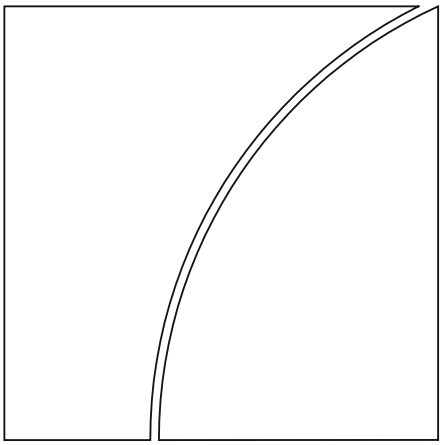
Financial Stability Institute



FSI Insights

on policy implementation

No 37

Suptech tools for prudential supervision and their use during the pandemic

by Kenton Beerman, Jermy Prenio and Raihan Zamil

December 2021

JEL classification: C45, C88, C89, G20, G38, O31, O32
Keywords: Suptech, prudential supervision, data analytics, innovation, AI, artificial intelligence, ML, machine learning, NLP, natural language processing

BANK FOR INTERNATIONAL SETTLEMENTS

FSI Insights are written by staff members of the Financial Stability Institute (FSI) of the Bank for International Settlements (BIS), often in collaboration with staff from supervisory agencies and central banks. The papers aim to contribute to international discussions on a range of contemporary regulatory and supervisory policy issues and implementation challenges faced by financial sector authorities. The views expressed in them are solely those of the authors and do not necessarily reflect those of the BIS or the Basel-based committees.

Authorised by the Chair of the FSI, Fernando Restoy

This publication is available on the BIS website (www.bis.org). To contact the BIS Media and Public Relations team, please email press@bis.org. You can sign up for email alerts at www.bis.org/emailalerts.htm.

ISSN 2522-2481 (print)
ISBN 978-92-9259-528-9 (print)

ISSN 2522-249X (online)
ISBN 978-92-9259-527-2 (online)

Contents

Suptech tools for prudential supervision and their use during the pandemic[1]

Executive summary

Financial authorities use suptech tools for a range of activities, including data analytics for prudential supervision whose use cases have recently grown. An earlier Financial Stability Institute (FSI) publication found that most suptech tools were used for reporting and misconduct analysis, with relatively few deployed for prudential supervision (di Castri et al (2019)). The Financial Stability Board (FSB (2020)) found similar results, though it observed a rise in suptech use cases for prudential purposes. The FSB attributed the increase to the automation of certain repetitive tasks in prudential supervision.

The pandemic prompted authorities to leverage more suptech tools in day-to-day supervision. Travel restrictions and social distancing protocols severely curtailed on-site inspections and led to a simultaneous shift of nearly all supervisory activities to an off-site surveillance approach. To help supervisors assess the prudential soundness of financial institutions remotely – including some tasks that were previously conducted on-site – authorities with existing suptech tools used them more extensively; at the same time, they also recognised the need to develop new data analytics tools for prudential purposes. Therefore, it is not surprising that authorities reported using, developing or experimenting with 71 discrete prudential supervisory tools as of this publication, up from only 12 tools in 2019.

Broader technological developments facilitated the migration of supervisory activities to a virtual environment and underpinned the wider use of suptech tools for prudential purposes. Data management platforms, file exchange protocols, collaboration software and communication tools enabled the shift to virtual supervision, partially offsetting limited on-site inspections. Meanwhile, the growth of non-traditional data sources that can have a bearing on a firm's risk profile and the advent of new analytical tools to help process and analyse data – such as artificial intelligence and machine learning – provided authorities with opportunities to deploy a range of suptech tools for prudential supervision.

This paper takes stock of suptech data analytics tools used for prudential purposes in 20 jurisdictions and explores the associated benefits, risks and implementation challenges. The findings are based on responses to an FSI survey by members of its Informal Suptech Network, combined with follow-up interviews with selected jurisdictions. Suptech data analytics for prudential supervision include tools to support supervisory risk assessments, such as credit, market, liquidity and operational risks and their implications for firm-wide earnings, capital adequacy and governance.

The 71 prudential suptech tools examined in this paper are classified into three categories and subsequently divided into subcategories. The top-tier categories are based on the type of data the tools scrutinise and are labelled as follows: (i) "tools for qualitative data"; (ii) "tools for quantitative data"; and (iii) "tools for qualitative and quantitative data". Within each of the three categories are various subcategories that classify how the tools are used. Tools that rely on mainly qualitative data represent slightly more than half of those examined; these tools are used for text analysis, text summarisation, information classification or sentiment analysis. Tools that mainly look at quantitative data and those that utilise both quantitative and qualitative data account for approximately 25% of use cases each. The former is used for risk identification, while the latter may be used for network analysis, peer group identification or automation of inspections.

[1] Jermy Prenio (Jermy.Prenio@bis.org) and Raihan Zamil (Raihan.Zamil@bis.org), Bank for International Settlements, Kenton Beerman (Kenton.Beerman@ny.frb.org), Federal Reserve Bank of New York. We are grateful to Joshua Tang, Helio Vale, Joy Wann and Diana Zaig for helpful comments. Marie-Christine Drexler provided valuable administrative support.

While suptech tools vary in design and purpose, all share at least one of two overarching objectives of extracting deeper supervisory insights and enhancing the efficiency of the supervision process. Tools that scan qualitative data often use natural language processing (NLP) and other artificial intelligence to comb through an astonishing array of materials to quickly find, summarise, classify and present relevant information for further review. These tools allow supervisors to consider a broader range of information in their prudential risk assessments. Tools that rely on quantitative data facilitate identification of high-risk banks and drivers of specific risks within banks, enabling a better allocation of supervisory resources. Tools that consider qualitative and quantitative data allow supervisors to assess relationships between entities that may not be apparent to the human eye; to enable construction of enhanced bank peer groups, facilitating more consistent supervision of firms with similar risk profiles; or to automate aspects of the inspection process, freeing up supervisory resources for higher-order tasks.

Suptech tools were widely deployed during the Covid-19 pandemic, particularly those that scrutinise qualitative data and support risk identification. The migration of on-site activities to off-site work, in conjunction with various ad hoc reports requested during the pandemic, added to the mounting stack of existing structured and unstructured data that required review. In the virtual environment, suptech tools proved indispensable, enabling supervisory reviews of corporate governance and asset quality, both of which are typically assessed on-site and often drive a firm's overall risk profile. NLP tools helped supervisors pinpoint corporate governance risks from voluminous documents that might otherwise not have been possible. Risk identification tools were also utilised to spot potential credit exposures that may be misclassified or underprovisioned, providing supervisors with a specific list of borrowers for follow-up.

Notwithstanding these tangible benefits, formidable implementation challenges remain, hampering wider adoption and acceptance of suptech tools. A key issue is the limited data science skills of supervisors. To address the skills gap, continued training of supervisors combined with hiring data scientists may help. Other critical issues involve data quality, particularly the unstructured data which underpin some suptech tools and the parameters that drive suptech outputs. An overly tight calibration might lead to the tool missing supervisory issues, while a very loose setting can result in flagging too many irrelevant issues. These challenges may point to a broader need to develop or update a suptech strategy that helps to facilitate supervisory buy-in and guide authorities' deployment of various suptech tools.

