



# BUILDING REGULATORY AND SUPERVISORY TECHNOLOGY ECOSYSTEMS

FOR ASIA'S FINANCIAL STABILITY  
AND SUSTAINABLE DEVELOPMENT

AUGUST 2022



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# Abbreviations

<b>AI</b>	artificial intelligence
<b>AML</b>	anti-money laundering
<b>API</b>	application programming interface
<b>BIS</b>	Bank for International Settlements
<b>CFT</b>	combating the financing of terrorism
<b>COVID-19</b>	coronavirus disease
<b>CQS</b>	Consolidated Quotation System
<b>CTS</b>	Consolidated Tape System
<b>DRR</b>	Digital Regulatory Reporting
<b>ECB</b>	European Central Bank
<b>EDGAR</b>	Electronic Data Gathering, Analysis, and Retrieval
<b>ESAP</b>	European Single Access Point
<b>ESG</b>	environment, social, and governance
<b>EU</b>	European Union
<b>FCA</b>	Financial Conduct Authority (United Kingdom)
<b>FDIC</b>	Federal Deposit Insurance Corporation
<b>FINRA</b>	United States Financial Industry Regulatory Authority
<b>FSI</b>	Financial Stability Institute
<b>GFIN</b>	Global Financial Innovation Network
<b>GRC</b>	governance, risk, and compliance
<b>ISDA</b>	International Swaps and Derivatives Association
<b>IT</b>	information technology
<b>KYC</b>	know your customer
<b>MAS</b>	Monetary Authority of Singapore
<b>SEC</b>	United States Securities and Exchange Commission
<b>SMEs</b>	small and medium-sized enterprises
<b>US</b>	United States
<b>VAR</b>	value at risk

# Executive Summary

Over the past 50 years, the financial sector has become one of the most digitalized, globalized, and regulated sectors of the global economy. Since the late 1960s, with the advent of the first ATM and the handheld calculator, finance has rapidly digitized and globalized in developed markets and most recently in emerging markets and developing countries.

The landscape of the financial services sector has also gone through significant transformation in the years since the 2008 global financial crisis, with finance dominated by three interrelated themes: the crisis itself; tremendous increases in financial regulation; and the application of a range of new technologies to finance such as big data, artificial intelligence, cloud infrastructure, and blockchain.

These developments have created regulatory challenges that call for new approaches to ensure effective regulation. This paper focuses on the evolution, role, and development of the use of technology in regulation, compliance, and financial infrastructure design in finance that have aided this effort.

Regulatory technology (regtech) refers to the use of technology—particularly information technology—for regulatory implementation, compliance, and monitoring; it is used by regulators, supervisors, market participants, infrastructure providers, and others. In other words, regtech encompasses the industry's use of technology to address regulation and compliance requirements, and supervisors' use of technology for supervision of regulatory and compliance requirements (often called supervisory technology or suptech). It also refers to policy makers' and regulators' implementation of regulatory systems and requirements in the context of the technological design of financial infrastructure, including through their interactions with market infrastructure providers.

While regtech has developed to its greatest extent in finance, it can and increasingly does form a part of any regulated industry, including health care, energy, transport, travel, and an increasing range of other areas, particularly sustainable development.

The emergence of a range of new entrants and new business models covered by the term financial technology (fintech) driven by these new technologies and innovations has challenged not only incumbent participants but also policy makers and regulators who have been pressed to readjust their approaches as a result of the opportunities and risks of new entrants, technologies, and strategies. The integration and embedding of technology expose financial industry participants to technology risks (techrisks), requiring strong oversight of the key vulnerabilities and data gateways through mature and proven solutions.

In addition to the opportunities and challenges of new technologies and new approaches from both the industry and regulatory standpoint, the growth of regulation has reshaped the regulatory and compliance landscape, requiring financial institutions to invest heavily to cope with regulatory and compliance requirements. The combination of demands from industry and regulators drives a strong call for technology-enabled compliance and oversight solutions. This is the idea of regtech. For a regulated entity, emerging technologies can increase the efficiency of meeting regulatory and compliance requirements; improve business outcomes by applying various forms of data analytics, including automation; and enhance risk management processes and systems. As one aspect, regtech can make anti-money laundering and know-your-customer compliance more manageable, reducing customer onboarding and compliance costs and supporting financial inclusion for individuals and small and medium-sized enterprises (SMEs).

At the same time, policy makers, regulators, and supervisors are increasingly looking at the digitalization of their operations and processes, reflected in suptech and financial infrastructure design.

Regtech can thus be seen as the use of technology for regulation, compliance, monitoring, and enforcement by regulators, supervisors, financial industry participants, and financial infrastructure providers.

While regtech was developing rapidly prior to 2020—with the financial industry spending over \$500 billion a year in 2019<sup>a</sup> on technology and hundreds of billions a year on compliance<sup>b</sup> and regulatory penalties in the period 2008 to 2019<sup>c</sup>—the coronavirus disease (COVID-19) pandemic has driven the development of regtech to new heights amid dramatic increases in the digitization of finance, compliance, and regulation. We can see this in particular in the context of industry (regtech), regulators and supervisors (suptech), and a significant focus on technological infrastructure for finance. This includes digital payments systems such as central bank digital currencies; sovereign digital identity systems; digital regulatory reporting; and new approaches to data and its storage, cloud systems. In Asia, the development of regtech/suptech ecosystems underpinned by appropriate financial infrastructure offers tremendous potential to accelerate sustainable development and innovation and build resilience against future crises.

The paper first highlights the interaction of industry use of technology in compliance and risk management; regulator and supervisor use of technology for supervision, monitoring, and enforcement; and the use of technology to embed regulatory requirements and systems into financial infrastructure. This is the regtech ecosystem, transforming finance and its regulation.

Second, it highlights that this idea of using technology for regulatory, supervisory, and compliance purposes is, in fact, not new but has been evolving in particular since the 1980s, and even before in the context of the development of technological infrastructure for finance.

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<sup>a</sup> For more information, see Gartner. 2020. Gartner Forecasts Worldwide Banking and Securities IT Spending to Decline 4.7% in 2020 Before 2021 Rebound. Press release. 12 August. <https://www.gartner.com/en/newsroom/press-releases/2020-08-12-gartner-forecasts-worldwide-banking-and-securities-it>.

<sup>b</sup> For more information, see International Federation of Accountants and Business at Organisation for Economic Co-operation and Development (OECD). 2018. *Regulatory Divergence: Costs, Risks, Impact*. <https://www.ifac.org/system/files/publications/files/IFAC-OECD-Regulatory-Divergence.pdf>.

<sup>c</sup> G. Finch. 2017. World's Biggest Banks Fined \$321 Billion Since Financial Crisis. *Bloomberg*. 2 March. <https://www.bloomberg.com/news/articles/2017-03-02/world-s-biggest-banks-fined-321-billion-since-financial-crisis>.

The modern use of technology for regulatory and supervisory purposes has evolved over three eras:

- (i) Evolution before the 2008 global financial crisis (1987 to 2008): Triggered by the market crash of 1987, regulators and supervisors also began to digitize their operations with the digitization of finance. This is epitomized by the evolution of the United States (US) Securities and Exchange Commission's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system, a financial market infrastructure system integrating digital disclosure requirements (regtech) and enabling monitoring of compliance and enforcement by supervisors (suptech). It is also epitomized by the evolution of methods to monitor and calculate market and other forms of risk, applicable capital, and other regulatory and risk management requirements.
- (ii) The aftermath of 2008 (2008 to 2019): Digitization and "datafication" of regulatory compliance and reporting processes resulting from the need for regulators to establish enhanced risk management in the aftermath of the global financial crisis, the London interbank offered rate or LIBOR crisis, and a series of major financial integrity actions involving major global financial institutions and continuing focus on behavior in the financial market. This era also saw the rise of fintech and Big Tech business models driven by big data. During this period, regulators and supervisors focused increasingly on their use of technology, particularly digitizing reporting requirements and building data analytics systems, to analyze the vast amounts of data coming to them as a result of increased reporting requirements as well as on the use of new technologies in finance in the context of fintech.
- (iii) COVID-19 and the next decade (2019 to present): Defined under the context of rapid digitalization since the outbreak of the COVID-19 pandemic and the urgent need to accelerate the adoption of digital financial services. This era is also underpinned by the increased use of blockchain and cryptocurrencies, with the critical need for cybersecurity.

As a result of COVID-19, policy makers, regulators, supervisors, and industry participants are focusing heavily on regtech and suptech, and thus heightening capabilities, enhancing data collection and visualization, reducing costs, and creating real-time monitoring. Regulators are using technology in the supervisory framework to reinforce financial resilience through better supervision, surveillance, and misconduct analysis.

Third, this paper highlights the necessity of using an ecosystem approach in designing regtech strategies and the fundamentals of designing an optimal architecture, alongside the policy considerations required for an integrated regtech and suptech ecosystem. This approach can accelerate the development of a transparent and harmonious ecosystem that supports the primary financial regulatory objectives of financial stability, financial integrity, fairness and investor and consumer protection, and market efficiency.

Finally, the paper introduces key policy frameworks that can enable ecosystem relationships at national, regional, and international levels, while showcasing vital agile data management and standardization frameworks. It also highlights the importance and key elements of supporting, creating, and building a local innovation ecosystem. It proposes ways for policy makers and regulators to build a regtech/suptech strategy that engages policy makers, regulated institutions, financial infrastructure operators, and ecosystem builders. These can bring all of these parties together in a cohesive manner to support sustainable development and financial stability.

# 1

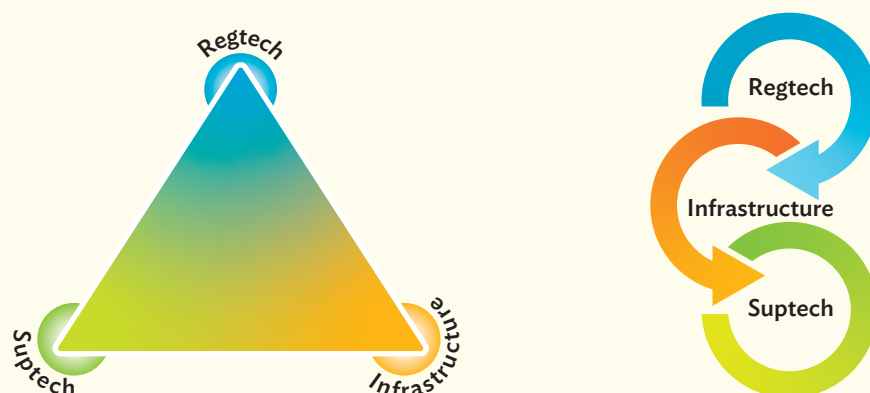
## Introduction

**R**egulatory technology (regtech) is the use of technology—particularly information technology—for regulatory implementation, compliance, monitoring, and enforcement by regulators, supervisors, market participants, infrastructure providers, and others. Regtech thus encompasses industry uses of technology to address regulation and compliance requirements. It also includes the supervisor’s use of technology to supervise regulatory and compliance requirements (often called supervisory technology or suptech). In addition, it includes the implementation of regulatory systems and requirements in the context of technological infrastructure for finance by policy makers and regulators, including through their interactions with financial market infrastructure providers.

As such, the scope of regtech is broad: an ecosystem ranging across the use of technology for compliance, from financial services participants and supervisors using technology to monitor compliance to infrastructure to establish digital regulatory requirements and systems by regulators, central banks, and policy makers.

As of now, regtech has developed most in finance. It is also increasingly forming a part of any regulated industry, including health care, insurance, energy, transport, and travel, among others. Additionally, in response to the growing importance of environment, social, and governance (ESG) in finance, regtech offers the potential to play a quintessential role in identifying, managing, and reporting ESG-related data and thus contributes to the discourse of sustainability.

**Figure 1: Regtech/Suptech Infrastructure Ecosystem**



Source: Authors.

The paper focuses on the evolution, role, and development of regtech in finance. Over the past 50 years, finance has become one of the most digitalized, globalized, and regulated sectors of the global economy. Since the late 1960s, with the advent of the first ATM and the handheld calculator, finance has rapidly digitized and globalized internationally, in developed markets, and most recently in emerging markets and developing countries.

The financial services sector went through significant transformation in the years following the 2008 global financial crisis, as three interrelated themes dominated the financial industry during 2010–2020: the crisis itself; tremendous increases in financial regulation; and the application of a range of new technologies to finance such as big data, artificial intelligence, cloud infrastructure, and blockchain.

The proliferation of financial technology (fintech) and the emergence of new entrants and innovative business models have challenged the incumbents. To keep up with the new entrants, the traditional financial institutions have increasingly integrated technologies into their day-to-day services. The integration of technology further exposes financial industry participants to novel technology risks (techrisks), requiring regulators to oversee the key vulnerabilities and data gateways. Moreover, policy makers and regulators need to readjust their regulatory and supervisory approaches to account for the opportunities and risks arising from the new entrants and their business models. The changing dynamics of the financial system, therefore, demand mature regulatory and supervisory solutions.

In addition to the opportunities and challenges of new technologies and new approaches from both the industry and regulatory standpoint, the growth of regulation has reshaped the regulatory and compliance landscape, requiring financial institutions to invest heavily to cope with regulatory and compliance requirements. The combination of demands from industry and regulators drives a strong call for technology-enabled compliance and oversight solutions. For a regulated entity, emerging technologies can increase the efficiency of meeting regulatory compliance, improve business outcomes through automated decision-making, and enhance risk management models and systems. Further, regtech can make compliance with anti-money laundering and know-your-customer (KYC) rules more manageable, reducing customer onboarding and compliance costs. This is the idea of regtech.

At the same time, policy makers, regulators, and supervisors are increasingly looking at the digitalization of their operations and processes, reflected in suptech and financial infrastructure ideas.

Regtech can thus be seen as using technology for regulation, compliance, monitoring, and enforcement by regulators, supervisors, financial industry participants, and financial infrastructure providers. In particular, we can see this in the industry (regtech); regulators and supervisors (suptech); and a primary focus on technological infrastructure for finance, particularly digital payments systems, sovereign digital identity systems, digital regulatory reporting systems, and new approaches to data storage, particularly cloud systems.

Although regtech was developing rapidly prior to 2020, the coronavirus disease (COVID-19) pandemic has driven it to entirely new heights as a result of dramatic increases in the digitization of finance, compliance, and regulation. The finance industry had been spending very large amounts on regulatory compliance: 4%–10% of revenue by some estimates, ranging from \$270 billion to \$780 billion globally, with some 40%–50% spent on technology and the balance on staffing, with \$180 billion on financial crime compliance alone in 2019. It had spent \$500 billion a year on technology as of the end of 2019 and paid over \$380 billion in regulatory penalties from 2009 to 2019.<sup>1</sup> Additionally, regulators are exploring central bank digital currencies in parallel to developments of the digital payment ecosystem. The pace has varied from the full implementation of such a currency in Cambodia and live national pilots in the People's Republic of China; to proofs of concept in Singapore and Hong Kong, China and preliminary research in most other jurisdictions.

This paper initially highlights the interaction of several factors. This includes the industry's use of technology in compliance and risk management; regulator and supervisor use of technology for supervision, monitoring, and enforcement; and the use of technology to embed regulatory requirements and systems into financial infrastructure. This is the regtech ecosystem transforming finance and its regulation. Unfortunately, despite their interlinkages, these aspects—regtech, suptech, and digital financial infrastructure—are too often considered in isolation rather than as aspects of a wider ecosystem. This paper takes this latter approach.

Second, we highlight that this idea of using technology for regulation, supervision, and compliance is, in fact, not new but has been evolving in particular since the 1980s, and even before in the context of the development of technological infrastructure for finance.

As a result of COVID-19, policy makers, regulators, supervisors, and industry participants are focusing heavily on regtech, suptech, and digital financial infrastructure. Regulators are using technology in the supervisory framework to reinforce financial resilience through better supervision, surveillance, and misconduct analysis. This boosts capabilities, enhancing data collection and visualization, reducing cost, and creating real-time monitoring.

Third, the paper highlights the need for an ecosystem approach in designing regtech strategies and the fundamentals of designing optimal architecture alongside the policies required for an integrated ecosystem that spans regtech, suptech, and digital financial infrastructure. Such an approach can accelerate the development of a transparent and harmonious system that helps regulators preserve financial stability and maintain market integrity. It also allows them to address market misconduct and protect consumers through a shared platform that regulated entities can use for compliance. In addition, supervisors can use this platform for monitoring and enforcement, and policy makers to support broader objectives such as access to information for markets and others.

