



## Algorithm Insights Risk and control considerations

August 2020

This document is intended to provide Senior Management with insights into algorithm risk management and to support further consideration of important aspects of their organisation's algorithm governance and control framework.

## Contents

Executive Summary	3
Algorithms in Your Organisation	4
Algorithm Utilisation	5
Algorithm Risk	6
The Regulatory Environment	7
Algorithm Governance	9
The Risk Management Framework	10
Conduct Risk and User Competency	12
Conclusions	13



# Executive Summary

Algorithms are becoming increasingly common in business processes throughout the financial services industry. The use of algorithms offers organisations a multitude of potential benefits, from increased productivity to improved customer experience, operational efficiency, and enhanced strategic planning. However, as an organisation's use of algorithms grows, the risks it faces from defective or biased algorithms grows in parallel and many of the benefits of algorithms use can be lost if the organisation does not develop its capacity to manage those risks effectively.

Regulators are also responding to the increased use of algorithms by creating new legislation aimed at ensuring that businesses have appropriate governance and control frameworks to manage algorithm risks effectively. Businesses will likely be required to have enhanced systems of control in place, if they are not already required to do so.

Against this backdrop, many organisations are taking a closer look at how they use algorithms in their business and the policies and procedures that they have in place around them. A good way to understand if your organisation is prepared to manage the risks inherent in its use of algorithms is to reflect on a few key questions about your algorithm risk management framework. We will present each of those questions in turn as we take you through our Algorithm Insights.

## A history of algorithm issues

### **Knight Shows How to Lose \$440 Million in 30 Minutes** **Bloomberg, August 2012**

"In the mother of all computer glitches, market-making firm Knight Capital Group lost \$440 million in 30 minutes on Aug. 1 when its trading software went, to use the technical term, kablooney."

The programme carried on executing orders for some time even after the firm knew it was malfunctioning. An investigation into the incident later revealed that the algorithm did not have a "kill switch", one of the most **basic controls**, which the firm could have used to shut it down quickly and save themselves the bulk of the losses.

### **Credit Suisse fined over algo failures** **Financial Times, January 2010**

"NYSE Euronext revealed on Wednesday it had for the first time fined a trading firm for failing to control its trading algorithms in a case that highlights the pitfalls of the rapid-fire electronic trading that has come to dominate many markets. "

The NYSE alleged that the firm had not managed the proprietary algorithm effectively and that it had also **failed to properly monitor the operation of the algorithm**, as evidenced by the fact that the firm was unaware of any issues until being notified of them by the NYSE.

### **How RBA's Easing Backfired in a Flash** **Crash for Aussie Bonds** **Bloomberg, March 2020**

"While the worst of the violent price moves were over in minutes, the impact is still reverberating. Low liquidity, algorithmic trading and a mismatch between investor expectations and the central bank's plan all played a role."

Market participants speculated that the selloff sparked by the RBA's announcement was **exacerbated by algorithmic trading activity**.

### **Apple's 'sexist' credit card investigated** **by US regulator** **BBC News, November 2019**

"A US financial regulator has opened an investigation into claims Apple's credit card offered different credit limits for men and women. It follows complaints - including from Apple's co-founder Steve Wozniak - that algorithms used to set limits might be inherently biased against women."

In a statement, the New York's Department of Financial Services (DFS) emphasised that **discrimination, even where it is unintentional, "violates New York law"**.

# Algorithms in Your Organisation

There is no industry agreed definition of an algorithm. The Oxford English Dictionary defines an algorithm as "a set of rules that must be followed when solving a particular problem". However, there are different types of algorithms and different terms are used to describe the characteristics of each. Therefore, a necessary first step in determining an organisation's approach to algorithm risk management is to define what the term "algorithm" means to it. Below are some key terms that stakeholders will want to be familiar with when deciding on their organisation's definition of an algorithm.

## 01 What is an algorithm?

- In essence, algorithms are automated routine processes or sequences of instructions for analysing data, solving problems, and performing tasks.
- Some legislation provides a technical definition of an algorithm for specific regulatory purposes, e.g. MiFID II defines algorithmic trading.
- Algorithms may use machine learning in order to improve performance, through exposure to data.

