CENTRAL BANKING
FOCUS REPORT

MACHINE-EXECUTABLE REGULATION
How artificial intelligence can offer efficiency gains

INTERVIEW
Kenneth Lamar

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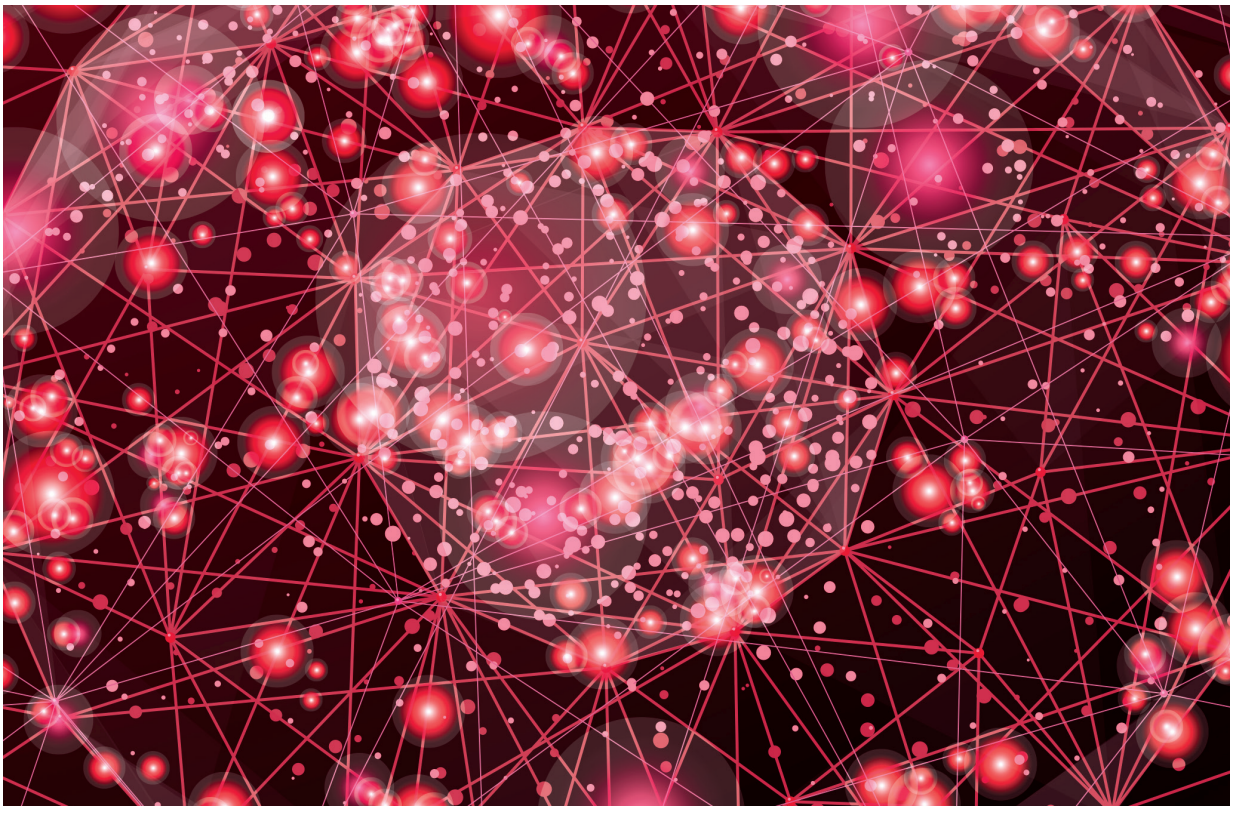
Experts discuss new risk-based assessment techniques

Risk-based supervision



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There is continuous debate within the financial world around the volume of regulation: market players want less of it, while everybody else demands more. Since the financial crisis, the majority has won out.

The regulatory burden placed upon banks and financial institutions has never been greater. This is not just a result of the sheer amount of new regulation, but also its scope. With the introduction of the revised Markets in Financial Instruments Directive (Mifid II) and Basel III, regulation has had both a multi-geographical and multidomain impact.

More regulation has resulted in a deluge of data, which financial firms, supervisors and regulators alike are struggling to handle and utilise. A new debate has thus emerged: are banks and regulators equipped to process this data to ensure a sounder financial system?

This focus report aims to offer assistance to financial regulators and supervisors in understanding the challenges that come hand in hand with evolution in the regulatory and supervisory environment. It explores how technology can assist in making assessments of the main risks supervisors need to devote their efforts to guard against..

The report examines the role artificial intelligence could play in the regulatory sphere, introducing the idea of machine-executable regulation. An interview with former Federal Reserve official Kenneth Lamar, an expert in the field of regulatory reporting, reveals the challenges faced by banks around their data capabilities; while a forum of panellists discusses whether technology can aid banks and regulators in making the most of data.

Central banks and other supervisors are only just beginning to realise the transformative impact technology could have on the industry. Technology solutions have the potential to reduce compliance costs, standardise and automate regulatory reporting, and close the gap between regulatory expectation and interpretation.

There is much work to do and we hope this report will provide some guidance on issues that are only just beginning to be discussed. ❑

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Artificial intelligence: The future of regulation?

The raft of new rules imposed on regulated financial institutions in the aftermath of the global financial crisis has a huge compliance cost. Could artificial intelligence offer efficiency gains? By Rachael King.

In November 2017, the UK Financial Conduct Authority (FCA) and the Bank of England (BoE) held a two-week 'TechSprint', bringing together members of the financial services industry to examine how technology could be used to make the current system of regulatory reporting more efficient.

The results may prove to be ground-breaking. Participants managed to successfully develop a proof of concept (PoC),[1] which embedded regulation into an algorithm – instead of the current set-up in which regulators issue rules that firms take months to interpret, before then requiring further time to adjust and adapt their systems to conform.

According to Andrew Burt, chief privacy officer at data management firm Immuta, the results from the PoC suggest regulatory changes could be implemented immediately, while financial institutions could demonstrate compliance faster and more cost-efficiently, easing the compliance burden on regulators and financial services organisations alike.

The TechSprint has made possible "a future in which regulations are directly embedded into software", Burt says.

In the PoC, the FCA was able to take a regulatory requirement from its handbook and translate it into a language a machine could understand. Using this language, other machines were then able to execute the regulatory requirement, "effectively pulling the required information directly from the firm", says Nick Cook, head of regulatory technology and advanced analytics at the FCA.

While the possibility of machine-readable and machine-executable regulatory reporting was proved using only a small subset of reporting rules within the FCA's handbook, Cook believes – in theory – the concept could be expanded to all regulatory reporting requirements in the future.