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<sup>1</sup> O. Bevan et al. 2019. The compliance function at an inflection point. McKinsey & Company. 7 January. <https://www.mckinsey.com/business-functions/risk-and-resilience/our-insights/the-compliance-function-at-an-inflection-point>; Consultancy.eu. 2020. *Four ways banks can improve risk & compliance efficiency*. 24 April. <https://www.consultancy.eu/news/4120/four-ways-banks-can-improve-risk-compliance-efficiency>; LexisNexis Risk Solutions. 2020. Financial Services Firms Spend \$180.9 Billion on Financial Crime Compliance, According to LexisNexis Risk Solutions Global Study. *CISION PR Newswire*. 7 April. <https://www.prnewswire.com/news-releases/financial-services-firms-spend-180-9-billion-on-financial-crime-compliance-according-to-lexisnexis-risk-solutions-global-study-301036194.html>; Duff & Phelps. 2021. *Valuation Insights*. <https://www.kroll.com/-/media/assets/pdfs/publications/valuation/valuation-insights/valuation-insights-first-quarter-2021.pdf>.

Finally, we introduce key policy frameworks that can enable ecosystem relationships at national, regional, and international levels, while showcasing vital agile data management and standardization frameworks. We also highlight the importance and key elements of support for creating and building a local innovation ecosystem. We propose ways to build a regtech/suptech/digital financial infrastructure strategy that engages policy makers, regulated institutions, and ecosystem builders, and brings all of these parties together to support more comprehensive financial stability, innovation, and sustainable development.



# 2

## The Regtech/Suptech Ecosystem: Rationale, Typology, and Opportunities

**R**egtech, in its narrow definition, refers to “technological solutions to the regulatory process.”<sup>2</sup> It is often described as the use of technology by the financial services industry for compliance. Under this view, it aims principally to reduce costs and enhance efficiency in complying with regulatory requirements.

Similarly, suptech is often defined narrowly as encompassing only the use of technology by regulators and supervisors. Under this narrow conception, a suptech tool, similar to regtech, is “limited to the use cases most relevant to regulators, as opposed to regulated firms,” especially those around market supervision.<sup>3</sup> The definition of suptech also includes, in this framework, innovative technologies used by the nonsupervisory authorities, such as financial intelligence unit (footnote 3).

Even narrowly, it is clear that regtech and suptech are necessarily interrelated: regtech applications include “any use of technology to match structured and unstructured data” that are analyzed meaningfully, helping regulators and regulated entities to automate compliance and the oversight process.<sup>4</sup> Regtech is driven by regulation created by regulators and the need of the financial industry to comply with regulatory requirements; suptech is the use of technology to monitor compliance with regulatory requirements. Both can thus be seen as two sides of the same coin. Often, the same firms provide services to both industry and regulators: the underpinning idea is that “companies that develop agile technology can not only help financial companies to better comply with regulations but also assist regulators in enforcing prudential regulation better and supervising financial institutions.”<sup>5</sup>

Financial infrastructure is often seen as yet another area where regulators, supervisors, and industry participants use technology to support markets and achieve regulatory and supervisory objectives. While often considered in isolation, financial infrastructures—such as payment and settlement systems and securities disclosure systems—intersects with financial regulatory goals and requirements with financial activities. Such infrastructure uses technology to facilitate transactions;

<sup>2</sup> Institute of International Finance. REGTECH: Exploring Solutions for Regulatory Change. Suade. <https://suade.org/learn/iif-regtech>; D. Aener, J. Barberis, R. Buckley. 2017. FinTech, RegTech, and the Reconceptualization of Financial Regulation. *Northwestern Journal of International and Business Law*. Vol. 37 (3). <https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1817&context=njilb>.

<sup>3</sup> S. di Castri et al. 2019. The suptech generations. *FSI Insights* No. 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

<sup>4</sup> World Bank Group and Cambridge Centre for Alternative Finance. 2020. *The Global Covid-19 FinTech Regulatory Rapid Assessment Study*. <https://www.jbs.cam.ac.uk/wp-content/uploads/2020/10/2020-ccaf-report-fintech-regulatory-rapid-assessment.pdf>.

<sup>5</sup> D. Aener, J. Barberis, R. Buckley. 2017. FinTech, RegTech, and the Reconceptualization of Financial Regulation. *Northwestern Journal of International and Business Law*. Vol. 37 (3). <https://scholarlycommons.law.northwestern.edu/cgi/viewcontent.cgi?article=1817&context=njilb>.

compliance with regulatory requirements; monitoring of regulatory requirements to support market functioning; and regulatory objectives such as financial stability, efficiency, and investor/consumer protection. It also embeds regulatory requirements and monitoring. For example, a stock exchange, a trading platform, and a settlement system integrate disclosure and listing requirements, providing market participants access to necessary information and data on trading activities. This serves dual purposes: first, market participants can use these data to make an informed investment decision; second, regulators and supervisors can use the data for regulatory and supervisory mandates. Financial infrastructure is thus often central to the regtech/suptech ecosystem. This is particularly true in digital regulatory reporting and payments infrastructure.

Together, these areas (often viewed as silos) comprise the regtech ecosystem. For policy makers, it offers significant opportunities to support financial stability, resilience, broader sustainable development, market integrity, financial inclusion, and market trust and confidence.

## A. Regtech/Suptech Rationale

The growth of technology is reshaping the regulatory landscape across industry participants, regulators, supervisors, policy makers, and digital financial infrastructure systems. Financial institutions invest hundreds of billions of dollars annually to cope with new regulations and support digitization and datafication of their processes.<sup>6</sup> In parallel, regulators are constantly challenged to supervise the evolving financial services sector,<sup>7</sup> highlighted by the 14,000+ pages of the US Dodd-Frank post-2008 financial regulatory reform legislation.<sup>8</sup> Regulators need to draw insights from the growing volume of traditional regulatory forms and reports submitted by firms and find ways to supervise less quantifiable factors, such as firm culture, that impact conduct. This combination of demands from industry and regulators drives a strong call for technology-enabled compliance and oversight solutions.<sup>9</sup>

While technology was predominantly used for operational and back-office processes in the past, the last decade has seen it become a key differentiator across the value chain, including in the front office and consumer interface. From the perspective of a regulated entity, regtech offers potentially massive cost savings in meeting regulatory and compliance obligations and increasing efficiency across processes.<sup>10</sup> Regtech focuses on the digitization of manual reporting and compliance processes, for example, in KYC requirements. This could offer further cost savings to the financial services industry and regulators. The exploitation of artificial intelligence (AI) and data analytics in

<sup>6</sup> International Federation of Accountants. 2018. Fragmented Financial Regulation: A \$780 Billion Tax on the Global Economy. 11 April. <https://www.ifac.org/knowledge-gateway/contributing-global-economy/discussion/fragmented-financial-regulation-780-billion>;

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<sup>7</sup> E. Schizas et al. 2020. The Global RegTech Industry Benchmark Report. SSRN Electronic Journal. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3560811](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3560811).

<sup>8</sup> Committee on Financial Services. 2014. *Assessing the Impact of the Dodd-Frank Act Four Years Later*. US Congress Hearing (23 July 2014). <https://www.govinfo.gov/content/pkg/CHRG-113hhrg91158/html/CHRG-113hhrg91158.htm>.

<sup>9</sup> Committee on Financial Services. 2014. House hearing, 113 Congress. <https://www.govinfo.gov/content/pkg/CHRG-113hhrg91158/html/CHRG-113hhrg91158.htm>.

<sup>10</sup> D. Arner, R. Buckley, and J. Barberis. 2016. The Evolution of FinTech: A New Post-Crisis Paradigm? *Georgetown Journal of International Law* 1271.

a regtech application can bolster compliance frameworks for anti-money laundering and combating the financing of terrorism, fraud detection mechanisms, transactions, and trade surveillance, enabling overall improvement of the financial sector.<sup>11</sup> Similarly, suptech tools and applications enhance regulators' capabilities in processing large data sets and enforcing regulatory compliance (footnote 11). Further, these applications allow regulators to respond quickly to market developments, provide consumer protection, and enhance institutional supervision.

Regtech/suptech applications reduce the need for manually interpreting data. Typically, regulators have relied on aggregated and summarized reports about the performance of financial institutions,<sup>12</sup> which could obscure the problematic information, nuances, and anomalies, "requiring regulators to invest significant time and resources to uncover them."<sup>13</sup> Often, regulators have relied on reports with outdated data. Sometimes, regulated entities are mandated to submit specific reports at the end of a quarter or annually, such as the Federal Deposit Insurance Corporation (FDIC) Consolidated Report of Condition and Income,<sup>14</sup> which the banks offer to their regulatory agencies on the last day of each quarter. The lack of access to real-time data means that regulators are dealing with significant blind spots. It becomes challenging for them to monitor threats and risky situations, especially when market turbulence is high. And this challenge became more prominent after the COVID-19 pandemic broke, as financial industries rapidly digitalized their product offerings and contactless operations. Decentralized finance poses another set of challenges in tracking financial crimes and market manipulation.

In the wake of digital transformation and nuanced innovation, regulators thus need to use tech-enabled solutions to better regulate, enforce compliance, and preserve financial stability, while protecting consumers and sustainable financial development. Moreover, the adoption of payments underpinned by blockchain calls for regulators to step up supervisory techniques to enable them to encounter more significant challenges, such as stablecoin and central bank digital currencies' macroeconomic implications, financial stability challenges, and market integrity risks. Regulators can use AI tools—such as machine learning and natural language processing—to collect, sort, combine, and analyze data. Such tools can provide continuous, uninterrupted reporting for the auditing, finance, and risk management areas, and sharpen the surveillance of market trends and emerging risks. This can transform the data regulators' reliance on scale, timeliness, and usefulness when overseeing the financial sector.

<sup>11</sup> Financial Conduct Authority. 2022. Data Analytics and Artificial Intelligence (AI). 17 February. <https://www.fca.org.uk/firms/data-analytics-artificial-intelligence-ai>.

<sup>12</sup> An example of this type of summarized and aggregated report would be FDIC's Summary of Deposits requirements. This is the annual survey of branch office deposits for all FDIC-insured institutions, including insured United States (US) branches of foreign banks. See FDIC. 2020. Summary of Deposits Survey and Filing for 30 June 2020. <https://www.fdic.gov/resources/bankers/call-reports/sod/2020-06-sod-instructions.pdf>.

<sup>13</sup> J. A. Barefoot. 2021. Financial Regulation for the Digital Age. The Regulatory Review. 6 May. <https://www.theregreview.org/2021/05/06/barefoot-financial-regulation-for-digital-age/>.

<sup>14</sup> FDIC. 2022. Bank Call Report Information (updated June 2022). <https://www.fdic.gov/regulations/resources/call/call.html>.

**Table 1: Financial Stability Board Survey Results on Potential Regtech/Suptech Benefits**

<b>Enhanced capabilities</b>	<ul style="list-style-type: none"> <li>Artificial intelligence and advanced technologies enhance decision-making in supervisory measures.</li> <li>The application of deep learning in large and complex data sources allows more effective oversight, especially in high-frequency trading.</li> </ul>
<b>Data collection and visualization</b>	<ul style="list-style-type: none"> <li>Suptech applications reduce the complexity of data and enhance the extraction of more meaningful data.</li> <li>Regtech can drive resource efficiencies in collating data for regulatory filings.</li> </ul>
<b>Cost reduction</b>	<ul style="list-style-type: none"> <li>Digitalization of data improves efficiency and effectiveness, reducing regulators' operational, information technology, and staffing costs.</li> <li>Regtech tools could potentially minimize the costs of regulatory reporting, data collection, and risk management for regulated entities.</li> </ul>
<b>Real-time monitoring</b>	<ul style="list-style-type: none"> <li>Suptech tools allow real-time monitoring of threats that can impair market integrity and financial stability.</li> <li>Regtech applications support real-time risk management by regulated entities.</li> </ul>

Source: Financial Stability Board. The Use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions: Market Developments and Financial Stability Implications. Basel. <https://www.fsb.org/wp-content/uploads/P091020.pdf>.

Regtech and suptech tools have significant implications for overall financial stability. Suptech can potentially enhance the supervisory entities' oversight and visibility in the financial market.<sup>15</sup> More broadly, regulators in the securities market can potentially use digital ledger technology as a node and thus have access to all real-time data.<sup>16</sup> More oversight, visibility, and real-time data enable regulators to “support forward-looking, judgment-based, supervision and policy-making.”<sup>17</sup> Under a prudential regulatory objective, technology in the supervisory framework can reinforce financial resilience through better supervision, surveillance, and misconduct analysis. A 2020 survey conducted by the Bank for International Settlements' Irving Fisher Committee reveals that the use of big data and machine learning across central banks and supervisory authorities across the world rose to 80%—a sharp rise from 30% in 2015.<sup>18</sup> The data are frequently used as input for economic research, to support financial stability and suptech- and regtech-related work, and in key policy areas such as monetary and financial stability.<sup>19</sup>

For a regulated entity, emerging technologies can increase the efficiency of meeting regulatory compliance, improve business outcomes through automated decision-making, and enhance risk management models.<sup>20</sup> Regulators are mainly concerned with modeling risks associated with cybersecurity, model risk, and contagion risk. They are using regtech and suptech to enhance their understanding of these models. Further, regtech can make anti-money laundering and KYC compliance more manageable. It reduces customer onboarding and compliance costs and helps achieve regulatory goals of enhancing

<sup>15</sup> FSB, “The Use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions: Market Developments and Financial Stability Implications” (FSB, 09 October 2020) <<https://www.fsb.org/wp-content/uploads/P091020.pdf>> accessed 05 May 2022.

<sup>16</sup> International Organization of Securities Commission (IOSCO), “IOSCO Research Report on Financial Technologies (Fintech)” (IOSCO, February 2017) <<https://www.iosco.org/library/pubdocs/pdf/IOSCOPD554.pdf>> accessed 05 May 2022.

<sup>17</sup> FSB (2020) (n 22).

<sup>18</sup> Irvine Fisher Committee on Central Bank Statistics, “Use of Big Data Sources and Applications at Central Banks” IFC Report No. 13 (Bank for International Settlements, February 2021) <[https://www.bis.org/ifc/publ/ifc\\_report\\_13.pdf](https://www.bis.org/ifc/publ/ifc_report_13.pdf)> accessed 05 May 2022.

<sup>19</sup> Irvine Fisher Committee (2021) (n 25).

<sup>20</sup> FSB (2020) (n 22).

market integrity, with increased efficiency and speed in activities such as transaction monitoring and sanction screening while reducing false positives, which typically require manual checks. The integration of automation between regtech and suptech tools can significantly decrease human error and thus, increase the potential gains of regulators and regulated entities. Real-time monitoring technology can spot market anomalies and enable regulators to take preventive measures and, in some cases, penalize the potential malicious actor. However, the heightened integration of technology, including the prolific use of application programming interfaces (APIs) for real-time data, exposes the organizations to increased technology risks, especially when it comes to real-time transactions and consumer data. This also increases the “attack” surface available for bad actors. Therefore, the need increases for strong oversight of the key vulnerabilities and data gateways through mature and proven solutions.

The benefits of an ecosystem that serves both regulators and regulated entities are manifold (Table 2):

**Table 2: Benefits of a Regtech/Suptech Ecosystem**

Micro Benefits	Macro Benefits
<ul style="list-style-type: none"> <li>• Interconnected and shared platforms</li> <li>• Real-time data and monitoring</li> <li>• Increased transparency and disclosure</li> <li>• Allows regulators to have more timely interventions and update regulations to keep up with updates in technology</li> <li>• Regulatory clarity and reduced compliance costs for all parties</li> <li>• Eliminate redundancies</li> </ul>	<ul style="list-style-type: none"> <li>• Increased financial inclusion</li> <li>• More transparency means more risk-related data leading to predictability and better preparation</li> <li>• Increased surveillance protects market integrity and enforces market misconduct</li> <li>• Investor confidence</li> <li>• Financial stability</li> <li>• Sustainable financial system</li> </ul>

Source: Authors.

## B. The Regtech/Suptech Industry

As of the end of 2019, the financial services industry was spending over \$500 billion per year on technology, making it one of the largest spenders in the sector. At the same time, the financial services industry was spending hundreds of billions of dollars on compliance costs, with a significant portion of this on technology. The industry initially focused on recruiting large teams of compliance professionals to address compliance gaps, which were largely manual and rule-based intensive workflows and resulted in very high false-positive ratios.<sup>21</sup> The high costs of compliance teams coupled with inefficiencies in the traditional analog approach led banks to seek to harness technology for their compliance requirements. The other driver for regtech was the over \$300 billion in regulatory fines that financial institutions globally paid between 2008 and 2019, highlighting the financial, reputational, and legal driving force behind regtech.<sup>22</sup>

<sup>21</sup> C. Correia. 2015. False Positives: A Growing Headache. *The Global Treasurer*. 8 October. <https://www.theglobaltreasurer.com/2015/10/08/false-positives-a-growing-headache/>.