## 02 What is machine learning?

- Machine learning is a type of cognitive technology and is the science of teaching machines how to learn by themselves.
- The programs capture data from the environment and feed it to the machine learning model.
- In order for machine learning to be implemented, neural networks are used.

## 03 What is a neural network?

- A neural network is a computer model used for implementing machine learning and is comprised of a set of algorithms that are designed to mimic aspects of the human brain's structure and functions, such as recognising patterns.
- Deep learning is a complex type of machine learning that uses many layers of virtual neurons.

## 04 What is a cognitive technology?

- Cognitive technologies refer to the underlying technologies that enable Artificial Intelligence (AI). This includes machine learning.
- AI is the theory and development of computer systems that are able to perform tasks that normally require human intelligence.
- Other types of cognitive technologies include computer vision, natural language processing, pattern recognition and data mining.

### **Reflection points:**

***How has your organisation defined the term "algorithm"?***

***Does your organisation have an algorithm policy that governs how its algorithms are used and managed?***



# Algorithm Utilisation

Once an organisation has an agreed definition of an algorithm, it must then identify where such algorithms are deployed across the business, and it may be surprising to see the myriad of places where they can be found.

Algorithms have diversified roles affecting all aspects of society, from loan approvals, recruiting, and financial trading to search engines, product recommendations, and fraud detection. They can be found in almost every industry, from the public sector, to finance, manufacturing and social media.

Regardless of the industry, algorithms can be used across many businesses and functions, examples of which are set out below:

## Business Division

- Asset allocation
- Asset/deal pricing
- Trade execution

## Legal & Finance

- Contract generation
- Report generation

## Consumer Relationship

- Targeted marketing campaigns
- Monitoring social media for consumer insights
- Banking account application processes



## IT

- Cyber security
- System testing and maintenance

## Risk & Compliance

- Credit scoring
- Compliance monitoring
- Fraud detection

## Human Resources

- Workforce planning
- Resume screening
- Performance management
- Payroll

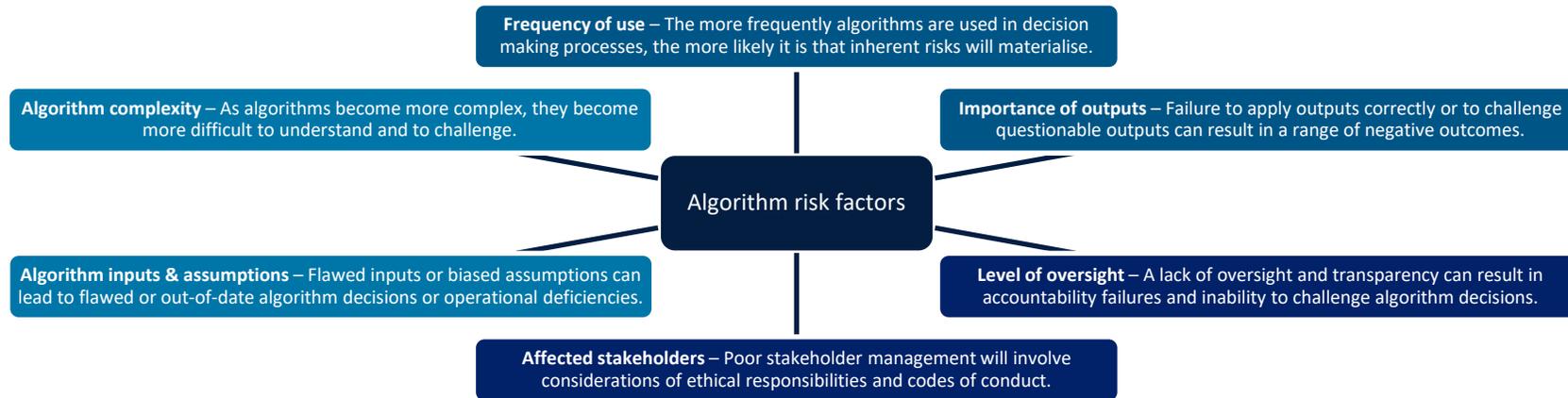
**Reflection point:**

***Have you considered where algorithms may be present in your organisation?***



# Algorithm Risk

It may be challenging for organisations to know exactly how their algorithms were developed and they may be using algorithms without having fully considered the risks that they bring. Risks are present across the development and design of algorithms, the inputs and training data used, the operation of the algorithm itself and as part of algorithm outputs and decisions made. We present below key risk factors which may increase the potential for risks to materialise:



Once identified algorithm risks can generally be grouped into the following key risk types:

- **Reputational risk** - The use of algorithms can create reputational risks if the organisation's stakeholders believe they are not aligned to the ethics and values of the organisation or if the algorithms are designed to covertly manipulate consumers, regulators, or employees.
- **Financial risk** - Flawed algorithms, especially those used for financial and strategic decision making, can result in significant revenue loss for organisations and negatively impact the integrity of their financial reporting.
- **Operational risk** - As algorithms are often used to automate operational areas, errors can result in significant operational disruptions.
- **Regulatory risk** - Algorithms making decisions that violate the law, circumvent existing rules and regulations, or discriminate against certain groups of people can expose organisations to regulatory and legal action.
- **Technology risk** - The wide-scale use of advanced algorithms can open up new points of vulnerability for IT infrastructure.
- **Strategic risk** - With algorithms being used increasingly as sources for strategic decision making, errors or vulnerabilities within them can put an organisation at a competitive disadvantage.

**Reflection point:**

*Have you considered the key algorithm risks that your organisation may be facing and the steps it should be taking to mitigate them?*

*Have you considered the potential impact of your organisation's algorithms functioning improperly?*



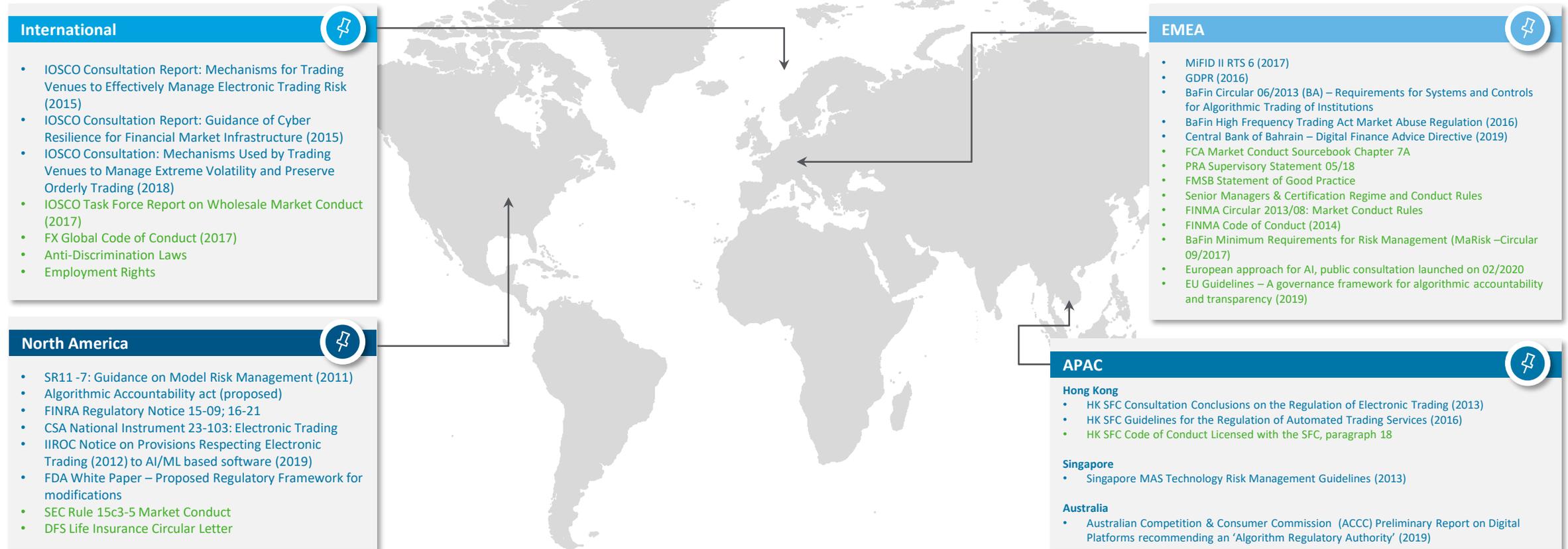
# The Regulatory Environment

**Color Code:**

Primary Applicable Regulations/Guidelines

Peripheral Regulations/Guidelines

Over the past years there has been a surge of regulatory activity in response to the significant increase in the use of algorithms in Financial Services. There is a growing consensus around the key requirements that should be placed on businesses and organisations need to be aware of what is/will be expected of them, both now and in the future. The diagram below illustrates some of the existing and proposed legislation and guidelines that may impact your organisation's use of algorithms:



# The Regulatory Environment (continued)

As shown on the previous page, lawmakers have already produced a significant amount of legislation which relates to the use of algorithms and it is important to understand its applicability to your organisation. We note several common risk and control themes running through these regulations. The table below illustrates key similarities across four major regulations/guidelines. Organisations can use this type of analysis when reviewing their risk management frameworks.

## Example regulation benchmarking

Aspect/Requirement of Regulation	MiFID II	GDPR	EU Guidelines on Algorithms	Accountability Act (proposed)
Algorithm Inventory	✓	✗	✗	✓
Periodic Self-Assessment	✓	✗	✓	✓
Right to Correct & Object	✗	✓	✗	✓
Stricter Controls over Personal Data Usage	✗	✓	✓	✓
Independent Third Party Audits	✗	✗	✓	✓
Algorithm Testing & Validation	✓	✗	✓	✓
Accountability Requirements	✓	✓	✓	✓
Algorithm Decision Audit Trail	✓	✗	✓	✓
Establishing a Governance Framework	✓	✓	✓	✓

## The potential impacts of algorithm regulation

While it is difficult to predict all of the effects of algorithm regulation under development, responses to early legislative proposals can provide insights into what a good algorithm risk management framework may look like. We anticipate that the greatest impacts of forthcoming regulation will be felt in six key areas:

- New Systems & Controls
- Algorithm Audits
- Testing & Validation
- Greater Scrutiny on Algorithm Development
- Demand for Algorithm Specialists
- Wider Public Awareness

Organisations that have not previously been within the scope of algorithm legislation may find it challenging to implement the necessary internal systems and controls. On the following pages, we present some key considerations for firms in terms of governance and risk management frameworks.