Regulatory clampdown

The BoE's chief economist, Andrew Haldane, estimates the cost of the global financial crisis at somewhere between $60 trillion and $200 trillion.[2] It is therefore unsurprising that governments asked regulators to firm up rules and prosecute institutions found guilty of breaching existing regulations. Some of the world's largest banks – including Bank of America Merrill Lynch, BNP Paribas, HSBC, JP Morgan and UBS – were hit with large fines. In the US alone, financial

institutions have spent more than $160 billion on fines for non-compliance.

Since 2009, large swaths of new regulation have been introduced in an attempt to make the financial system more resilient. The number of rule changes global financial institutions must adhere to on a daily basis has trebled since 2001 to an average of almost 200 revisions a day, according to Thomson Reuters.

John Byrne, chief executive of regulatory technology – or 'regtech' – firm Corlytics, believes the figures may even be slightly higher. "Firms receive around 220 regulatory notices daily. That's 50,000 a year. Now imagine that each one of those notices are around 100 pages long – that's five million pages a year firms have to read and decipher," he says.

David Hardoon, Monetary Authority of Singapore

Not only has the volume of regulation increased, its nature and scope has also changed. The second Markets in Financial Instruments Directive, the Foreign Account Tax Compliance Act and the General Data Protection Regulation all have an impact on multiple geographies and domains, presenting an additional challenge for regulated institutions.

Some institutions have significantly increased the number of compliance professionals they employ. Data from HSBC shows the UK bank increased its compliance head count from 1,750 to 7,000 between 2007 and 2016. And HSBC is not the exception; the overall cost of compliance is estimated at up to $1 billion a year for a major bank.

Martyn Evans, chief of consulting at Altus Consulting, says one in four financial institutions globally spend 5% of their net income implementing regulatory change. "This is not the answer to achieving compliance in the long term – it's not sustainable," he says.

In total, the global cost of regulatory compliance is estimated to be around $80 billion and could reach $120 billion in the next five years, according to Thomson Reuters. And while some believe the peak of new regulatory requirements brought in post-crisis will soon tail off, others suggest it could become the norm.

"The change has indeed been the increase in the sheer volume of regulations in terms of both frequency and granularity," says David Hardoon, chief data officer at the Monetary Authority of Singapore. "However, recent focus has been on data quality, machine readability and automation."

A different approach

Technology already offers part of the answer to the greater regulatory burden – as it already does for many other processes in banking. But these technology services do not yet help financial institutions cope with the constant influx of new regulation.

"Technology will be the most significant factor in delivering compliance in the long term, but the current solutions only solve specific issues," Evans says. In other words, he highlights that regulatory reporting is still a strain for many. In the UK, the FCA demands firms under its jurisdiction send reports based on specifications in the handbook and legislation applicable to the European Union.

Reporting institutions can often find it difficult to meet these obligations; it

requires significant effort to navigate and interpret regulation and there is often a need to rely on external professional services providers to understand what information the regulator needs and when.

Firms then implement and codify these interpretations into their in-house regulatory reporting systems. Each firm does this manually, which creates the risk of different interpretations and inconsistent reporting.

"Whichever way you look at it, there are currently a lot of inefficient processes that try to close the gap between what the handbooks are trying to achieve and what is actually reported," says PJ Di Giammarino, chief executive of regulatory analysis firm JWG.

Market solutions

A number of regtech firms have attempted to make these processes simpler.

Speaking at an event in London in February this year, Mark Holmes, chief executive of tech firm Waymark, explained how artificial intelligence (AI) can be integrated into existing systems to scan and dissect the reams of regulation sent to firms daily.

"AI can help connect firms to relevant information, and can aggregate data to then break regulation down into a universal language," he said. Waymark's solution applies a natural-language processing system that sits within a firm's current system and parses through the regulation documents, effectively translating them into a marked-up HTML file.

Firms are then able to discern which parts of the regulation are applicable to them and send it to the right part of the business to be implemented in whichever way it sees fit.

New start-up Covi Analytics offers a similar solution with its product Cmile. Like Waymark, Cmile dissects the information within regulatory documents and extracts the relevant sections based on a customer's specific requirements.

The information is then compiled onto a dashboard and colour-coded to allow financial institutions to see whether a piece of regulation has been enacted by the relevant department.

The software can also provide industry benchmark information to highlight to financial institutions where they rank among their peers in terms of compliance. However, chief executive of Covi Analytics Waleed Sarwaar says this is heavily dependent on more institutions using the software to get an accurate reading.

Intelligent regulation

One firm, however, has gone a step further and taken the tech to the regulator.

In September 2017, the FCA became the first regulator to publish an intelligent regulatory handbook. The handbook, which is used by thousands of regulated financial institutions and their advisers daily, is more than 20,000 pages long and contains binding regulatory obligations and guidance for firms. Partnering with Corlytics, the FCA sought to "democratise the handbook", making it more accessible. In doing so, it hoped to transform the handbook from a legal document to a fully searchable database.

"We put a metadata structure – much like that used by Google – in place, transforming the handbook from a comprehensive legal index to a highly accessible tool for all users," Corlytics' Byrne explains.

The software essentially tags words and phrases with a central taxonomy,[3] making it machine-readable; 3,000 metadata tags were added to the original text.

"The teams have gone to different sections of the handbook and machine-

learnt them. Then, using a combination of regulatory lawyers and data scientists, they have auto-tagged the rest of the handbook," Corlytics said in a statement at the time.

A similar approach is used in certain sectors of the medical profession – most notably in cancer research. By analysing the text, using machine-learning analytics, oncology research has made great strides in the diagnosis of certain forms of cancer. In one approach, a machine is 'trained' using a dataset of sample images of tumours that have been classified by a physician. The computer uses the classification information to develop its own pattern-recognition criteria with which to identify tumour types.

"At Corlytics, we have moved into the same building as a lot of specialist medical data scientists to better understand what they do. Using trained models, we are able to teach them how to understand and interpret the data," Byrne explains.

John Byrne, Corlytics

"To best do this you need subject experts who can program and understand analytics, working alongside data scientists," he adds. "Lawyers – in our case – who can code; we have swapped the oncologists with regulatory lawyers. Their training makes for consistent and accurate analytics."

Corlytics' solution is the first step towards standardised regulation, an initiative that, if devised on a global scale, could exponentially reduce the regulatory burden.

According to Hardoon, for standardised regulation to be implemented, the industry would require a common understanding of data – a centralised data taxonomy and data model could be one option to achieve this.

"Standardised data would facilitate smoother data collection and sharing, and reduce regulatory reporting burdens. It would also improve overall standards of governance and analysis," Hardoon says.

However, he also notes there would need to be some form of flexibility to allow for individual firms' specific circumstances and interpretations. "Industry-wide data standards and taxonomies may be most effective when developed though joint industry efforts and collaborations," Hardoon says.

Machine execution

While machines can now read digitised regulatory documents, will it be possible in the future for new regulations to be implemented automatically?