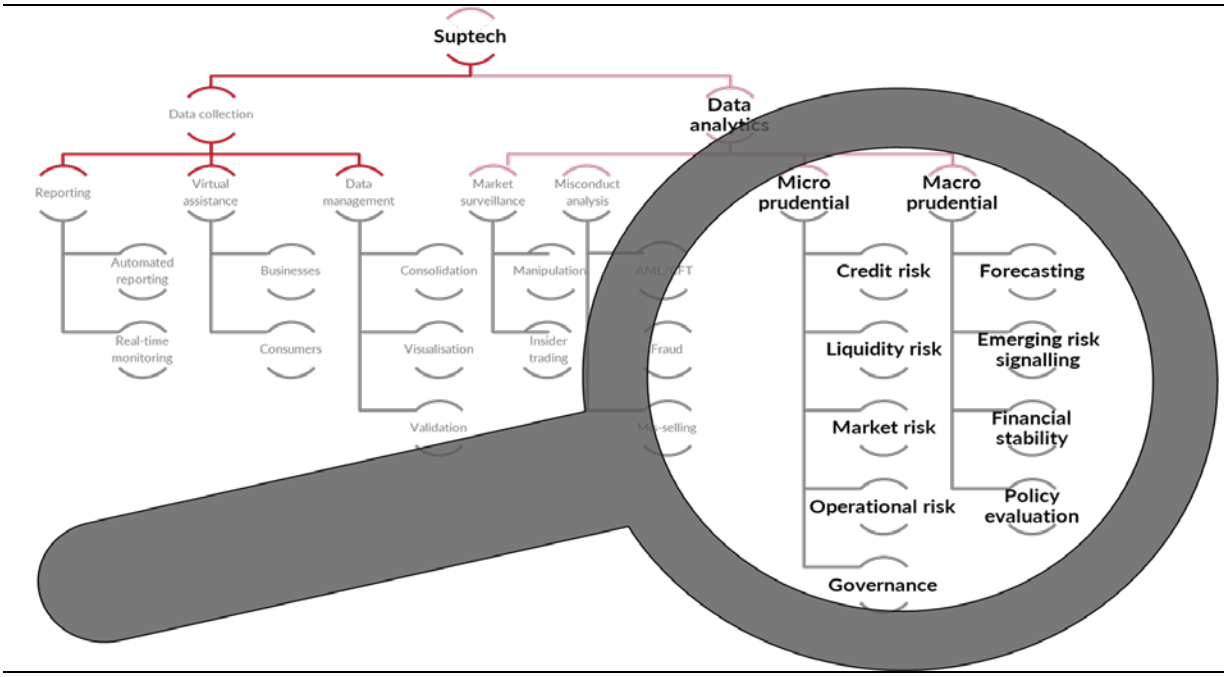
As suptech tools take on a greater role in prudential supervision, supervisory judgment may diminish. Suptech tools are automating lower-value, labour-intensive tasks and supporting higher-value, judgment-based functions. These trends are now accelerating, particularly the development of tools that target complex risk assessments that entail judgment. As these tools get operationalised, supervisors could rely less on their own judgment and depend more on the suptech output to identify key supervisory issues. If this transpires, it may lead to supervisory blind spots and a broader loss of institutional knowledge based on the art of judgment-based supervision. While authorities have emphasised that suptech tools support, rather than replace, supervisory judgment, explicit policies that acknowledge the tensions between, and outline the respective roles of, supervisory judgment and suptech tool outputs, could help.

Experience with virtual inspections and wider use of suptech tools have sparked a broader debate on the future of supervision. During the pandemic, authorities demonstrated the ability to shift all supervisory activities to an off-site stance. This has blurred the lines between on- and off-site roles, prompting a rethink on the modes of supervision in the post-pandemic, digital era. The shift to virtual supervision, however, was not frictionless. On the supervisory side, managing remote teams became a challenge; and while communication tools enabled virtual meetings, there are no good substitutes for in-person meetings with bank staff, which provide supervisors with critical insights on the quality of a bank's internal controls and risk management practices. On the technology front, the pandemic highlighted some gaps in authorities' own technological infrastructure, while exposing varied technological capabilities of supervised firms. While there will always be a crucial role for on-site inspections, there may be scope for more supervisory work to be conducted off-site, depending, in part, on the evolution of technological innovations, including the broader deployment of suptech tools in prudential supervision.

Section 1 – Introduction

1. **FSI Insights no 19 ("The suptech generations") defined suptech as the use of innovative technology by financial authorities to support their work.**[2] For this purpose, "innovative technology" refers to the application of big data or artificial intelligence (AI) to tools used by financial authorities. "Financial authorities" refers to authorities with supervisory and non-supervisory functions (ie financial intelligence units without supervisory mandates). As such, suptech use cases can be found in the whole range of activities that financial authorities undertake – from data collection, including data management, to data analytics (Chart 1). Within data analytics, suptech use cases can help in market oversight, conduct supervision and prudential supervision. This paper focuses on suptech data analytics tools for prudential supervision.

Mapping of suptech to different supervisory areas — Chart 1



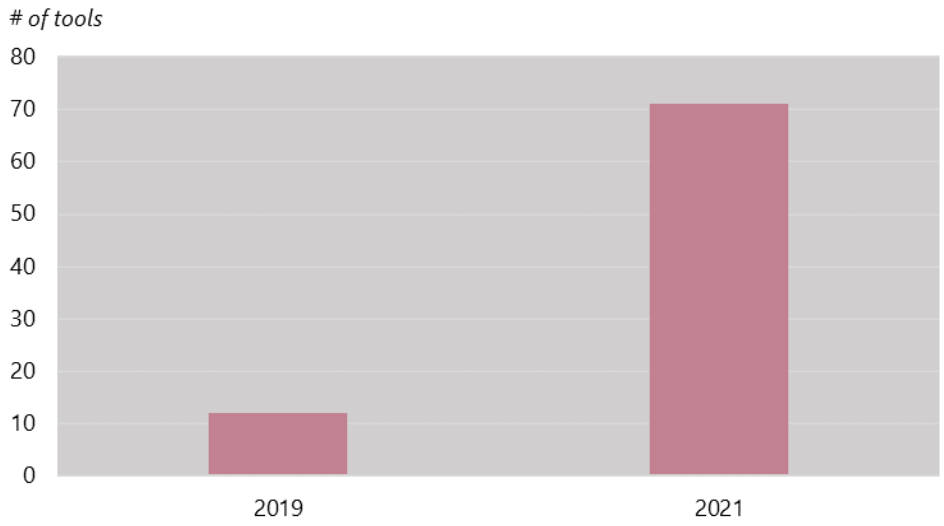
Source: Adapted from Broeders and Prenio (2018).

2. **Suptech data analytics tools for prudential supervision made up only a small fraction of total use cases, but this proportion may be changing.** Of the 99 suptech use cases examined in FSI Insights no 19, the majority were for reporting (32%) and misconduct analysis (30%), with only a few for prudential supervision (12%).[3] FSB (2020) found a similar pattern in the distribution of suptech use cases but noted the increased in prudential use cases in recent years. It attributed this increase to the relatively rule-based nature of some prudential tasks. Authorities therefore were able to easily codify some of these assessments in suptech tools, thus introducing efficiencies in the supervisory processes. Indeed, compared with the suptech data analytics tools for prudential supervision examined in 2019, the number of tools examined for this paper represents a significant increase (Chart 2).

[2] di Castri et al (2019).

[3] Ibid.

Reported suptech data analytics tools for prudential supervision Chart 2



Source: FSI surveys of central banks and supervisory authorities.

3. **The pandemic has constrained supervisory activities and may have provided an impetus for the development of more suptech use cases for prudential supervision.** On-site inspections have been severely limited or non-existent in almost all jurisdictions. The pandemic forced supervision work to focus more on off-site monitoring, using whatever data and analytics tools supervisors had. Authorities with operational suptech tools found them quite useful under the circumstances. At the same time, authorities considered additional use cases that would have been useful given limited on-site inspections. The shift to off-site activities during the pandemic, plus the expectation that the "new normal" might continue to mean less on-site activities, may push authorities to leverage more suptech tools on a permanent basis.