### Reflection point:

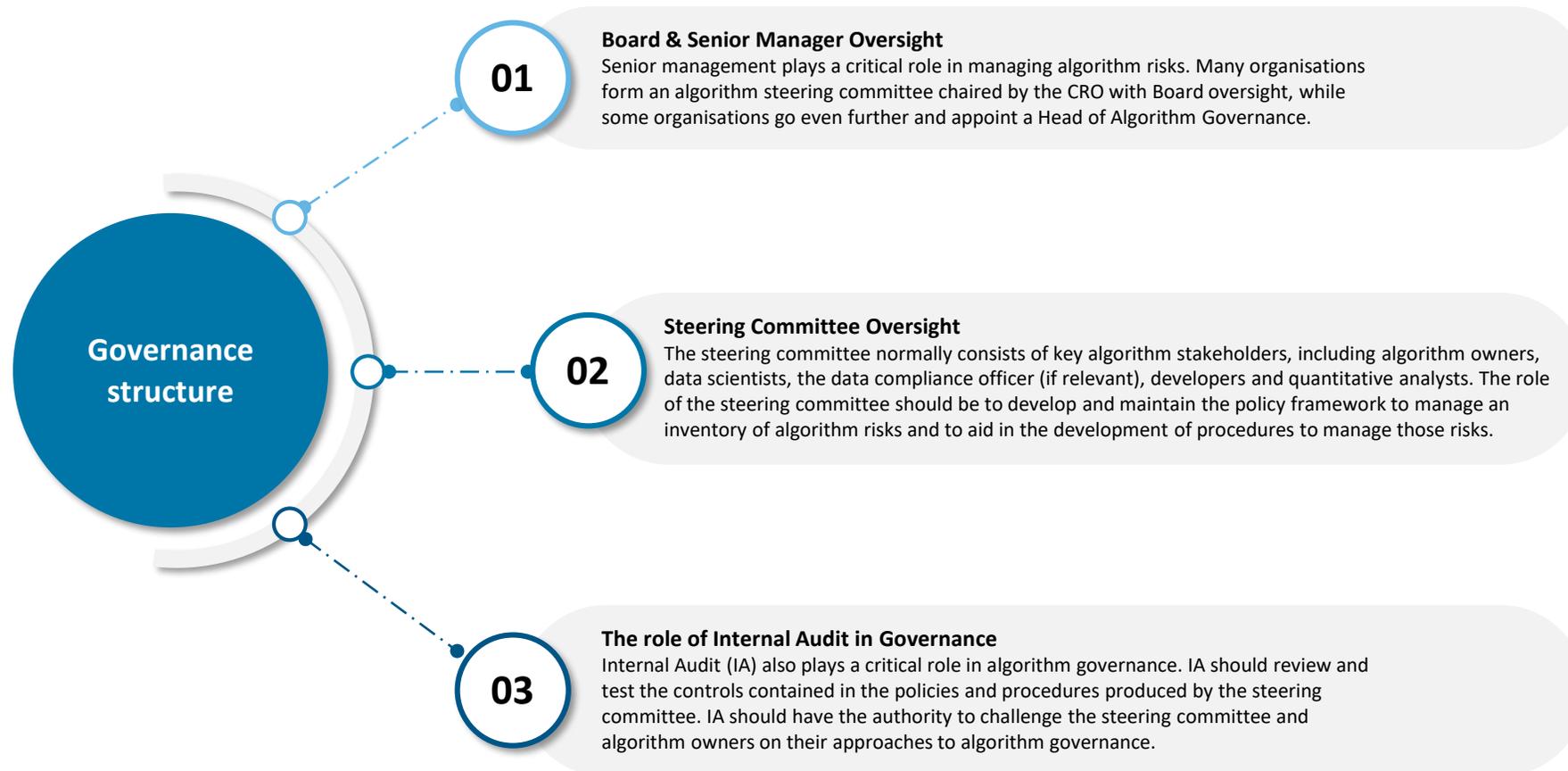
*Have you considered how the regulatory environment may impact the use of algorithms at your organisation?*

*What is your organisation doing to maintain its awareness of regulatory developments that may impact your use of algorithms?*



# Algorithm Governance

The presence of algorithm risks requires organisations to establish appropriate ways of mitigating them. Businesses should treat algorithm risk like they do any other key business risk, by setting up an appropriately tailored governance structure and risk management framework.



## **Reflection points:**

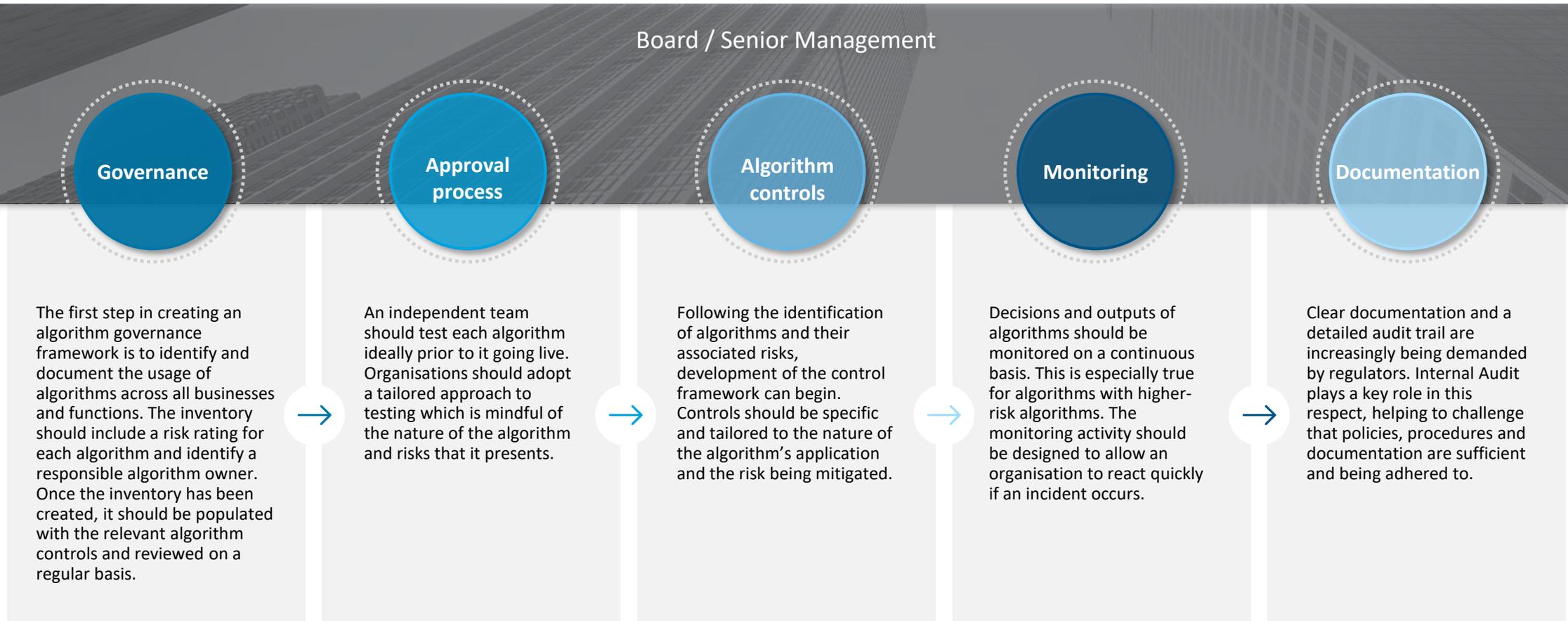
***Is the Board / Senior Management at your organisation sufficiently aware of the use of algorithms across the business?***