Chief executive of TrackMyRisk, Matt Hodges-Long, believes this is extremely likely. "For this to happen, firms need to have their regulated processes mapped as data so the impact of the regulatory change and the response could be automated," he says.

The FCA's latest TechSprint revealed that some regulation already lends itself to being implemented by a machine, but the current structure of most regulation makes it difficult for the information to be translated. "Regulation tends to be principle-based, but firms want to be told what to do and how to adhere to the regulation," Cmile's Sarwaar says.

As a result, for regulation to be machine-executable there needs to be a change in how it is written and constructed. "For machine-executable regulation to be a reality, we need to start disambiguating parts of the regulation – we need more uniformity," says Byrne. "Instead of lawyers being the only people involved in

Nick Cook, Financial Conduct Authority

drafting rules, it needs to be done by a broader cohort, so a greater degree of precision can be established.

"We need to go back to understanding how regulation is formed, why it is formed and who the users are."

Having worked with the FCA, Byrne believes it will take a number of years before entire regulatory handbooks become machine-executable. In the meantime, he suggests regulators begin examining which aspects of regulation can be automated.

"We are a very long way from achieving this [machine-executable regulation] right now, but the FCA's work indicates a direction of travel as the costs and complexity of regulatory compliance are unsustainable for some," says Hodges-Long.

Hardoon agrees that machine-executable regulation will be in place within the next 10 years, but stressed not all regulation would lend itself to be structured in such a way. Machine-executable regulation will only be implementable in cases where it is "clear, unambiguous and quantitative in nature", he says. For example, there are already automated limits in place for trading to curb excessive volatility.

"Some features that are required for machine-executable regulation to be implemented include the use of accurate and timely data," Hardoon says. "The data must have well-established data lineage for accountability and traceability."

However, even in these instances, Hardoon says the fundamental difficulty for any form of regulation will be the identification and assessment of its intention, which he believes computers will not be able to discern.

Intelligent architecture

While the race towards machine-executable regulation is well on its way, there is still a long way to go, with some financial technology firms calling for regulation and compliance enforcement to keep pace with the speed of innovation.

There are signs, however, that other regulators are moving ahead aggressively in this area. A number of regulators in the US, including the newly formed Consumer Financial Protection Bureau and the Federal Communications Commission (FCC) are converting their regulations into digital format. For the FCC, this has simply involved transforming its PDF regulation into an XML format, opening up the possibility for the document to be read by a machine. As Byrne says: "The next phase will be to implement an intelligent architecture."

"We envisage that the future of regulation is one that will undoubtedly include consumption of significant amounts of data, leverage on automation and the exploration of AI and machine learning," Hardoon says. ❑

Notes

1. Financial Conduct Authority, November 2017, *Model driven machine executable regulatory reporting TechSprint*, https://bit.ly/2Ku5j7s
2. Andrew Haldane, March 2010, *The $100 Billion Question*, https://bit.ly/2raQej2
3. Financial Conduct Authority, *FCA Handbook: PRIN 1.1 Application and purpose*, https://bit.ly/2rbWUgR

Reducing the regulatory burden

Former Federal Reserve Bank of New York senior vice-president Kenneth Lamar discusses risk-based reporting, its challenges and how fintech could help relieve firms from regulatory pressure.

How has the approach to risk-based reporting/supervision changed since the financial crisis?

Kenneth Lamar: The true transformational change that has occurred in supervisory data is the level of granularity and complexity of the data demanded from firms, particularly the largest ones. It has signalled a move away from thinking about financial institutions in broad categories, and the size of the files now received by regulators and the actual number of transactions they look at has increased significantly. This allows the regulators to think in terms of systemic risk and the risk profile of individual firms.

Prior to the financial crisis, a lot of the information collected – particularly around risk – was dependent on the individual institution's own management information system. The change in reporting has standardised this approach. Creating clear data definitions allows regulators to compare firms across the sector and develop meaningful aggregations.

Has the shift to a more risk-sensitive approach to supervision changed firms' approach to reporting?

Kenneth Lamar: The change has meant firms are having to manage their data across the organisation on a global level, which has resulted in a better understanding of the regulatory expectations around data qualities and data definitions.

For example, in capital planning, how much time did a retail credit card business line spend focusing on the data needs for regulatory capital? Now, a great deal of attention is given to the data in all material business lines and the data impact on regulatory capital. This has initiated a culture shift where data no longer just belongs in the realm of corporate finance; it is no longer a back-office process. Firms have to start thinking about their data practices strategically, and they have a long way to go.

Has this move to 'box-ticking' helped or hindered regulators in understanding markets and risk?

Kenneth Lamar: It has absolutely helped regulators understand markets and risks. It has allowed them to focus and cut the data any way they want, depending on what is going on in the market locally and globally. It has also helped bring a

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discipline to viewing how risk is managed. A key challenge for regulators in using a data-driven approach is the risk associated with data quality. How do regulators know the data being supplied to them by firms is correct? If you are data-dependent, an assessment of data quality and data limitations must be available.

Granular products and transactional data give regulators a view of the firm in detail that did not previously exist. Regulators can now manipulate and integrate data to understand the financial position and risk of a firm, market or sector. But if the data being supplied is not of a high quality, has material inaccuracies or is incomplete, then regulators' analyses and actions are at risk. This is one of the greatest risks every central banker or regulator faces. The growth and complexity of data makes this a very real challenge for regulators.

How do the regulators ensure the quality of the data it receives is correct and up to standard?

Kenneth Lamar: There are a couple of different ways to validate data quality. One of the most effective is through on-site validation programmes where regulators go into firms and test the quality of their data. Firms can also use their internal and external audit functions to prove the quality of their data to regulators and that associated controls are where they should be. Regulators can also ensure data quality is an institutional imperative by ensuring accountability from principal officers; for example, chief financial officers, chief revenue officers and senior directors can attest to the data quality and controls when submitting data.

Regulatory authorities have also become very specific about their expectations from firms in terms of data quality. They have considered how to validate the data they receive in a disciplined way. With the emergence of innovative financial technology – referred to as 'fintech' – some are now asking how technology can be used for quality assurance.

How should firms go about disseminating and aggregating the data required for this new way of regulatory reporting?

Kenneth Lamar: It is really important for financial firms to foster a firm-wide culture whereby everybody is accountable in the data-gathering process. Usually, the corporate finance department is responsible for actually aggregating the data and then providing it to the regulators. But to have high-quality data, firms must ensure each department is accountable for the data the department owns. The best way to do this is to enforce strong accountability policies.

The corporate finance department should act as a defence, but should not be the only party held accountable if the data is incorrect. It should be responsible for checking the data, validating the data and going back to the business lines if there are anomalies. Internal audit is the final point of control available for firms as the third line of defence.