<sup>22</sup> Financial industry spending over \$300 billion a year on compliance. See Gartner (2020).

As digital financial services have evolved over the last decade, the focus has primarily been on fintech as one segment covering all technology start-ups that service the industry. Regtech solutions were also often listed under this broad umbrella, given the relatively small number of regtech start-ups in the early to mid-part of the last decade. Additionally, with regtech applications also applicable across multiple industries, there was less focus on classifying the segment, and they were seen as a component of the ecosystem. However, with a significantly increased regulatory burden for financial institutions underpinned by advances in technology, there has been tremendous growth in the number of regtech start-ups. The reality, however, is that regtech continues to be dominated by established players, with the major market coming from the incumbent financial services industry. With a large number of fintech and Big Tech firms now offering licensed and regulated products, their regulatory obligations have also heightened, leading to increased demand for regtech solutions by these players.

**Figure 2: Big Tech in Financial Services**

Big Tech	Main Businesses	Banking	Credit Provision	Payments	Crowdfunding	Asset Management	Insurance
Google	Internet search/ advertising	✓*		✓			
Apple	Tech/producing hardware			✓			
Facebook	Social media/ advertising			✓			
Amazon	E-commerce/ online retail		✓	✓	✓		✓
Alibaba (Ant Group)	E-commerce/ online retail	✓	✓	✓	✓	✓	✓
Baidu	Internet search/ advertising	✓	✓	✓	✓	✓	✓
Tencent	Tech/ gaming and messaging	✓	✓	✓	✓	✓	✓

✓\* Originally planned to launch in 2021. However, as of October 2021, Google has abandoned its plan to offer bank accounts to users. Source: JJ. Elias and H. 2021. Google Abandons Plans to Offer Bank Accounts to Users. CNBC. 21 October. <https://www.cnbc.com/2021/10/01/google-abandons-plans-to-offer-plex-bank-accounts-to-users.html>.

Source: J. C. Crisanto, J. Ehrentraud, and M. Fabian. 2021. Big Techs in Finance: Regulatory Approaches and Policy Options. *Financial Stability Institute Briefs* No. 12. <https://www.bis.org/fsi/fsibriefs12.pdf>.

**Table 3: Licenses Held by Big Tech Companies in Different Jurisdictions**

	Brazil			People's Republic of China			European Union			Hong Kong, China SAR			United Kingdom			United States		
License held	B	C	P	B	C	P	B	C	P	B	C	P	B	C	P	B	C	P
Amazon									✓						✓			✓
Apple																		✓
Facebook									✓						✓			✓
Google									✓						✓			✓
Alibaba			✓	✓*	✓	✓			✓	✓		✓			✓			✓
Baidu				✓*	✓	✓												
Tencent				✓*	✓	✓				✓								

B = banking license; C = credit license; P = payment license; SAR = Special Administrative Region; ✓ = big tech has entity within group that holds financial license; ✓\* = shareholding of big tech in these banks is below 50%.

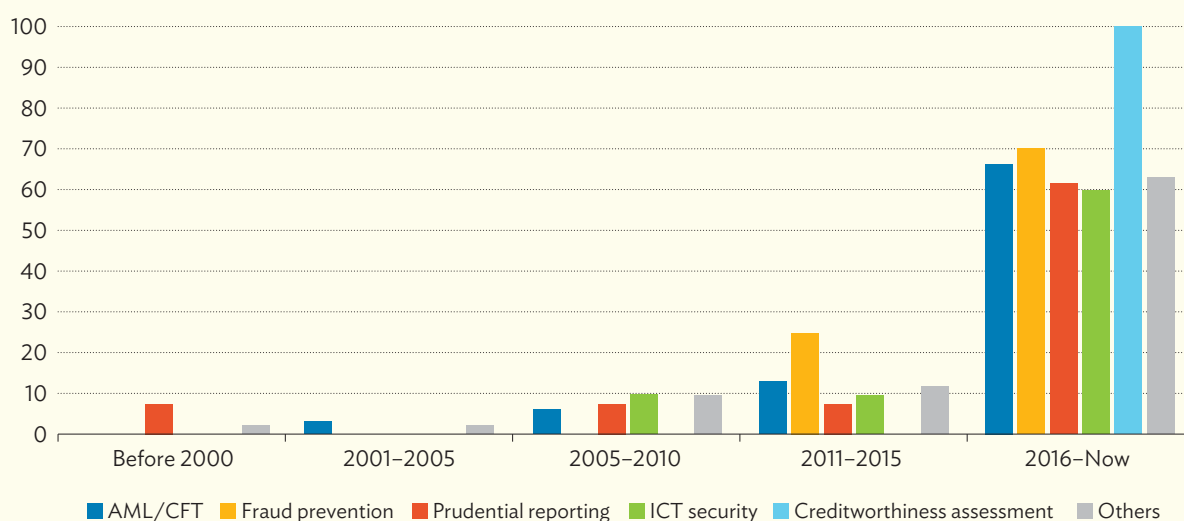
market presence in partnership or joint venture with other financial institutions;

big tech offers financial services both through partnership or joint venture with other financial institutions and has entity within group that holds financial license

Source: J. C. Crisanto, J. Ehrentraud, and M. Fabian. 2021. Big Techs in Finance: Regulatory Approaches and Policy Options. *Financial Stability Institute Briefs* No. 12. <https://www.bis.org/fsi/fsibriefs12.pdf>.

**Figure 3: Number of Regtech Projects Going Live in the European Union Over the Last 2 Decades**

(%)



AML/CFT = anti-money laundering and combating the financing of terrorism, ICT = information and communication technology.

Source: European Banking Authority (EBA). 2021. *EBA Analysis of Regtech in the European Union Financial Sector*. 29 June. <https://www.eba.europa.eu/eba-assesses-benefits-challenges-and-risks-regtech-use-eu-and-puts-forward-steps-be-taken-support>.



In this context, the provision of regtech and suptech services to the financial services industry—incumbents, regulators, and new entrants alike—is led very much by established firms, including Big Tech firms, data and infrastructure providers, consulting and advisory firms, as well as a growing number of regtech start-ups. Technology firms such as IBM, Amazon, and Microsoft have invested in solutions for enterprises while also acquiring other specialized players to supplement their offerings. For example, IBM acquired Promontory in 2016, a 600-person regulatory compliance firm, with the primary aim to teach IBM’s AI, Watson. Amazon and Microsoft’s cloud offerings, Amazon Web Services and Azure, respectively, have integrated regtech solutions, such as data protection, cybersecurity, and even regulatory reporting for the financial institutions and fintech firms that use their cloud services. Traditional financial data players in the data intelligence and data infrastructure segments offer their clients stand-alone and integrated regtech solutions. S&P Intelligence, NASDAQ, Bloomberg, and LSE Refinitiv rely on big data analytics and AI to provide solutions on a host of themes, including market forensics, transaction monitoring, risk management, and regulatory compliance. In a similar vein, large consulting firms such as KPMG and Deloitte and specialists such as Lexis Nexis and Thomson Reuters have dedicated regtech teams to support their clients. They also work closely with regulators, supervisors, and policy makers to support policy actions and ecosystem engagement on regtech.

With most financial institutions seeking to increase regtech use to address compliance, reduce costs, enhance risk management, and improve strategic performance, there is also a high degree of satisfaction with regtech offerings. As per a European Banking Authority survey, 70% of financial institutions are satisfied with the realized benefits of regtech solutions, with the highest level of positive feedback seen across security, fraud prevention, and creditworthiness-related solutions.

## C. Regtech/Suptech Typology: Financial Regulation

Driven by regulation, regtech and suptech cover all the major areas of financial regulation. These include financial stability and prudential regulation (such as BCBS 239 compliance),<sup>23</sup> disclosure and reporting (for example, in the securities systems such as the US Securities and Exchange Commission’s EDGAR),<sup>24</sup> market integrity (with anti-money laundering and combating the financing of terrorism [AML/CFT] a critical industry focus as well as an area where policy makers and supervisors are focusing increasingly on building infrastructure through digital identity systems and networked databases), consumer and investor protection (in the monitoring of trading activities for manipulation and insider dealing), data and cybersecurity, and—a new and rapidly growing area—sustainability.

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<sup>23</sup> Bank for International Settlements. 2021. *Basel Committee on Banking Supervision – Principles for Operational Resilience*. <https://www.bis.org/bcbs/publ/d516.pdf>.

<sup>24</sup> A detailed analysis, *infra*, Section III A.



Figure 4: Regtech Use Areas by Financial Regulators



AML = anti-money laundering.

Notes: CRS is the OECD-recommended Common Reporting Standard. <https://www.oecd.org/tax/automatic-exchange/common-reporting-standard/>; FATCA is the United States' Foreign Account Tax Compliance Act. <https://www.irs.gov/businesses/corporations/foreign-account-tax-compliance-act-fatca>; GRC is Governance, Risk, and Compliance. <https://www.oci.org/about/what-is-grc/?msclkid=7a086fa5cf1d11ec8d4d376ea38e5774>.

Source: Hong Kong Monetary Authority and KPMG. 2020. *Transforming Risk Management and Compliance: Harnessing the Power of Regtech*. <https://www.hkma.gov.hk/media/eng/doc/key-information/press-release/2020/20201102e3a1.pdf>.

# 3

## Evolution of Regtech and Suptech

While the term regtech is new, the use of technology for compliance, supervision, regulation, monitoring, enforcement, and market infrastructure is not. The modern use of technology for regulatory and supervisory purposes has evolved over three key periods.

### A. Modern Foundations: 1987–2008

The early development of regtech can be traced back to the 1990s, following the “Black Monday” market crash in 1987—an event generally attributed to computer program-driven trading strategies (such as hedging, index arbitrage, and portfolio insurance).<sup>25</sup> While program trading was the epitome of innovation, attracting many investors, the market crash of 1987 exposed its vulnerability and how it could be strained and come close to breaking in extreme conditions.<sup>26</sup> It became apparent that the system in use could not instantly process the information in a rapidly changing environment (footnote 26). It further demonstrated the need to establish a transparent “trading information system” that could “monitor transactions and conditions in related markets” and provide the necessary information to investors to make an informed investment decision (footnote 26). As a result, after the 1987 stock market crash, regulators were looking to increase the visibility of the trading market. Consequently, at the beginning of the 1990s, “institutions encountered increasing regulatory challenges as they became more global, catalyzing the development of large compliance and risk management departments.”<sup>27</sup>

One of the first regtech tools we can refer to is the Consolidated Tape System (CTS) and Consolidated Quotation System (CQS), which disseminate real-time trade and market information. The Consolidated Tape Association governs the CTS and CQS. Since the late 1970s, all Securities and Exchange Commission (SEC)-registered exchanges and market centers that trade on the New York Stock Exchange or SEC-listed securities (as it was then known) send their trades and quotes to a central consolidator that combines data streams produced from CTS and CQS and distributed worldwide.

<sup>25</sup> In “program trading” strategies, computers were set up to quickly trade particular amounts of a large number of stocks. This was closely associated with index arbitrage, but it was actually a generic term that encompassed several trading strategies, including asset allocation and hedging, portfolio insurance, and index arbitrage. For details, see L. Solomon and H. Dicker. 1988. The Crash of 1987: A Legal and Public Policy Analysis. *Fordham Law Review* vol. 57(2). <https://ir.lawnet.fordham.edu/flr/vol57/iss2/2/>; see also M. De Belleville Katzenbach. 1987. *An Overview of Program Trading and Its Impact on Current Market Practices*. New York: The New York Stock Exchange.

<sup>26</sup> M. Carlson. 2006. A Brief History of the 1987 Stock Market Crash with a Discussion of the Federal Reserve Response. *Finance and Economic Discussion Series* 2007–13. <https://www.federalreserve.gov/pubs/feds/2007/200713/>.

<sup>27</sup> HedgeThink. A RegTech Overview – Where We Have Come from And Where We Are Going. <https://www.hedgethink.com/a-regtech-overview-where-we-have-come-from-and-where-we-are-going/>.

Another early regtech tool is the EDGAR system, adopted by the SEC in early 1993<sup>28</sup> to enhance processing speed and efficiency and make corporate and financial information available to investors.<sup>29</sup> Since its launch in 1993, EDGAR has had enormous implications for investor communities to make data immediately available to anyone who has access to computers and the EDGAR database (footnote 29).

In 1994, a new regtech tool was developed that companies could use to measure risks using reasonable probability.<sup>30</sup> Known as value at risk (VAR), the risk management tool was widely used to assess risks concerning derivatives. It became popular among financial institutions and regulators to evaluate all kinds of financial troubles.<sup>31</sup> From a prudential regulatory standpoint, the VAR framework was incorporated in the Basel I Capital Accord. Its subsequent amendment in 1996 gave banks the discretion to use their proprietary VAR system to compute capital requirements and evaluate market risks. Subsequently, the Basel II Capital Accord incorporated significance reliance on financial institutions' internal quantitative risk management.<sup>32</sup>

Since the beginning of the 2000s, two significant events accelerated the need for the widespread use of technology in regulatory and supervisory activities. First, the 9/11 terrorist attacks in the US exposed the global financial system to greater risk of terrorist financing and money laundering.<sup>33</sup> Bad actors tend to leverage the internet to transfer and source funds, which international banks, regulators, and law enforcement agencies were not fully equipped to detect and deter promptly.<sup>34</sup> Rapid globalization exasperated regulatory challenges as regulators struggled to track trade-based money laundering.<sup>35</sup>

Second, the false sense of security and complacency proved to be a gross mistake when the global financial crisis of 2008 unfolded.<sup>36</sup> While the crisis was complex with multifaceted contributing factors, it became evident that the then regulatory mechanisms and reporting requirements in use provided regulators with tunnel vision leading to their failure to monitor activities that were taking place over the counter. Regulators' confidence in financial institutions' internal risk assessment tools did not end well. Thus, the 2008 financial crisis marked the end of the first phase of the evolution of regtech.

<sup>28</sup> The process started in 1984 when the SEC allocated \$30 million to start the EDGAR pilot program. EDGAR aimed to establish "an electronically accessible database providing a more efficient and less costly method whereby the investing public could get the information it needed." See Help – History of EDGAR. EDGAR Online & The SEC's EDGAR Filing System. <https://help.edgar-online.com/edgar/history.asp?site=pro>.

<sup>29</sup> US Securities and Exchange Commission. 2006. Electronic and the EDGAR System: A Regulatory Overview. <https://www.sec.gov/info/edgar/regoverview.htm>.

<sup>30</sup> VAR was developed in response to the failures of various companies that used derivatives inappropriately and lacked internal control mechanisms. Also, the early 1990s and 2000s showed the interconnectedness of the financial system and how it was prone to spill-over effects from financial contagion. Examples: the US savings and loans crisis in the 1980s and the Japanese banking crisis in the 1990s.

<sup>31</sup> Despite VaR's popularity, the system was also criticized for its misrepresentation and misuses. For details on the limitation of VAR, see A. Krause. 2003. Exploring the Limitations of Value at Risk: How Good is It in Practice? *Journal of Risk Finance* vol. 4(2).

<sup>32</sup> International Monetary Fund (IMF). 2005. *Implementation of Basel II – Implications for the World Bank and the IMF*. 22 July. <http://www.imf.org/external/np/pp/eng/2005/072205.htm#s2>.

<sup>33</sup> United Nations Office on Drugs and Crime. 2012. *The Use of the Internet for Terrorist Purposes*. New York: United Nations. [https://www.unodc.org/documents/frontpage/Use\\_of\\_Internet\\_for\\_Terrorist\\_Purposes.pdf](https://www.unodc.org/documents/frontpage/Use_of_Internet_for_Terrorist_Purposes.pdf).

<sup>34</sup> Financial Action Task Force Groupe d'action financière (FATF-GAFI). 2008. *Money Laundering and Terrorist Financing Vulnerabilities of Commercial Websites and Internet Payment Systems*. 18 June. <https://www.fatf-gafi.org/media/fatf/documents/reports/ML%20TF%20Vulnerabilities%20of%20Commercial%20Websites%20and%20Internet%20Payment%20Systems.pdf>.