***Have you considered whether the governance structure in place for overseeing the use of algorithms at your organisation is adequate?***



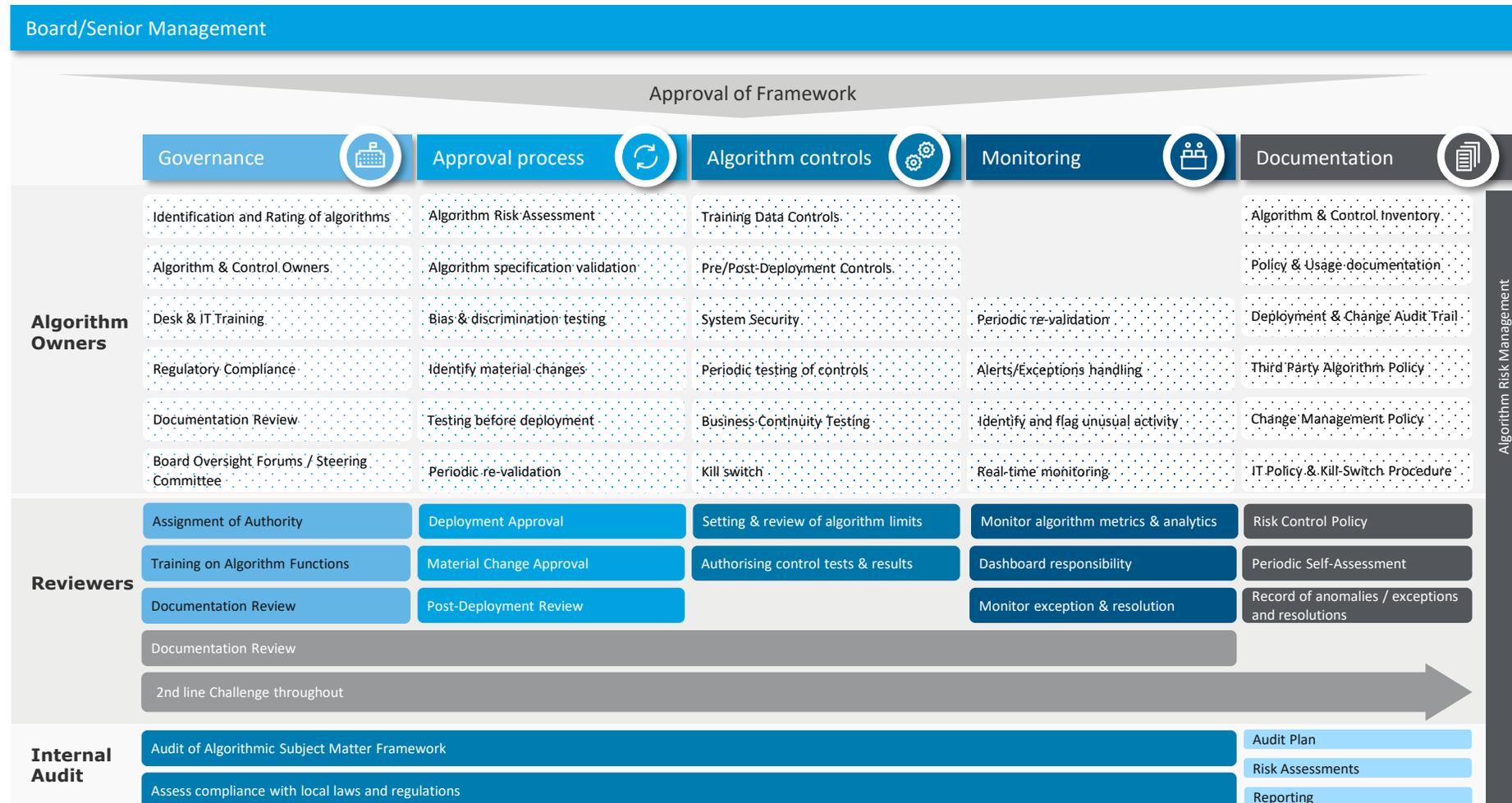
# The Algorithm Risk Management Framework