From an aggregation standpoint, both the corporate finance and internal audit departments should develop programmes to help the other departments disseminate what regulators require from them – the expectations and the impact. One of the key activities to ensure data quality is end-to-end transaction testing. Done correctly, transaction testing validates the controls around the data from the point it is onboarded to the point it is delivered to a regulator. So if something is wrong with the quality of the data, it can be inferred that something is failing in the controls. The testing uncovers the root cause of these problems.

Kenneth Lamar, Former Senior Vice-President,
Federal Reserve Bank of New York

Kenneth Lamar is the former senior vice-president, head of the statistic function and senior adviser to the director of research at the Federal Reserve Bank of New York, where he was responsible for most of the New York Fed's data collection systems and data quality programmes. He has also held a number of leadership positions within the Federal Reserve System supporting the design of data collections, associated quality assurance programmes and the implementation of data collection programmes. He is the founder and principal partner at Lamar Associates and works as an independent senior adviser at the Deloitte Centre for Regulatory Strategies. Lamar is also a member of the AxiomSL advisory board.

Do firms have the resources and capabilities to manage the data required of them?

Kenneth Lamar: They are working on it. I think we are at a point where firms are starting to understand the data circulating within their organisations. However, much of this data is redundant and, due to a lack of standardisation, remains in business lines' subsystems. So one of the things firms should do is standardise data across the organisation. After this, reporting processes will become far easier. The next step would be for them to start looking at whether data can be organised or tagged in an automated fashion.

Currently, many firms take a siloed approach to data management. Business lines believe the data belongs to them and when the regulator asks for information they will give them what they can. Instead, firms should be looking at how to leverage the data across the entire organisation. A culture shift must occur for this to happen – not a regulatory change. Firms need to realise that their data is an asset, and once used can help businesses not only meet regulatory expectations but manage risk more effectively.

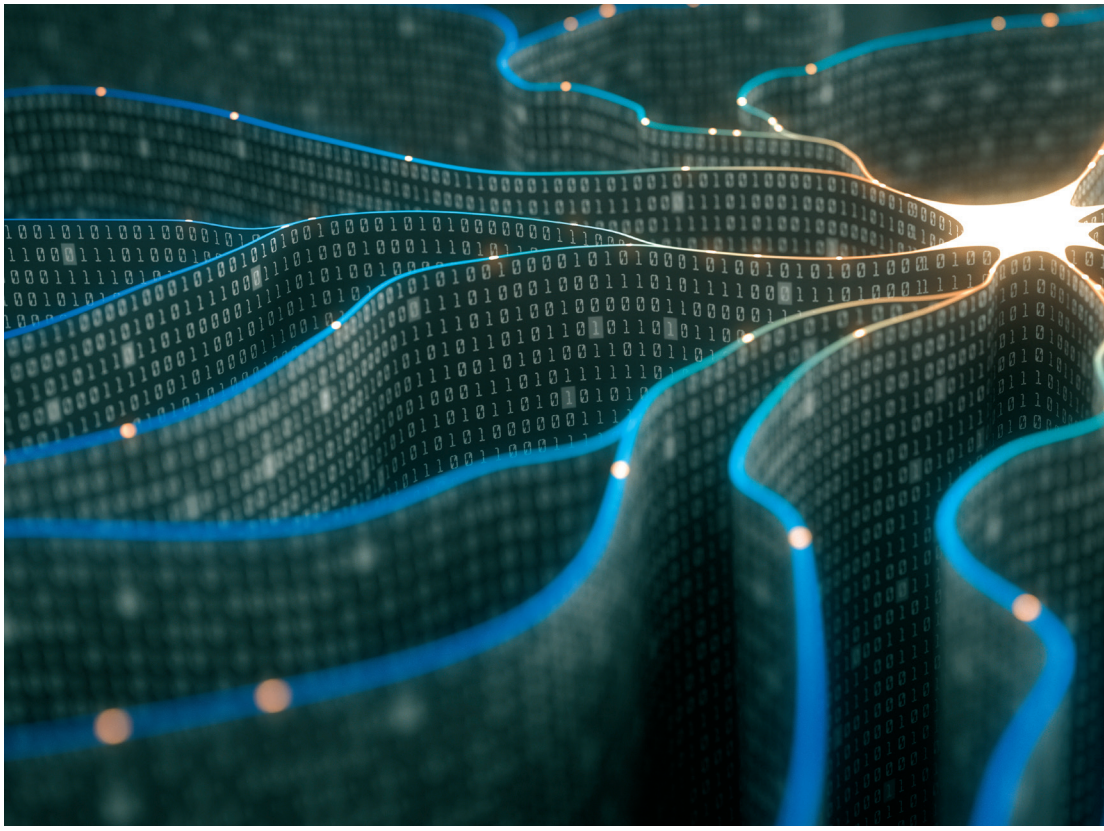
Is the solution to the ever-growing data burden more of the same – standardised regulation?

Kenneth Lamar: That is absolutely one of the keys to reducing the burden. Treating products, transactions and reference data equally across data collection not only reduces the reporting burden and costs, but increases data quality. Not all regulation lends itself to standardisation – sometimes there needs to be nuance for the benefit of the data. When this occurs, the nuances should be explicitly stated.

How do firms validate data? And can fintech solutions aid this process?

Kenneth Lamar: I think it is important for regulators and firms to first standardise their data. Fintech and regulatory technology – known as 'regtech' – are solutions that can help this process, from helping to build data management tools to data tagging.

One of the challenges in this space is managing and implementing strategic solutions that have long runways, at the same time as conducting business as usual. Firms still have to file – on a quarterly, daily or weekly basis – tactical



solutions while moving forward on strategic investments. Regtech can help streamline and increase efficiencies in current processes, such as in the use of robotics in the report creation process.

But firms also have to think about the long-term strategic solution. What is their future data platform going to look like and how can the firm migrate to it? Some have made a start in this direction, but the pace at which technology evolves means a solution for problems arising out of a long-term project quickly becomes outdated. So the real challenge is dividing the project up in a way that is achievable.

The UK's Financial Conduct Authority is working to create machine-readable regulation, with the notion it could be machine-executed in the future. Do you think this is a possibility?

Kenneth Lamar: Yes, I think it is. Regulation has become so complex and there is so much of it: there are compliance rules, capital rules, liquidity rules, supervisory demands, and so on. If regulation were to become machine-readable and then machine-executable, firms could react to regulatory demands quickly, accurately and with fewer costs.

But, for this to happen, building up the relevant expertise is really important. You need to have people who understand the data and who can build a system that will understand it to the same extent and be able to meet the firm's needs. But firms do not always invest – whether financially or in manpower – if it is not certain whether it will result in a positive impact to the bottom line. If it can be proved that the investment will have a direct impact on the firm's profitability,

senior management is far more likely to sign off on it.