<sup>35</sup> The World Bank. Trade (% of GDP). <https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS> (accessed 05 May 2022).

<sup>36</sup> J. Barberis, D. Arner, and R. Buckley. 2018. *The RegTech Book: The Financial Technology Handbook for Investors, Entrepreneurs, and Visionaries in Regulation*. Hoboken, New Jersey: Wiley.

## B. Regtech After the Global Financial Crisis of 2008–2019

The landscape of the financial services sector went through a significant transformation post-financial crisis in 2008. The gradual change in the financial market, services, and institutions can be attributed to changes due to an overhaul in financial regulation and significant advances in technology innovation, mainly due to rapid mobile phone technology changes since the launch of smartphones in 2007. Within the context of banking, the nature of financial markets, services, and institutions is changing due to new entrants' disruptive and innovative technological practices following the latest financial crisis.<sup>37</sup> Fintech further exposed the weaknesses of incumbent financial institutions' business models, thus accentuating their regulatory burden.<sup>38</sup> The emergence of fintech also continually pushed regulators to readjust their methodology toward supervision and licensing.<sup>39</sup> Additionally, new business models have emerged with new technology and innovation that require a change in the regulations' approach from prescriptive to principle-based. This iterative process has gradually increased regulators' sophistication in their understanding of fintech innovations and business models and triggered the innovation of regtech and suptech.

### 1. Post-Crisis Regulatory Reforms

The post-financial crisis reforms required the regulators to establish enhanced risk-based capital, leverage, and liquidity requirements, overall risk management requirements, resolution plans, credit exposure reporting, additional prudential standards, and improved public disclosure requirements for banks and nonbank entities.<sup>40</sup> On an international level, regulators agreed to adopt similar accounting and reporting standards (such as Generally Accepted Accounting Principles<sup>41</sup> and International Financial Reporting Standards)<sup>42</sup> and harmonize the collection of consolidated data on bilateral counterparty and credit risks of systemically important banks.<sup>43</sup> The crisis also revealed that banks' information technology and data frameworks were insufficient to “support the broad management of financial risks.”<sup>44</sup>

Aside from banking, nonbank financial institutions and securities markets also came under stricter regulatory and supervisory requirements. For instance, the European Union (EU) introduced Directive 2013/34/EU (also known as the accounting directive), requiring all listed companies with securities traded on a regulated market to prepare their consolidated financial statements following

<sup>37</sup> P. Gomber, J. Koch, and M. Siering. 2017. Digital Finance and FinTech: Current Research and Future Research Direction. *Journal of Business Economics* 87 (5).

<sup>38</sup> I. Anagnostopoulos. 2018. Fintech and Regtech: Impact on Regulators and Banks. *Journal of Economics and Business* vol. 100, pp.7-25. <https://www.sciencedirect.com/science/article/abs/pii/S014861951730142X>.

<sup>39</sup> D. Zetzsche et al. 2017. Regulating a Revolution: From Regulatory Sandboxes to Smart Regulation. *Fordham Journal of Corporate and Financial Law* 23 (1).

<sup>40</sup> R. Guynn and D. Polk, and Wardwell LLP. 2010. The Financial Panic of 2008 and Financial Regulatory Reform. *Harvard Law School Forum on Corporate Governance*. 20 November. <https://corpgov.law.harvard.edu/2010/11/20/the-financial-panic-of-2008-and-financial-regulatory-reform/>.

<sup>41</sup> *Accounting.com*. 2022. What is GAAP? 2 May. <https://www.accounting.com/resources/gaap/>.

<sup>42</sup> IFRS. 2022. ISSB delivers proposals that create comprehensive global baseline of sustainability disclosures. 31 March. <https://www.ifrs.org/news-and-events/news/2022/03/issb-delivers-proposals-that-create-comprehensive-global-baseline-of-sustainability-disclosures/>.

<sup>43</sup> S. Claessens and L. Kodres. 2014 The Regulatory Responses to the Global Financial Crisis: Some Uncomfortable Questions. *IMF Working Paper* 14/46. <https://www.imf.org/external/pubs/ft/wp/2014/wp1446.pdf>.

<sup>44</sup> Bank for International Settlements. 2013. *Basel Committee on Banking Supervision—Principles for Effective Risk Data Aggregation and Risk Reporting*. <https://www.bis.org/publ/bcbs239.pdf>.

International Financial Reporting Standards.<sup>45</sup> In the US, the securities market went through a drastic transformation. The Dodd-Frank Act required the securities firms to comply with increased disclosure regime, risk retention mechanism, and capital adequacy requirements.<sup>46</sup>

Against this backdrop, Regtech 2.0 emerged to respond to post-financial crisis regulatory reforms. During this phase, startup companies and self-regulatory organizations came up with tech-enabled solutions to help financial institutions and securities firms comply with the regulatory requirements. From a consumer's standpoint, these strict regulatory and compliance requirements have two significant implications—first, they dramatically increased the reporting and compliance costs for banks, many of which were forced to shrink their lending activities; second, due to banks' restricted and heavily regulated lending activities combined with significantly higher compliance costs, the credit market became stagnant.<sup>47</sup>

The regulatory changes in banking and other financial sectors, along with strict disclosure requirements, led to a growing number of unbanked/underbanked customers. Consumer onboarding norms, especially know-your-customer (KYC) requirements, were significantly raised to combat money laundering and terrorist financing. With rapid developments in technology, start-ups and technology firms started developing fintech solutions that could cater to the underserved and unserved population. The increasing use of fintech applications warranted the regulators to adopt technologies in regulatory and supervisory activities gradually.

## 2. Digitalization and Datafication of Finance and New Risks

With the proliferation of fintech, the use of AI and big data has increased in the financial services sector. For instance, since a large number of fintech consumers come from the unbanked and underbanked communities, fintech companies are heavily reliant on using machine learning algorithms to process online loan applications, instantly assess creditworthiness, and compute the probability of credit default. With the increased availability and granularity of data, new infrastructures were developed, such as cloud computing and application programming interfaces (APIs), that allowed large data sets to be collected, stored, and analyzed.

However, these developments also came with an increase in cyber risk for all participants. New cybersecurity, data security and privacy, and technological risks became significant threats to financial stability and national security.<sup>48</sup> The advent of open banking and use of APIs meant financial institutions need to maintain robust cybersecurity policies and frameworks. As many institutions began to deploy cloud solutions for various operations, it meant a severe cyber attack could lead to significant losses in funds and business while increasing systematic risks. Regulators paid increasing

<sup>45</sup> European Commission. Financial Reporting: EU Rules on Financial Information Disclosed by Companies. [https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/financial-reporting\\_en#ifrs-financial-statements](https://ec.europa.eu/info/business-economy-euro/company-reporting-and-auditing/company-reporting/financial-reporting_en#ifrs-financial-statements).

<sup>46</sup> S.Schwarz. 2015 Securitization and Post-Crisis Financial Regulation. Cornell Law Review 101 (115). [https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=6249&context=faculty\\_scholarship](https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=6249&context=faculty_scholarship).

<sup>47</sup> P. Stein, T. Goland, and R. Schiff. 2012. Two Trillion and Counting: Assessing the Credit Gap for Micro, Small, and Medium-Size Enterprises in the Developing World. World Bank Working Paper No. 71315. <http://documents.worldbank.org/curated/en/386141468331458415/pdf/713150WP0Box370rillion0and0counting.pdf>.

<sup>48</sup> See R. Buckley et al. 2019. The Dark Side of Digital Financial Transformation: The New Risks of FinTech and the Rise of TechRisk. UNSW Law Research Paper 19-89. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3478640](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3478640).

attention to authorized institutions' cybersecurity resilience and preparedness to avoid potential outages of services and, more importantly, to protect user data. For example, the Hong Kong Monetary Authority (HKMA), in 2016, introduced the Enhanced Competency Framework<sup>49</sup> and raised the Cyber Resilience Assessment Framework and Intelligence-led Cyber Attack Simulation Testing<sup>50</sup> for authorized institutions to enhance their cybersecurity competencies and capabilities.

Moreover, once Big Tech companies (such as Tencent, Amazon, Google, and Alibaba) entered finance, their data-based business models and network effects gave rise to two new challenges. The first challenge arises “in the context of new forms of potentially systemically important infrastructure (such as data and cloud services providers) (footnote 50).” The second challenge is linked data's economic scalability and network effects, “resulting in the potential for systemic risk from new forms of “Too Big to Fail” and “Too Connected to Fail” phenomena (footnote 50).”

In light of the new development, regtech 2.0 provides the foundation for a shift toward a proportionate, risk-based approach underpinned by efficient data management and market supervision. Emerged as a post-crisis regulatory response and in the context of the emerging tech-centric financial sector, regtech 2.0 primarily concerns the digitization and datafication of regulatory compliance and reporting processes. Successful regtech development includes (i) application of big data approaches, (ii) strengthening of cybersecurity, and (iii) facilitation of macroprudential policy.<sup>51</sup> Concerning big data, regulators are starting to consider technological solutions for managing anti-money laundering and KYC compliance information produced by industry participants, such as suspicious transaction reports.

As a leading example, in 2017, the Monetary Authority of Singapore (MAS) established a Data Analytics Group. One of the group's initiatives focused on developing a shared service utility to enhance KYC checks, improve the quality of risk management, and reduce time and costs. Lower KYC costs can foster financial inclusion by making onboarding less expensive for institutions. The MAS has also collaborated with the Bank for International Settlements (BIS) for the project Nexus, which simplifies cross-border payments by connecting real-time payment systems in each jurisdiction. The Nexus system design will include features for supporting banks' use of sanction screening by enhancing compliance.

As a second example, India Stack emerged, India's pathbreaking digital infrastructure strategy, perhaps now the leading example of an ecosystem approach to regtech, supotech, and financial infrastructure.<sup>52</sup> It combined a national system of sovereign digital identification to enable financial access and inclusion based on electronic payments with a range of data management and analytics systems. A government-run electronic KYC utility, for example, helps banks and other financial institutions to confirm the identity of potential customers at a fraction of previous costs. By allowing regulations to a broad range of available technology solutions, many jurisdictions have started to allow a varying degree of digital and video onboarding for customers.

<sup>49</sup> HKMA. 2016. Guide to Enhanced Competency Framework on Cybersecurity. <https://www.hkma.gov.hk/media/eng/doc/key-information/guidelines-and-circular/2016/20161219e1.pdf>

<sup>50</sup> HKMA. 2016. The Cyber Resilience Assessment Framework. Presentation Cybersecurity Summit 2016. <https://www.hkma.gov.hk/media/eng/doc/key-information/speeches/s20160518e2.pdf>.

<sup>51</sup> D. Arner, J. Barberis, and R. Buckley. 2017. FinTech and RegTech in a Nutshell, and the Future in a Sandbox. *CFA Research Brief*. <https://www.cfainstitute.org/-/media/documents/article/rf-brief/rfbr-v3-n4-1.pdf>.

<sup>52</sup> For a general analysis, see V. Raghavan, S. Jain, and P. Varma. 2019. India Stack—Digital Infrastructure as Public Good. *Communications of the ACM* 62 (11). pp. 76–81. <https://doi.org/10.1145/3355625>.



Lastly, one of the critical developments of this period was the evolution of blockchain technology—a form of distributed ledger technology. Bitcoin—a blockchain-based digital asset—showed the prospects of a transparent, faster, efficient, and cheaper method of transferring payments on a decentralized peer-to-peer network without involving financial intermediaries. Although the potential of using bitcoin as a reliable payment instrument soon became questionable due to its volatility and speculative nature, the underpinning blockchain technology demonstrated enormous use-cases in various sectors, ranging from finance to supply chains. Further, the Ethereum blockchain development brought with it the use of programmable smart contracts. These smart contracts can be programmed with various data processing conditions, while benefitting from instant data reconciliation and transparency. In the financial sector, International Swaps and Derivatives Association promotes smart contract use in enabling efficient execution and monitoring of complex derivative products.<sup>53</sup> With the technology maturing over time, distributed ledger technologies will play a significant role in shaping financial services and regulatory oversight and the use of regtech.

## C. COVID-19 and Digital Financial Transformation: 2019 to Present

Regtech 3.0 is defined under the context of rapid digitalization since the outbreak of the COVID-19 pandemic. With social distancing, lockdowns, and physical hygiene measures, the need was urgent to accelerate the adoption of digital financial services, such as contactless payment, and expand non-face-to-face digital financial and payment-related services. Most countries saw a rapid uptick in digital finance adoption during the last 2 years. Financial sectors, including Big Tech companies, started engaging in innovative technology-based solutions to achieve faster, cheaper, and contactless payments and financial services to respond to the market's growing needs. Many jurisdictions updated their mandates to enable digital onboarding while providing guidelines for increased digital transactions. On the other hand, there was further development. Online trading and financial services also increased dramatically, particularly among younger people globally.<sup>54</sup>

Technology and finance have together been central to resilience in the face of the pandemic and particularly its attendant lockdowns around the world, and to responding to the crisis and seeking to support the recovery. Lockdowns and social distancing have rapidly accelerated digitalization worldwide, fast-tracking the adoption of digital financial services by several years.<sup>55</sup> If the pandemic had struck a mere decade earlier, the existing technology would have meant the capacity for so many of us to work from home would have been severely constrained. Overall, much higher face-to-face interactions between people would have been necessary during lockdowns.

<sup>53</sup> ISDA. 2019 Legal Guidelines for Smart Derivatives Contracts: Collateral. 12 September. <https://www.isda.org/2019/09/12/legal-guidelines-for-smart-derivatives-contracts-collateral/>.

<sup>54</sup> K. Park. 2021. Easy Money? Gen Z Invest Online to Beat Coronavirus Woes. *Reuters*. 18 March. <https://www.reuters.com/article/usglobal-investment-generation-z-idUSKBN2BB00K>.

<sup>55</sup> McKinsey & Company. 2020. *How COVID-19 has Pushed Companies over the Technology Tipping Point – and Transformed Business Forever*. 5 October. <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever>.

Unlike 2008 when finance was central to the problem, since 2020, finance has been central to resilience and response. If we look at the experience since 2020, we can identify four major areas where digitalization of finance is moving forward rapidly as a result of the “digitization of everything”: electronic payments; use of technology for regulatory and supervisory purposes, digital identity, and market integrity; and Big Tech and digital finance platforms.

One of the most dramatic changes has come in the context of regtech and suptech. Faced with working from home, financial institutions and their staff—including frontline, trading, compliance, legal, risk management, and management—had to rapidly implement digitized communications and working systems.<sup>56</sup> This process has accelerated the digitalization of finance, particularly of incumbents and large financial institutions across the globe. COVID-19 also expedited a drive toward a cloud-based infrastructure to support the full range of processes, activities, and data storage.

In addition to the financial services industry, COVID-19 has transformed the attitudes and approaches of regulators, supervisors, and central banks worldwide to use technology in their operations and activities.<sup>57</sup> Where pre-COVID-19 meetings would have been face-to-face, they are now virtual. Supervisory functions have had to move online, particularly what would formerly have been on-site supervisory activities. Interactions with industry compliance staff have also moved online. As a result, central banks, regulators, and supervisors are looking not only at how technological infrastructure can be improved but also at digitizing and datafying their operations and systems.

The COVID-19 pandemic has accelerated the adoption of suptech tools among supervisors, particularly in qualitative data scrutiny and risk identification. Although the pandemic exposed the vulnerabilities of authorities’ digital infrastructure and their ability to handle supervisory work virtually, this also created a potential avenue for furthering technological integration and redesigning the future of supervision. As reported by the Financial Stability Institute (FSI), suptech tools during the pandemic “proved indispensable,” facilitating supervisors to review corporate governance and asset quality typically conducted on-site (footnote 57). The use of natural language processing and risk identification tools helped supervisors indicate corporate governance risks and potential credit risks without going through the voluminous documents (footnote 57). This off-site supervision mode is a paradigm shift triggering regulators and supervisors to rethink the methods of supervision in the post-pandemic digital era, including the extensive use of suptech tools in prudential supervision (footnote 57). In the coming years, the evolution of next-generation quantum computing driven by vastly increasing computing power and platforms, like Google Tensor, has the potential to empower supervisory analysis at an entirely new level of sophistication. At the same time, however, these systems pose major risks from the standpoint of existing systems and approaches in industry, regulators, and digital financial infrastructure. As a result, they will likely drive an entirely new round of regtech/suptech/digital financial infrastructure ecosystem development.

<sup>56</sup> D. Arner et al. 2021. Digital Finance, COVID-19 and Existential Sustainability Crises: Setting the Agenda for the 2020s. *University of Hong Kong Faculty of Law Research Paper*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3783605](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3783605).