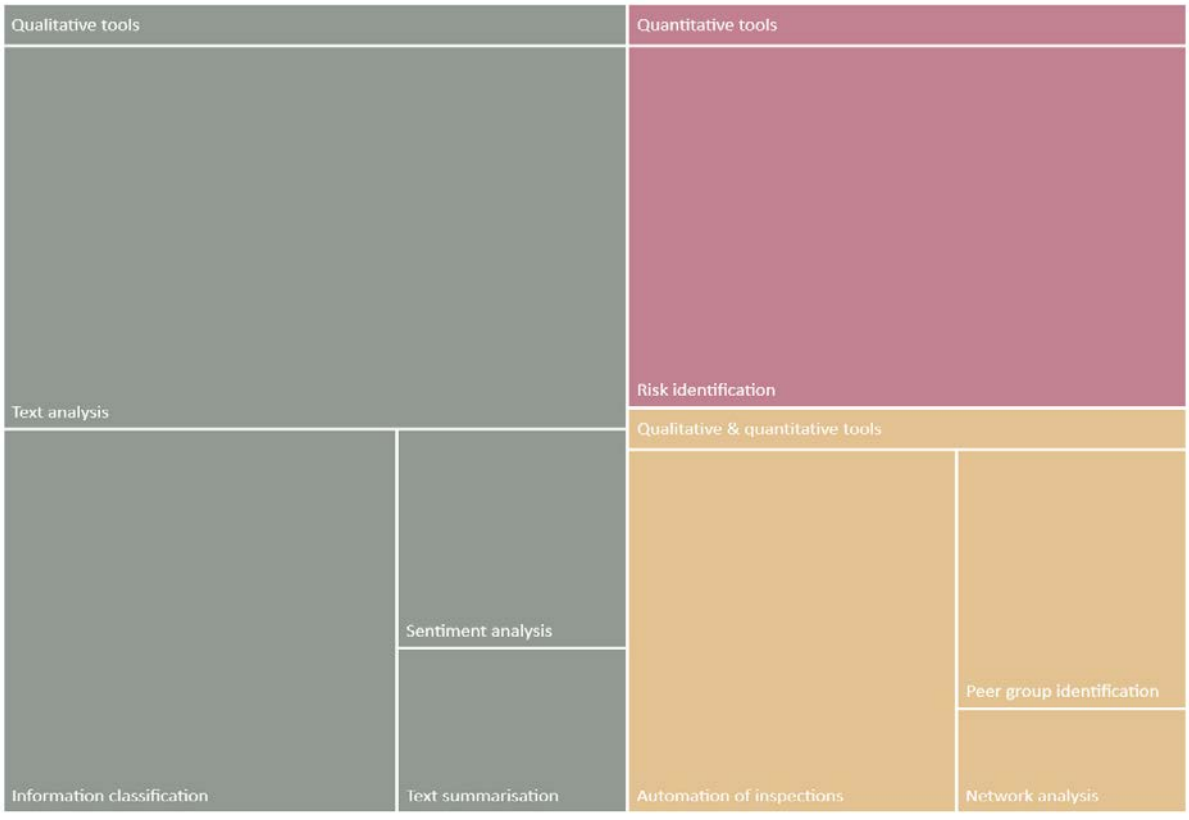
4. **This paper provides an overview of the state of play of suptech data analytics tools for prudential supervision in a number of jurisdictions around the world.** It benefited from 21 responses to a survey sent to members of the FSI's Informal Suptech Network (see Annex 1 for a list of authorities that responded to the survey). Survey responses were supplemented with interviews of some responding authorities, to discuss their suptech tools in detail and/or clarify their responses. Section 2 describes and classifies these tools according to the data they analyse and/or their objectives. Section 3 offers some observations on authorities' practices throughout the suptech life cycle, including governance, identification of use cases, deployment to supervisors and measurement of effectiveness. Section 4 examines how suptech tools are being used during the pandemic and describes areas where they proved to be particularly useful. Section 5 discusses practical considerations in using suptech tools, including lessons learned during the pandemic. Section 6 concludes.

Section 2 – Types of suptech data analytics tools for prudential supervision

5. **The paper examines 71 suptech data analytics tools for prudential supervision.** Authorities that responded to the survey reported 130 suptech use cases. Out of these, we considered use cases that are for reporting, data management (ie validation, visualisation, storage, aggregation etc), conduct supervision and anti-money laundering (AML) oversight as out-of-scope for this paper.[4] The discussions that follow pertain only to the remaining 71 suptech data analytics tools.

6. **Suptech tools for prudential supervision are grouped into three broad classifications, each of which can be further classified into subcategories (Chart 3)**. The broad classifications are based on what types of data the tools mainly look at – qualitative, quantitative or both. The subcategories are based on how the tools are used, with some tools classified in more than one subcategory. Tools that mainly focus on qualitative data may be used for text analysis, text summarisation, information classification or sentiment analysis. Tools that mainly look at quantitative data are used for risk identification. Tools that look relatively equally at both qualitative and quantitative data may be used for network analysis, peer group identification or automation of inspections.[5]

Composition of suptech tools — Chart 3



Source: FSI survey of central banks and supervisory authorities.

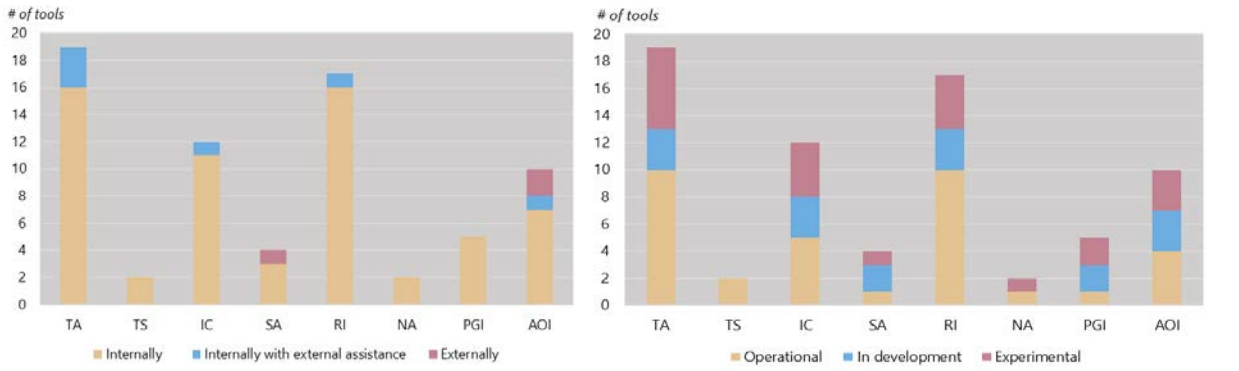
[4] Regulatory reporting is a critical foundation for suptech data analytics tools to thrive. For more details on suptech tools and other innovations in regulatory reporting, see Crisanto et al (2020).

[5] It is recognised that there is no foolproof way of classifying some of the tools. In cases where there is lack of clarity, the tools are classified based on authors' judgment as to: (i) the types of data the tools most likely look at; and (ii) how the tools are used.

7. **Tools that mainly use qualitative data make up slightly more than half of those examined.** Tools that mainly use quantitative data and those that use both qualitative and quantitative data each account for about a quarter. In terms of subcategories, tools for text analysis are the most common, followed by tools for risk identification, information classification and automation of inspections. The prevalence of tools for qualitative data reflects the importance of aiding supervisors in reviewing documents in text format, which until now they still have to do manually. Tools that analyse both qualitative and quantitative data is another area where suptech shows great potential, since these enable the integration of both types of data for deeper insights. Meanwhile, supervisors already have existing tools to analyse quantitative data, so the focus of suptech is simply on how to improve them.

8. **Many of the tools are already operational, and almost all of them were or are being developed internally (Chart 4).** Operational tools make up 48% of the tools examined, while in-development and experimental tools make up 22% and 30%, respectively. Meanwhile, only three of the tools were developed exclusively by external parties, and six were joint collaborations by internal and external parties. The rest were or are being developed internally. Quite a few of the agencies have data scientists that develop the tools, often with input from line supervisors. For tools relying on some external assistance to bolster internal development, advice can come from universities or related research bodies. The extent of collaboration with line supervisors during the development phase appears to be correlated with the degree to which the tool is eventually intended to be used more widely by supervisors. The wider the supervisory use that is envisioned, the more initial input is sought from line supervisors.

Development of suptech tools — Chart 4



TA = text analysis ; TS = text summarisation ; IC = information classification ; SA = sentiment analysis ; RI = risk identification ; NA = network analysis; PGI = peer group identification; AOI = automation of inspections.

Source: FSI survey of central banks and supervisory authorities.

Tools for mainly qualitative data

9. **Text analysis uses machine learning (ML) to obtain specific information from a document.** Text analysis covers a range of use cases in natural language processing (NLP). Text is often unstructured data that is either confidential or non-confidential, but which serves a supervisory purpose. Documents that can be reviewed in an automated way range from contracts to auditors' statements, from press articles to operational risk reporting, from meeting minutes at a firm to bank risk profiles. The goal is to automate the searching of information in order to save supervisors' time and energy. Examples of such tools include the Bank of Spain's (BdE) text mining for wiser sampling, the European Central Bank's (ECB) Automated Topic Modeling, the Bank of Thailand's (BoT) board minute analyser and the Bank of Italy's (BdI) corporate governance analysis.

