. The World Bank Findex found that, between 2011 and 2017, more than 1.2 billion new account holders globally entered the formal financial system.[7] The influx of new Fintech product offerings promises to democratize the financial industry further by increasing competition and choice, lowering transaction costs and prices for customers, and broadening reach. Superplatforms such as Facebook, Google, and Alibaba (also known as "TechFins") are making inroads in the payments space and have their sights set on other services.[8]

The rapid pace of digitization and financial innovation contrasts with the relatively slow adaptation of regulatory and supervisory methodologies and technologies. The data architectures – i.e., the collection of systems and processes that capture, store, and render data from supervised financial institutions for purposes of regulatory compliance – that undergird most of financial oversight nowadays are becoming increasingly outmoded. Having been designed around data that was relatively low-frequency and low-volume, they now struggle to absorb the surfeit of data being generated by DFS, and are unable run the complex Big Data models needed to adequately supervise digital FSPs. Thus, the relatively limited memory and processing power of existing data transmission channels (e.g., email or courier), databases (on-site servers or compact discs), and analytical tools (usually Excel spreadsheets) are becoming binding constraints for supervisors (see Box 1 below).

For many supervisors, the influx of new digital FSPs aggravates existing pain points in their data architecture. From prudential supervision, to anti-money laundering and combating the financing of terrorism (AML/CFT), to consumer protection, supervisors contend with embedded inefficiencies and blunt analytical tools (see Section 5 for real-world case studies). The prevalence of manual processing and antiquated technologies in regulatory data extraction, validation, storage, and analysis leads to long reporting lags, regulatory blind spots, and minefields of operational risks. As a result, supervisors may register signs of stress in the financial system too late and at an overly high level of analysis, making it difficult to identify and address their causes. Moreover, operational risks imply that problems may be self-inflicted – for instance, if the central bank itself becomes the victim of a hack, as occurred at the central bank of Bangladesh in 2016.[9] Time-consuming and resource-intensive manual processes also detract from analysis and policymaking, including the approval of new business models and products. The upshot is that supervision is rendered more retrospective and reactive.

The reasons for the observed divergence in technological readiness are manifold, ranging from "sticky" legacy IT systems, a dearth of human resource capacity, and coordination failures among government agencies. They also reflect the changing nature and expanding mandates of financial supervisory and regulatory authorities. Until the mid-1990s, financial authorities were primarily tasked with ensuring price stability and preserving the soundness of the financial system. At the end of the 1990s, and especially after 9/11 and the 2008/2009 global financial crisis, their mandates started to incorporate additional agendas such as financial integrity,[10] consumer protection, and competition, in part because the global financial crisis showed them to be intertwined with financial stability.[11] Financial inclusion also became a prominent focal point, with many countries making international commitments[12] and drafting national strategies to that end. Together these additional objectives have added to the demand on scarce resources within the regulatory and supervisory institutions.

1.2 Financial globalization and cross-border supervision

The digital financial products that are coming to market are by their nature more fluid than their earlier counterparts in that they cross national and industry borders more seamlessly and cheaply. Digital platforms such as TransferWise are providing peer-to-peer, cross-border payments at a fraction of the time and cost of direct wire transfers, while those like BitPesa provide similar services for business-to-business needs.[13] In some cases (e.g., cryptocurrencies), these products can circumvent established exchanges and capital controls altogether.

DFS are also broadening participation in international financial markets by enabling a wider array of consumers – including small- and medium-sized enterprises, artisans, freelancers, and the like – to transact internationally. Whereas cross-border finance was once the preserve of governments, multinational corporations, and major financial institutions, today virtually anyone can lend to or borrow from abroad via peer-to-peer platforms such as Kiva, CrowdCredit, and Zopa.[14]

The sums sent through innovative digital cross-border channels are still small compared to traditional electronic fund transfers (i.e., banks and international money transfer houses), but they are growing rapidly.[15] Indeed, whereas the volume of global gross capital flows has fallen by two-thirds since the global financial crisis in 2009 amid a retrenchment in global correspondent banking, the trend in Fintech flows has been accelerating.[16] These digital platforms for cross-border payments, remittance transfers, lending, and trade finance are proliferating in both mature and low-income markets. They are being joined by TechFin superplatforms such as Facebook, which, for instance, obtained an e-money license from the Central Bank of Ireland in 2016 that allows it to provide payment services across all 27 EU member states.[17]

Faced with increasing digital disintermediation of relatively concentrated, protected lines of business, traditional players such as banks and insurance companies are investing heavily to catch up. In 2016, for instance, JP Morgan Chase spent US$600 million on Fintech solutions to improve its mobile and digital offerings.[18] Moreover, as banks incorporate new solutions to manage AML/CFT risks and modernize trade finance, the de-risking trend in correspondent banking underway for the past decade may well reverse.[19] This may add further momentum to the wave of digital financial globalization currently confronting financial authorities.

Digitization is set to increase the velocity, volume, and volatility of cross-border capital flows, which could put countries' balance of payments and exchange rates under greater pressure. The implications for prudential oversight are still unclear. In order to preserve policy effectiveness and mitigate emerging risks to financial stability, regulators and supervisors may need to collaborate and coordinate more closely with one another. As the International Monetary Fund (IMF) cautions:

> *"As new technologies operate seamlessly across borders, international cooperation is essential to ensure effective regulation. At present, there is little consistency in regulatory approaches across jurisdictions. This may undermine regulation at the national level and create incentives for regulatory arbitrage. Greater harmonization between national regulatory frameworks would help level the playing field and facilitate the adoption of these technologies on a global scale."* [20]

Bilateral and multilateral initiatives are already underway to improve international cooperation. For instance, the Australian Securities and Investment Commission (ASIC) has signed agreements with the UK Financial Conduct Authority (FCA) to share information between their respective "Innovation Hubs."[21] International standard setters such as the Financial Action Task Force on Money Laundering (FATF), the Basel Committee on Banking Supervision and the Committee on Payments and Market Infrastructures coordinate common approaches and issue guidance on preserving financial integrity and stability in a globalized, digital-first world.[22]

In order for these regulatory and supervisory efforts to match the speed and scale of the technological changes underfoot, greater exchange of data and intelligence plus integration of data architectures between authorities will be necessary. This, in turn, will necessitate RegTech[2] and SupTech solutions that can communicate as seamlessly as the financial products they oversee.

Box 1: R²A Survey - Rising Demand for Superpowers

The RegTech for Regulators Accelerator (R²A) has conducted a survey of twelve financial authorities representing nineteen countries to understand their regulatory data realities, needs, and challenges.

Their responses indicate that financial authorities are eager to acquire "superpowers" that would allow them to enhance data analytics, automate data validation processes, and improve security of data validation.

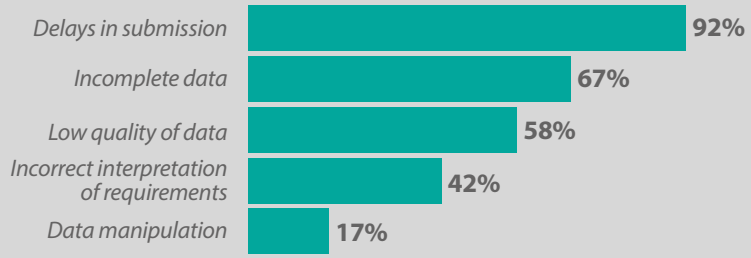
According to the survey, improvements in the quality of collected data and data analytics will have an impact on financial inclusion and customer protection, among other policy objectives.[i]

[i] Additional information is available on the R²A website at www.R2Accelerator.org.

Key findings:

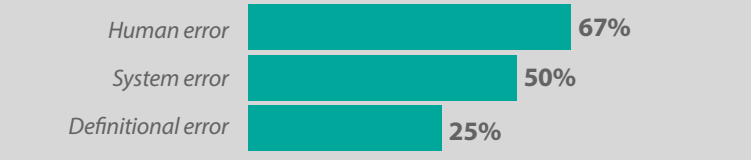
- Financial authorities are still transmitting data from reporting institutions by post/courier, email, and data portals that possess security risks and affect the processing speed.
- Extensible Markup Language (XML) is the most commonly used data collection and exchange protocol given its simplicity and generality.
- Financial authorities have an opportunity to amass huge amounts of data to monitor key risk metrics and identify early signs of stress from monthly or quarterly collection of prudential, transactional, and statistical data.
- However, delays in report submission, incomplete data, and low-quality data make it difficult to generate real-time analytics. Instead, analytics are backward-looking and reactive.
- Most financial authorities use Excel spreadsheets to analyze data even though Excel is not designed for processing large datasets and complex analytics.
- The greatest challenges faced by financial authorities are time consuming data validation, lack of appropriate analytical tools, and insufficient human resources with data analytics skills.

Data collection challenges



Responses % of financial authorities

Data validation challenges



Responses % of financial authorities

2 RegTech²/SupTech Opportunities

2.1 Augmenting the capabilities of financial authorities

RegTech[2] and SupTech solutions enhance the capabilities of financial authorities to meet the challenges posed by digitization and digital globalization as well as the expansion of their mandates. They lend themselves especially well to the implementation of new data-intensive, risk-based supervision. They do so by furnishing authorities with tools that can (i) capture larger and richer datasets from more varied sources, (ii) automate administrative procedures, and (iii) digitize, accelerate and augment their analytical capabilities. A sample of these tools and their applications is presented later in Section 3.