<sup>57</sup> For example, see K. Beerman, J. Prenio, and R. Zamil. 2021. *FSI Insights on Policy Implementation 37—Suptech Tools for Prudential Supervision and their Use during the Pandemic*. Bank for International Settlements. <https://www.bis.org/fsi/publ/insights37.pdf>.



# 4

## Regtech/Suptech Ecosystem Development: Strategic Approaches and Examples

Regulators globally are now very aware of the risks and opportunities that arise due to digitalization. Simultaneously, the financial industry has been transformed via technology to enhance efficiencies, while policy makers are focusing on how digital financial infrastructure can be improved to support resilience, inclusion, and broader sustainable development.<sup>58</sup>

### A. United Kingdom Financial Conduct Authority, Monetary Authority of Singapore, and India Stack

Several major central banks and regulators have sought to develop regtech/suptech ecosystem strategies in the last 5 years. We provide examples from three different jurisdictions—the United Kingdom for its regtech and suptech applications, Singapore for an ecosystem approach, and India for an infrastructure strategy.

#### 1. United Kingdom Financial Conduct Authority

The United Kingdom Financial Conduct Authority (FCA) is considered one of the first movers in adopting regtech applications. In 2015, it identified four areas where regulators could become more involved to support the adoption of regtech: (i) providing regulatory expertise, (ii) supporting the current fintech and regtech environment; (iii) guidance on acceptable standards; and (iv) addressing barriers to entry, innovation, and adoption. To pursue these goals, the authority invented “Project Innovate,” which has helped provide clarity to fintech and regtech firms about regulatory requirements, collaborate with stakeholders, and understand and address barriers to entry innovation adoption of regtech.<sup>59</sup>

<sup>58</sup> A. Friend. 2021. *The Financial Conduct Authority's Innovation Journey: Moving Forward in the Face of Uncertainty*. Alliance for Innovation Regulation. p. 27. <https://regulationinnovation.org/wp-content/uploads/2021/03/The-FCAs-Innovation-Journey-Moving-Forward-in-the-Face-of-Uncertainty-AIR-Final-2.pdf#page=27>.

<sup>59</sup> Financial Conduct Authority. 2015. *Call for Input: Supporting the Development and Adoption of RegTech*. London: FCA. <https://www.fca.org.uk/publication/call-for-input/regtech-call-for-input.pdf>. Cited in A. Friend. 2021. (n 74).

Three main components of the FCA's Project Innovate fundamentally shaped regulators' early approach toward regtech:

### a. Digital Regulatory Reporting

Digital Regulatory Reporting (DRR) aims to convert financial information into a digital form that can be quickly and inexpensively reported or even obtained by regulators as needed, with appropriate limits and controls. DRR provides regulators with complete information in real-time, enabling them to risk trends while also reducing the industry's regulatory assets. It aims to reduce the regulatory reporting burden on firms by making the process more efficient while improving the quality of 500,000 scheduled regulatory reports the FCA alone receives every year.<sup>60</sup> Following the FCA's path, the BIS, the Group of Twenty, the MAS, the FDIC, and the New York State Department of Financial Services have developed DRR projects.

### b. Machine-Readable Regulation

Machine-readable regulations are an essential part of DRR. Many regulators have begun innovative work in this area. The US Financial Industry Regulatory Authority (FINRA) builds a taxonomy of its rules that enable electronic tagging, allowing computers to read requirements and track updates.<sup>61</sup>

### c. Machine-Executable Regulation

The United Kingdom and Singapore have tested self-implementing regulations, known as "machine-executable" regulations. This system allows regulators to issue rules generated through computer code. Regulated firms can integrate the code into their systems to produce an automatic and accurate report within a few seconds.

## 2. Monetary Authority of Singapore

The MAS uses regtech strategies to advance Singapore's fintech ecosystem, especially in digital identification (ID) electronic KYC (e-KYC), data governance, and platforms for innovation.<sup>62</sup> In this regard, the MAS partnered with the Smart National Digital Government Office and the Government Technology Agency to develop Singpass—Singapore's National Digital ID.<sup>63</sup> The platform aims to provide the residents of Singapore with a verified and signed digital ID that they can conveniently secure online and use for financial transactions. For surveillance activities, the MAS uses the machine algorithm model trained with high-risk AML/CFT cases and is used to detect potential cases.<sup>64</sup> Another regtech application adopted by the MAS is Apollo—an advanced data science tool that automates reviewing firms' trade-related data by leveraging the use of algorithms and statistical analysis and spots

<sup>60</sup> Financial Conduct Authority. 2017. Digital Regulatory Reporting. 14 October. <https://www.fca.org.uk/innovation/regtech/digital-regulatory-reporting>.

<sup>61</sup> Footnote 15.

<sup>62</sup> P. C. Heikes, N. Lye, and A. Shergill. 2021. RegTech and SupTech Initiatives in Asia. *Linklaters*. 27 July. <https://www.linklaters.com/en/>.

<sup>63</sup> Monetary Authority of Singapore (MAS). Digital ID and e-KYC. <https://www.mas.gov.sg/development/fintech/technologies---digital-id-and-e-kyc>.

<sup>64</sup> MAS. Regulatory Technology (RegTech). <https://www.mas.gov.sg/development/fintech/technologies---regtech>.

suspicious trades and market manipulation.<sup>65</sup> On a national level, Singapore has adopted a national AI strategy to facilitate developing and deploying scalable and impactful AI solutions across various sectors.<sup>66</sup> Further, the MAS has recently announced a \$42 million regtech grant scheme available to Singapore-based financial institutions to encourage them to adopt and integrate regtech solutions in their risk management and compliance functions.<sup>67</sup>

### 3. India Stack

India Stack involves four layers of digital infrastructure.<sup>68</sup> The first layer consists of a digital identification program—Aadhaar. Launched in 2010, this is India’s national biometric identification system in which a registered person receives a unique 12-digit identification number.<sup>69</sup> Almost 90% of the Indian population now has a digital ID that allows them to access a number of financial services. The second layer is the establishment of bank accounts to deliver national services. In 2014, the Indian government initiated a large-scale financial development program called the Pradhan Mantri Jan Dhan Yojana to expand banking services for all unbanked Indian populations and facilitate “convenient access to saving accounts through a debit card and mobile banking.” It is reported: “[w]ithin a year of its inception, the program opened 166 million accounts and has expanded since then with almost 384 million accounts in operation in 2019. Eighty percent of the accounts opened reside in public sector banks, and half of these accounts have been opened in rural areas.” The third is an interoperable payments system using a common API. Known as Unified Payments Interface, the standard approach to APIs fosters competition in digital financial services in India<sup>70</sup> and builds an ecosystem for data and payment. Fourth is a series of e-KYC initiatives allowing individuals to provide their financial details to financial services and other providers. These e-KYC utility platforms show how regtech can improve the integrity of financial markets and reduce risks.

Based on India’s experience and other successful examples mentioned above, including Kenya, the People’s Republic of China, and the Russian Federation, a major study for the Alliance for Financial Inclusion highlighted a strategy focusing on four pillars of digital financial infrastructure to support digital financial transformation.<sup>71</sup> Before COVID-19, it was thus clear that digital finance offered a clear strategy for improving financial inclusion. COVID-19, however, has demonstrated the necessity of digital finance from the standpoint of crisis resilience, response, and recovery.

<sup>65</sup> A. Shen. 2019 MAS Uses Machine Learning to Spot Market Manipulation. *Central Banking*. 5 April. <https://www.centralbanking.com/fintech/regtech-suptech/4129566/mas-uses-machine-learning-to-spot-market-manipulation>.

<sup>66</sup> Smart Nation Digital Government Office. 2019. *National Artificial Intelligence Strategy: Advancing Our Smart Nation Journey*. <https://www.smartnation.gov.sg/files/publications/national-ai-strategy-summary.pdf>.

<sup>67</sup> MAS. 2021. MAS Commits \$42m to Spur Adoption of Technology Solutions for Risk Management and Regulatory Compliance. Media release 30 April. <https://www.mas.gov.sg/news/media-releases/2021/mas-commits-42m-to-spur-adoption-of-technologysolutions>.

<sup>68</sup> A. Bose. 2016 India’s Fintech Revolution is Primed to Put Banks Out of Business. *TechCrunch*. 14 June. <https://techcrunch.com/2016/06/14/indias-fintech-revolution-is-primed-to-put-banks-out-of-business>. To learn more about IndiaStack, see DigFin. 2020. What is the India Stack? Nandan Nilekani Explains. 28 July. <https://www.digfingroup.com/what-is-india-stack/>.

<sup>69</sup> Y. Carriere-Swallow, V. Haksar, and M. Patnam. 2021. India’s Approach to Open Banking: Some Implications for Financial Inclusion. *IMF Working Paper* 21 (52). <https://www.imf.org/external/pubs/ft/fandd/2021/07/india-stack-financial-access-and-digitalinclusion.htm>.

<sup>70</sup> Y. Carriere-Swallow, V. Haksar, and M. Patnam. 2021. Stacking up Financial Inclusion Gains in India. IMF Finance and Development. <https://www.imf.org/external/pubs/ft/fandd/2021/07/india-stack-financial-access-and-digital-inclusion.htm>.

<sup>71</sup> D. Arner, R. Buckley, and D. Zetzsche. 2018. Fintech for Financial Inclusion: A Framework for Digital Financial Transformation. *UNSW Law Research Paper* No. 18-87. 4 September. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3245287](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3245287).

## 4. Examples from Other Asian Economies

Governments in Southeast Asia are primary adopters of regtech strategies. Fifty percent of Southeast Asian economies had developed regtech initiatives, according to a 2019 study by the Cambridge Centre for Alternative Finance.<sup>72</sup> Table 2 highlights a range of regtech initiatives in Asia.

**Table 4: Regtech and Suptech Initiatives in Asia**

Economy	Initiatives
<b>Hong Kong, China</b>	<ul style="list-style-type: none"> <li>• The Hong Kong Monetary Authority (HKMA) adopted a 2-year road map to promote regtech adoption to foster a diverse and interactive regtech ecosystem in Hong Kong, China.<sup>a</sup></li> <li>• The HKMA developed Commercial Data Interchange—a consent-based common standard that establishes a secure digital ecosystem wherein data can be flown from data owners to banks institutions through data providers.<sup>b</sup></li> <li>• Hong Kong, China's Security and Futures Commission is working on utilizing data analytics tools to identify market misconduct and suspicious trading behaviors.<sup>c</sup></li> </ul>
<b>Brunei Darussalam</b>	<ul style="list-style-type: none"> <li>• Authoriti Monetari Brunei Darussalam has partnered with Vizor Software, a regulatory vendor, to collect financial data through a single portal and generate insights and reports using the data gathered.<sup>d</sup></li> </ul>
<b>Philippines</b>	<ul style="list-style-type: none"> <li>• The Philippines's Bangko Sentral ng Pilipinas, in collaboration with the regtech for Regulators Accelerator, is developing regtech and suptech solutions.<sup>e</sup></li> <li>• The central bank has launched an application programming interface (API)-based suptech tool for submitting prudential reports by supervised financial institutions.<sup>f</sup> This will help simplify data processing and analysis of over 100,000 data points, bringing down the time to process from around 30 minutes to 10 seconds.<sup>g</sup></li> </ul>
<b>Thailand</b>	<ul style="list-style-type: none"> <li>• The Bank of Thailand is leveraging distributed ledger technology for a wide range of financial services, such as savings bonds, issuance, distribution, and sales.<sup>h</sup></li> <li>• The central bank has also been using the nonperforming loan-based artificial intelligence system for data compilation, including data from the Government Fiscal Management Information System. This system can process unstructured documents in Thai, reducing the time from 3 days to 30 minutes for such compilations.<sup>i</sup></li> <li>• The Office of Insurance Commission (OIC) has developed a central data project, OIC Gateway, to link insurance information from multiple insurers in real-time using APIs through the OIC's data center. This will enable insurance users to validate their policy information via the official LINE account of the OIC.<sup>j</sup></li> <li>• The three major regulators, the Bank of Thailand, the Securities and Exchange Commission, and the OIC, were among the first in the region to launch regulatory sandboxes since 2016/2017, promoting innovative solutions in their respective verticals.</li> </ul>
<b>Malaysia</b>	<ul style="list-style-type: none"> <li>• With an aim to improve small and medium-sized enterprise access to financial products and create an equal field for competition among fintech companies, Bank Negara Malaysia launched an Open API initiative.</li> <li>• The Securities Commission Malaysia had initiated the use of artificial intelligence and big data to monitor and report corporate governance of listed companies on the Bursa Malaysia.<sup>k</sup></li> </ul>

*continued on next page.*

<sup>72</sup> M. Soriano et al. 2021. The ASEAN FinTech Ecosystem Benchmarking Study. *SSRN Electronic Journal*. <https://www.jbs.cam.ac.uk/faculty-research/centres/alternative-finance/publications/the-asean-fintech-ecosystem-benchmarking-study/>.

Table 4 continued.

Economy	Initiatives
Korea, Republic of	<ul style="list-style-type: none"> <li>• The country launched the RegTech Development Council to facilitate the development and use of regtech and curb risks arising from fintech innovation.</li> <li>• The council is working on initiating a pilot test for machine-readable regulation translating financial regulations to machine language.<sup>l</sup></li> <li>• The regtech platform created within the Financial Security Institute provides “an automated compliance management service, an automated financial security service, and a search and notice service on intelligent regulation (footnote l).”</li> </ul>

<sup>a</sup> Hong Kong Monetary Authority (HKMA). *Transforming Risk Management and Compliance: Harnessing the Power of Regtech*. <https://www.hkma.gov.hk/media/eng/doc/key-information/press-release/2020/20201102e3a1.pdf>.

<sup>b</sup> HKMA. 2020. Hong Kong FinTech Week 2020. 2 November. <https://www.hkma.gov.hk/eng/news-and-media/press-releases/2020/11/20201102-3/>.

<sup>c</sup> Securities and Futures Commission. 2021. *Circular to licensed corporations Reminder of Data Standards for Order Life Cycles*. 28 April. <https://apps.sfc.hk/edistributionWeb/gateway/EN/circular/intermediaries/supervision/doc?refNo=21EC15>.

<sup>d</sup> *Fintech Futures*. 2017. Brunei's central bank selects Vizor for financial data revamp. 31 January. <https://www.fintechfutures.com/2017/01/bruneis-central-bank-selects-vizor-for-financial-data-revamp>.

<sup>e</sup> M. L. Lopez. 2018. BSP to use regulatory and supervisory technology. *BusinessWorld*. 2 April. <https://www.bworldonline.com/banking-finance/2018/04/02/146906/bsp-to-use-regulatory-and-supervisory-technology/>.

<sup>f</sup> Bangko Sentral ng Pilipinas. 2021. MEMORANDUM NO. M-2021: *Submission of Prudential Reports Using Application Programming Interface (API)*. <https://www.bsp.gov.ph/Regulations/Issuances/2021/M-2021-052.pdf>.

<sup>g</sup> R. King. 2019. Data Management Initiative: Central Bank of the Philippines. *Central Banking*. 4 September. <https://www.centralbanking.com/fintech/4397411/data-management-initiative-central-bank-of-the-philippines>.

<sup>h</sup> *Fintechnews Singapore*. 2019. In Southeast Asia, 50% of Financial of Financial Authorities Have Developed Regtech Initiatives. 18 December. <https://fintechnews.sg/33936/regtech/in-southeast-asia-50-of-financial-of-financial-authorities-have-developed-regtech-initiatives-finds-new-research>.

<sup>i</sup> R. King. 2020. Artificial Intelligence Initiative: Bank of Thailand. *Central Banking*. 28 October. <https://www.centralbanking.com/awards/7671396/artificial-intelligence-initiative-bank-of-thailand>.

<sup>j</sup> CIT - Center of Insurtech, Thailand. OIC Gateway. <https://cit.oic.or.th/oicgateway.html>.

<sup>k</sup> Securities Commission Malaysia. 2017. SC releases new Malaysian code on corporate governance to strengthen corporate culture. News release. 26 April. <https://www.sc.com.my/resources/media/media-release/sc-releases-new-malaysian-code-on-corporate-governance-to-strengthen-corporate-culture>.

<sup>l</sup> Global Legal Insights. *Fintech Laws and Regulations - Korea*. <https://www.globallegalinsights.com/practice-areas/fintech-laws-and-regulations/korea>.

Source: Authors.