10. **While such tools are used for various purposes, all can identify commonly used words in a certain context and can analyse a wide set of documents across a range of supervisory use cases.** The BdE's tool analyses unstructured data from an institution's credit files to obtain a sample of credit exposures that may have been wrongly identified as "performing". At the ECB, Automated Topic Modelling analyses textual data to better identify – in relation to manual processes – general topics written in banks' Supervisory Review and Evaluation narratives.[6] The BoT tool analyses board minutes to identify risks that are being discussed and to assess the degree of board engagement. Similarly, the BdI tool aims to apply text mining to board of directors' meeting minutes to help deepen the analysis of bank governance (see Box 1 in Annex 2 for more details on the BoT and BdI tools).

11. **Text summarisation is the process of highlighting key points in large documents for quicker supervisory consumption.** Text summarisation is closely related to text analysis, but the difference is that the former focuses on summarising text while the latter focuses on finding information. Summarisation tools condense the amount of text into a manageable portion to read quickly, such as creating an overview paragraph from multiple pages.[7] The Central Bank of Brazil's (BCB) MARIA summarisation tool uses an unsupervised ML algorithm to summarise long texts, allowing supervisors and management to screen and evaluate content beforehand. MARIA is currently being improved with state-of-the-art algorithms, which are in the final stages of training. The Federal Reserve Bank of New York's (FRBNY) Language Extraction (LEX) tool includes development of a summarisation tool alongside 15 other use cases (see Box 2 in Annex 2 for more details on LEX).

12. **Information classification seeks to understand patterns from large amounts of unstructured data, with the intent to classify and structure information in a more organised way.** Authorities are classifying and organising a wide range of text, including regulatory submissions, news articles and other documents. The Guernsey Financial Services Commission (GFSC) has an experimental tool that classifies documents with material supervisory concerns, and aims to reduce supervisory effort by "flagging" only those documents with material issues for manual review (see Box 3 in Annex 2 for more details on this tool). The BdE has an experimental tool that determines automatically whether a supervisory document has been correctly classified or misclassified. The tool, which uses NLP, is expected to review how BdE staff classify documents they upload into the system and identify any potential misclassification.[8] This will help improve the quality of unstructured data in the BdE's system.

13. **Sentiment analysis uses NLP to determine whether data are positive, negative or neutral.** Among the suptech tools examined, relatively few focus primarily on sentiment analysis despite the relatively high level of interest such tools attracted from authorities in previous years. A few authorities have standalone sentiment analysis tools, such as the BoT's tool to measure institutions' sensitivity and opinion towards its Covid-related policies and relief measures. The Qatar Financial Centre Regulatory Authority (QFCRA) is developing a tweet sentiment tool, which will allow supervisors to better gauge public sentiment surrounding their firms on a daily basis (see Box 4 in Annex 2 for more details on this tool). In addition, a few authorities have incorporated sentiment analysis for other uses. The BdI's experimental corporate governance analysis tool applies sentiment analysis to gauge the tone of intervention by individual board directors. The Monetary Authority of Singapore (MAS) is developing an integrated surveillance platform that collates data from various sources (eg news, financial statements, macroeconomic indicators, regulatory reports) and applies various ML techniques, including

[6] Other uses cases are also being explored.

[7] Summaries can give quick insights into texts, but they may not necessarily reduce the amount of text that is ultimately read. Some argue that supervisors may still need to read the full text to gain a contextual understanding, at least until the suptech summaries are more refined.

[8] Classification of the various documents is done by type, eg on-site inspection report, authorisation assessment, off-site supervision memo. The tool helps the Quality Assurance Unit within the Supervision General Directorate to perform its reviews.

sentiment analysis, to facilitate in-depth analysis and risk identification. Several other authorities are planning to develop sentiment analysis tools or incorporate sentiment analysis into future iterations of their text analysis tools.

Tools for mainly quantitative data

14. **Risk identification tools help to spot risks at financial institutions by using mainly quantitative and/or structured data.** Capital, credit and liquidity are some of the risk areas targeted. The BCB's ADAM tool is an ML-based application looking for customers with high probability of default and whose expected loss may not be adequately recognised by supervised entities (see Box 5 in Annex 2 for more details on this tool). The Swiss Financial Market Supervisory Authority (FINMA) has developed or is developing several tools for different uses, such as forecasting supervisory categories of banks based on predictions of how their risks would evolve and estimating (using ML) risk-weighted assets of small banks that are no longer required to submit such reports.[9] The MAS integrated surveillance platform mentioned above also aims to identify risks at financial institutions based on various data, including quantitative as well as qualitative data.[10] The Central Bank of the Republic of Austria (OeNB) has a tool that identifies high-risk banks by considering profitability, capital adequacy and various risks, including credit, market, operational, liquidity and funding risks. The Netherlands Bank (DNB) has an experimental tool that combines monthly regulatory reporting data with daily payment systems data to estimate a daily proxy of the liquidity risk ratio of supervised institutions. The QFCRA is developing a risk scorer tool that will provide an independent view of banks' risks and challenges supervisory teams to arrive at consistent scores in their internal supervisory rating process.

Tools for both qualitative and quantitative data

15. **Network analysis tools look at relationships between entities to better understand how risks cascade from one entity to the other.** Network analysis tools draw on a range of quantitative and qualitative data and methods, from neural analysis to pattern recognition. The BdE's tool analyses the relationships between entities, identifying not only formal relationships but also less formal connections that would be difficult or impossible for supervisors to find manually. This allows the BdE to evaluate the impact of a given risk across the whole network (see Box 6 in Annex 2 for more details on this tool). FINMA's experimental tool automates the identification of links between persons from various structured and unstructured data sources, with the potential to be used in a range of prudential use cases. One area of work going forward may be how network analysis assesses the likelihood that current relationships may foresee not just current but also emerging risk concerns.

16. **Tools that enhance peer group identification – which sets the foundation for off-site monitoring – aim to recognise similarities between supervised entities.** The methods might be similar to network analysis but the objectives are different; hence, they are separately classified. These tools allow for a consistent supervisory approach to banks with similar risk profiles. FINMA's experimental peer group determination tool challenges the existing rules-based peer group system by applying unsupervised clustering algorithms to key variables upon which firms are categorised. Similarly, the QFCRA is developing a tool that will separately analyse firms' assets and liabilities instead of looking at the whole balance sheet

[9] These include small banks that are considered highly capitalised, liquid and safe.

[10] The MAS integrated surveillance platform is a good example of a tool that spans several subcategories. This platform can be expected to process both quantitative and qualitative data. The MAS tool is currently in a pilot phase with supervisors, and its classification can thus be closely monitored as it becomes operational.

in identifying peer groups. In doing so, it identifies closely related investment and funding strategies. The OeNB is also developing a tool that will identify similarities between firms that may have gone unnoticed (see Box 7 in Annex 2 for more details on the FINMA and OeNB tools).

17. **Inspection automation tools are intended to make the multi-step examination process simpler and more efficient.** The tools in this category are an especially varied group, with some covering one step of the examination and others seeking to cover the entire process (see Boxes 8–11 in Annex 2 for more details on several of these tools). Many of these tools also contain elements of the other categories, such as risk identification, text analysis or sentiment analysis. The BCB has a tool that aims to simplify manually intensive steps, including the creation of working papers and draft communications to financial institutions. The BdI is experimenting with tools that will automate assessment tracing, report drafting, references to previous regulations, indications of similar findings and other aspects of the review process. The Central Bank of Malaysia (BNM) has developed a writing aid using NLP/ML to assist supervisors in drafting supervisory letters to ensure that the tone is consistent and that BNM's concerns are clearly communicated to financial institutions. The ECB's OSICredit processes data on credit risk exposures, implements methodologies on sampling and aggregates inspection results. The MAS is developing a similar tool that will automate data analysis during inspections (eg for credit risk management review).[11]

Section 3 – Suptech tool life cycle observations

18. **Support from the board and senior management drives suptech development and use in authorities.** Without strong support from the board and senior management, development and use of suptech tools cannot gain wide traction within the organisation. For example, at the ECB a board committee has both endorsed the suptech strategy and supported innovation teams for individual projects. Heads at several authorities have highlighted digital transformation and data-driven innovation as key strategic goals for the next few years.[12] The BCB points out that having suptech "sponsors" on the board and in senior management often helps: in their specific case, BCB sponsors typically hear about ideas for suptech tools even before proofs-of-concept are developed.