The replacement of human decision making with algorithmic decision making requires organisations to adapt their risk management framework. Our Algorithm Risk Management Framework (ARMF) on the following page can act as a guide for businesses looking to understand the sort of structures and controls that are required in respect of their algorithm use. The ARMF consists of the following elements:



# The Algorithm Risk Management Framework

Below is an example of a generic ARMF, which includes five pillars across three lines of defence. This framework can be considered against your organisation's requirements, depending on the scope, scale and nature of the algorithm risks present. We have used this approach successfully at many firms when considering the adequacy of their algorithm control framework in light of business and/or regulatory requirements.



## Reflection points:

*Do you have a cross-firm algorithm risk control framework and have you considered how your organisation could improve the robustness of this framework?*

*Does your organisation review and enhance its control framework as technologies and requirements evolve over time?*



# Conduct Risk and User Competency

In the financial services industry, two areas that are a particular focus of regulators are conduct and competency. Organisations need to ensure that their algorithms produce fair outcomes for their clients and that they have suitably skilled personnel in key positions across the organisation to use and manage their algorithms.

## Algorithm conduct risk

Many traditional sources of conduct risk are mitigated when direct human intervention is eliminated from the decision making process. However, conduct risk can remain embedded in the algorithm development process and throughout the algorithm lifecycle. Bias embedded during development is a common source of conduct risk that can be very difficult to eliminate.

Whether from poor design, out-of-date features or errors in implementation, algorithms can undermine objectives of:

- Treating customers fairly
- Supporting and protecting the integrity of the marketplace
- Promoting effective competition in the interests of consumers

Organisations need to consider how they can identify and mitigate conduct risk at each stage of the algorithm lifecycle.

## Required knowledge, skills and experience

Algorithm outputs are often not used in isolation but are part of wider processes that involves human oversight or intervention.

Users need to be trained to a sufficiently high level to be able to understand when an algorithm result should be used and when it should not.

If the user is not sufficiently trained, oversight is lost. This then magnifies existing algorithm risks rather than mitigating them.

Users also need to be able to challenge results where necessary – if a user thinks that an algorithm has delivered a questionable result, then they should have the power to effectively overrule the algorithm.

### **Reflection points:**

***Have you considered how algorithms may cause potential customer or market detriment?***

***Have you considered where you may need to build knowledge and understanding of algorithm risk and control at your organisation?***



# Conclusions

The increasing use of algorithms in business processes throughout the financial services industry means that organisations need to adapt their governance and control frameworks to manage the increasing risk. It is important that Senior Management challenge their business and functional leads on this topic.