How should central banks use their regulatory data to maximum effect?

Kenneth Lamar: They must be very transparent. There is a lot of pressure on central bankers and regulators to publish aggregated results of regulatory data. Data users want that data very much – not just firms and academics, but the public and the media too. So, it is really important for them to be able to publish what they can without putting a firm at risk by disclosing its priority information.

They need to continue to educate the public and firms on how regulatory data is being used, how it is being viewed and why it is important. For example, when individual country crises occur, data users will often analyse publicly available data on country risk, drawing conclusions about the size of exposure to a country that may differ from what the firm disclosed in its public financial statements. So it is really important for regulators to explain how data is used and what it represents, and it is just as crucial to explain what it is not.

When looking at data, what sort of analytical techniques should central banks use to get the most out of it?

Kenneth Lamar: First, data operations – people who ensure data is accurate, and attempt to understand the raw datasets that come in from firms. This type of person looks to employ tools that could process the data quickly, discover outliers and perform some comparative analysis. Second is how regulators use that data to either assess risk or include data in supervisory models. In these cases, tools that can handle the large volume of data that is now available are required.

How can central banks and other financial supervisors find a balance between judgement and data-driven risk assessment?

Kenneth Lamar: It is all about the people; you need really good people who understand the data and the outcomes you are seeking. Individuals such as these are hard to find because they need to understand why the data was created, what it measures and what it all means in terms of risk to the organisation. Finding these people – who can build, design and collate data and then make judgements – is the key challenge for firms. Firms that do not seek out this expertise, and take a more formalistic approach when making judgements, tend to find themselves in trouble. ❑

The move to risk-based supervision

Rapid regulatory change has led to a steep increase in data volumes and policies, and a new environment has opened up for discussions on effective regulatory supervision and a transition to risk-based supervision.

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In the past decade, financial firms have faced tremendous change and so have the regulators overseeing them. Traditionally, supervisors have performed their prudential supervisory role by way of compliance-based supervision, but the tougher rules enforced to ensure banks can remain safe and sound following the global financial crisis have led to new challenges for regulators.

While supervised entities are expected to comply with prudential rules, and regulators continue to ensure that the regulated entities comply with them, the way the latter is undertaken is changing. Previously commonplace methods have been deemed outdated, following the pressure regulators have been under to introduce stricter policies to improve oversight, and the new rule-heavy environment has led to regulators signalling a need to avoid a 'one-size-fits-all' approach to supervision and risk assessments.

As regulators have continued to face a data overload following the financial crisis and the introduction of new reporting requirements, the multidimensional approach to supervising regulated entities has become more difficult to maintain without regulators significantly increasing head count. In other words, the traditional way of dividing resources equally between regulated entities is losing momentum because it is no longer necessarily an optimal way to safeguard the financial system.

Justin McCarthy, chairman of the global board at the Professional Risk Managers' International Association (PRMIA), explains that, in the past, "regulators may have spread their resources, including staff, evenly across many regulated entities", but "we have realised that allocating them in a risk-driven manner is a more effective way to do this". While the old way of splitting resources between regulated entities may still work for some, in most jurisdictions it is no longer seen as the most effective way to supervise the financial market because the size and reach of different entities will modify the risk they pose to the financial markets.

Following increased regulatory focus on mitigating systemic risk, regulators have needed to rethink their approach, and the result has been a transition to risk-based supervision. For regulators, the significant benefit of a move to a risk-

based solution is improved efficiency, as they can better allocate resources, and more economies are realising that taking a risk-based approach is the best way to protect the market. "It has been well adopted in developed economies," says McCarthy, who was involved in the adoption of risk-based supervision by the Irish Financial Regulator at the Central Bank of Ireland following recommendations from the European Central Bank.

Tackling systemic risk

Risk-based supervision requires regulators to assess the risk of individual entities and, by collating the resulting view of these entities, they can judge the systemic risk to the wider economy. McCarthy explains that, instead of giving every single bank a fair lookover, regulators are now asking: "Where are the risks in our economies?" To protect investors and mitigate systemic risk in the market, regulators taking a risk-based approach can spend more time supervising entities that pose increased risk. By adopting this approach, regulators can allocate their limited resources to the entities with the greatest risk and focus on the areas within these entities deemed to be high risk.

An important concept within risk-based supervision is the difference between the probability of an adverse event at a supervised entity and the impact that this event may have on the wider economy. Despite the probability of a large firm failing being minimal, the focus for the regulator may need to be on allocating resources to supervising that entity if the collapse of that firm could have a severe impact on the wider economy.

This approach also means there needs to be an acceptance that some smaller entities may have fewer resources allocated to their supervision because their collapse would have a limited impact on the wider economy. It may even be that some of these firms fail from time to time, but that too needs to be accepted when the impact of their failure on the wider economy is minimal. McCarthy explains that if, for example, a regulator only has a small team looking at a thousand foreign exchange shops, one of the thousand may fail and someone may lose a small amount of money, but this outcome could be overseen by the ombudsman.

Taking the leap

For many regulators, the move to a risk-based approach will represent a significant change, with staff being asked to supervise in a new way and the regulator having to implement new risk assessment software. Initially, a regulator would need to rely on the data and tools to assess risk, rather than judgement, and a combination of expertise, data and technology will create a recipe for success. "When they're bringing in a risk-based approach, they have to appreciate it will take time to build the resources and skills needed," says Joanne Horgan, chief innovation officer, Vizor Software.

The first step will be to encourage staff engagement, and PRMIA's McCarthy says informing staff about the new way of supervising, and explaining that their organisation will be doing things differently going forward, will be key. Supervisory staff will need to be educated in where risk lies and how to report those risks to their managers.

In addition, regulators will need the appropriate tools to succeed with risk-based supervision, including the software and data required to assess risks of individual entities. With modern technology, regulators can collate and consolidate data, set key risk indicators (KRIs) and identify inherent risks.

A prerequisite for generating the greatest value from risk systems will be getting the data right, and regulators moving to risk-based supervision may also have to address data challenges to improve its consistency, reliability and integrity. Traditionally, regulators may have used paper reviews and stored data in disparate systems, creating potential for duplication and errors. Manual and paper-intensive processes can compromise data quality, and to improve efficiencies and succeed with a risk-based approach it is essential for firms to combine data in a single system and enhance automation. Horgan emphasises the importance of ensuring supervisors are making decisions based on data that is up to date and centralised to provide a holistic view of risk.

Bringing data sources together in a single system also means firms benefit from enhanced access to data, which can be used to produce early-warning reports. With Vizor Risk-Based Supervision, for example, regulators have online access to up-to-date KRIs that might inform early supervisory interventions. "Timeliness is really important. You're not going to do a full risk assessment every week," says Horgan, who explains that timely access to information offers regulators the opportunity to react quickly to a market event and re-evaluate a group of firms on a particular focus area – cyber security, for example.