Through RegTech[2]/SupTech, financial authorities can generate deeper insights and exploit ecosystem linkages that benefit all their main competences, including financial stability, fighting financial crime, market conduct, competition dynamics, financial inclusion and innovation. The adoption of RegTech[2] and SupTech can also have positive spillovers on market efficiency, consumer welfare, and governance (see Theory of Change below). These stem from their potential to lower transaction costs for individuals and firms seeking to enter the financial service market, and their ability to reduce information asymmetries between regulators, providers, and consumers. Some of the benefits that might flow from the adoption of new technology are critical for better supervision of the financial sector – both at country level and across borders – while others extend to the development of new policy and regulatory approaches and open data platforms.

More proactive, evidence-informed policy and regulatory approaches

An enabling regulatory environment is crucial to allowing inclusive and resilient business models to emerge and flourish. RegTech[2]/SupTech solutions can increase the evidence base for policy development and rule-making. Richer datasets allow for more sophisticated modeling and impact analysis when defining prudential requirements, for example. Adding new channels of data collection can improve the feedback loop between financial authorities, FSPs, and consumers. For instance, new means of collecting and analyzing customer feedback (e.g., chatbots) and understanding their behaviors (e.g., AI) can give consumers a louder voice in shaping regulation. Such inputs could induce more user-friendly and consumer-oriented regulation. RegTech[2]/SupTech solutions can also streamline licensing and compliance procedures of firms seeking to enter new markets or lines of business, thereby further lowering the regulatory barriers to entry.

RegTech[2]/SupTech can also help to craft smarter policies to drive financial inclusion and close the gender gap. Access to richer supply-side data adds context and color to demand-side surveys on financial inclusion, thus painting a more holistic and nuanced picture of the degree of financial exclusion in a given market. Such data can then serve as quantifiable benchmarks against which to measure progress towards financial inclusion goals. For instance, disaggregating high-quality supply-side data by sex (e.g., how many men and women are reached by a given channel or product) can expose gender gaps in financial service delivery, which can then be triangulated with data from customer complaints to understand and address barriers to usage. Since women are excluded from the financial system at a higher rate than men, targeting gender-based measures could yield disproportionate returns to investment in financial inclusion programs.[23]

More responsive, efficient, and effective supervision

With more powerful analytical tools, richer data, and smarter visualizations at their disposal, financial authorities can be more thorough in their oversight of the market and more targeted in the allocation of resources for on-site inspections. Technology-enabled, data-driven, risk-based supervision is more proportional to the risk profile and systemic importance of the entities being

supervised. This should make compliance less onerous for smaller and simpler providers, and free up time and resources for the supervisors to oversee a wider array of service providers and probe deeper into their operations.

Access to richer data and better analytics helps supervisors monitor and enforce regulatory compliance more effectively. Mining customer complaints data, for example, can uncover anti-competitive behavior and market misconduct where once these may have gone unnoticed (see section 5.1 and Snapshot - SupTech Enables Mexican Pension Supervisor to Catch Collusion Among Pension Providers). From an AML standpoint, ML can reveal patterns of suspicious financial behavior that are practically imperceptible by traditional detection methods (see section 5.3). SupTech applications can also enable prudential supervisors and payment system overseers to track key risk metrics and performance indicators (e.g., FSP's solvency and liquidity ratios, payment failure rates and settlement times, etc.) more frequently and precisely (see sections 5.2 and 5.4), which in turn facilitates timelier and more targeted supervisory interventions.

Better cross-sector, cross-border collaboration

RegTech²/SupTech solutions have the potential to improve and harmonize the collection, storage, and transfer of data securely between departments and across jurisdictions. Such data sharing is increasingly needed as digital financial globalization advances and authorities are compelled to coordinate policies and market interventions. RegTech²/SupTech can provide centralized (i.e., one data warehouse) or decentralized models (different databases with compatible protocols and formats) to integrate datasets from different sources.

As the volume of data available increases and the capabilities of machine learning improve, RegTech²/SupTech algorithms will gain currency in collaborations between financial authorities. By sharing the underlying algorithms, financial authorities will be able to validate their successes while enjoying access to a community that might suggest improvements and share algorithms of their own. Ultimately, such collaboration will allow authorities to leverage larger data-sets in developing and training more effective algorithms.

Drive market development by lowering compliance costs

RegTech²/SupTech solutions can streamline licensing and compliance procedures of firms seeking to enter new markets or lines of business, thereby directly lowering regulatory barriers to entry.

Moreover, a financial authority that handles richer and more up-to-date datasets can make insights available to the FSPs and (current and potential) users of financial services through open data portals. Providing valuable market intelligence to FSPs is a powerful way to spur the innovation of more inclusive business models and products. For example, opening customer complaints data can shed light on unmet or poorly served needs, possibly prompting a rethink of business strategy or sparking the creation of new products or services.

Financial authorities can provide open datasets that both new entrants and incumbents can mine to improve their relative competitiveness by extracting strategic insights about market dynamics and new opportunities to grow market share. For instance, analytical overlays such as geo-tagged payments data on maps (see the Nigeria data stack example below) can reveal gaps in a providers' network coverage or untapped pockets of demand. Without open data, firms have to rely on costlier or lower-quality sources for their business intelligence, such as in-house research teams or private data providers. This puts smaller and under-resourced providers at a disadvantage, undermining competition.

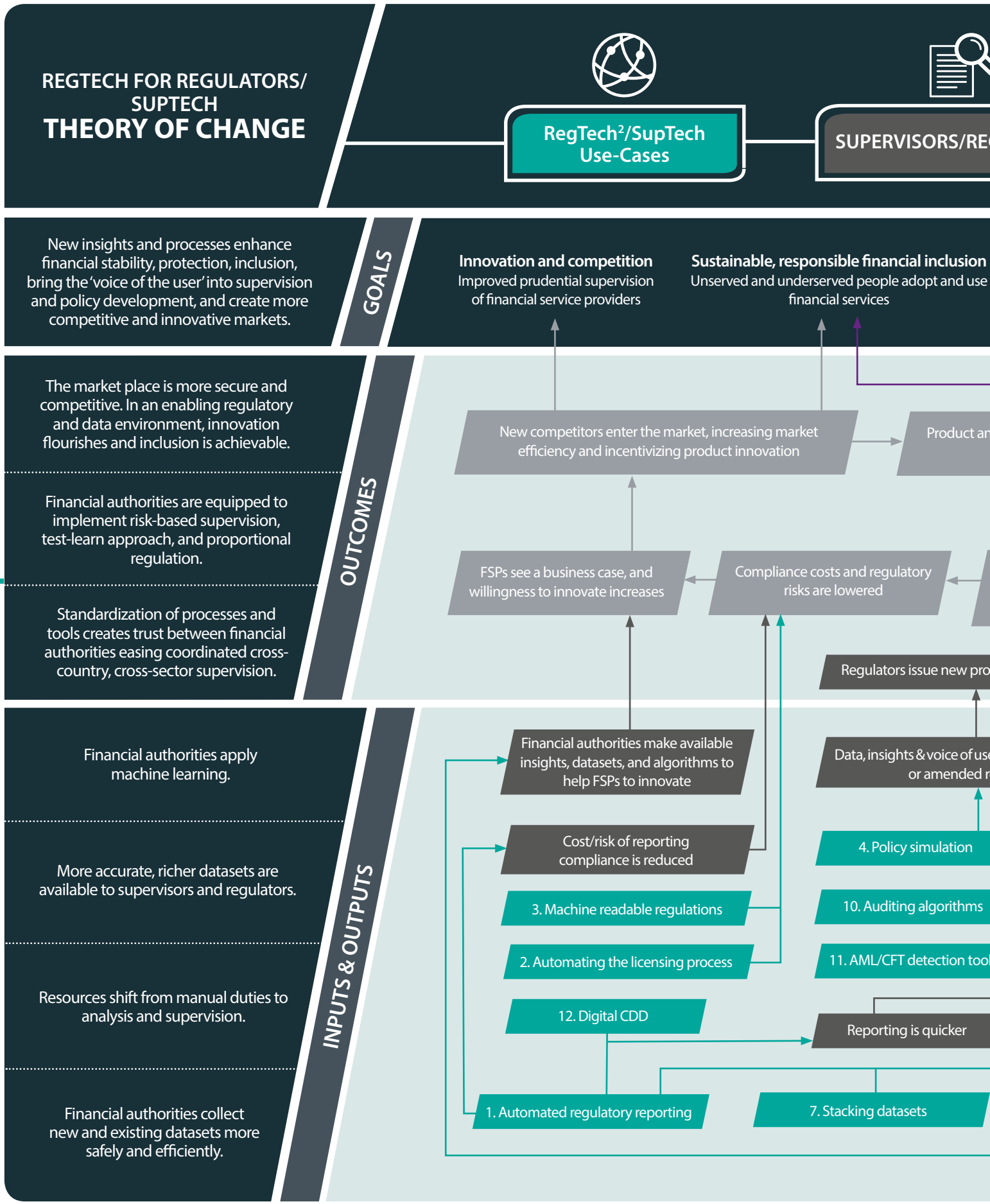
Box 2: Snapshot - SupTech Enables Mexican Pension Supervisor to Catch Collusion Among Pension Providers