The development of a robust algorithm risk management and control framework is a journey, but it's not a journey that your organisation needs to take alone: Deloitte is here to help with our experience and insights on the subject



Thank you for spending some time with us to explore our insights on algorithms and the risks that they may create in your organisation. If you would like to hear more about algorithm risk management or if you would like to consider further the risks that algorithms may be presenting in your organisation and the steps you are taking to control them, please contact:



**Mark Cankett**  
Partner

Tel: +44 (0) 207 007 5150  
Email: [mcankett@deloitte.co.uk](mailto:mcankett@deloitte.co.uk)

Mark is a Partner in our Banking & Capital Markets Group in London and the Global Lead for Algorithm Assurance for our firm. He has a broad experience across financial services audit, assurance/advisory, regulatory compliance, regulatory investigations and financial services disputes. Mark's experience has provided him with a strong understanding of algorithmic trading risk and control frameworks across the financial services industry.



**Steve Farrell**  
Partner

Tel: +44 (0) 207 303 7491  
Email: [stephenfarrell@deloitte.co.uk](mailto:stephenfarrell@deloitte.co.uk)

Stephen is a Partner in our Banking & Capital Markets Group in London and has a leadership role in the Firm's Algorithm Assurance engagements. He has extensive experience in financial services audit, internal audit, and regulatory projects. He has worked with a range of financial institutions, having developed a thorough technical understanding of electronic and algorithmic trading control practices, and has supported firms across the globe in the design and build of control frameworks to meet regulatory requirements and industry best practices.



**Barry Liddy**  
Director

Tel: +44 (0) 207 303 6430  
Email: [bliddy@deloitte.co.uk](mailto:bliddy@deloitte.co.uk)

Barry is a Director in our Banking & Capital Markets Group in London and has over 15 years experience spread across industry and financial services. Barry has lead several large projects specifically focused on enhancing our banking clients control frameworks. Barry is the Director of our Algorithm Assurance team, leading our dialogue with regulators in this topic, and is supporting a number of firms with their Self Assessment and Validation exercises.



**Roger Smith**  
Senior Manager

Tel: +44 (0) 207 303 0753  
Email: [rsmith@deloitte.co.uk](mailto:rsmith@deloitte.co.uk)

Roger is a Senior Manager in the Banking & Capital Markets Group in London and has experience in trading, remediation, and regulatory change. He has a deep understanding of algorithms and algorithmic trading, gained through over 20 years of experience at major financial institutions in the UK and in Europe. He has worked as a senior SME on algorithmic trading engagements and has developed a thorough knowledge of regulation and compliance in that area.



**Gaby Rodriguez Elesgaray**  
Senior Manager

Tel: +44 (0) 207 007 9888  
Email: [grodriguezdelesgaray@deloitte.co.uk](mailto:grodriguezdelesgaray@deloitte.co.uk)

Gaby is a Senior Manager in the Banking & Capital Markets Group in London and a member of our Algorithm Assurance team. She has extensive experience in assurance and remediation engagements with G-SIBs and brings to the team a strong understanding the evolving regulatory requirements in respect of algorithmic trading across MiFID II, the PRA Supervisory Statement, FCA Publication and FMSB Statement of Good Practice.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited ("DTTL"), its global network of member firms and their related entities. DTTL (also referred to as "Deloitte Global") and each of its member firms are legally separate and independent entities. DTTL does not provide services to clients. Please see [www.deloitte.com/about](http://www.deloitte.com/about) to learn more. Deloitte is a leading global provider of audit and assurance, consulting, financial advisory, risk advisory, tax and related services. Our network of member firms in more than 150 countries and territories serves four out of five Fortune Global 500® companies. Learn how Deloitte's approximately 264,000 people make an impact that matters at [www.deloitte.com](http://www.deloitte.com).

This communication contains general information only, and none of Deloitte Touche Tohmatsu Limited, its member firms or their related entities (collectively, the "Deloitte network") is, by means of this communication, rendering professional advice or services. Before making any decision or taking any action that may affect your finances or your business, you should consult a qualified professional adviser. No entity in the Deloitte network shall be responsible for any loss whatsoever sustained by any person who relies on this communication.

© 2020. For information, contact Deloitte Touche Tohmatsu Limited.

Designed by CoRe Creative Services. RITM0519559