19. **Appropriate governance arrangements complement effective "tone from the top".** Governance challenges are often cited by larger organisations, which are struggling to find the right level of centralisation in their suptech development work. The "hub and spoke" governance model seems to be working for those that have adopted it. However, for authorities that do not have formalised and organisation-wide suptech strategies, individual units[13] sometimes end up experimenting with suptech tools on their own. This could lead to redundancies and inefficiencies, contrary to what suptech aims to achieve.

20. **Supervisors play critical roles in all facets of the suptech life cycle.** Data scientists within authorities generally get ideas on what tools to develop from interacting with supervisors. Based on these ideas, "minimum viable products" are developed and piloted to a few supervisors. Feedback from the pilot group in terms of the tool's usefulness and compliance with set objectives or performance metrics inform the decision on whether to further develop or operationalise it. In addition, some authorities use "rule-of-

[11] Separate work at the FRBNY and HKMA on robotic process automation (RPA) remains nascent, yet the eventual outcome may be very significant in terms of reducing manual processes in report analysis, data extraction, data tagging, data pre-populating and records processing.

[12] A few examples include FINMA, the QFCRA and the ECB. See also di Castri et al (2019).

[13] For example, those in charge of banking, insurance and non-bank institutions.

thumb" criteria such as level of innovation, cost of and time to implementation. Senior management or an independent reviewer sometimes evaluate pilot results before recommending progress to the next stage. However, it is recognised that assessing net value added of any suptech use case, and thus prioritising suptech projects, is not straightforward given high demand and limited resources.

21. **Once operational, the tools are deployed to supervisors based on need, but authorities recognise the importance of making all supervisors aware that such tools exist.** Some tools with broad application are available to all supervisors. Others with very specific applications can be accessed only by supervisors that directly use them. In some authorities, supervisors need to explicitly request access to suptech tools. Whether access is automatically granted or requires approval, awareness among supervisors that the tools exist can be an important component of successful deployment. High awareness allows supervisors to decide which tools are most appropriate for their needs, and it also facilitates gathering feedback or flagging data quality concerns to improve the tools.

22. **The effectiveness of suptech tools is generally measured through a mixture of qualitative feedback and quantitative metrics.** Qualitative feedback can come in various forms, including review of the tool output and supervisors' observations on its user-friendliness. Several authorities mentioned assessing effectiveness through ongoing exchanges between those with data science skills and front-line supervisors/other users. In some cases, this involves quantitative metrics, such as number of supervisory hours saved doing analysis compared with previous processes, or number of supervisory issues identified by supervisors unaided by the tool. Authorities also subject their suptech tools to more formal model validation. They recognise that the right balance should be achieved between "false positives" and "false negatives".[14] Tightening modelling criteria may reduce noise in the results, but it could also lead to the tool not spotting supervisory issues. Loosening criteria could lead to too much noise, which could also result in the tool not being of much help in identifying real issues.

23. **While many authorities view their operational suptech tools as effective, they also recognise that there is room for further improvement.** One authority described their suptech tools as "living and breathing organisms" that continue to evolve based on ongoing feedback and validation. Authorities are therefore still tinkering with suptech tools that are already being used. In addition, numerous authorities are experimenting with or developing improved versions of their existing operational tools. For many authorities, greater effectiveness in predicting emerging trends, rather than just analysing past data, is a key part of the improvements envisioned. This would also help define how effectiveness would be measured for future suptech tools.

Section 4 – Suptech usage during the pandemic

24. **The pandemic-triggered migration of all supervisory activities to a virtual environment has been facilitated by technology-enabled tools.** Advancements in, and the availability of, technological infrastructure such as document-sharing platforms, collaboration tools and videoconferencing capabilities enabled supervisors to carry out certain on-site functions and all off-site activities remotely. Authorities used various platforms to receive/exchange electronic documents, for example by establishing a private and secure cloud platform to facilitate document-sharing with supervised entities. Meanwhile, the use of collaboration software helped supervisory teams to coordinate their activities and work together in a virtual setting. Lastly, authorities utilised videoconferencing tools to communicate internally within supervisory teams and externally with bank management, including virtual meetings (eg general

[14] See also Broeders and Prenio (2018) and Coelho et al (2019). As mentioned in Broeders and Prenio (2018), false positives are results that indicate culpable behaviour exists when in fact it does not. False negatives occur if the technology is unable to detect actual cases.

interactions, system walk-throughs and exit meetings) that would otherwise have been conducted in-person.

25. **Heavy reliance on off-site supervision helped to partially offset the scaled-down and remote nature of on-site inspections.** Some authorities modified their on-site activities to account for the remote work environment, for example, by carrying forward the pre-pandemic on-site supervisory rating assigned to a firm,[15] and shifting away from large on-site credit file reviews to challenging banks' underlying credit risk models. Many authorities also adapted the focus of their off-site activities to monitor the pandemic's impact on an institution's overall risk profile. This, in turn, required additional data collection efforts – such as ad hoc reports and questionnaires from supervised entities related to their Covid-19-affected credit exposures – and more frequent engagement with bank management. Beyond the scrutiny placed on credit risk, one jurisdiction (BCB) obtained more detailed reports from supervised entities to closely monitor funding, liquidity and foreign exchange risk. Another authority (Bdl) required banks to provide a self-assessment on the sustainability of their business model in the light of the pandemic.

26. **Suptech tools supported the pandemic-induced shift to offsite supervision, by enabling supervisors to consider a broader range of qualitative and quantitative data that may impact a firm's risk profile.** Outside traditional (structured) regulatory returns, off-site supervision benefits from unstructured data sources, such as internal bank-generated reports, board and committee minutes, newspaper articles, social media chatter, audited financial statements, other company filings and analyst research reports. The migration of certain on-site activities to off-site work, together with various pandemic-related ad hoc reports and associated monitoring programmes, added to the pile of structured and unstructured data. In this regard, tools to process qualitative data, particularly those used for text analysis, text summarisation and information classification, as well as tools for risk identification, have proven to be quite useful.

27. **NLP tools have been utilised to support various supervisory risk assessments, including corporate governance.** NLP tools have been used by several authorities to identify corporate governance risks that supervisors may not have found manually. Documents that may have bearing on a bank's corporate governance practices encompass numerous materials drawn from confidential and publicly available sources covering all risk disciplines. For example, some FRBNY supervisors have been using NLP to refine supervisory views in examination and monitoring work. In particular, firms that are under enforcement actions are often required to submit progress reports and related materials to demonstrate the steps being taken to address the identified areas of supervisory concern. These documents can run up to thousands of pages long, making it essentially impossible for the human eye to fully digest. NLP has been applied to find specific information about whether institutions are meeting applicable board governance provisions, providing FRBNY supervisors with a powerful tool to help support their corporate governance risk assessments.

28. **The supervisory review of credit quality – a time-consuming task that often drives a firm's overall risk profile – has been a particular area of focus during the pandemic.** Credit file reviews traditionally exhaust a disproportionate share of supervisory resources, given that poor asset quality[16] and underfunded loan loss provisions can materially affect a firm's earnings and regulatory capital. The financial consequences of the pandemic have accentuated these concerns and prompted authorities to redouble efforts to monitor credit risk. Nevertheless, policies and restrictions in response to the pandemic, including regulatory forbearance measures, governmental support programmes and the temporary suspension of on-site inspections, have hampered supervisors' ability to ascertain a firm's credit risk profile.

[15] The ECB retained a firm's pre-pandemic supervisory rating unless changes were justified by exceptional circumstances that affected individual banks. See ECB 2020 Annual Report on Supervisory Activities for further details.

[16] In addition, poor asset quality is often a precursor for heightened liquidity risk, including because institutional fund providers who are not covered by deposit insurance may be sensitive to the bank's deteriorating credit risk profile.

29. **To facilitate credit risk assessments in a virtual setting, authorities have deployed various suptech tools to help supervisors identify exposures that may be misclassified or underprovisioned.** The BCB uses its tool to identify bank borrowers with a high probability of default[17] that may not be identified by supervised entities. This tool allows for a scan of the entire credit portfolio – rather than just a subset under traditional sampling methods – and presents supervisors with a tailored list of credit files for further scrutiny. The BdE's tool leverages unstructured data to flag credit exposures that are classified by the bank as "performing" but may warrant a "non-performing" designation, for supervisory follow-up. An algorithm runs keywords (eg moratorium) through the tool to automatically identify potential misclassifications of exposures, followed by a manual validation of the results. The ECB's tool challenges a bank's loan loss provisioning practices, by statistically sampling a subset of retail credit exposures based on pre-specified stratification criteria and feeding these exposures through its own supervisory model, which projects expected credit losses (ECLs). Supervisors compare the model-generated results with the bank's actual level of ECLs as the basis for discussions with bank management.