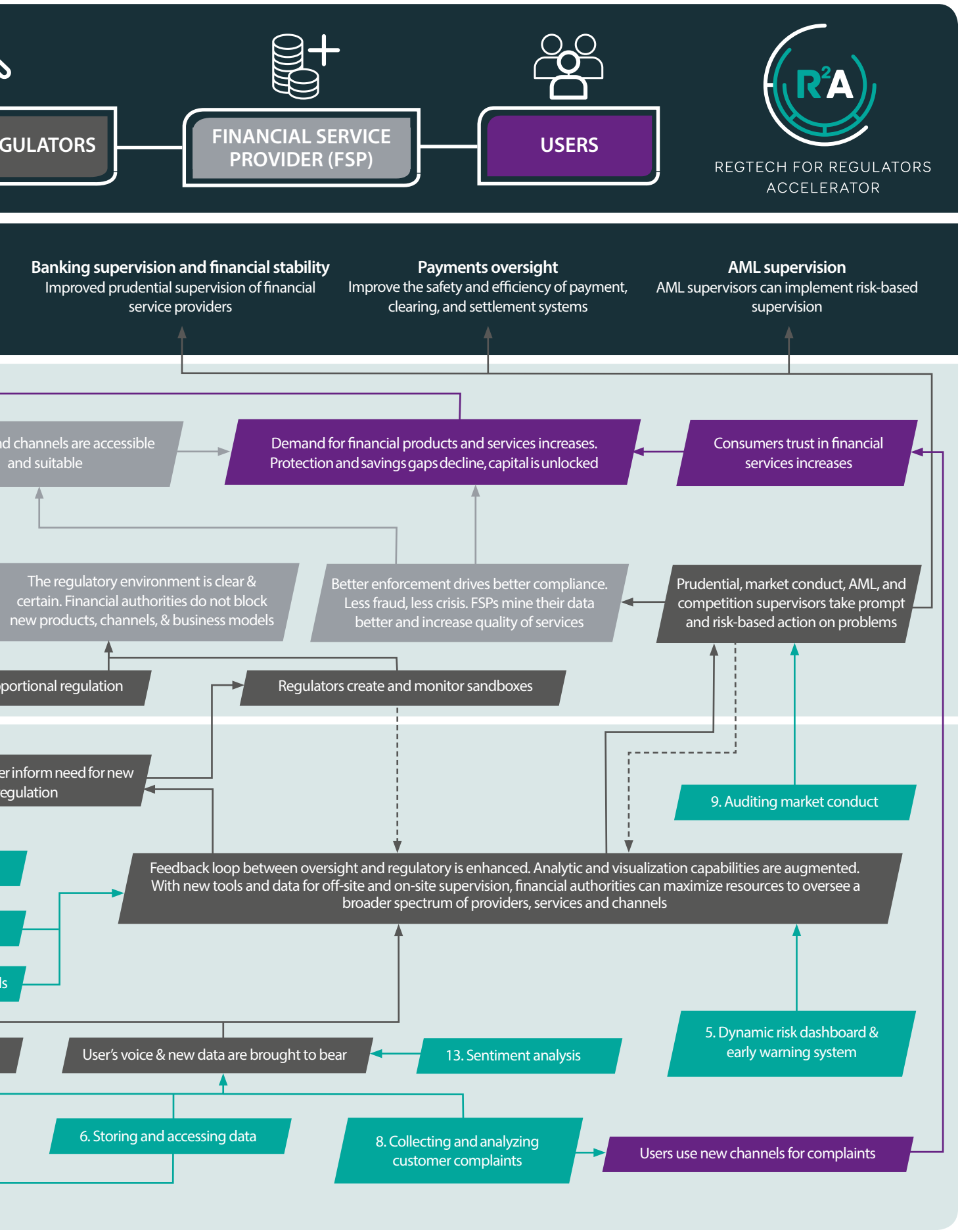
Mexico's National Commission for the Pension System (Consar) launched an initiative in 2013 to fortify the pension system against emerging fraud risks and to promote financial inclusion. The impetus came from the growing burden on the traditional pension supervision model, which was ill-equipped to meet emerging cybersecurity challenges given its antiquated processes and systems. It also arose from the need to curb anti-competitive practices in the retirement savings system as well as to address the country's widening pension savings and coverage gaps.

Digitization was a major thrust of the reform effort. By replacing paper-based processes with digital documents and identities, Consar greatly increased its capacity to monitor compliance and prevent fraud. In particular, online information processing and multi-factor digital authentication (voice and fingerprints) helped Consar to detect and clamp down on widespread mis-selling and identity theft by agents. Better supervision also enabled Consar to spot collusion between several major pension fund administrators (known as afores), which on several occasions between 2012 and 2014 conspired to prevent participants from switching between funds. As a consequence, in 2017 the competition authority levied the biggest-ever fine (1.1 billion Mexican pesos) on four of the largest afores.

To attract previously excluded populations (e.g., migrants, domestic workers, the self-employed) into the retirement system and to incentivize voluntary savings generally, Consar introduced a mobile application (AforeMóvil) that streamlined the processes of opening an individual savings account, making contributions, and viewing and updating account information, as well as basic pension planning.

As for encouraging greater competition among Mexico's afores, Consar used enhanced digital data analytics to monitor competitive dynamics, and open data platforms to strengthen market discipline. For instance, an online risk dashboard and company snapshots now allow users to compare the financial performance and risk-return profiles of all afores in the system. This helps consumer make more informed decisions about their choice of pension administrator and also encourages the afores to focus on customer satisfaction and competition.


REGTECH FOR REGULATORS/ SUPTECH
THEORY OF CHANGE
RegTech²/SupTech Use-Cases
SUPERVISORS/RE
New insights and processes enhance financial stability, protection, inclusion, bring the 'voice of the user' into supervision and policy development, and create more competitive and innovative markets.
GOALS
Innovation and competition
Improved prudential supervision of financial service providers
Sustainable, responsible financial inclusion
Unserved and underserved people adopt and use financial services
The market place is more secure and competitive. In an enabling regulatory and data environment, innovation flourishes and inclusion is achievable.
Financial authorities are equipped to implement risk-based supervision, test-learn approach, and proportional regulation.
Standardization of processes and tools creates trust between financial authorities easing coordinated cross-country, cross-sector supervision.
OUTCOMES
New competitors enter the market, increasing market efficiency and incentivizing product innovation
Product an
FSPs see a business case, and willingness to innovate increases
Compliance costs and regulatory risks are lowered
Regulators issue new pro
Financial authorities apply machine learning.
More accurate, richer datasets are available to supervisors and regulators.
Resources shift from manual duties to analysis and supervision.
Financial authorities collect new and existing datasets more safely and efficiently.
INPUTS & OUTPUTS
Financial authorities make available insights, datasets, and algorithms to help FSPs to innovate
Data, insights & voice of use or amended r
Cost/risk of reporting compliance is reduced
4. Policy simulation
3. Machine readable regulations
10. Auditing algorithms
2. Automating the licensing process
11. AML/CFT detection tool
12. Digital CDD
Reporting is quicker
1. Automated regulatory reporting
7. Stacking datasets


GULATORS
FINANCIAL SERVICE PROVIDER (FSP)
USERS
R²A
REGTECH FOR REGULATORS ACCELERATOR
Banking supervision and financial stability
Improved prudential supervision of financial service providers
Payments oversight
Improve the safety and efficiency of payment, clearing, and settlement systems
AML supervision
AML supervisors can implement risk-based supervision
d channels are accessible and suitable
Demand for financial products and services increases. Protection and savings gaps decline, capital is unlocked
Consumers trust in financial services increases
The regulatory environment is clear & certain. Financial authorities do not block new products, channels, & business models
Better enforcement drives better compliance. Less fraud, less crisis. FSPs mine their data better and increase quality of services
Prudential, market conduct, AML, and competition supervisors take prompt and risk-based action on problems
portional regulation
Regulators create and monitor sandboxes
er inform need for new egulation
9. Auditing market conduct
Feedback loop between oversight and regulatory is enhanced. Analytic and visualization capabilities are augmented. With new tools and data for off-site and on-site supervision, financial authorities can maximize resources to oversee a broader spectrum of providers, services and channels
ls
User's voice & new data are brought to bear
13. Sentiment analysis
5. Dynamic risk dashboard & early warning system
6. Storing and accessing data
8. Collecting and analyzing customer complaints
Users use new channels for complaints

3 RegTech²/SupTech Applications

3.1 Solutions for the age of data abundance

The wealth of regulatory and supervisory data being generated by compliance reporting, consumer complaints, raw transactional data feeds, suspicious transaction reports, and so on often exceeds the processing power and storage capacity of conventional databases and analytics engines. These conventional methods tend to rely on in-house/on-site servers, desktop applications, and manual workarounds (i.e., human-based processes and tools to transfer, manipulate, or alter data used to be aggregated or reported), as opposed to cloud-based servers, web-based applications and automated processes.[24] Simply put: data is growing too rapidly, by too much, and in too many forms to be properly accommodated within the existing data architectures. This limitation can hamper the ability of regulators and supervisors to perform their duties, and exposes them to operational risks, which in turn may stifle the growth of digital financial services.