In fact, the aim of risk-based supervision is to deliver a control system that enables regulators to identify risks early enough to notify regulated entities before it is too late to act. For regulators to succeed with this, the system in place must offer flexibility and opportunities to make any necessary changes. Although data can be collated and analysed within a system, there is also a need for human decision-making at some stage in the process, and the system needs to handle both a data-based approach and a judgement-based approach. "You have to have a system that allows you to react," says Horgan, who stresses the importance of a risk-based approach allowing regulators to be proactive: "There could be something happening outside an established data approach that a supervisor needs to override."

Setting KRIs

When making technology decisions, another important factor will be KRIs, and a system's ability to both automatically calculate KRIs and combine them with other insights. KRIs are one of the tools that will help regulators assess the risk each supervised entity poses to the wider economy. Thus, establishing and setting up appropriate KRIs can help turn data into a powerful tool.

As part of a risk-based approach, regulators need to come up with key ratios or use out-of-the-box KRIs. Vizor Risk-Based Supervision, for example, offers out-of-the-box KRIs per sector that are auto-calculated quarterly or annually. The KRIs are populated with data that a supervisor partly acquires during regular prudential returns, such as quarterly results. "The key to successful implementation of risk-based supervision is agreeing or acquiring a useful set of KRIs that can be easily assembled using data from sources such as prudential returns," says McCarthy, who explains that it is a source of great frustration for compliance teams when regulators make *ad hoc* data requests instead of reusing data from prudential returns where possible: "If a jurisdiction is perceived to have a more expensive cost of compliance, then this may give a financial entity some concerns about being regulated in that jurisdiction."

In addition to making better use of the financial data collected, there has also been a shift to looking at other elements of the supervised entities, and super-

vision has expanded into considering business plans and overall viability of a supervised entity. Vizor's Horgan says there is now other data that regulators need to collect and, in addition to the business plan, this could be information on cyber security or the performance of the board of directors. Individual risks such as credit, market and operational risk may be well managed and mitigated in an entity, but the additional information could help regulators assess whether the overall business model is sustainable. "An entity may be able to show they are complying with the prudential rules set by the supervisor, but the supervisor would now also look at whether the way they are doing business is putting consumers at risk," explains McCarthy.

To perform an overall risk assessment, regulators also need to take on-site and off-site assessments into account. Data from these assessments needs to be integrated with other data sources, and regulators approach assessments very differently. Some may choose to use a questionnaire as part of an on-site assessment, and the value of the entries could then be entered into the system and contribute to the risk score. In other cases, assessments will be judgement-based, but the observations will still be valuable for the overall risk score, and regulators need systems to be flexible enough to allow for a mix of judgement and data in risk assessment.

With advances in data management and technology, regulators can also analyse the risk scores by comparing entities to peers and looking at specific sectors of the financial markets to manage emerging systemic risk across the wider economy. Making comparisons means regulators can take a consistent approach to supervision across a sector and reduce the possibility of criticism once risks are identified and being mitigated.

The next steps on the journey to risk-based supervision will now be continuing to leverage new technology to boost efficiency. "A machine can come up with the same response as humans, and we need to get better at delegating to computers," says McCarthy. Technology such as machine learning can play an important role in enhancing supervision of smaller regulated entities, which may be allocated fewer resources under a risk-based approach.

Although machine-learning algorithms are not new, there are now clear opportunities for regulators to leverage machine learning to obtain an overview of risks associated with the regulated entities whose collapse would not have a severe impact on the wider economy. The data on these entities is still collected, and leveraging technology to analyse the data means regulators can gain a market-wide view of risk. According to Horgan, regulators can also use historical data and algorithms to allow a machine to assess where certain behaviours have led to a problem in the past and thus anticipate risks in a certain sector. "We definitely see opportunities with machine learning based on published results from trials by the UK Financial Conduct Authority and the Bank of England, among others," she says.

As the evolution to risk-based supervision continues, demand will grow for flexible systems that can be tailored to cater for the different needs of regulators, using a mix of data-driven and judgement-based approaches. The wave of regulatory change in recent years has strengthened the case for regulators to leverage technology that can allow for increased flexibility and reduced time to action. In the current market, innovative technology, training of supervisors and complete and timely data are all stepping stones on the road to promoting stability in the financial system. ❑

New risks and opportunities

Central Banking convened a panel of experts to discuss how central banks and other authorities are making use of new risk-based assessment techniques to remain ahead of the fintech curve.

The Panel

Joanne Horgan
Chief Innovation Officer, Vizor Software

Justin McCarthy
Chairman of the Global Board, Professional Risk Managers' International Association

Rabi Mishra
Chief General Manager, Reserve Bank of India

Moderator: Dan Hinge
News Editor, Central Banking Publications

Rapid developments in financial technology – commonly referred to as 'fintech' – have enhanced the need for high-quality risk-based supervision as threats evolve and move to new areas of the financial system. Greater quantities of data present not only new opportunities for detecting and responding to risks, but also challenges.

Among the topics under discussion are the best methods and practices for collecting and combining qualitative and quantitative data, why central banks and financial regulators should invest in advanced regulatory and supervisory technology, how that technology can aid co-operation between regulators and the regulated, and the application of expert judgement in setting an overall risk score of regulated entities. The panel also addresses issues around increased amounts of data, how central banks and other authorities are making use of new risk-based assessment techniques to stay ahead of the curve and offers insight to those looking to harness risk reporting to better protect financial stability.

From left: Dan Hinge, Justin McCarthy, Joanne Horgan

How do you define risk-based supervision, and how does it differ from other forms of supervision?

Justin McCarthy, Professional Risk Managers' International Association: Traditionally, regulators would have taken much more of a compliance-driven approach – supervisory staff in regulatory bodies would go in with a set of rules, they would compare the firm to these rules and measure an organisation against them. Often there would be no consideration of the larger systemic risk to the economy from different organisations. Also, this approach would only look at individual organisations, do its supervision and present its findings. The risk-based supervision approach takes a view that certain firms – if they were to experience an unfortunate event such as a collapse – would do a particular level of damage to the national economy. With risk-based supervision, regulators can allocate limited resources to where there are larger risks in the economy.

Can you describe your experience with risk-based supervision in India?

Rabi Mishra, Reserve Bank of India (RBI): Since the global financial crisis, there has been a significant shift towards a risk-based framework; however, since 2012 the 'Camels' approach – whereby a firm's capital adequacy, asset quality, management, earnings, liquidity and sensitivity are assessed – has been replaced with an elaborate risk-based approach to supervision. The Camels approach essentially uses a backward-looking methodology and transaction-testing model. It also has the drawback of being a 'one-size-fits-all' approach, and is behind the curve when it comes to keeping pace with industry as it is seen to be static in nature. Moreover, in the compliance-based Camels approach, individual risks are examined in isolation, whereas in a risk-based framework it is the interaction between risks that are observed.

