

Algorithm Insights

Risk and control considerations

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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.

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Executive Summary

Algorithms are becoming increasingly common in business processes of organisations, government and general society. 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 grow, the risks it faces from defective or biased algorithms grow 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 expectations on businesses to ensure they 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



A class action lawsuit due to a faulty Income Compliance algorithm resulted in \$1.5+ billion settlement



A major bank was required to write-off over \$2m in loan balances due to a programming error in their automated serviceability calculator



A multinational organisation's machine learning recruitment tool was found to be biased against women



A widely used algorithm that predicts which patients will benefit from extra medical care was underestimating the health needs of the sickest black patients.



An error in the trading software of a financial services company resulted in the accidental purchase of almost \$7 billion shares within an hour



The SEC charged a stock exchange \$10 million for "poor systems and decision making"



The SEC fined a multinational insurance company \$200+ million for investor losses caused by a known error in investment algorithm.



A stock exchange's computer malfunction caused almost 20,000 erroneous trades, that were later cancelled

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?



Algorithms Across Industries

Algorithms can be found in many industries and their application varies from sector to sector, as does their risk profile. Below we present a few real-world examples of how algorithms can be employed:

Industries and Sectors



Government

- Customer service automation
- Disease tracking
- Emergency services rationalization
- Workflow/task automation



Life Science Health Care

- RSA (Cryptosystem) for confidential health data
- Disease diagnosis
- Drug discovery
- Treatment recommendation
- Real-time surgical support



Financial Services & Insurance

- Algorithmic Trading
- Robo-advising for investors
- Consumer lending
- Insurance policy pricing
- Customer service automation
- Fraud detection



Human Resources

- Algorithmic Trading
- Robo-advising for investors
- Consumer lending
- Insurance policy pricing
- Customer service automation
- Fraud detection



Travel & Hospitality

- Personalized search
- Dynamic pricing
- Virtual and augmented reality



Utilities & Manufacturing

- Smart grids and distributed generation
- Predictive maintenance
- Business process automation



Aerospace & Defense

- Autonomous air traffic control and flights
- Virtual and augmented reality
- Battlefield tactics
- Predictive maintenance



Logistics

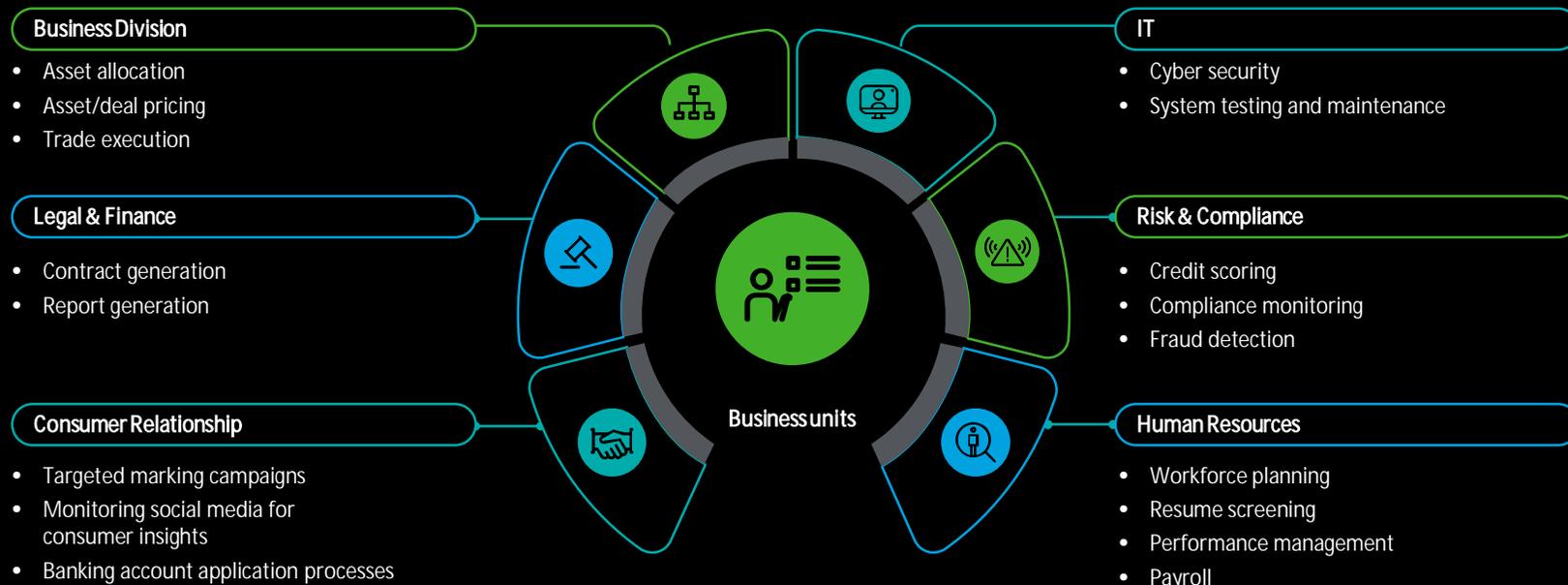
- Storage and transportation rationalization
- Delivery automation
- Customer service contact automation