RegTech^2/SupTech solutions leverage innovative technologies to relieve pain points of traditional data architectures and mine new data sources. These include application programming interfaces (APIs), artificial intelligence (AI), machine learning (ML), machine reading (MR), distributed ledger technologies (DLTs), biometrics, natural language processing (NLP), Big Data analytics, smart contracts, cloud computing, cryptography, and the like. They confer the power to automate or accelerate manual processes, and to generate insights that may escape or exceed the capability of human analysis.

For the purposes of financial sector regulation and supervision, the possible applications are manifold – some that are already being deployed, others that are only in the exploratory or experimental stages of development. What follows is a list of actual and possible use-cases, although it is by no means exhaustive. Each use-case notes a particular challenge confronting regulators/supervisors and explores the corresponding opportunities presented by RegTech^2/SupTech solutions:

1. Automated regulatory reporting
2. Automating the licensing process
3. Machine readable regulation
4. Modeling policy simulations
5. Running dynamic risk dashboards, stress tests, and early warning systems (EWS)
6. Storing and accessing data
7. Stacking datasets
8. Collecting and analyzing customer complaints
9. Auditing market conduct
10. Auditing algorithms
11. Enhanced detection of money-laundering and financing of terrorism
12. Digital customer due diligence (CDD)
13. Sentiment analysis

1 Automated regulatory reporting

It is currently common practice for FSPs to fill out standard reporting templates – using Excel, txt, XML, etc. – on a daily, weekly, monthly, quarterly, or annual basis (depending upon the specific requirements for different products, types of data, and institutions) and submit these to the supervisor via mail, email, or data portals. This process is time-consuming, laborious, and vulnerable to operational and cybersecurity risks. Moreover, size and format constraints as well as security concerns can limit the granularity of the data and flexibility of the reports being submitted, and by extension, the insights that might be generated from them.

APIs can overcome this problem by allowing different systems to communicate and share data directly with one another, often in real time, without the need for a manual workaround or human intermediation. APIs that process and validate compliance submissions can free up significant time and resources currently dedicated to manual validation and aggregation on both the sending and receiving ends. Indeed, given their central role in feeding databases upon which much of the AI and Big Data applications run, APIs can be considered the backbone of RegTech² and SupTech.

API-based reporting is rapidly catching on. The Tanzania Communications Regulatory Authority has trialed a solution in which interfaces collect data at call data record (CDR) level from all mobile network operators. This system has been extended in partnership with tech-firm GVG's M3 software to include collection of real-time transaction-level data on mobile money. In some markets, entire banking business models are being built around the technology (i.e., "Open Banking").[25] In Rwanda and the Philippines, the central banks have developed API-based solutions to collect data from the supervised FSPs (see section 5.2).[26] In Austria, the central bank uses a reporting system that follows similar principles of automatization but is based on a datacube system.[27]

2 Automating the licensing process

Financial authorities are responsible for providing a clear and transparent framework that specifies the requirements to apply for and obtain an operating license. In practice, both the regulator and the regulated expend a significant amount of time and resources navigating labyrinthine application processes and parsing legal texts. Faced with ambiguity, providers may flood the licensing authorities with requests for clarification or guidance on the licensing requirements and procedures. When this guidance is not forthcoming, the cost, complexity, and uncertainty of the licensing process might deter potential entrants from applying.

AI could help to streamline the application and licensing processes and mitigate some of the related uncertainty. For instance, a chatbot might be programmed to respond to routine questions from applicants or interested parties. Chatbots are able to converse via text or voice, using natural language processing (NLP), fielding questions that have clear-cut answers and escalating those that do not to the appropriate (human) party. Such automation enables the regulator/supervisor to receive, digest, and act on a higher volume of enquiries in a timelier fashion. Examples from the wider economy are plentiful and growing steadily

(think Apple's Siri, IBM's Watson, and Amazon's Alexa, for instance); in financial regulation and supervision, however, chatbots are still relatively rare.

Another AI solution for licensing might assist with the verification of application documents and credentials. Machine reading (MR) using optical character recognition should enable computers to quickly parse applications. Robotic Process Automation (RPA) could then extract and transfer the relevant information into databases and cross-reference it against licensing requirements. Again, use-cases abound in other financial sectors; for instance, machines are already able to automatically read, interpret, extract, and summarize the content of complex legal documents pertaining to financial derivatives.[28] JP Morgan's Contract Intelligence software, an AI application that parses contracts automatically, has reportedly already saved hundreds of thousands of person-hours per year. [29]

3 Machine readable regulation

Navigating a constantly-evolving regulatory landscape can be taxing for supervised entities. Staying current and compliant with latest regulations may require a dedicated legal team to monitor, interpret, and react to regulatory changes. This can put smaller providers at a competitive disadvantage. Furthermore, as more Fintech regulation is rolled out across jurisdictions, providers will need to determine whether they need to apply for new licenses to continue operating.

Leveraging optical character recognition, financial authorities can issue regulations in an electronic format to make them quickly readable and searchable by both machines and humans (figure 2). Furthermore, such machine-readable regulation can be assimilated immediately by an FSPs' regulatory systems without the need for human interpretation.[30] This would reduce the administrative and legal burden on the providers who, using semantic technology and digital models, would be able to quickly ascertain the regulatory provisions that apply to their businesses. Loading machine-readable regulation into a centralized, publicly-accessible database could provide a platform for frictionless distribution for regulators and more intuitive and timely navigation solutions for supervised entities.[31]

Figure 2: Example of structure and machine-readable output regulation

RAW REGULATION


DIRECTIVES

DIRECTIVE 2009/110/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL

of 16 September 2009

MACHINE READABLE REGULATION

Regulation:	**Directive 2009/110/EC**
title	Directives
objective	Prudential supervision of the business of electronic money institutions
instrument	Directive 2009/110/EC
authority	EC
validityDate	09/01/2009
applicableIn	EEA

Rule:	**Directive 2009/110/EC/TitleII/Article 3 – Rule 1**
mandatory	true
target	electronic money institutions
requirement	Directive, Articles 5 and 10 to 15, Article 17(7) and Articles 18 to 25 of Directive 2007/64/EC shall apply to electronic money institutions

Rule:	**Directive 2009/110/EC/TitleII/Article 3 – Rule 3**
mandatory	true
target	electronic money institutions
requirement	inform the competent authorities in advance of any material change in

Rule:	**Directive 2009/110/EC/TitleII/Article 3 – Rule 3**
mandatory	true
target	any natural or legal person who has taken a decision to acquire or dispose of, directly or indirectly, a qualifying holding within the meaning of point 11 of Article 4 of Directive 2006/48/EC in an electronic money institution, or to further increase or reduce, directly or indirectly, such qualifying holding as a result of which the proportion of the capital or of the voting rights held would reach, exceed or fall below 20 %, 30 % or 50 %, or so that the electronic money institution would become or cease to be its subsidiary
requirement	into shall inform the competent authorities of their intention in advance of such acquisition, disposal, increase or reduction.

Source: BFA, European Commission

Automating compliance can go one step further using machine-readable regulation that self-executes using "smart contracts." Typically based on DLT, these digital contracts trigger automatically when certain conditions are met; for example, a report or data might be generated and transmitted to the supervisory authority if a given key risk indicator is breached. In theory, FSPs would be able to map their regulatory requirements directly onto the data that they hold, creating the potential for straight-through-processing of regulatory filings. The UK Financial Conduct Authority, which has spearheaded this application for financial regulation, argues that "the accuracy of data submissions could be improved and their costs reduced, changes to regulatory requirements could be implemented more quickly, and a reduction in compliance costs could lower barriers to entry and promote competition."[32] Swiss bank UBS is leading a pilot with several other institutions to use Ethereum smart contracts to improve the quality of counterparty reference data through anonymous reconciliation under MiFID II.[33]

4 Policy simulations

In their quest for sustainable development, financial authorities need to balance and reconcile policy and economic objectives. Understanding the linkages that influence trade-offs and synergies across these objectives is critical. However, the linkages between the proposed reform and their distributional effects (positive and negative, short- and long-run) are often assumed rather than analyzed.

Governments and financial authorities can use RegTech² to conduct policy simulations and regulatory impact assessments to evaluate new policy initiatives and regulatory reforms. Modeling an ecosystem – by "creating a computational environment that allows for a type of controlled experimentation" – has been explored in other industries including in health[34] and education,[35] where rich data is readily available. Within financial supervision and inclusion policy, however, these types of scenario analyses and forecasting happen less frequently and are generally conducted through time-consuming, resource-intensive workshops and manual analyses – if at all.