There are two main objectives in India for risk-based supervision. The first is ensuring the soundness of the individual banks, thereby protecting the interests of depositors. The interest of the depositors is the priority, and the second objective is to safeguard the stability of the financial system. The risk-based approach to supervision aims to achieve these objectives via a process of proactive assessment of the measured risks. The critical difference is that, under a risk-based approach, a more organised structure is in place to identify and quantify the activities of the

bank that carry greater risk, and also to assess the risk management practices and controls in place to mitigate the risk.

How has risk-based supervision developed in recent years?

Justin McCarthy: Since the financial crisis, an understanding has been reached that we have to do things differently, that something failed in how we were supervising entities. Too often, a supervisory team would go into an entity and someone would look at the credit risk, someone would look at the market risk and then someone at operational risk, but no one was standing back and asking: 'Is this a viable business model? Is this an organisation that can continue to function in future years?' A big part of it has been saying that we now have different kinds of risk in the organisation.

In what ways does risk-based supervision require a balance between a judgement-based approach and a data-driven one?

Joanne Horgan, Vizor: I think you need both. Having data come in a timely manner directly from the firm with the assurance that it has been quality-checked is really important, but you also need to have that wider view and be able to see the interaction of those different risks. This is about the probability of failure and its impact across a lot of different risk categories. Collecting the data is essential but, equally, so is having a system where the supervisor can exercise judgement based on the key risk indicators (KRIs). This ideal system combines the data-driven approach producing automatic calculations with key indicators being flagged to the supervisor, and then a system where judgement can be exercised and recorded.

According to our poll, about 70% of people are actively using risk-based supervision and another 20% or so are planning to use it in the future – only about 12% say they are not yet using it.

Justin McCarthy: That is interesting because this is an approach that has been increasingly adopted over the past few years, so one might have expected the take-up to be closer to 100%. A big part of the risk-based supervision project I undertook in Ireland was organisational change. Technology is a huge enabler, but a major aspect is going into an organisation and telling them how we are going to carry out our supervision from now on.

Joanne Horgan: Technology is a really important factor in this as it is an enabler of risk-based supervision. It's not the entire solution – but its does provide a solid foundation for a change in approach. You need the team to establish the goals and long-term direction, and then the technology needs to be able to adapt as the approach becomes more embedded. When an organisation is starting with the risk-based supervision approach, it often needs an existing framework to work with, and there are some common themes in terms of risk categories and KRIs that you might derive from; but each jurisdiction will have a particular way it wants to approach the overall risk framework, and you need technology that is capable of changing with that over time.

Rabi Mishra: One of the key ingredients in a risk-based supervision framework is technological data mining analysis. Risk-based supervision is critically dependent

Joanne Horgan, Chief Innovation Officer, Vizor
Joanne Horgan has designed and delivered regulatory solutions for some of the world's top financial regulators, working with more than 20 central banks and financial regulators worldwide. Having joined Vizor in 2003, Horgan progressed through a variety of roles and was appointed to the board of directors in 2012. Between 2013 and 2017, she took on the role of chief operating officer and now leads the product management and innovation teams in Dublin.

on the robustness and the authenticity of data provided by regulated entities. Banks need to be encouraged to remain on board in the tasks of developing IT systems with similar wavelength to the supervisor, so that the online data transmission from each of the banks to bring them onto a single centralised platform at the supervisor's end is smoothened. For example, in India there is a central repository of information on the large credits that collects, stores and disseminates data on all the borrowers' stressed credit exposures. The purpose of such a mechanism is to improve transparency of credit information, which in turn enables banks to identify the borrower's financial status to help recognise and resolve asset quality problems.

Is there such a thing as too much data?

Justin McCarthy: It's wonderful to gather huge amounts of data, and there is a comfort in having as much data as you are able to. The challenge, however, lies in finding ways to use it. I worked at a senior level in a large bank last year – we were receiving requests from our regulators for vast amounts of data. You're left wondering if they are using it all and, frustratingly, different departments of the regulator will request it at different times. There is an onus on the regulator to show the regulated entities that this data is actually being used.

Joanne Horgan: Where you have a regulator that perhaps has an advanced analytics system in place, with a very clear stream of data coming from the regulated entities and going into an analytics system, it's wonderful. We sometimes find that it may take a while to get to that point, so a regulator may want to start more simply if you're introducing risk-based supervision. It's really about collecting the data that's important, in a timely manner, making sure it's quality-checked and then ensuring it is usable downstream with the right context and quality indicators.

How realistic is it to expect banks to do more to upgrade their IT systems to make it easier for data sharing?

Justin McCarthy: One of the biggest problems in banking at the moment is a cost challenge – as banks have to hold more capital, they're encouraged to take less risk, and I know from banking clients there is a huge challenge to get any kind of budget size involved. The flipside is if someone said: 'We will reduce the cost of regulation if you put in place the systems as it will allow us to gather data easier.'

Joanne Horgan: I think there is a challenge to show that the cost of an IT spend is going to be paid back in some way. IT, and technology in general, definitely has the potential to reduce the cost of compliance, but there is an onus on regulators and banks to work more closely together and with the wider fintech or regulatory technology – known as 'regtech' – communities to really look at how these IT investments are going to generate a return. There is a challenge on both sides to work together to ensure any IT spend is justified and is delivering real business value.

Joanne Horgan

How is data, for stress testing in particular, different? How can regulators and supervisors ensure that it is accurate?

Justin McCarthy: It's a subset of the same problem because you would hope the data you get is valid and correct. They have probably spent a huge amount of time gathering all that data from different systems within the organisation. One of the problems with stress testing is that it becomes quite public and political when the results are published.

Extensible Business Reporting Language (XBRL) is something we are hearing quite a lot about. How far has it spread, and is it the 'gold standard' in data collection?

Joanne Horgan: XBRL has been around for quite some time, and is used extensively in Europe and Asia. It is a very good format for data collection, but is not the only format. This goes back to some of the concerns from the industry about a format being mandated, which may be expensive to implement at regulated entities. The benefit of collecting the data in a standardised format, as in Europe, is that it enables the national competent authorities to send the data to the European supervisory authorities to undertake comparisons and analytics. It's about making sure the structure suits the type of data you want to collect. For a risk-based approach, there is a significant amount of structured or quantitative data to collect to derive ratios or KRIs, but there are also going to be unstructured pieces of information and qualitative feedback that need to be captured, for example, when analysing the business model of an entity.

What formats does the RBI use, and how does the bank organise that data?