Algorithm Utilisation

Once an organisation has an agreed definition of an algorithm, it should 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:



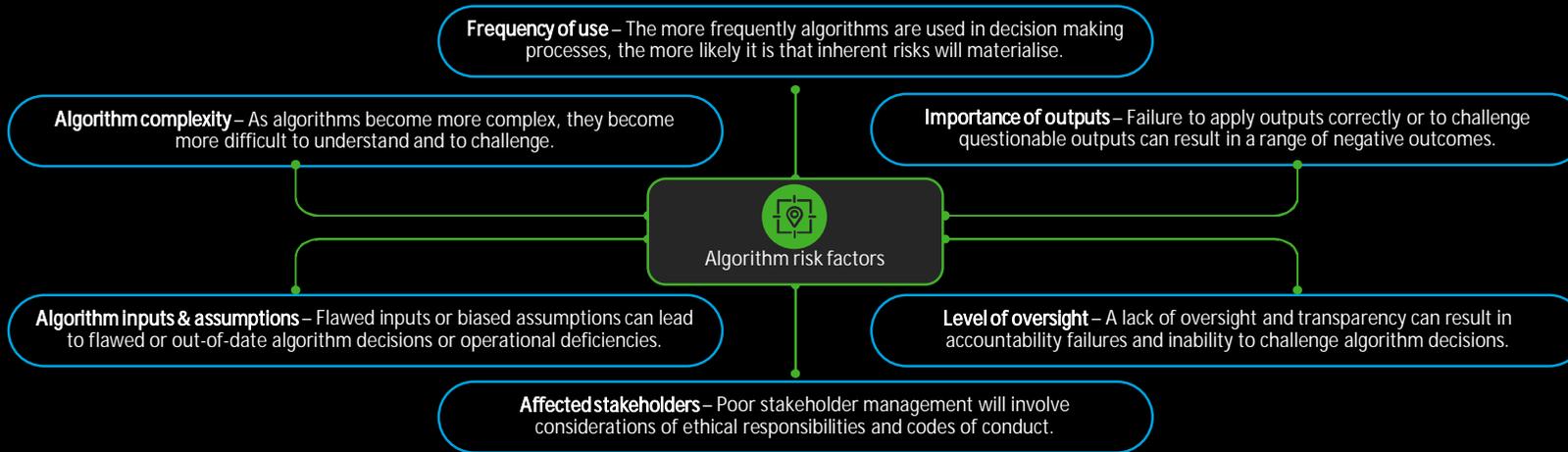
Reflection points

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 points

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

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:

Color Code:

Primary Applicable Regulations/Guidelines

Peripheral Regulations/Guidelines



The Regulatory Environment (continued)

As shown on the previous page, lawmakers have already produced a significant amount of regulation 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 points