Increased digitization of policy and regulation plus API-based compliance reporting have made high-quality financial and non-financial data available to power policy simulation engines. Predictive analytics – a subset of ML that uses statistical trends in historical data to predict future trends within a given confidence level – is readily applicable to supply-side regulatory data. Similarly, free and open-source data science tools, such as machine learning as a service (MLaaS) platforms, can be leveraged to model the effects of regulation and policies.[36]

5 Dynamic risk dashboards and early warning systems (EWS)

Regulators and supervisors use dynamic diagnostic tools to monitor the vital signs of the financial sector and identify early signs of stress. Risk dashboards, for instance, draw on the latest available financial market data, typically from quarterly or monthly regulatory filings, to generate aggregate key risk metrics such as capital or liquidity ratios. When a ratio deviates from a critical threshold or trigger value, the dashboard raises a flag and an investigation ensues. Commonly, dashboards are presented as a traffic light or heat map together with a qualitative assessment of the perceived level and trend in risk.[37]

In many jurisdictions, data scarcity and reporting lags mean such dashboards are cumbersome to use and too static to serve as effective barometers of financial sector health. As a result, their usefulness is limited to backward-looking analyses of market developments. Warning signals about potential risk accumulations or stress build-ups may go unnoticed and unheeded. As the financial ecosystem grows in complexity and potential systemic risks multiply, the need for an effective supervisory early warning system is more necessary and urgent.

Stress tests assess banks' capital adequacy against a range of hypothetical shocks to their balance sheets, such as a sudden repricing of interest rates or a breakdown in the payments system. While stress-testing exercises are generally done intermittently and only with point-in-time data, they still demand significant technological capabilities to collect large sets of historical data and perform complicated value-at-risk computations. As new Fintech products and players enter the financial marketplace, the set of conceivable stress scenarios and the demands on the data infrastructure will grow. More frequent, more complex, and more data-intensive tests will be needed.

Advanced data analytics can provide regulators and supervisors with new and more powerful tools to follow financial market developments, identify risk drivers and early warning signs, and perform stress tests. Technological solutions such as data stacks (see the Nigerian example in the section below) could overcome data limitations by feeding dashboards with more frequent and more granular datasets. Anomaly detection, another subset of ML, can then be leveraged to quantitatively identify outliers in a given dataset. This, in turn, would allow for more dynamic risk monitoring and evaluation, and enable more timely and effective risk management and control. Richer visualization tools could enhance the descriptive, diagnostic, predictive, and prescriptive power of dashboards, which could help supervisors and policymakers get a better read of financial conditions.

6 Storing and accessing data

Data storage is a challenge for all financial market participants. The sensitive nature of financial data, the high set-up and sunk costs of IT infrastructure, and the stickiness of legacy technology can impose binding constraints on supervisors' ability to generate, store, manage, and use data.

A related issue is the siloed manner in which data are often stored. Depending on which department has requested the data, they can end up in a database belonging exclusively to that department, inaccessible to regulators in other areas. In more extreme cases, these databases can be even more fragmented, with data on each interaction with each supervised entity contained in a physical file or compact disk (CD) in "cold" storage.

Even in cases where there is a centralized database, it is frequently not scalable to the point where it can store all the data at once, leaving supervisors to work with only a subset of the data at a time.

Additionally, due to private network and infrastructure constraints, supervisors conducting on-site inspection might not have the relevant information at hand.

Cloud computing provides one possible solution to data storage and access constraints. Here data is stored, managed, and processed on remote and shared servers hosted on the internet, as opposed to on servers and computers owned and locally maintained by each user.[38] Cloud-computing enables on-demand and remote network access to secure databases, which provide virtually infinite storage space at a fraction of the cost of an equivalent in-house/on-premises server. Supervisory data loaded into an access-controlled, cloud-based platform can also provide security advantages over the transmission of single files and physical media like USB-connected "thumb drives" and CDs. In general, using cloud-based services could increase the flexibility, mobility, and efficiency of supervisors' data architectures.

More advanced data warehousing architectures such as "data lakes" allow for even greater scalability, versatility, and computational power than traditional databases. The key difference lies in the shift from a traditional extract, transform, and load (ETL) workflow in data warehousing and analytics, to a new extract, load, and transform (ELT) process.[39] In other words, "streams" of structured and (crucially) unstructured data from various sources fill the lake without needing to be configured to meet the specific requirements of the platform. Users can come to examine, "dive in," or take samples of the lake as they please.[40] The data can be transformed on demand for visualization, analysis, or export.

7 Stacking datasets

Another issue with fragmented databases and desktop applications is that alternative data sources cannot easily be integrated for purposes of ecosystem analysis or statistical modeling. Combining structured and unstructured datasets is especially challenging in ETL-type architectures. While this is not a binding constraint on supervisors' work, it does limit the depth and breadth of insights that can be gleaned from the data.

Using advanced data storage such as data lakes and Big Data tools, datasets can be "stacked" and analytically overlaid to extract new meanings. Combining demand-side surveys that might comprise population censuses or independent survey results, geo-spatial information (e.g., satellite imagery), or non-financial data with regulatory supply-side data might reveal previously-hidden relationships. For example, plotting geo-tagged transactional data over maps can give supervisors a bird's-eye view of the ecosystem, allowing them to spot pockets of financial exclusion or concentrations of risk, such as a clustering of failed transactions in one geographic area that might signal infrastructure problems.

8 Collecting and analyzing customer complaints

Supervisors generally have access to financial consumer complaints data only in an aggregate form, such as reports from supervised entities that specify the quantity of complaints received in the past month by category. Typically, the only instance when a regulator might see the details of a complaint is when an issue is escalated by a financial institution to the regulator, or when a customer complains directly to the financial authority. Complaints submitted via phone, email, mail, or in person are not easily transformed into data that can be captured. Furthermore, significant resources can be expended responding to emails, staffing call centers, and meeting in person with customers. These data constraints ultimately limit the insights that can be generated for regulatory solutions.

Digital channels to submit complaints (e.g., online messaging and texting) are better for data collection than analog channels, and often cost less since fewer manual interventions are required. Chatbots can be programmed to register and categorize complaints on a large scale. Also, using ubiquitous digital platforms, such as mobile messenger apps, can improve the user experience, which may encourage more customers to voice their grievances. Richer data, in turn, can provide a more nuanced view of the customer's perspective.

Handling complaints can also be automated to a certain extent, reducing the time and resources required to address grievances. Big Data analytics can be used to assess the gravity of a complaint and escalate it to supervisors when necessary. More advanced techniques (e.g., GIS mapping, clustering) can be used to detect anomalies and possibly uncover systematic market misconduct.

9 Auditing market conduct

Aside from customer complaints and manual spot checks, supervisors have few means to audit market conduct. As a result, discriminatory, fraudulent, and predatory practices by FSPs might go unreported and undetected for long periods of time. Screening for such activity can be labor-intensive and time-consuming. Recent scandals involving mis-selling of mortgages, securities, and bank accounts are cases in point.[41] RegTech[2]/SupTech applications could eventually make supervisors' auditing work easier by web-scraping and machine reading content (e.g., price quotes, terms and conditions, etc.) from providers' websites and promotional materials to verify that FSPs are complying with pricing, transparency, suitability, and non-discrimination rules. Alternatively, consumers might one day be able to take pictures of the terms and conditions for financial service they are purchasing and submit them for compliance verification by AI-enabled screening software – a service that is already being offered in the private sector for certain legal documents.[42] For credit products offered digitally, the regulator may require that providers test the level of financial literacy of customers through a questionnaire whose results are recorded by the market conduct supervisor.

10 Auditing algorithms

AI-based risk assessment technology is rapidly pervading banking and insurance. The ability of machine learning algorithms and advanced quantitative methods to run increasingly-complex risk models using an ever-wider array of datasets is dramatically improving the speed and accuracy of credit scoring and insurance underwriting.

However, this precision also raises complicated ethical questions. Errors or bias in algorithms might contribute to systemic risk or might undermine consumer protection by intentionally or unintentionally discriminating against certain groups. For example, certain Big Data methods applied to actuarial analysis may generate risk pools that are closely correlated with race, gender, ethnicity, or religion.[43] Such segmentation might mean that some high-risk individuals, through no fault of their own, are denied coverage or face prohibitively high insurance premiums, exacerbating financial exclusion.[44] Furthermore, it might be difficult for supervisors to understand why an opaque and proprietary algorithm decided to deny credit or coverage, undermining their ability to fulfill core supervisory and consumer protection mandates.