Aside from regtech initiatives, regulators in Asia are establishing innovation hubs, incubators, and accelerators as part of their broader fintech strategies. For instance, Brunei Darussalam, Indonesia, Malaysia, Singapore, and Thailand have established innovation offices.<sup>73</sup>

<sup>73</sup> *Nikkei Asia*. 2021. Southeast Asian Tech Hubs Race to Become the Next Silicon Valley. 24 October. <https://asia.nikkei.com/Spotlight/The-Big-Story/Southeast-Asian-tech-hubs-race-to-become-the-next-Silicon-Valley>; *Tech Collective*. 2021. 6 tech hubs in Asia for founders and entrepreneurs. <https://techcollectivesea.com/2021/01/26/6-tech-hubs-in-asia-for-founders-and-entrepreneurs>.

## B. Digitization and Datafication of Regulation and Supervision

Along with regulatory tools, technologies are being integrated into the supervisory mechanisms. The FSI identifies two principal instruments of suptech application—data collection and data analytics.<sup>74</sup> Neural networks have gained popularity among supervisors for data analysis, big data, AI, natural language processing, machine learning, supervised learning, unsupervised learning, topical modelling, random forest, and image recognition (footnote 74).

Central banks are increasingly using big data in various cases. In this regard, central banks have adopted a comprehensive view of big data,<sup>75</sup> combining both structured and unstructured data sources from an increasing range of sources (footnote 75). According to the BIS survey, Asian central banks tend to analyze raw data sources collected from newspapers and online portals or web scraping (footnote 75). Examples of such unstructured raw data include mobility trends—location data collected through smartphones' GPS services and used by the Bank of Japan to support and monitor households' access to recreation areas during the COVID-19 pandemic;<sup>76</sup> data obtained from the internet search, such as Google Trends to analyze real-time market development;<sup>77</sup> and printed data from newspapers, firms' financial statements, and press releases (footnote 75). Hong Kong, China's Securities and Futures Commission announced that they contemplated deploying data analytics tools to identify trade-related market misconduct.<sup>78</sup>

Regionally, the European Central Bank (ECB) adopted the Digitalization Road Map and established the dedicated SupTech Hub to fully utilize the emerging data-driven technology's potential. The ECB further identified four building blocks to cater to digitalization among supervisory entities.<sup>79</sup> These are:

- Building a hub-and-spoke innovation model that can create joint projects across the EU and use synergies keeping in mind local specializations.
- Promoting a digital culture among supervisors so that they are fully engaged in digitalization.
- Creating an innovation ecosystem that includes a broad group of stakeholders, including start-ups and academia, and thus taking advantage of network externalities.
- Facilitating automation and enhancing existing systems.

<sup>74</sup> D. Broeders and J. Prenio. 2018. Innovative Technology in Financial Supervision (Suptech) – The Experience of Early Users. *FSI Insights on Policy Implementation No. 9*. Bank for International Settlements. <https://www.bis.org/fsi/publ/insights9.pdf>.

<sup>75</sup> In general, big data is defined by volume, velocity, and varieties only. G. Cornelli et al. 2022. Big Data in Asian Central Banks. *IFC Working Papers* 21. <https://www.bis.org/ifc/publ/ifcwork21.pdf>.

<sup>76</sup> Bank of Japan. 2020. Impact of COVID-19 on Private Consumption. In *Outlook Report*, July 2020. <https://www.boj.or.jp/en/mopo/outlook/box/2007box3a.pdf>. Cited in Cornelli et al. 2021. (n 96), 6.

<sup>77</sup> S. Doerr and L. Gambacorta. 2020. Identifying Regions at Risk with Google Trends: The Impact of COVID-19 on US Labor Markets. *BIS Bulletin* 8. <https://www.bis.org/publ/bisbull08.pdf>. Cited in Cornelli et al. 2021. (n 95), 6.

<sup>78</sup> Securities and Futures Commission. 2021. Circular to Licensed Corporations Reminder of Data Standards for Order Life Cycles. 28 April. <https://apps.sfc.hk/edistributionWeb/gateway/EN/circular/intermediaries/supervision/doc?refNo=21EC15>.

<sup>79</sup> European Central Bank. 2021. *The Necessity of Using Supervisory Technology*. Speech by Pentti Hakkarainen, Member of the Supervisory Board of the ECB, at the 33rd Annual Conference of the Group of Banking Supervisors from Central and Eastern Europe. Frankfurt am Main, 27 May. <https://www.bankingsupervision.europa.eu/press/speeches/date/2021/html/ssm.sp210527-8b69fbb1de.en.html>.



### Box 1: Suptech Use Cases

#### i. Financial Conduct Authority's cloud-based market oversight

The Financial Conduct Authority (FCA) utilizes cloud-based technology combined with natural language processing to generate market insights and intelligence for supervision purposes. Natural language processing helps analyze documents and texts faster and predict market risks through machine learning.<sup>a</sup> The FCA uses a data analytics tool to gather information and analyze data across web pages to detect online scams and misconduct. The FCA further developed synthetic data using agent-based modeling to help them identify data privacy issues and collaborate with third parties to test regtech-suptech solutions (footnote a).

#### ii. De Nederlandsche Bank's Smart Supervisor

Initiated by the central bank's Innovation Department, the Smart Supervisor is a demonstration of leveraging data and technology to support the supervisory process. The initiative aligns with its digital strategy and aims to adopt a data-driven approach and automate routine tasks.<sup>b</sup>

#### iii. The European Central Bank's Virtual Lab

The European Central Bank (ECB) is developing a suptech platform called "Virtual Lab"—a cloud-based hub-and-spoke innovation model enabling remote collaboration among the ECB and the national competent authorities through digital infrastructure.<sup>c</sup> The forum will allow the ECB and other national regulators to connect, share data, and collaborate on projects in a secure manner. The Virtual Hub uses advanced artificial intelligence, machine learning, and deep learning to promote "an inclusive data-driven and innovation-friendly culture."<sup>d</sup>

#### iv. The Monetary Authority of Singapore's Suspicious Transaction Report Network Analysis Tool

Within the suptech space, the Monetary Authority of Singapore has developed a well-equipped data analytics tool to analyze suspicious transaction reports, including identifying clusters of entities or individuals demonstrating suspicious behavior.<sup>e</sup> The analytics tool comprises structured data; however, it can also extract unstructured textual data within suspicious transaction reports using natural language processing models.

<sup>a</sup> Securities and Commodities Authority and Arab Federation of Exchanges. 2021. *Regulator's Response to COVID-19 Digitize, Automate, Manage: A Study of Regtech & Suptech in the GCC region*. <https://arab-exchanges.org/wp-content/uploads/2021/07/Suptech-Regtech-in-GCC-v5-final-for-release.pdf>.

<sup>b</sup> <https://www.dnb.nl/en/sector-information/supervision-stages/prior-to-supervision/iform/>.

<sup>c</sup> Financial Stability Board. 2020. *The Use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions*. 9 October. <https://www.fsb.org/wp-content/uploads/P091020.pdf>.

<sup>d</sup> European Central Bank. 2021. *Digital transformation of supervision picks up pace*. 17 February. [https://www.bankingsupervision.europa.eu/press/publications/newsletter/2021/html/ssm.nl210217\\_3.en.html](https://www.bankingsupervision.europa.eu/press/publications/newsletter/2021/html/ssm.nl210217_3.en.html).

<sup>e</sup> J. Devanesan. 2020. How Singapore polices financial crime with RegTech. *Techwire Asia*. 26 November. <https://techwireasia.com/2020/11/how-singapore-polices-financial-crime-with-regtech>.

Source: Authors

At an international level, the BIS is working on developing integrated regtech/suptech strategies. Two of their projects provide very good examples:

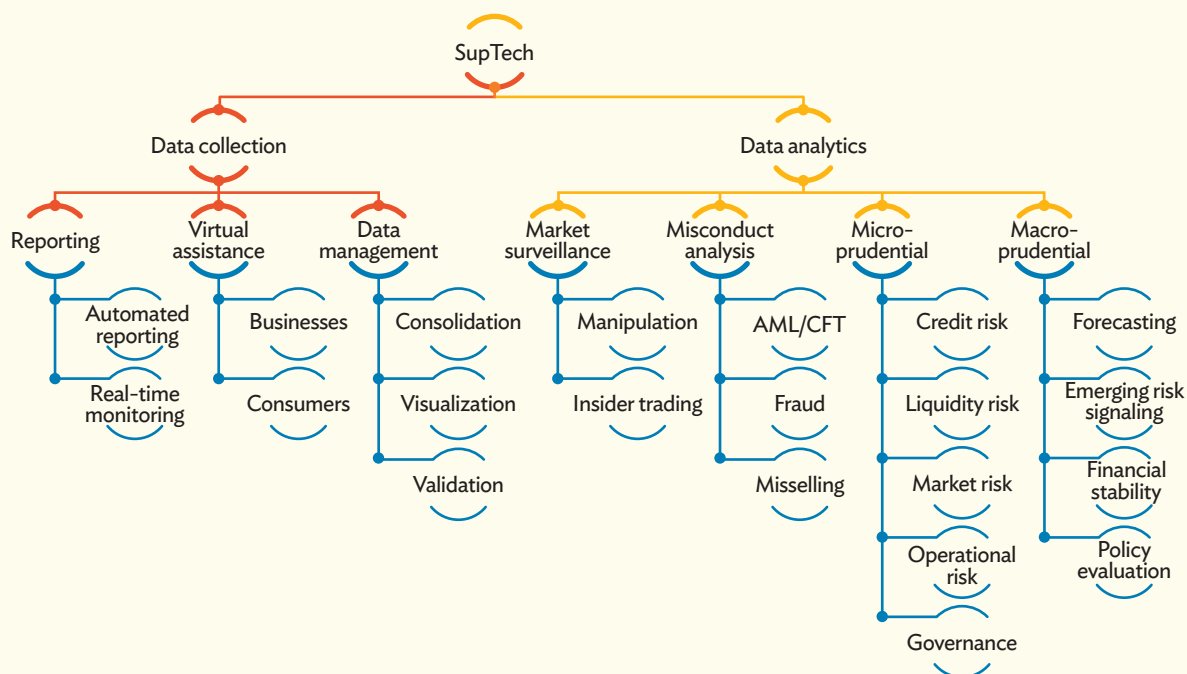
- **Project Ellipse:** An example of an integrated regtech/suptech approach based on a proof of concept launched by the BIS Innovation Hub. The project explores how supervision could become insights-based and data-driven using an integrated regulatory data and analytics platform. The development of the project has two phases. Currently, the project is in Phase I, in which the BIS is partnered with the MAS, the Bank of England, and the International Swaps and Derivatives Association.<sup>80</sup> The project uses a machine-executable data model and explores

<sup>80</sup> BIS, 'Ellipse: Regulatory Reporting and Data Analytics Platform' (BIS, 31 March 2022) <<https://www.bis.org/about/bisih/topics/suptech-regtech/ellipse.htm>> accessed 05 May 2022.

the concept of cross-border digital regulatory reporting. The reporting platform is built on “common data models” to reduce the friction and differences in reporting requirements by different supervisors (footnote 80). The subset of granular data collected from reporting regimes is deployed on the association’s Common Domain Model— “an open-source, standardized, machine-readable, and machine-executable model (footnote 80).” Phase II will explore how unstructured data can be extracted to generate insights reflecting early warnings from supervisory attention. During this phase, a single platform will be built to facilitate supervisors’ “on-demand” access to “timely and integrated sources of data” to pursue their supervisory activities (footnote 80). The project will develop a risk correlation and sentiment analysis of issues using advanced analytics tools, such as machine learning and natural language processing, that would alert supervisors in real time.<sup>81</sup>

- **Project Rio:** Developed by the BIS Innovation Hub, Project Rio aims to provide central banks with a monitoring tool capable of handling and analyzing real-time data. This will help central banks spot market dislocations, liquidity issues, and volatility in real time. The tool is built on open-source code and can pull millions of messages from multiple trading venues in a speedy manner.<sup>82</sup>

**Figure 5: Use of Suptech Applications to Conduct Financial Supervision**



AML/CFT = anti-money laundering and combating the financing of terrorism.

Source: S. di Castri et al. 2019. The Suptech Generations. *FSI Insights* No 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

<sup>81</sup> BIS Innovation Hub and MAS. 2022. *Project Ellipse: An Integrated Regulatory Data and Analytics Platform*. <https://www.bis.org/publ/othp48.pdf>.

<sup>82</sup> Bank for International Settlements (BIS). 2020. *Central Bankers of the Future*. Speech by Agustín Carstens, General Manager of the BIS, at the Deutsche Bundesbank’s Internal Discussion Series. Basel, 14 December. <https://www.bis.org/speeches/sp201214.pdf>.



Currently, the suptech applications in data collection mainly focus on reporting and monitoring, which can take the form of “automated reporting”<sup>83</sup> and “real-time monitoring.” Supervisory agencies currently use the data input approach, data pull approach, machine-readable regulation, and cloud computing for data collection, data management, consolidation, validation, and visualization while deploying APIs for these. Many regulators are in the process of formulating regulations for open APIs. Besides, supervisory agencies use virtual assistance, such as chatbots, for businesses and consumers to gain data on supervised entities (footnote 74).

**Figure 6: Suptech Use Cases**  
(Automated Reporting and Real-time Monitoring)



Source: S. di Castri et al. 2019. The Suptech Generations. *FSI Insights* No 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

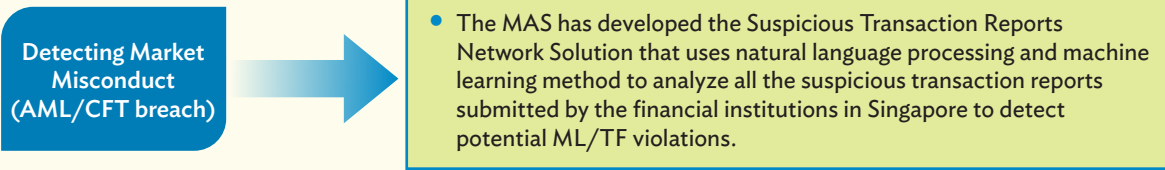
Suptech tools can also help supervisors analyze the collected data and use the analyses to get deeper insights into the activities of the regulated entities, perform market surveillance through real-time alerts, and penalize market misconduct. Further, suptech applications can detect possible anti-money laundering, combat the financing of terrorism violations, identify potential fraud,<sup>84</sup> and predict misselling. These suptech applications are helpful to dispense with the supervisory agencies’ broader micro-and macro-prudential regulatory objectives, ensure market integrity, and protect consumers. The supervisory entities rely on big data, AI, machine learning, supervised/unsupervised learning, neural networks, and others to analyze data (footnote 80). The FINRA and the SEC have used AI to monitor external “big data” and investigate potential market misconduct. Exchanges such as NASDAQ have also deployed AI to monitor US stock markets.<sup>85</sup>

<sup>83</sup> Automated reporting has the potential of harmonizing information technology (IT) platforms that connect both supervised entities and supervisory agencies. For instance, the Oesterreichische Nationalbank (Austrian central bank) has developed a uniform platform allowing regulated entities to feed reporting data through AuRep—a third-party buffer company. The system allows the banking sector to send critical information to the central bank without increasing the administrative burden for data providers. The data sent through AuRep are redundancy-free and harmonized. The National Bank of Rwanda uses “data pull approach” to extract data from the diverse IT systems across financial institutions in Rwanda.

<sup>84</sup> The SEC uses the techniques of unsupervised learning, topical modelling, and supervised learning to detect money laundering and any anomalies among market participants requiring regulators’ attention.

<sup>85</sup> MarketInsite. 2019. For the First Time, NASDAQ is Using Artificial Intelligence to Surveil US Stock Market. *NASDAQ*. 7 November. <https://www.nasdaq.com/articles/for-the-first-time-nasdaq-is-using-artificial-intelligence-to-surveil-u.s.-stock-market>.