Rabi Mishra: We have developed a compendium of data point definitions to aid the standardisation of information flow across banks. The RBI has made significant progress in accessing information directly from transaction-level data. The change in data collection and compilation has predominantly occurred in two areas: (1) the standardisation of inputs, and (2) minimising manual intervention and data transformation in banks. This technology and risk-based supervision are risk- and bank-specific. Systemically important banks attract more supervisory

Justin McCarthy, Chairman of the Global Board, Professional Risk Managers' International Association (PRMIA)
Justin McCarthy has held roles at firms that include Bank of America Merrill Lynch, Ulster Bank, EMC, PwC and the Irish Financial Regulator at the Central Bank of Ireland. His work on the Probability Risk and Impact System risk-based supervision framework with the Financial Regulator included exposure to banking, funds and insurance risk practices, as well as quantitative work on related impact models. McCarthy is chair of the global board of directors of PRMIA, works as a strategy, governance, risk and compliance consultant, and is a lecturer and trainer. He has a BSc from University College Cork and an MBA from the Michael Smurfit Graduate School of Business at University College Dublin.

attention, and so require more of this type of technological investment. Also, we are working widely in the area of fraud, taking steps to prevent hacking and cyber-related risk while simultaneously creating an infrastructure on banks' information flow to the central bank and supervisors.

What can smaller central banks do to keep pace with this technological challenge?

Joanne Horgan: It's a very good point that Dr Mishra makes – some of these advancements have been employed in the RBI, such as looking at transaction-level data and making more of a direct data flow between banks and the central bank. For some smaller central banks, that might seem light years away, but it's not – it's happening today in smaller jurisdictions. Just because some central banks may not have the capabilities today to collect XBRL or acquire this type of transactional data does not mean they cannot implement an effective risk-based supervision approach and technology system. It is important to begin leveraging technology – if it's Excel for now, start using Excel, but start to standardise templates, put rules on the data, get it into a centralised supervisory system and look to move into more standardised XML or XBRL and more automated systems over time. It is important for smaller central banks to know there is technology already available that does not have huge implementation costs and timelines.

We've spoken a lot about the quantitative data so far, but what is the best way of combining qualitative and quantitative data?

Justin McCarthy: Qualitative data is interesting because you might have large numbers of notes, board meetings and minutes being brought in. Traditionally, you would require somebody to attend board and committee meetings, and meet with the audit committee – and that's very resource-intensive. We can take that approach and then have somebody perhaps assess the data and write something relatively unstructured into your supervision system.

Joanne Horgan: Technology has to be able to collect both structured and comparatively unstructured data. It is very important to make sure all of the qualitative data that comes from the firm is combined in one database, but also to look at how to use new technologies for the future. When you are talking about judgement, you need somebody that has a lot of experience because they have to

understand what all the different sources of information they might have are based on. There is huge potential for technology to assist here, even with a judgement-based approach. If technology can handle the quantitative data component, this frees up the specialist resource required to look at the qualitative data. Over time, machine learning will also become more frequently deployed in these scenarios.

Justin McCarthy

Has the price of technological investment reduced sufficiently, and are there tools available to allow smaller supervisors to implement machine leaning and other big data techniques?

Joanne Horgan: It's still quite early. There are tools being added continually and there is published evidence of trial concepts coming from different regulators. The time it takes to implement and the cost of investment in technology are still quite high, but they are coming down. And the more engagement that regulators have with the fintech and regtech communities, the more we're going to see that speed up.

We're in a digital age now; it no longer takes three to five years for these changes to happen – they are happening very quickly now. There are a couple of examples of real-use cases in the regulatory space, but I think machine learning is still quite limited to the bigger regulators with more budget for experimentation. It's just important that the technologies will become more commoditised and more accessible over time.

What can supervisors do to be more forward-looking? How can we move ahead and look at emerging risks?

Justin McCarthy: That depends on your horizon for emerging risk, because some of the early-warning systems might be saying we have a bubble emerging in a certain part of the economy. Cyber is something we are hearing more about, and you're left wondering how you can get a structure in place for your supervisory staff so they can perform an adequate review of something that is an emerging risk. You may not have staff on hand that are experts, so how can you put in place a controlled assessment and review of data that can flag potential issues with cyber in your sector? And we may have to help identify where one of our banks will have to bring in outside expertise to work on it.

Joanne Horgan: Whatever IT system you have, it is really important that it is flexible enough to collect the data you want, whenever you want it. It is also important that you have enough data and skills internally, and can forecast based on trends in the data. Spotting emerging risks has to be based on more than just the data that you collect directly from regulated entities – for example, there is market sentiment analysis. Perhaps ensuring you have a system in place that can handle many different sources of data and has the capabilities to combine them and look at potential emerging risks provides the best basis to be forward-looking and future-proof.

Rabi Mishra, Chief General Manager, Reserve Bank of India (RBI)

Dr Rabi Mishra is a career central banker with professional expertise in on-site examination of banks, managing financial instability, macro-prudential policymaking and enterprise risk management of central banks. He currently heads the risk monitoring department at the RBI, India's central bank, as its chief general manager. With the expertise to combine people, ideas and logistics for optimum returns, Dr Mishra has had a successful hand in incubating new edifices and systems. He is a highly regarded economist with a doctorate in financial economics, completing postdoctoral research in financial economics at Harvard University.

Rabi Mishra: Our discussion on risk-based supervision is, by definition, forward-looking, and there are areas in which a forward-looking approach can use larger data availability: for stress testing; for bubble detection and as an early-warning mechanism; for financial fraud detection; and for assessing the creditworthiness of borrowers and the realisable value of the collateral promised with the loan.

According to our poll, in terms of the human element, top of the list of challenges faced by central banks, next to data, is resources and skills.

Rabi Mishra: Skills are an issue. The industry has been confronted with a tremendous requirement for skill, which has resulted in many turning to outsourcing – creating another of these interesting areas of outsourcing risk. I would summarise the future priority as being skill and ethics in manpower. Technology will come and go, but what remains is basic common sense and honest human beings. Without these, nothing will work.

Justin McCarthy: Use new technology, such as machine learning, to save resources, and some of the interactions discussed. I have seen examples of small projects that can turn data into judgement, so also try to do a small project – start with something small and make it work.

Joanne Horgan: It's a combination of technology and human judgement – we're not at that stage where we've got machines making decisions for us, but I do think that anyone introducing risk-based supervision should invest in technology that is future-proof. It needs to be able to acquire additional data over time while maintaining data quality and context information so that this larger pool of data can be used for more machine-assisted decisions in the future. ❑

This is a summary of the forum that was convened by Central Banking and moderated by Central Banking's news editor, Dan Hinge. The commentary and responses to this forum are personal and do not necessarily reflect the views and opinions of the panellists' respective organisations.

Watch the complete forum, Risk-based supervision: New risks and opportunities*, at www.centralbanking.com/3509531*