Section 5 – Practical considerations

30. **Availability of data science skills affects how widely authorities can deploy some suptech tools.** Limited data science skills among supervisors are cited by several authorities as a reason why certain tools are not more widely deployed.[18] Some authorities are addressing this by designing user-friendly interfaces accessible to staff without data science skills. Authorities in general are ramping up their capacity-building efforts in data science, including training existing staff or hiring new staff with relevant backgrounds.[19],[20] Equipping supervisors with data science skills is instrumental in bridging the language gap between data scientists who develop the tools and those that use them. This ensures that accumulated supervisory experience and expertise properly inform the development of suptech tools.

31. **In addition to acquiring the right skills, clarifying what suptech tools are meant to be used for is also important in their effective adoption.** Supervisors are quick to recognise the value of some suptech tools. This is especially true for those that make supervisory processes easier and less cumbersome (eg text summarisation tools). However, suptech tools that try to identify more complex supervisory issues (eg risk identification tools) may be viewed as tools that seek to question supervisors' judgment. A risk identification tool in one authority, for example, received resistance from some of their supervisors who viewed it as a way to catch their mistakes – a view that has been exacerbated by a strong internal audit culture put in place to improve supervisory processes. This example highlights the importance of change management, and the need to emphasise that findings of suptech tools do not dictate supervisory decisions and actions. Rather, findings from these tools provide supplementary information that is meant to feed into a broader analysis that will, in turn, inform such decisions and actions.

32. **Authorities need to consider data-related challenges in implementing suptech tools.**[21] Data quality, reliability and completeness can be an issue for non-traditional sources of information (eg social media, despite being a source of valuable real-time information). Volume and size of data also remain issues. Some authorities are addressing this by moving to the cloud, but cloud security remains a concern

[17] BCB staff noted that their ML tool is "trained" by employing the qualitative and quantitative decision-making factors used by supervisors in their assessment of credit files. These data are then fed into the ML algorithms that are used to identify borrowers with a high probability of default.

[18] For example, one authority has rolled out a multi-week AI/ML training programme for its supervisors that can be done remotely.

[19] For suptech tools that are developed externally, one practical consideration is the limited number of licenses that an authority has for the tool.

[20] See Broeders and Prenio (2018) for a discussion on resource issues.

[21] See Broeders and Prenio (2018) for a discussion on data-related challenges.

for many authorities, in particular regarding data confidentiality. Some authorities also mention challenges related to interoperability across their different databases. Moreover, integration of regulatory data with data from other sources could also be a challenge. Many authorities are already moving towards a centralised data storage, for example through the use of data lakes. In summary, authorities need to strengthen various aspects of how they collect data – including governance, quality, granularity, timeliness and management – which comprise the "raw materials" that feed into the development of various suptech tools.

33. **The experience with suptech tools during the pandemic provides a number of lessons.** An overarching issue is the need to continue investments in IT infrastructure, setting the foundation to conduct supervisory work and unlocking the potential to apply suptech tools remotely. The pandemic highlighted some gaps in authorities' IT infrastructure.[22] Authorities that made large investments in it before the pandemic, for example by putting in place the infrastructure to collect granular data at the transactional level and investing in new AI analytical tools several years back, noted that they were able to adjust to the new working environment easily and effectively.

34. **The pandemic also underscores the need for authorities to have structures in place that allow suptech tools to be used more effectively, particularly as additional tools are deployed.** Authorities are actively developing NLP tools to address the fundamental challenge of managing and synthesising the large and growing volume of unstructured data. Beyond this, several authorities are exploring multiple suptech tools with differing purposes. Supervisors are continuing to develop relatively newer tools for sentiment analysis, network analysis, peer group identification and inspection automation. They are also starting to explore ways to assess climate-related and cyber risks, as well as those arising from digital-only financial firms, using NLP and other ML-based tools. These developments highlight the need to better integrate various tools and to implement appropriate governance structures around their experimentation and use.

35. **Greater deployment of suptech tools has led to concerns that they could potentially minimise the importance of supervisory judgment.** There is a risk that supervisors would simply rely on suptech tools to identify key issues, which, in turn, could lead to assumptions that what the tools do not detect does not exist. It could de-emphasise supervisory judgment and might lead to missing nuances in supervisory issues that may not be fully captured by suptech tools. Decision-makers and data scientists have stressed that suptech tools are expected to support, and not replace, supervisory judgment. That said, there is no "bright line" between tools that help to automate repetitive tasks versus those that serve as a proxy for supervisory judgment. For example, some authorities deploy suptech tools to draft written communication to supervised entities, a repetitive task that entails judgment. Others provide a computer-generated rating assigned to a bank to challenge supervisory risk assessments, which are inherently judgmental in nature. While the above tools are subject to supervisory review, the incentives for supervisors to continue exercising judgment may diminish as more supervisory tasks are automated.

36. **Successful deployment of suptech tools may lead to broader questions about whether some on-site tasks can remain off-site even after the pandemic.** Suptech tools have enabled effective off-site monitoring of banks. As authorities prepare for a post-pandemic world, they are also assessing the right balance between on- and off-site activities. A natural question is whether on-site inspections are needed at all. But it should be noted that the shift to virtual supervision led to challenges in managing remote teams.[23] Moreover, one survey respondent noted that on-site inspections cannot be fully replaced by off-site monitoring, since the opportunity to physically observe and assess a bank's internal controls and processes is as critical as remotely monitoring its financial figures.[24] Supervision of governance is

[22] It also exposed differences in technological capabilities in firms. See McWilliams (2020) for details.

[23] Eirea et al (2021).

[24] See also Badat et al (2021) for a discussion of the "non-tangible" benefits of on-site inspections.

another area that is hard to replicate off-site. One authority has undertaken an exercise mapping out supervisory areas that can or cannot be automated, and identified governance in the latter category.

37. **As suptech tools play greater roles in day-to-day supervision, supervisory authorities also need to consider the implications for supervised entities.** Use of suptech tools can result in benefits for supervised entities, particularly through efficiency gains in supervisory processes. However, authorities recognise that it could also induce changes in supervised entities' behaviours, especially as more information about the tools are disclosed. Supervised entities could utilise disclosed information to engineer desired outcomes. Given this concern, authorities continue to weigh the pros and cons of disclosing information on its suptech tools.[25]

Section 6 – Conclusion

38. **Suptech data analytics tools are making prudential supervision more efficient and bringing new insights on risks, areas of concern and other supervisory issues.** These tools use a range of data, both qualitative and quantitative, from different sources. Tools for text analysis, text summarisation and information classification allow for much faster extraction of useful insights from voluminous documents than would be manually possible. Tools for sentiment analysis, risk identification, network analysis and peer group identification provide insights from data that may not have been detected by just using traditional rule-based or statistical tools. Furthermore, tools that automate parts of the inspection process result in both more efficiencies and more significant supervisory information.

39. **Suptech tools, particularly those for analysing unstructured data and risk identification, proved essential during the pandemic.** The migration of most on-site activities to off-site work and the various pandemic-related reports required by authorities added to the already huge pile of structured and unstructured data that supervisors must go through. In particular, suptech tools have given much needed support in the supervisory reviews of corporate governance and credit risk. NLP tools have been able to identify potential corporate governance risks from a large set of documents that may have bearing on a bank's governance practices. Authorities also deployed risk identification and other suptech tools that help supervisors identify credit exposures that may be misclassified or underprovisioned.

40. **The pandemic experience highlighted the need for continued improvements in IT infrastructure and data collection practices, which can support ongoing exploration of new suptech tools.** A sound IT infrastructure offers an effective platform for deploying suptech tools, while improved data collection practices open further possibilities on the types of analyses supervisors can perform with suptech. Authorities are already exploring emergent tools that could have far-reaching impacts. Network analysis tools may be able to assess the likelihood that current interconnections between entities may foresee not just existing but also emerging risk concerns. Peer identification tools may result in a deeper understanding of similarities between supervised firms, perhaps making the supervisory scoping, review and analysis wrap-up process more consistent and resource-efficient. Sentiment analysis tools may provide more nuanced insights on information gathered not just from social media, but from confidential supervisory data as well. Inspection automation tools could overhaul the whole supervision process, thus profoundly affecting resource management. Authorities are also experimenting with tools that could be applied to broader themes that may shape our post-pandemic supervisory world, including climate change, cyber and the supervision of digital-only financial firms.