Regulators and supervisors may prevent biased outcomes rather than proscribe certain algorithmic designs altogether by developing their own algorithms to audit those of FSPs. Supervisors can create "robots" that masquerade online as financial service clients with varying attributes. By analyzing the treatment that these robots receive, they could detect biases in automated processes from credit scoring to insurance underwriting.[45] Other techniques seek to pry open the "black boxes" by, for instance, statistically deriving the relative weight of each factor in the algorithm (the quantitative input influence method), or using known biases in an algorithm's results to identify and "vaccinate" biases from the input data (the mirror-image method).[46] These techniques are part of a growing auditing toolkit being developed by advocates of "algorithmic transparency," which may well become a focus for regulators and supervisors going forward.[47]

11 Enhanced detection of money-laundering and financing of terrorism

The rules-based approach to detecting money laundering and the financing of terrorism generally involves compliance officers scrutinizing client profiles and transactional data for anomalous patterns that match certain predefined filtering rules. The process is labor-intensive, time-consuming, and susceptible to human error and bias.[48]

RegTech²/SupTech technologies such as ML have the potential to enhance the accuracy, efficiency, and predictive power of traditional methods or supplant them altogether. ML models are capable of incorporating a wider array of variables and relationships in their analysis, including social media profiles and networks.[49] They may catch more complex or nonlinear money laundering techniques that go undetected by less sophisticated methods. ML also augments traditional methods by, for example, structuring the data into more precise risk segments or laundering scenarios before they are subjected to human analysis. Where permissible and appropriate, these data can be complemented with external data sources, such as information scraped from social media or the "deep web." Existing applications of ML to AML/CFT have already demonstrated their effectiveness in lowering the incidence of false negatives and false positives.[50]

In addition to flagging suspicious activities, RegTech²/SupTech can aid in the validation of suspicious activity reports (SARs) submitted by reporting entities, while making follow-up investigations (both on-site and off) quicker and more targeted. Some RegTech²/SupTech applications can automate information gathering before an inspection, thereby saving supervisors' time doing preparatory work.[51] For instance, supervised entities can be required to submit transaction-level data automatically via APIs to a centralized repository of historical data. These then enable supervisors to conduct more detailed background research to validate new SARs quickly and efficiently (see Section 5.3 below).

12 Digital customer due diligence (CDD)

The difficulties in verifying proof-of-identity and related personal information for purposes of customer due diligence (CDD) is a major constraint for FSPs, especially in low-income markets where formal records and titles are frequently nonexistent or cumbersome and expensive to obtain. Digital identities can streamline CDD by automating paper processes, enabling online or mobile onboarding of new accounts, and accessing alternative/digital proofs of identity.[52]

Financial authorities and FSPs are increasingly collaborating in the use of digital identities through know your customer (KYC) utilities and other emerging collaborative approaches to CDD. The most well-known example is India's Aadhaar, which now covers virtually the entire Indian population. Here the authorities vouche for the data, limiting FSPs' obligations to only two steps in FATF's CDD requirements – identification of customers and identity verification – by simply checking the main database. They also facilitate AML/CFT oversight by quickly and reliably identifying parties to transactions and establishing beneficial ownership.[53]

In the future, other distributed ledger technologies (DLT) such as blockchain will likely play a more prominent role in KYC, acting as a transparent repository to record transactions and counterparties. Blockchain is a decentralized, distributed, immutable, consensus-based database technology that was designed to be the backbone of the Bitcoin cryptocurrency. It has since grown beyond its Bitcoin roots to serve as a database technology behind everything from identity management[54] to property records[55] to managing music royalties.[56] Its RegTech²/SupTech potential extends beyond KYC to, for example, agent registries and blacklists.

13 Sentiment analysis

NLP enables the use of information scraped from the web to measure and track market sentiment. Supervisors can employ sentiment analysis as real-time risk indicators, for example, to predict bank runs. Banca d'Italia, the Italian central bank, has analyzed tweets and the sentiment they express to nowcast and forecast trends in retail deposits – a negative sentiment flags lower retail deposits growth rates, and vice versa.[57] Its Twitter-based sentiment indicator also detects contagion dynamics across banks in distress. Similarly, the U.S. Securities and Exchange Commission (SEC) is using NLP to assess the tonality of registrant filings, which reveals the sentiment of a text by counting terms with a negative connotation.[58] Using ML algorithms, tonality can be converted into a risk metric that helps to identify firms that indicate a heightened risk of misconduct or SEC rule violation.

Figure 3: RegTech²/SupTech matrix

* Includes "smart contracts"
** Includes natural language processing and optical character recognition

Source: BFA


100000
10000
8000
6000
4000
2000
0
-2000
-4000
-6000
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Innovation
Branding
Solution
Marketing
Analysis
Ideas
Success
Management
Technology
Innovation

4 Risks and Challenges

While RegTech^2 and SupTech can solve many of the operational risks and inefficiencies inherent in manual and paper-based processes, they also introduce a different set of challenges for regulators and supervisors. Bugs, hacks, and other failures in critical IT systems could cause glitches or shutdowns with potentially serious cascading effects for financial stability and economic activity. Recent prominent incidents such as the 2010 stock market "flash crash" or the mishandling of private data by social media companies as well as numerous cybersecurity breaches have underscored such concerns.[59] Technical lapses can be costly not only in economic terms; they also undermine trust in the technology underlying them. For example, a mis-programmed customer complaints chatbot that gives out false or misleading information to users can cause more grievances than it resolves.

Rigorous testing and quality assurance can mitigate these technology and cybersecurity risks to a certain extent, but financial authorities still need to be mindful of RegTech^2/SupTech's limitations and drawbacks. Over-reliance can breed complacency, instilling a false sense of security. For example, a high-tech regulatory reporting and analysis system is only as good as the data that goes into it, as per the familiar maxim "garbage in, garbage out." While RegTech^2 and SupTech applications can help to validate data and spot errors or bias, human oversight and quality control (e.g., through on-site inspections) will remain indispensable.

A related risk is that automation leads to the "de-skilling" of the workforce because of atrophy or attrition.[60] With machines doing most of the heavy lifting, supervisors and regulators may fall out of practice or choose to switch careers. To guard against this, efficiency gains can be reinvested into generating more research and insights, widening the scope of supervision, deepening investigations, and conducting more targeted inspections. Automation should enhance the capabilities of supervisors and regulators, not replace them.

Implementation may also prove challenging. Many governments, especially those in low-income countries, lack the institutional capacity and technological readiness to fully implement, operate, and maintain even relatively lean RegTech^2/SupTech solutions. Financial authorities may choose to prioritize other large-scale initiatives, such as aligning regulation and supervisory frameworks with international standards for risk-based supervision or update their real time gross settlements systems, leaving little budget to pursue RegTech^2/SupTech. In other cases, the authorities might be more preoccupied with first perfecting basic reporting and compliance processes, let alone high-tech ones. This reality may make full-stack RegTech^2/SupTech solutions a distant prospect for some financial authorities.

Resistance from within the financial authorities can be another obstacle, particularly if labor-saving and efficiency-enhancing technologies threaten (or promise) to cut jobs or rents. Internal opposition can make RegTech^2/SupTech initiatives politically as well as economically costly. Bureaucratic politics may also come into play. Institutional rivalries may block or slow the flow of data between and within departments. Fragmentation of databases across the public and private institutions can produce coordination failures. Strong political will and leadership is therefore necessary to overcome these obstacles, but it is hardly sufficient without some degree of buy-in from stakeholders and staff who carry the initiatives forward.

Supervised entities for their part may also lack the capacity or inclination to adopt the reporting structures and processes needed to complement the authorities' RegTech^2/SupTech-enabled applications. Providers might be required to invest in upgrading their reporting and compliance systems. Those with large sunk costs in legacy compliance software and hardware (e.g., mainframe servers) may be loath to write them off. Or they may oppose the authorities' efforts out of legitimate concerns about intrusion of privacy, government overreach, or abuse of authority. After all, just as RegTech^2/SupTech can help regulators and supervisors perform their jobs more dutifully, so too can they be abused for corrupt or nefarious ends. Whatever the reason, providers might succeed in blocking or delaying enactment of new regulations or implementation of reporting requirements. This risk is especially acute in jurisdictions that are susceptible to regulatory capture.

5 Prototyping Solutions in Mexico, Nigeria, and the Philippines

A number of financial authorities are already taking steps toward deploying RegTech[2]/SupTech solutions. Their experiences can shed led light on the opportunities and challenges that financial authorities elsewhere may encounter as they embark on the same journey.

5.1 Bangko Sentral ng Pilipinas' chatbot and complaints management system

The Financial Consumer Protection Department (FCPD) of the central bank of the Philippines (Bangko Sentral ng Pilipinas or BSP), which is charged with empowering and protecting financial consumers, has partnered with R[2]A and Sinitic to develop a chatbot and processing utility solution for customer complaints. The chatbot solution allows Filipinos to file complaints through their mobile handsets (either feature or smart phones) via an app or via SMS. Using technologies such as natural language processing (NLP) and ML, the application accepts complaints in either English or Tagalog, processes them (i.e., classifies and assigns a case number), and either responds to the complaint directly or escalates it to the call center. The call center files these complaints alongside those coming from other sources (voice calls, mail, emails, kiosks) and stores the data in a central database. This database, in turn, feeds into the array of possible responses available to the chatbot. Finally, a reporting and management interface enables call center employees to view relevant analytics for the chatbot, export complaint reports, and manage the configuration of the chatbot's internal logic.