**Figure 7: Suptech Use Cases**  
(Detecting Market Misconduct)

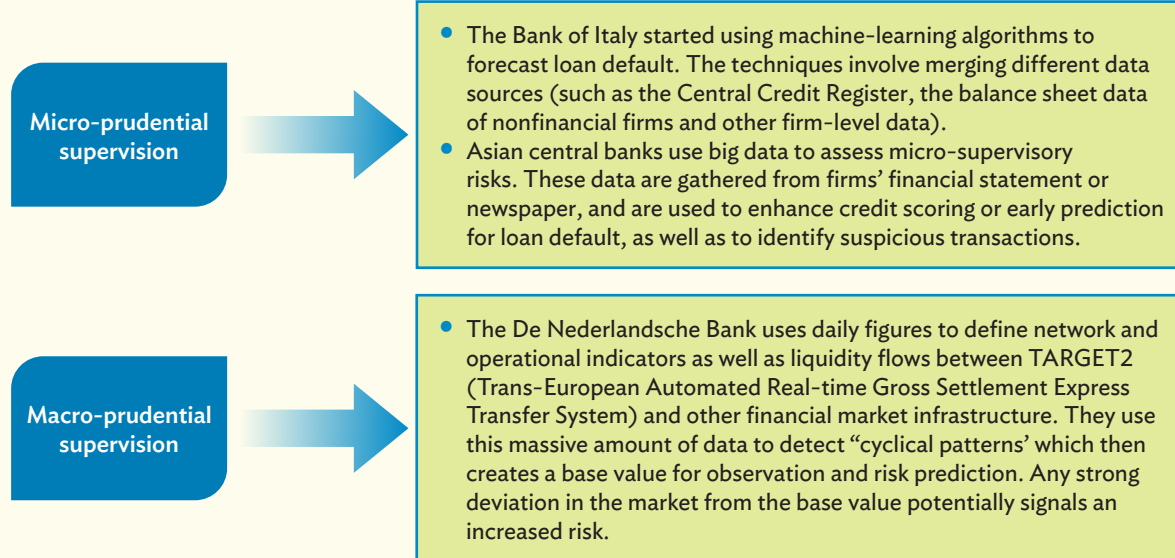


AML/CFT = anti-money laundering and combating the financing of terrorism, MAS = Monetary Authority of Singapore, ML/TF = money laundering/terrorism financing.

Source: S. di Castri et al. 2019. The Suptech Generations. *FSI Insights* No 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

From a prudential regulatory standpoint, suptech applications are helpful to dispense with the supervisory agencies' broader micro-and macro-prudential regulatory goals, ensure market integrity, and protect consumers (footnote 74).

**Figure 8: Suptech Use Cases**  
(Micro-prudential Supervision and Macro-prudential Supervision)

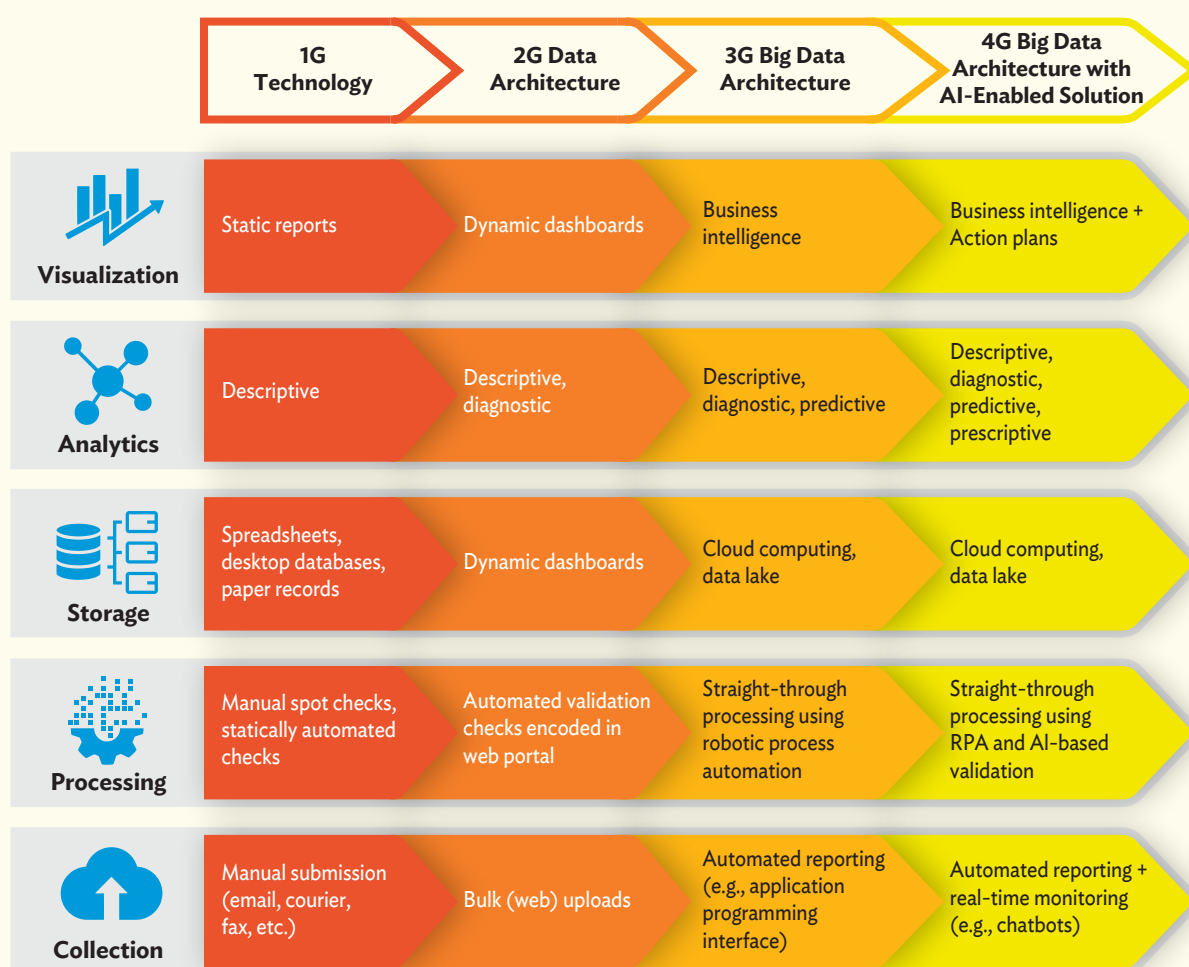


Source: S. di Castri et al. 2019. The Suptech Generations. *FSI Insights* No 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

## C. Evolution of Regulatory Strategies

In a nutshell, the use of technologies by regulators can be divided into four generations. The first generation involves data management workflows that are heavily manual and primarily descriptive analytics. The second generation covers the digitization and automation of certain paper-based and manual processes in the data pipeline, and the third generation includes significant data architecture. The fourth generation involves the addition of sophisticated analytics as the defining characteristic (footnote 74).

**Figure 9: Generations of Technology Used by Financial Authorities**



1G = First generation, 2G = Second generation, 3G = Third generation, 4G = Fourth generation, AI = artificial intelligence, RPA = robotic process automation.

Source: S. di Castri et al. 2019. The Suptech Generations. *FSI Insights* No 19. 17 October. <https://www.bis.org/fsi/publ/insights19.htm>.

# 5

## Design Lessons: An Ecosystem Approach

Current regtech/supotech strategies adopted or developed by supervisory/regulatory authorities have several approaches. In a report published by the FSI-BIS, supervisory entities usually adopt three principal strategies to improve supotech tools (footnote 74).

These strategies include

- (i) a specific supotech road map setting out “a deliberate path to adopting big data and ai process and systems” that support the work of regulatory and supervisory agencies (footnote 74);
- (ii) an institution-wide data-driven approach that intends to transform the analog manual process and systems into a digital one by using advanced data analytics tools; and
- (iii) experimental or ad hoc strategies pursuing a specific goal.<sup>86</sup>

Looking ahead, regulatory authorities (supervisory and nonsupervisory) need to integrate ecosystem approaches to regtech, supotech, and related digital financial infrastructure to support the broader objectives of preserving financial stability, maintaining market integrity, enforcing market misconduct, and protecting consumers through a shared platform which regulated entities can utilize for compliance purposes. They can also look to leverage federated learning models at the ecosystem level. These learning models can be built and hosted by a neutral third-party agency with the regulator’s support, aiming to harness financial and other data spread across multiple locations. Going forward, this is likely to be a central strategic and financial stability focus on jurisdictions around the world: building financial data governance systems to both maximize the value of data while at the same time addressing security concerns, including personal, financial, and national.<sup>87</sup>

In doing so, a number of principles are central.

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<sup>86</sup> This can include strategies like innovation labs, accelerators, or techsprints.

<sup>87</sup> See D. Arner, G. Castellano, and E. Selga. 2022. Financial Data Governance: The Datafication of Finance, the Rise of Open Banking and the End of the Data Centralization Paradigm/. *University of Hong Kong Faculty of Law Research Paper 2022/08*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=4040604](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4040604).

## A. Cybersecurity, Data Protection, and Data Privacy

Cybersecurity is a crucial barrier that could discourage financial institutions and regulators from adopting regtech/supotech solutions due to the massive use of digital tools, involvement of third-party vendors, and interconnectedness of regulatory platforms. A regtech/supotech ecosystem can involve a shared information technology (IT) platform or infrastructure connecting various IT systems across the financial institutions and regulators. A weak or vulnerable gateway with the regtech vendor could expose regulatory data to potential hacks and breaches. Therefore, building a solid cybersecurity system is of paramount importance.

Another crucial component of an optimal regtech/supotech architecture is preserving data privacy. While a supervisory agency has access to a large pool of data obtained from the financial institutions, there should be a firewall between data relevant for their regulatory purpose and data that are not.

Similar measures should also be taken to protect data security and prevent data leakage. In this regard, the potential of using privacy-preserving AI/machine learning (such as federated learning, decentralized storage and analytics) can be tested.<sup>88</sup> Additionally, regulators will need to clearly define data localization requirements and access to cloud platforms.

## B. Data Standardization and Cross-Border Data

Data standardization, quality, and completeness are vital for an effective regtech/supotech ecosystem. With different jurisdictions and supervisors using varying data standards and fields, it can be very challenging for regulated entities and supporting regtech firms to accurately comply with reporting standards in a timely and cost-efficient manner. Harmonizing data standards and reporting fields can benefit both regulators and institutions. Further, cross-border use of data can provide more efficiency to supervisors to combat transnational crime, protect market integrity, and maintain financial resiliency. If addressed appropriately, the efficiencies can help lower barriers to cross-border payment, thereby enabling lower costs of remittances while positively impacting financial including and bringing more people into the formal financial ecosystem. However, the main challenge in this regard is the domestic laws on data privacy. A supotech network among cross-border regulators, such as the Global Financial Innovation Network,<sup>89</sup> can potentially ease regulatory frictions by increasing the understanding of new technology solutions, sharing relevant cross-border data exchange, and facilitating dialogue on reducing cross border issues. These initiatives are also valuable for helping regulatory and data harmonization.

<sup>88</sup> There are four pillars of privacy-preserving machine learning: (i) training data privacy (that a malicious actor will not be able to reverse-engineer the training data); (ii) input privacy (that a user's input data cannot be observed by other parties); (iii) output privacy (that the output of a model is not visible by anyone except for the user whose data is being inferred upon); (iv) model privacy (that the model cannot be stolen by a malicious party).

<sup>89</sup> Global Financial Innovation Network. About GFIN. <https://www.thegfin.com/about>.

## C. Appropriate Use of Analytic Tools

When used responsibly and effectively, AI and machine learning can significantly improve the efficiency of regtech/suptech tools, enhance business processes, mitigate risks, and facilitate more robust decision-making.<sup>90</sup> However, machine-learning algorithms also have vulnerabilities and, if left unchecked, can produce unintended outcomes.<sup>91</sup> For instance, a self-training machine learning model can produce biased outcomes if fed with biased data. The nature and the increasing use of AI and machine-learning tools also carry the risk of systematic misuse, resulting in widespread impacts and perpetuation of biases. Additionally, errors/flaws in the algorithms could lead to false positives and disruption in surveillance processes. To prevent unintended outcomes, human supervision is integral, especially in regtech and suptech. Regulators need to develop clear guidelines on the governance of algorithms and data biases, which remain a significant challenge despite efforts to overcome the lack of transparency from using AI black boxes. A good reference is the MAS's developed FEAT (fairness, ethics, accountability, transparency), which deals with the ethical use of AI and machine learning in finance (footnote 90). From a consumer's perspective, the ethical and responsible use of AI and machine learning promotes trust in AI and data analytics and builds confidence in the financial system. From a regulatory perspective, the best approach focuses on a combination of internal and external reviews along with a direct human supervision. In many jurisdictions, regulators tend to stress the explainability requirements of AI to ensure an AI system also have arrangements in place to explain its operations.<sup>92</sup> Existing financial regulatory approaches thus provide a potential basis to address related questions in other regulated industries. It is also the case that similar sorts of approaches need to be applied in the context of AI use by financial regulators, supervisors, and digital infrastructure providers.

## D. Sustainability

An integrated regtech/suptech ecosystem allows robust risk-data management and reliable predictability, utilizing the micro-and macro-prudential regulatory framework. Through an interconnected ecosystem, regulators can ensure substantial visibility, obtain information regarding the firm culture, and be better informed on the safety and soundness of a financial institution. This eventually ensures the resilience of the overall financial system. Further, the regtech applications have reduced the cost of customer onboarding and enabled a more straightforward digital ID mechanism, potentially increasing financial inclusion. Real-time monitoring and detecting fraud can significantly enhance investors' confidence which means an inclusive, participatory, and sound financial system. The development of digital financial infrastructure supporting digital reporting, compliance, and data transparency, provides important opportunities. For example, the European Single Access Point (ESAP),<sup>93</sup> proposed by the European Commission, is designed to integrate the full range of

<sup>90</sup> MAS. 2018. *Principles to Promote Fairness, Ethics, Accountability and Transparency (FEAT) in the Use of Artificial Intelligence and Data Analytics in Singapore's Financial Sector*. <https://www.mas.gov.sg/-/media/MAS/News%20and%20Publications/Monographs%20and%20Information%20Papers/FEAT%20Principles%20Final.pdf>.

<sup>91</sup> C. DeBrusk. 2018. The Risk of Machine-Learning Bias (and How to Prevent It). *MIT Sloan Management Review*. 26 March. <https://sloanreview.mit.edu/article/the-risk-of-machine-learning-bias-and-how-to-prevent-it/>.

<sup>92</sup> See D. Zetzsche et al. 2020. Artificial Intelligence in Finance: Putting the Human in the Loop. *University of Hong Kong Faculty of Law Research Paper* 2020/006. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3531711](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3531711).

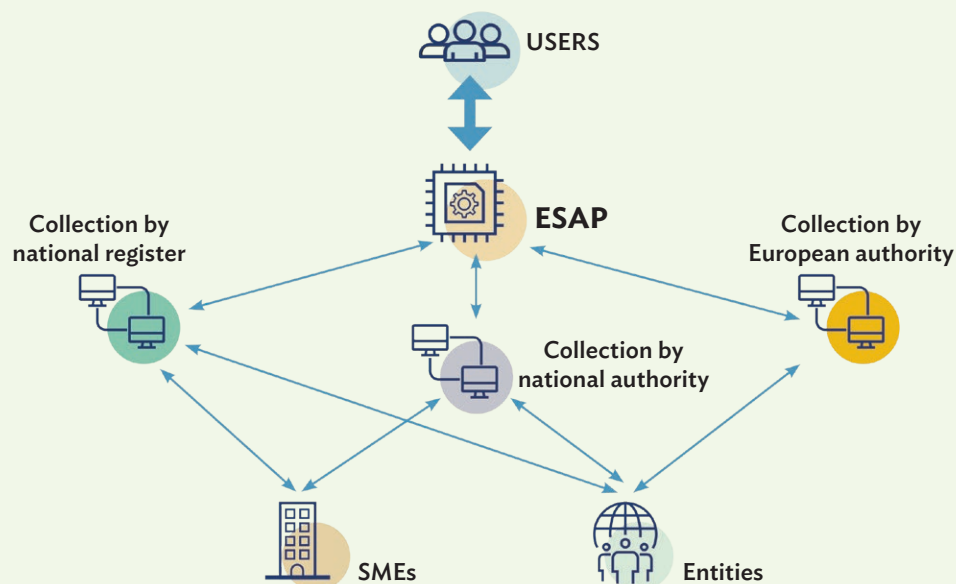
<sup>93</sup> To be established by 2024. See European Economic and Social Committee Opinion on European Single Access Point (ESAP) [2022] ECO/574-EESC-2021-06391.

financial and environment, social, and governance (ESG) disclosures required under EU legislation into a single system based on standardized data.<sup>94</sup> This requires compliance through digital regulatory reporting (regtech), empowering supervisory monitoring (suptech) in the context of digital financial infrastructure, and thereby supporting a range of core financial regulatory policy objectives, including enhancing efficiency, supporting sustainable development, protecting investors and consumers, and reducing systemic risk. The ESAP is anticipated to be contributing to the implementation of the EU's Strategy for Financing the Transition to a Sustainable Economy and the Europe Green Deal "by making easily available and useable information about the sustainability" of European corporations.<sup>95</sup>

### Box 2: The Foundational Elements of the European Single Access Point

Three main components of the European Single Access Point are data collection at the national and European Union-level, centralized data infrastructure, and access to data and availability of machine-readable data. The European Securities and Markets Authority will ensure that European Union-level financial and sustainability-related information is free and publicly available.