41. **Implementation challenges – from lagging data science skills to governance complexities, from data quality to data integration – continue to hinder broader deployment and acceptance of suptech tools.** Many of these challenges have scaled up and become pressing as more suptech tools are

[25] See Broeders and Prenio (2018).

operationalised. Continued capacity-building through training and hiring can alleviate data science skill shortages. An emphasis on developing or updating a suptech strategy can clarify governance arrangements and soften supervisors' resistance to new ways of doing their daily work.[26] In addition, data quality will continue to be a limitation of data from alternative sources, such as social media. Moreover, while many authorities are already finding ways to integrate data from disparate sources, including using centralised data storage such as data lakes or the cloud, security issues remain a concern, particularly those relating to cloud storage.

42. **It is important that deployment of suptech tools be accompanied by appropriate safeguards to mitigate potential unintended consequences.** Appropriate governance frameworks have been crucial in spurring suptech development and usage, including suptech strategies and buy-in from the board and senior management. Going forward, governance structures may have to clearly address the growing and often ill-defined role of suptech tools in the organisation. As more suptech tools are deployed, supervisors may not be incentivised to exercise judgment and instead just rely on the tools to detect issues. Such over-reliance on suptech could diminish judgment-based supervision and could eventually lead to more supervisory blind spots. There is also the broader issue of whether there is still a role for on-site inspections. However, supervisory judgment is heavily informed by physically observing and assessing banks' governance, culture and controls. Authorities have been clear that suptech tools are meant to enhance, not replace, supervisory judgment. Nevertheless, this message needs to be reinforced by introducing clear guidelines on the role of suptech in supervisory processes.

[26] The messages on common suptech strategy are worth bearing in mind, from di Castri, et al (2019) and Broeders and Prenio (2018).

References

Badat, F, D Garcia Ocampo and J Yong (2021): "Redefining insurance supervision for the new normal", *FSI Briefs*, no 13, April.

Broeders, D and J Prenio (2018): "Innovative technology in financial supervision (suptech) – the experience of early users", *FSI Insights on policy implementation*, no 9, July.

Coelho, R, M De Simoni and J Prenio (2019): "Suptech applications for anti-money laundering", *FSI Insights on policy implementation*, no 18, August.

Crisanto, J, K Kienecker, J Prenio and E Tan (2020): "From data reporting to data-sharing: how far can suptech and other innovations challenge the status quo of regulatory reporting?", *FSI Insights on policy implementation*, no 29, December.

di Castri, S, S Hohl, A Kulenkampff and J Prenio (2019): "The suptech generations", *FSI Insights on policy implementation*, no 19, October.

Eirea, S, M Oroz and C Díez (2021): "Adapting the supervision of credit institutions to the Covid-19 crisis", *Bank of Spain Financial Stability Review*, issue 40.

European Central Bank (ECB) (2020): *ECB Annual Report on supervisory activities 2020*.

Financial Stability Board (FSB) (2020): *The Use of Supervisory and Regulatory Technology by Authorities and Regulated Institutions: Market developments and financial stability implications*, October.

McWilliams, J (2020): "From principles to practice: improving and modernising bank supervision", remarks given at the Federal Reserve Board conference on "Bank supervision: past, present and future", December.

Annex 1: List of authorities that responded to the survey

Country	Authority
Australia	Australian Prudential Regulatory Authority (APRA)
Austria	Central Bank of the Republic of Austria (OeNB)
Belgium	National Bank of Belgium (NBB)
Brazil	Central Bank of Brazil (BCB)
Denmark	Danmarks Nationalbank (DK)
Euro area	European Central Bank (ECB)
Germany	Deutsche Bundesbank (DB)
Greece	Bank of Greece (BoG)
Guernsey	Guernsey Financial Services Commission (GFSC)
Hong Kong SAR	Hong Kong Monetary Authority (HKMA)
Hong Kong SAR	Securities & Futures Commission of Hong Kong (SFCHK)
Italy	Bank of Italy (BdI)
Malaysia	Central Bank of Malaysia (BNM)
Mexico	Bank of Mexico (Banxico)
Netherlands	Netherlands Bank (DNB)
Qatar	Qatar Financial Centre Regulatory Authority (QFCRA)
Singapore	Monetary Authority of Singapore (MAS)
Spain	Bank of Spain (BdE)
Switzerland	Swiss Financial Market Authority (FINMA)
Thailand	Bank of Thailand (BoT)
United States	Federal Reserve System (FRS)

Source: FSI survey of central banks and supervisory authorities.

Annex 2: Suptech use cases

The following 11 use cases reflect the individual experiences of each identified authority.

Box 1

Bank of Thailand (BoT) board minutes analyser and Bank of Italy (BdI) corporate governance analysis

Tool classification: Text analysis (with sentiment analysis for the BdI tool)

Tool description: The BoT and BdI each use AI/ML to analyse board meeting minutes of financial institutions, with some interesting similarities and differences in their respective approaches.

Supervisory use and deployment: One key goal of both tools is to reduce the amount of time that examiners spend reading a large volume of board minutes, freeing up time to focus on emerging risks in much greater depth. Both tools develop a structured framework for analysing unstructured data, quantifying variables such as participation level and participation "mode" (BoT), or the number and topic of interventions (BdI).

- BoT tool: The tool was initially conceptualised to assist supervisors in their review of culture and behaviour of bank boards. To help inform such assessments, the tool analysed board minutes encompassing a three-year span (2016–18) at 19 Thai banks to assess: (i) the topics covered at each meeting; (ii) time spent per topic; and (iii) board member contributions at each meeting, by quantifying the number of enquiries, reports, comments and requests for action by board members. The tool measured board contributions individually as well as by subgroups, such as executive, non-executive and independent non-executive directors. The tool has allowed construction of key risk appetite and risk management indicators, including the level of board engagement. An ongoing challenge has been finding the right balance between text mining and expert judgment. Wider deployment of the tools is also a challenge because of the technical skills required to run it.
- BdI tool: Board and committee minutes are structured in a data set, with sentiment analysis then applied in order to gauge whether individual directors are intervening positively or negatively. The tool is expected to support off-site supervision of banking and other entities.

Status: Operational for the BoT tool. Experimental for the BdI tool, with results from a feasibility study expected at a later date.

Who developed? Internally developed. Both tools were created internally as collaborations between supervisors and IT/data analytics experts.

Box 2

Federal Reserve System (FRS) NLP-LEX

Tool classification: Text analysis and text summarisation

Tool description: The FRS has operationalised an NLP tool called Language Extraction (LEX) that applies AI/ML techniques to analyse documents from multiple repositories. LEX automates risk annotation of documents, allowing for text analysis, document summarisation and analytics on a much broader and deeper scale.

Supervisory use and deployment: LEX cuts by 50% the time spent reviewing larger document submissions. The amount of time FRS supervisors have spent searching for information has been steadily creeping up over the last several years, including for enforcement actions. LEX is designed to allow examiners to spend more time analysing information and less time searching for information. The tool has been particularly good at finding "unknown unknowns", discovering many sentences that may have been missed by examiners, including via the summarisation tool, which has become increasingly effective at capturing the essence of a document or part of a document.

LEX is now used across the entire FRS, with 15 use cases and counting. LEX has been repositioned as a platform upon which all FRS supervisors can develop as many tailored use cases as needed. Key use cases include: (i) climate change (started in summer 2020 to monitor discussions in board packages); (ii) cloud adoption; (iii) board effectiveness; (iv) consumer compliance (review of quarterly enforcement action updates as well as annual firm assessments in hundreds of business lines); and (v) cyber risk (identifying trends in ransomware and other cyber discussions). Specific LEX use cases have been set up since March 2020 to allow for off-site monitoring and supervision. For example, the Covid use case was set up within just one week to enable effective monitoring of Covid chatter in response to the remote working setup.

Status: Operational

Who developed? Internally developed. Internal resources have been used at every stage, including data scientists, software developers and line supervisors. It was decided not to use external resources because of the confidential nature of the supervisory information and inflexibility of the vendor products.