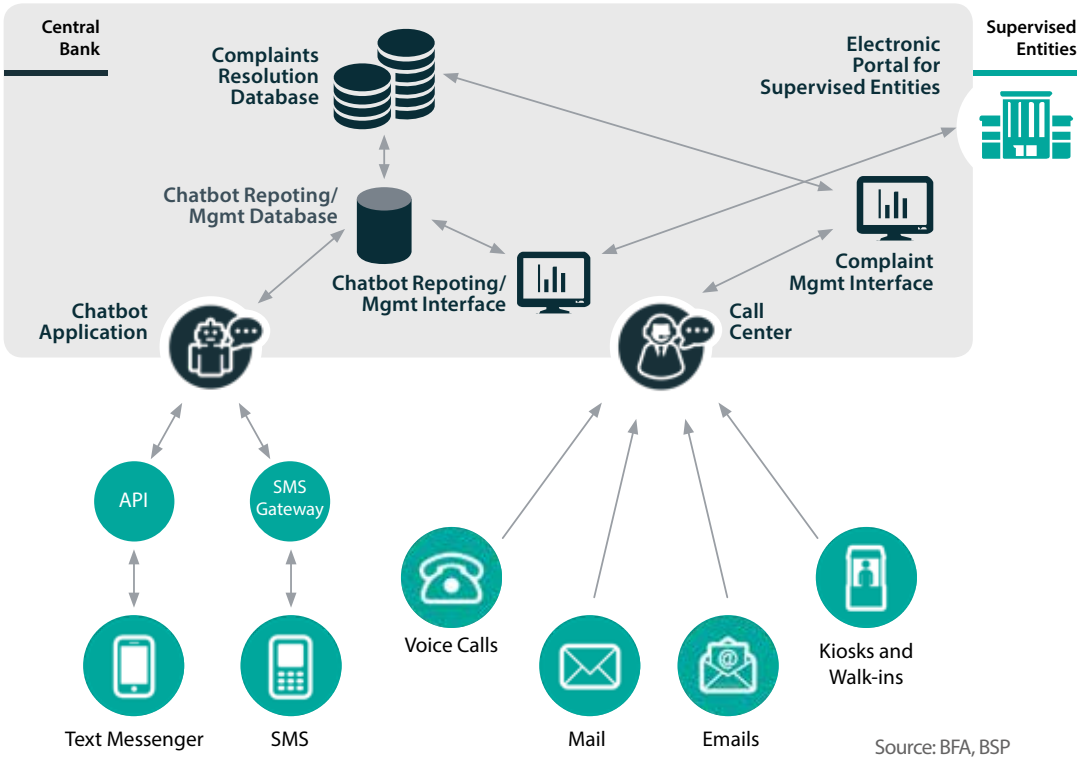
This system enables the BSP to:

i. Address queries and complaints through the chatbot.

ii. Manage the structure and flow of automated conversations based on expertise and historical data.

iii. Use data and insights gathered through the chatbot for oversight and policy development.

Figure 4: BSP chatbot architecture



Source: BFA, BSP

The BSP's previous consumer complaints system was limited by outdated communication channels, an incomplete database of customer complaints, reliance on manual processing, and few analytics tools. There was low accessibility from outside of the Metro Manila area, and little understanding of the customer experience by the central bank. Even with a relatively low number of complaints to process, FCPD staff were overburdened and the BSP's consumer protection mandate was complicated.

The new system adds new communications channels to democratize consumer protection and amplify the voice of consumers, has the potential to detect market misconduct, and provides insights into the customer experience. Furthermore, it reduces supervisors' workload and response time by delegating mundane and routine tasks (e.g., directing non-BSP complaints to the right institution) to chatbots, so human labor can be allocated to complex tasks such as analyzing recurrent types of fraud and conducting on-site inspections. [61]

5.2 Bangko Sentral ng Pilipinas' application programming interface (API) and prudential reporting and visualization application

BSP has developed with R²A and Compliant Risk Technology (CRT) an API and back office reporting and visualization application to:

i. Allow financial institutions to submit high-quality, granular data digitally and automatically to BSP with higher frequency.

ii. Enable BSP staff to make data validation faster and analysis sharper by generating customized reports for supervisory and policy development purposes in different formats and near-real time.

The project reduces compliance costs significantly and assists BSP in generating timely, crisper insights on the Philippine financial sector to implement a risk-based supervisory approach and to develop policies such as the financial inclusion strategy.

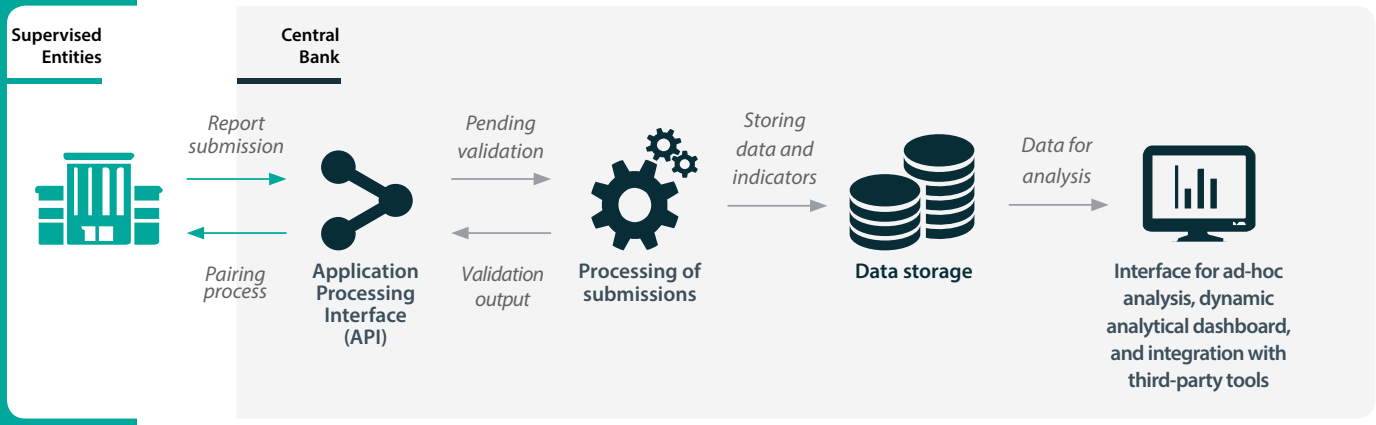
Previously the BSP's Supervisory Data Center (SDC) team received incomplete, late, and or inconsistent reports. Data cleaning and validation consumed significant resources and e-mailing compliance reports (as well as follow-up communications to address inconsistencies and errors) was inherently insecure. The quantity of available data that was actually analyzed was limited as the collection, validation, and mining process was primarily manual and resource-intensive.

The solution (figure 5) provides BSP with more granular, higher-frequency, and higher-quality data from supervised institutions via APIs and containerized or otherwise packaged client software. Automation allows for consistent and timely submission, which dramatically reduces penalties for late or erroneous submissions. Automation also improves the data validation process by detecting duplicate submissions and mistakes when the data are pushed to the data warehouse, thereby giving the financial institution time to make corrections.

The BSP is able to implement new regulations and amendments on existing raw data since the scope of the data sent by financial institutions typically doesn't change, only the manner in which it is structured. This avoids time-consuming and error-prone system updates by individual financial institutions.

From the data submitted, the SDC generates customized reports for BSP staff automatically and quickly. Visualization software allows the data to be presented in a more meaningful and digestible way in the form of charts, graphs, and dashboards in near-real time. Data can be requested at much faster intervals (hourly even) so that more granular statistics and measurements can be generated. Finally, data security has dramatically improved since automated communications are secured with industry-standard encryption, including any measures specifically called for by financial regulation.

Figure 5: R²A/BSP API data architecture



Source: BFA, BSP

5.3 Mexico's AML data storage and analytics tool

The Comisión Nacional Bancaria y de Valores (CNBV), Mexico's national banking and securities commission, is charged with supervising its financial system. CNBV is reengineering its data infrastructure to strengthen its AML supervisory capacity and to accommodate a growing Fintech sector. The core of the new data infrastructure developed with R²A and Gestell is a central, access-controlled data storage platform that can house transactional data submitted by supervised entities via APIs (figure 6).

This platform will:

i. Allow financial institutions to submit information for AML compliance digitally and automatically.

ii. Increase the volume, granularity, and frequency – and improve the quality – of AML-related data.

iii. Enable CNBV to retrieve and mine historical records.

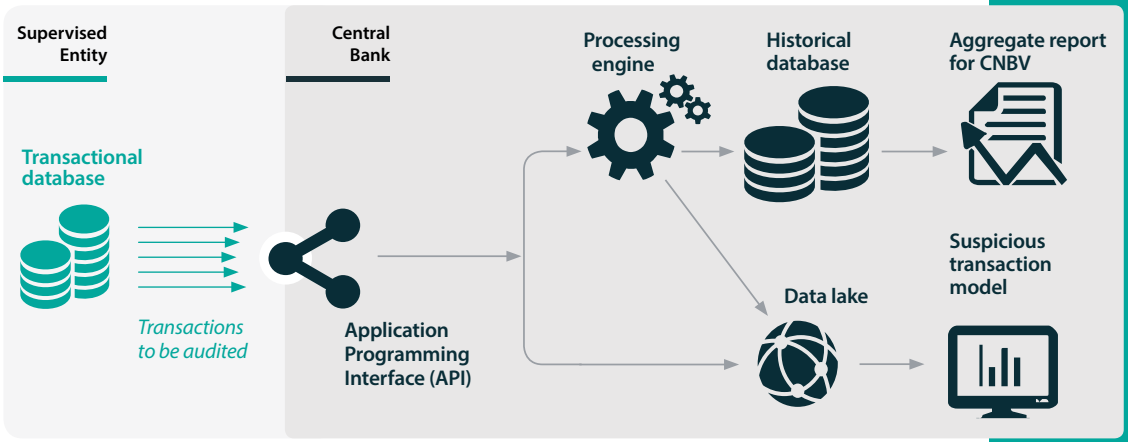
iv. Enable CNBV to improve AML-related data validation and augment analytical capabilities using ML.

v. Generate customized reports for supervision and policy development.