**Figure: The Potential Design of the ESAP**



ESAP = European Single Access Point, SMEs = small and medium enterprises.

Source: European Commission. 2021. *2021 Capital Markets Union Package: European Single Access Point*. 25 November. [https://ec.europa.eu/info/sites/default/files/business\\_economy\\_euro/banking\\_and\\_finance/documents/211125-capital-markets-union-package-esap-factsheet\\_en.pdf](https://ec.europa.eu/info/sites/default/files/business_economy_euro/banking_and_finance/documents/211125-capital-markets-union-package-esap-factsheet_en.pdf).

<sup>94</sup> The ESAP proposal is also in line with the EU's Digital Finance Strategy announced in September 2020.

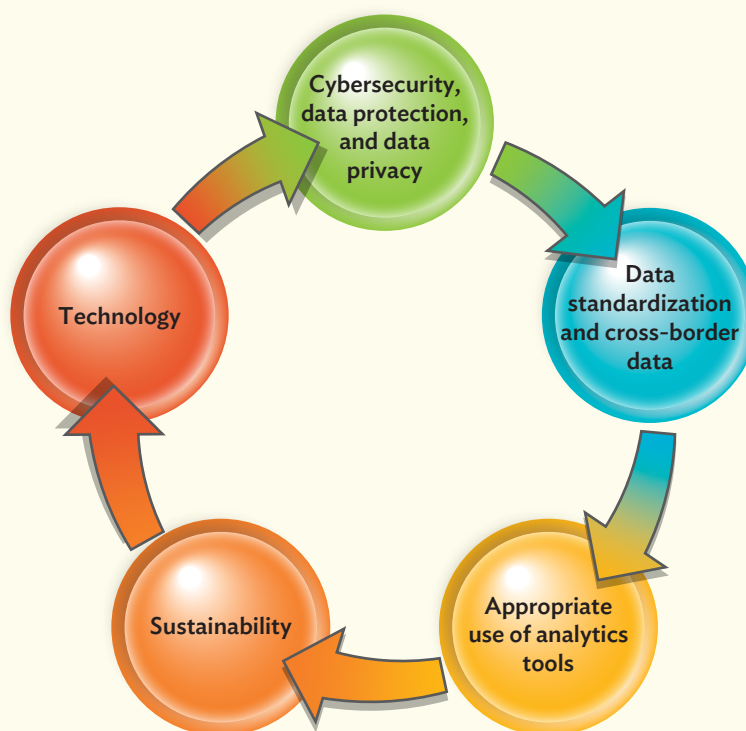
<sup>95</sup> European Commission (EC) proposal for a Regulation of the European Parliament and of the Council establishing a European Single Access Point providing access to publicly available information of relevance to financial services, capital markets, and sustainability [2021] COM/2021/723 final.



## E. Technology

It is often suggested that technology neutrality is an overall objective. It is sometimes said that an ideal regtech/supotech ecosystem should ensure a technology-neutral approach, meaning no specific technology is preferred nor prejudiced or prevented from the use.<sup>96</sup> From the standpoint of supotech and infrastructure, certain aspects of technology choice are necessary. For instance, digital regulatory reporting benefits from the standardization of format. The overall objective is to promote digitization and datafication, which often requires technological choices, particularly in core infrastructures such as payment and securities infrastructure. At the same time, regulators will continually review new technologies for potential adoption based on synergy among innovation, scalability, and competition across the financial sector. This improves regulators' capabilities to pursue the regulatory objectives of "consumer protection, prudential resilience, market integrity, and ultimately financial stability (footnote 97)." It also allows regulators to deploy new technologies that may emerge, such as the rapid development of blockchain and distributed ledger technology in recent years.

**Figure 11: Underlying Principles of Regtech/Supotech Ecosystem Development Strategies**



Source: Authors

<sup>96</sup> European Bank Authority (EBA). 2021. EBA assesses benefits, challenges and risks of RegTech use in the EU and puts forward steps to be taken to support sound adoption and scale-up of RegTech solutions. News release. 29 June. <https://www.eba.europa.eu/eba-assesses-benefits-challenges-and-risks-regtech-use-eu-and-puts-forward-steps-be-taken-support>.

# 6

## Developing a Regtech/ Suptech Ecosystem: Lessons and Strategies

To develop a robust regtech/suptech ecosystem, one needs to build a strategy that engages policy makers, regulators and supervisors, regulated institutions, infrastructure providers, and ecosystem builders and brings these parties together cohesively. One of the key benefits of an ecosystem approach is to help the broader industry move to an entirely new level of capabilities globally to detect and eliminate financial crime. This is a common objective of the industry, wherein there is no competition and a non-zero-sum outcome.

Drawing from experience to date, four central elements underlie a successful strategic approach to regtech/suptech ecosystem development:

- (i) High-level commitment to a “digital-first” approach to finance and financial regulation and supervision: This is central to achieving the overall goal of building better financial and regulatory systems through technology.
- (ii) Introducing policy frameworks that enable ecosystem relationships at national, regional, and international levels.
- (iii) Establishing agile data management and data standardization frameworks.
- (iv) Supporting the creation and building of a local innovation ecosystem that spreads beyond financial supervision to include start-ups and academia and benefits from network externalities.

This approach enhances efficiency and compliance and helps regulators build better financial systems that are more resilient and more effective in supporting sustainable development.<sup>97</sup>

### A. High-Level Commitment: Digital First

Experience shows that central to success is a high level of commitment within the lead agency to a “digital first” strategy, both for the central bank/regulator/supervisor itself and the wider industry. From this comes a process of digitizing internal operations and data storage and management systems, a process of digitizing interactions with the regulated industry, particularly through digital

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<sup>97</sup> See Arner, Buckley, and Barberis (2016) (n 5).

reporting. From it also comes the process of datafication through the application of analytics to digital data to enhance effectiveness in achieving the regulator's mandates along with supporting broader sustainable development.

**Figure 12: Regtech/Suptech Ecosystem Strategies**



Source: Authors

## B. Introducing Policy Frameworks That Enable Ecosystem Relationships at National, Regional, and International Levels

With the global nature of financial markets, coupled with the fact that technological advancements are borderless, policy makers need to create frameworks that can facilitate engagement at an international level while enabling the development of the local ecosystem. The policy framework can have three layers in developing strategies—national, regional, and international.

### 1. National Level

Successful regtech and suptech integration require the government to adopt a broader national strategy setting out the potential for developing innovation hubs, incubators, accelerators, and regulatory sandboxes. Developing and testing innovative regtech and suptech tools and applications at the national level will encourage regtech firms to build solutions for the local markets while engaging regulated institutions to participate and adopt these solutions. It will also help the regulators create enabling policies and regulations to use these solutions. The regulatory sandbox approach has been one of the critical instruments to enable this strategy across all types of regulators. For instance, within Southeast Asia, a popular initiative undertaken by regulators is supporting the establishment of regulatory sandboxes—a “safe space” where financial services providers can test innovative technological solutions without an immediate regulatory repercussion.<sup>98</sup> Southeast Asian countries, such as Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand, have already established regulatory sandboxes as part of their comprehensive digital transformation program. Policies need to be drawn out and refined constantly to help financial institutions innovate and use innovative solutions from regtech providers that keep pace with rapid technological innovations. The policy makers also need to incorporate a strategy to build the technology competency of their teams for them to have a deeper understanding of the market developments of digital tools while enabling them to be agile in responding to newer technology developments. This should include data science analytics, AI/machine learning, APIs, and digital skills.

### 2. Regional Level

Establishing a regional hub with digital infrastructure for remote collaboration: A good way to build regional capabilities for regtech and suptech is to establish a regional hub that can facilitate cross-regional synergies and leverage shared resources. Regulators can adopt similar approaches to specific tools or processes and, where feasible, develop them together to achieve speedy outcomes. This can be implemented at a national level for large countries and an international level, supported by a regional body such as the “virtual suptech lab” set up by the European Central Bank (ECB).<sup>99</sup> The ECB’s virtual platform provides the digital infrastructure for remote collaboration across the single

<sup>98</sup> Dan Quan, “A Few Thoughts on Regulatory Sandboxes” (Stanford PACS, 05 May 2022) <<https://pacscenter.stanford.edu/a-few-thoughts-on-regulatory-sandboxes/>> accessed 05 May 2022.

<sup>99</sup> ECB, “Digital Transformation of Supervision Picks Up Pace” Supervision Newsletter (17 February 2021) <[https://www.bankingsupervision.europa.eu/press/publications/newsletter/2021/html/ssm.nl210217\\_3.en.html](https://www.bankingsupervision.europa.eu/press/publications/newsletter/2021/html/ssm.nl210217_3.en.html)> accessed 05 May 2022.

supervisory mechanism and is a cloud-based platform that will enable all stakeholders to connect, share content, and collaborate on joint projects in a secured environment. Activities carried out via the shared platform will include developing, executing, and sharing Python and R models, connecting to a centralized data hub, using existing microservices shared by platform participants, taking part in a digital training curriculum, and joining virtual projects teams of interest. A cross-jurisdictional sandbox like the API Exchange—an online global fintech marketplace and sandbox platform established by the Association of Southeast Asian Nations (ASEAN) Bankers Association, International Finance Corporation, and MAS—can be fruitful in creating a collaborative regtech/suptech ecosystem within the region.<sup>100</sup> Perhaps more significantly, digital infrastructure such as EDGAR, ESAP, and digital identity (corporate and individual) could be developed at the regional level, for instance through the ASEAN Capital Markets Forum, as mechanisms to use technology to better achieve regulatory and supervisory objectives in support of wider sustainable development.

### 3. International/Cross-Regional Level

Globally, regtech/suptech development can be quite varied, with some jurisdictions well ahead of their peers and others still in the initial phase of adoption. Through global standard-setting bodies, such as the BIS and other international organizations, there can be a mechanism for shared platforms where authorities can exchange information on their suptech initiatives and collaborate to review developments.

One such initiative is the BIS's Project Ellipse, a proof of concept launched by the BIS's Singapore Innovation Hub to explore how supervision could become insights-based and data-driven using an integrated regulatory data and analytics platform. Project Ellipse would enable regulatory authorities, as the ultimate end users of the platform, to digitally extract, query, and analyze a large quantity of data from diverse sources. These data could then be relevant to current events in real time and visible via dashboards, informing authorities of early supervisory actions that may need to be taken. Another example is the Global Financial Innovation Framework, established to provide a forum for joint work and regulatory trials.<sup>101</sup> The network was created to provide a more efficient way for innovative firms to interact with regulators, helping them navigate between countries as they look to scale and test new ideas. One of the vital network initiatives is the regtech/suptech challenges run globally, including the GFIN cross-border testing initiative to test innovative products, services, or business models across more than one country or jurisdiction.

## C. Frameworks for Data Management and Standardization

Data management is a critical part of a regtech/suptech policy framework. Agile data management and standardization frameworks are crucial for the development of the ecosystem as they provide the foundation for data standardization and harmonization, underpinned by good quality data. This also allows international regtech providers to integrate their solutions relatively easily with financial

<sup>100</sup> *Fintechnews Singapore*. 2018. APIX, a Global Marketplace for Cross-Border Fintech Services Officially Hits the Market. 14 November. <https://fintechnews.sg/26086/ai/mas-modi-launch-fintech-marketplace-apix-sandbox>.

<sup>101</sup> Global Financial Innovation Network. RegTech & SupTech. <https://www.thegfin.com/regtech-suptech>.

institutions. The frameworks for this need to be developed in conjunction with other ecosystem players, particularly with financial institutions and regtech providers. The key elements will need to include agile frameworks for data collection, storage, management, processing, and data analysis and visualization tools. These frameworks must also have a process for seamlessly incorporating future technological advancements/enhancements.

## D. Supporting Ecosystem Development

While policy frameworks are essential to create a structure for regtech/suptech locally, it is crucial that policy makers actively support the development of local innovation ecosystems that spreads beyond banking supervision to include start-ups and academia and benefit from network externalities. The establishment of industry bodies, such as fintech associations/regtech associations, can help create an organized structure for industry-regulatory cooperation. It also enables the market players to collaborate in developing innovative solutions.

With active regulatory participation, the policy makers can get market insights on new technology solutions while building their understanding of challenges faced by both financial institutions and regtech providers. This will help the policy makers develop more forward-looking guidelines and accelerate the development of digital finance initiatives. These organizations also form an important channel to gain market input on regulatory consultations and implement regulatory initiatives with a significant technology element (e.g., open banking, digital onboarding, etc.). The work done by the Australian Securities and Investment Commission and the Hong Kong Monetary Authority provides good examples of regulatory engagement for the development of regtech in the local markets. The commission established its Innovation Hub in March 2015 to help fintech and regtech businesses navigate Australia's regulatory system in the financial services sector without compromising investor and financial consumer trust and confidence.

# 7

## Conclusion

Although using technology for regulatory, supervisory, and compliance is not new, the integration of technologies has progressed steadily since the 1980s and even before in the context of the development of technological infrastructure for finance. This paper has highlighted the interaction of industry use of technology in compliance and risk management; regulators' and supervisor' use of technology for supervision, monitoring, and enforcement; and technology to embed regulatory requirements and systems into financial infrastructure. Regtech and suptech applications were developed to respond to growing market needs, address the regulatory vacuum, and arm regulators with advanced tools to monitor and oversee compliance. We demonstrate that, over time, regulators' and supervisors' need for utilizing regtech and suptech were shaped by several incidents—such as the 1987 stock market crash, the 9/11 terrorist attacks in 2001, the global financial crisis of 2008, and the COVID-19 pandemic—which have driven digitalization, among other things. Simultaneously, the proliferation of fintech and the invention of new technologies like big data, AI, machine learning, and analytics tools are reshaping the regulatory and supervisory objectives, accelerating the exponential growth of regtech and suptech.

The COVID-19 pandemic prompted the policy makers, regulators, supervisors, and industry participants to focus heavily on regtech and suptech, bringing the benefits of heightened capabilities, enhanced data collection and visualization, cost reduction, and real-time monitoring. Lockdowns and non-face-to-face finance, financial compliance, and financial supervision have transformed the approaches and attitudes to the use of technology by regulators, supervisors, and policy makers. This is because of the necessity of using technology in the supervisory framework to reinforce financial resiliency through improved off-site supervision, surveillance, and misconduct analysis.

The paper highlights the necessity of using an ecosystem approach in designing regtech strategies and the fundamentals of designing an optimal architecture, alongside the policy considerations required for an integrated regtech and suptech ecosystem. This approach can accelerate the development of a transparent and harmonious ecosystem that supports the major financial regulatory objectives of financial stability, financial integrity, fairness and investor and consumer protection, and market efficiency. Digital regulatory reporting requirements are often central to driving the overall ecosystem and often one of the best starting points for regulators and policy makers looking to drive regtech/suptech ecosystem development forward.



Finally, the paper introduces key policy frameworks that can enable the development of strategic ecosystem relationships at national, regional, and international levels, while showcasing vital agile data management and standardization frameworks. The paper also emphasizes the importance and key elements of supporting, creating, and building a local innovation ecosystem. Looking forward, policy makers and regulators need to develop regtech/supotech strategies that engage policy makers, regulated institutions, financial infrastructure operators, and ecosystem builders, and bring all of these parties together cohesively to support sustainable development and financial stability. Central to these strategies is a “digital first” approach from policy makers, central banks, regulators, and supervisors, in their operations, in their regulatory requirements, and from the standpoint of their strategic direction for the financial sector.

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## **Building Regulatory and Supervisory Technology Ecosystems**

*For Asia's Financial Stability and Sustainable Development*

This publication explores the use of regulatory technology (regtech) in finance. It discusses how to design an optimal architecture, alongside policy considerations for an integrated regtech and supervisory technology ecosystem. It highlights the interaction of industry use of technology in compliance and risk management; regulator and supervisor use of technology for supervision, monitoring, and enforcement; and use of technology to embed regulatory requirements and systems into financial infrastructure. The publication introduces key policy frameworks that enable ecosystem relationships at national, regional, and international levels, and showcases vital agile data management and standardization frameworks.

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