Box 3

Guernsey Financial Services Commission (GFSC) classification and identification of documents

Tool classification: Information classification

Tool description: The GFSC is experimenting with NLP to classify and identify documents with material issues of supervisory concern.

Supervisory use and deployment: The tool aims to reduce supervisory effort by flagging only those documents with issues deemed material for manual review. It also seeks to improve the likelihood of identifying material issues.

Supervisors within the investment division are expected to use the tool on an ongoing basis. The goal is that the tool will aid ongoing offsite supervision, particularly for smaller firms, including thematic work via the tagging and reviewing of electronic documents submitted by firms, as well as the identification of patterns in matters of material concern. This tool may also be combined with work in the development pipeline, such as risk identification within a network of associated entities, combined with an analysis of other complementary data.

Status: Experimental

Who developed? Internally developed, with supervisors identifying the use case

Box 4

Qatar Financial Centre Regulatory Authority (QFCRA) tweet sentiment

Tool classification: Sentiment analysis

Tool description: The QFCRA is developing a tweet sentiment tool which detects tweets both directly relevant to supervised firms or those that reflect their operating environment (eg developments in the hydrocarbon sector (eg petroleum, natural gas) or in the regional or global economy).

Supervisory use and deployment: This tool seeks to enable supervisors to see and classify by topics all relevant tweets associated with their supervised firms. The objective is for supervisors to start each day with an idea of where the sentiment surrounding their firms is moving, and thus obtain early signals of potential supervisory issues.

This tool aligns closely with the goal of the Qatar 2030 Strategic Plan for Financial Sector Regulation, which is to achieve continuous, real-time monitoring of supervised entities and not depend on periodic data. This strategic push is benefiting greatly from the Qatari government's contract with Microsoft for all public IT infrastructure needs, which includes substantial resources in sentiment analysis as well as other AI/ML tools and cloud storage.

All supervisors will have access to this tool once it enters production.

Status: In development

Who developed? Internally developed by Supervision's Data Science Team

Box 5

Central Bank of Brazil (BCB) ADAM

Tool classification: Risk identification

Tool description: The BCB is using ADAM to examine the entire credit portfolio of a supervised firm and identify credit exposures with inadequately recognised expected loss (EL).

Supervisory use and deployment: The BCB requires banks to classify credit exposures based on their EL ranges. ADAM identifies credit exposures with high ELs (ie 50-100%) but that banks incorrectly classified.

ADAM has impressive scale and results in a huge time gain. It can analyse 3 million exposures to customers in just 24 hours, while a team of 10 experienced inspectors would take 30 years to do the same. ADAM was first used by non-banking supervision teams and then increasingly used for banking supervision. Now all inspectors have access to it and can continuously enhance it.

ADAM was initially trained using data from credit portfolio analyses by inspectors in 2015 (and also some in 2013 and 2014). Training data are regularly updated with field inspection data.

Status: Operational

Who developed? Internally developed

Box 6

Bank of Spain (BdE) relation inference graphs

Tool classification: Network analysis

Tool description: The BdE is using relation inference graphs to spot both formal and informal relationships that may exist between different entities (eg borrowers), making it easier to evaluate risk impact.

Supervisory use and deployment: In a credit file review, this tool enhances risk evaluation by identifying formal relationships between borrowers based on financial statement data and less formal connections that would be difficult or impossible for supervisors to find manually. These less formal connections can be inferred using data such as entities' shared collateral, company names, geographic location and other information found in the BdE's credit risk register. The main objective is to evaluate the interconnections between different borrowers and assess how the failure of one could potentially affect the lending bank.

The tool is accessible to all inspectors. Remote work has accelerated adoption as it has proven to be very useful during off-site inspections.

Status: Operational

Who developed? Internally developed

Box 7

Central Bank of the Republic of Austria (OeNB) BODT and Swiss Financial Market Authority (FINMA) peer group determination

Tool classification: Peer group identification

Tool description: The OeNB and FINMA are each developing tools that aim to identify peer groups of similar banks based on key variables. For the OeNB Bank Outlier Detection Tool (BODT), these variables can include riskiness, business model and counterparty portfolio. BODT builds on reporting data from the OeNB and the ECB's Single Supervisory Mechanism, using both established and relatively new methodologies, such as principal component analysis, k-means, spectral clustering, random forest and t-distributed stochastic neighbour embedding.

Supervisory use and deployment: For both the OeNB and FINMA, the identification of peer groups improves the quality of supervision by gaining a deeper understanding of similarities between entities. FINMA mentions how this process can challenge the existing rules-based peer group system. The OeNB states that identifying similarities which had so far gone unnoticed can improve consistency, with supervisors then treating similar banks in a similar fashion, which in turn can limit reputational and legal risks for the authority.

Status: Experimental for the FINMA tool. In development for the OeNB tool. The OeNB plans to extend team size and composition after the proof-of-concept phase is complete to include more off-site supervisors.

Who developed? Internally developed. Both tools are being developed internally as collaborations between supervisors and IT/data scientists.

Box 8

Central Bank of Brazil (BCB) EVE

Tool classification: Automation of inspections

Tool description: The BCB uses this tool to conduct automated end-to-end inspections without human interference. In particular, the tool automates the creation of working papers (ie internal reports containing all supervisory analyses) and the drafting of communications to firms.

Supervisory use and deployment: EVE seeks to automate supervisory processes that do not require subjective opinions. Simulations showed that the tool can do the job 200 times faster than inspection teams. It was piloted in 2020 by supervisors in charge of fintech firms, but since then has been made available to other supervisors.

The BCB is currently testing the tool in the supervision of six areas: governance, risk/capital management, treasury, credit, other assets and liabilities, and economic/financial condition. Early indications suggest that while supervision of some areas may be easy to automate (eg credit), others may not be as straightforward (eg governance).

Status: Operational

Who developed? Internally developed

Box 9

European Central Bank (ECB) OSICredit application

Tool classification: Automation of inspections

Tool description: The OSICredit application provides end-to-end support to credit inspections, including on- and off-site credit file reviews.

Supervisory use and deployment: The tool simplifies inspectors' work by processing structured inspection data on credit risk exposures, creating credit file review templates, implementing methodologies for statistical and judgmental sampling and aggregating inspection results. The tool therefore helps achieve consistency in the implementation of complex on-site methodologies. It has also been heavily used for off-site inspections during remote work.

The tool is available to inspectors as a standalone laptop application. An online solution is being assessed.

Status: Operational

Who Developed? Externally developed in collaboration with ECB and national supervisors

Box 10

Monetary Authority of Singapore (MAS) data analytics for inspections

Tool classification: Automation of inspections

Tool description: MAS is developing tools to automate the data analysis process so that inspectors can analyse entire data sets instead of only relying on sampling. Inspectors will be able to focus on statistical outliers, enhancing their ability to identify specific transactions of greater concern.

Supervisory use and deployment: These tools aim to automate the process of reviewing voluminous quantitative data from supervised firms. There are various use cases. For prudential supervision, MAS is automating the process of reviewing creditworthiness of a bank's borrowers to assess the quality of the bank's credit underwriting, risk management and provisioning frameworks and processes. Without the tool, an inspector typically selects a sample of borrowers to review, which could take from half a day to three days depending on the experience of the inspector. This tool enables a much faster review of all and not just a sample of borrowers.

A prototype has been developed to support capital market supervisors in reviewing firms' trade allocations and prices. It is being tested on trading data from several fund managers. Concurrently, the tool for creditworthiness review is being piloted with a bank.

Status: In development

Who developed? Internally developed

Box 11

Central Bank of Malaysia (BNM) Supervisory Letter Writing Aid

Tool classification: Automation of inspections

Tool description: BNM's Supervisory Letter Writing Aid is helping to automate a key part of communication. This tool provides assistance in supervisory letter preparation, powered by NLP/ML.

Supervisory use and deployment: The goal is to reduce the time required to write a supervisory letter. The Writing Aid analyses the tone used and provides sentence suggestions, based on historical written correspondence. The tool also continually learns the more it is used, ensuring more consistency in letters over time. It is among a suite of tools upon which BNM has increasingly relied during remote supervision for continuous monitoring and assessment of firms.

Status: Operational

Who developed? Internally developed among BNM technologists, data scientists and supervisors