Once securely stored, the platform renders the data in risk dashboards, alerts, and statistical reports using ML models, advanced data analytics, and cutting-edge visualization tools (e.g., algorithms and notifications). It identifies outliers (suspicious transactions, clients, or reports, including risk factors that are not visible to the human eye) and informs and targets on-site visits.

Previously, the CNBV lacked an efficient means to extract insights from existing data since supervisors often had to upload appropriate data from compact discs and paper files, and analyze them in Excel spreadsheets. The new solution will allow the CNBV to reduce inefficiencies and generate deeper intelligence, making AML supervision more risk-based and providing sharper guidance to supervised institutions on how to improve their AML compliance systems, which should reduce compliance costs. As the CNBV is about to introduce a new regulatory framework for the Fintech sector, this platform will be critical to its supervision and impact.

Figure 6: CNBV AML data architecture



Source: BFA, Gestell

5.4 Nigeria's transactions "data stack"

The Central Bank of Nigeria (CBN), the Nigeria Inter-Bank Settlement System Plc (NIBSS), and the BFA team are redesigning their data infrastructure in order to guide supervision and policy-making more effectively and generate richer open datasets for public and private use. The main users of the so-called "data stack" and their corresponding needs are:

i. The CBN supervisors, to better monitor risks and more closely supervise banks and payment system operators – including prudential, AML/CFT, market conduct, and competition supervision.

ii. The CBN policymakers and regulators, to capture evidence that informs new strategies (e.g., financial inclusion policies) and regulatory interventions as well as their monitoring and evaluation (M&E).

iii. The government agencies, to better design and monitor fiscal transfers, digitization of payments, and financial inclusion programs.

iv. The private sector, to identify business opportunities and innovate products and channels.

v. The donor community, to assess the impact of their actions and investments, and design new programs.

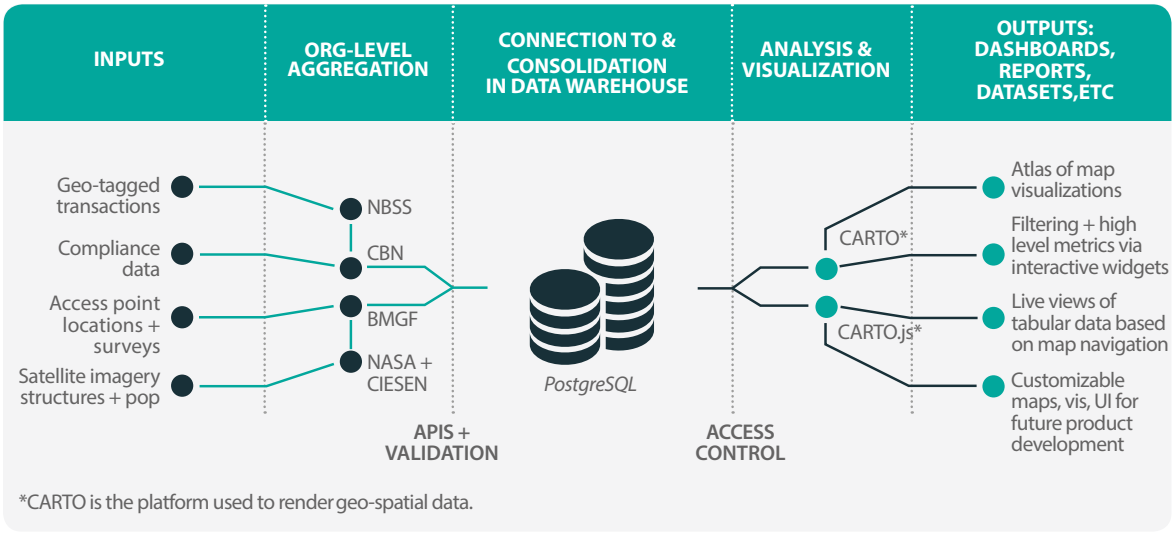
vi. Customers, to make more informed decisions.

The core of the new data infrastructure (figure 7) consists of a transactional data warehouse and dashboards for CBN and other stakeholders to access, visualize, and digest relevant payments data. The warehouse is populated via APIs with real-time transactional data from NIBSS and compliance data from CBN. Upon validation, the data is consolidated and stored in a relational SQL database, where it can be joined and queried at will. Additional layers of demand-side data (e.g., access point locations, satellite imagery, population statistics, and financial inclusion indicators) can then be stacked on top of this supply-side core in order to enrich and contextualize the transactional data.

Once the data is properly and securely housed, it can be made available to public and private stakeholders in the form of reports and dashboards that can be tailored to their particular requirements and preferences. Rich and interactive data visualizations are included at the front-end of the Data Stack to facilitate analysis and decision-making for each user.

For regulators and supervisors, the task of converting voluminous raw data into easily digestible insights is critical for ensuring policy effectiveness and responsiveness. Accordingly, the data stack allows NIBSS and CBN to view key risk metrics and indicators in real time on a risk dashboard, which can serve as both a compliance monitoring tool and an early warning system.

Figure 7: Nigeria's Data Stack prototype



Source: BFA

Conclusions

Digital channels and financial technology (Fintech) are driving unprecedented growth and innovation in financial services. The divergence in technological readiness between financial authorities and the entities they oversee poses risks to customers and financial stability and integrity. Regulators and supervisors are beginning to enhance their capabilities to address those challenges and drive financial inclusion and innovation. A number of central banks, insurance and capital market regulators, and supervisors have developed solutions that leverage new technologies and Big Data. RegTech[2] and SupTech may equip financial authorities with the tools to address new, complex challenges and bring financial regulation and supervision into the new era of data abundance.

What will the twenty-first century regulator or supervisor look like? Drawing together the applications explored in this paper, we can sketch out a few of the powers that regulators and supervisors of the future may possess:

- On-demand access to real time supply-side data from reporting institutions.
- The ability to complement and contextualize that data with feeds from other sources of information.
- A robust and secure data architecture within which to store and retrieve data at will.
- Advanced analytical tools to draw insights and refine supervision and policymaking.
- User-friendly open data portals to make relevant information available to stakeholders in the broader public sector and private sector.
- Enhanced capabilities and confidence to accommodate new firms and previously-excluded customers within the formal financial ecosystem.
- Interoperable systems and platforms to share intelligence and coordinate policies fluidly across borders.

Such capabilities will not supplant traditional methods of supervision such as on-site inspections completely and their full deployment will likely take many more years. After all, the gap between human capabilities and AI remains large.[62] Privacy concerns may also slow application.

However, the use of all or some combination of these capabilities will become increasingly necessary for financial authorities to maintain policy coherence, comprehensiveness, and credibility in a digital-first future. Regulators and supervisors will be forced to adapt to a rapidly-evolving regulatory environment whose traditional boundaries are blurring, in which digitization and datafication engender new risks and complexities, and for which broader mandates covering both stability and inclusion are indispensable. Failure to do so may incentivize regulatory arbitrage, or worse, it may lead to lapses in oversight and the accumulation of systemic vulnerabilities. Given these challenges, new approaches to maintaining the resilience, security, and integrity of financial systems will be needed. These should embrace the abundance of high-quality data and accommodate product innovation by incorporating appropriate technology and adopting consumer-centric risk-based supervision.

The technological tools for this approach either already exist or are in rapid development. This report has showcased a few possible applications of RegTech^2 and SupTech, and other use-cases will emerge as these technologies are further refined and adapted. Indeed, the application of cloud computing, AI, ML, blockchain, and smart contracts to financial regulation and supervision is still largely untested. Recent prototypes mentioned here are as the first iteration of an ongoing regulatory modernization process.

The implications of RegTech^2/SupTech for financial inclusion and financial-sector development are clear. Regulatory compliance typically entails significant costs for businesses that act as barriers to entry for firms (especially Fintechs) and increase costs to customers, especially informal-sector companies or poor households. Furthermore, concerns about penalties and reputational damage due to cumbersome regulations can make FSPs more risk averse (and so less innovative and inclusive). RegTech^2/SupTech can help to lessen these costs and assuage fears by streamlining and rationalizing regulatory approval, reporting, and compliance processes, and by creating an enabling regulatory environment for Fintechs.

There are several clear takeaways and recommendations for authorities at this critical juncture in the field of financial regulation and supervision; to name a few:

- Prepare for the data wave by upgrading data infrastructures preemptively, in particular developing API railways between financial authorities and FSPs to allow granular and timely data to flow seamlessly between the two.
- Collaborate with fellow regulators and supervisors in advance to anticipate and shape future data and tech standards.
- Create accelerators and innovation labs to gain exposure to new products and vendors, and to foster growth.
- Create a proper environment for RegTech^2/SupTech experimentation.
- Publish synthetic data and supervisory methodologies to facilitate RegTech^2/SupTech product innovation and experimentation.
- Develop RegTech^2/SupTech procurement policies and guidelines to screen vendors and contain costs.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Endnotes

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