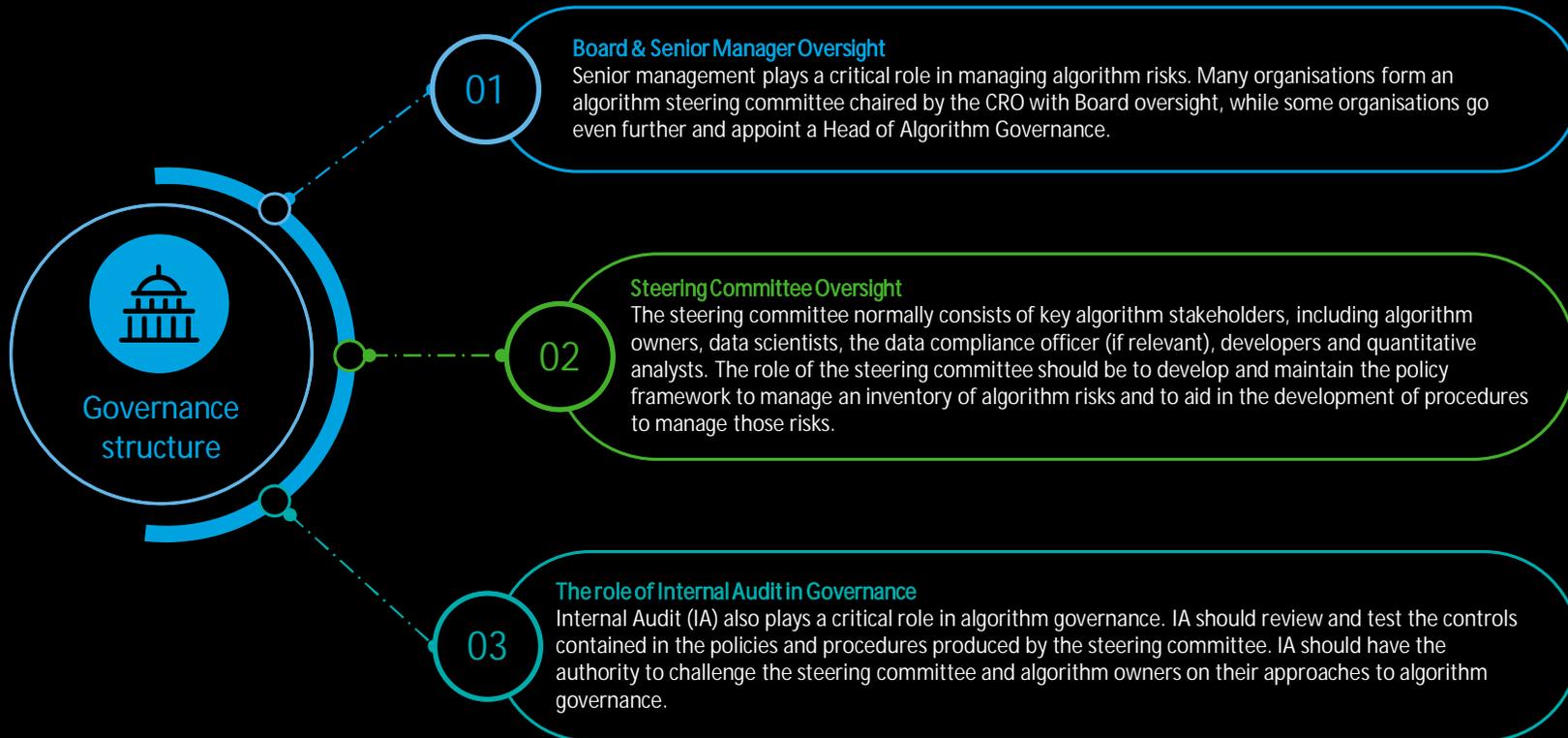
Have you considered how the regulatory environment may impact the use of algorithms at your organisation?

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:



Board/Senior Management



Governance

The first step in creating an algorithm governance framework is to identify and document the usage of algorithms across all businesses and functions. The inventory should include a risk rating for each algorithm and identify a responsible algorithm owner. Once the inventory has been created, it should be populated with the relevant algorithm controls and reviewed on a regular basis.



Approval process

An independent team should test each algorithm ideally prior to it going live. Organisations should adopt a tailored approach to testing which is mindful of the nature of the algorithm and risks that it presents.



Algorithm controls

Following the identification of algorithms and their associated risks, development of the control framework can begin. Controls should be specific and tailored to the nature of the algorithm's application and the risk being mitigated.



Monitoring

Decisions and outputs of algorithms should be monitored on a continuous basis. This is especially true for algorithms with higher-risk algorithms. The monitoring activity should be designed to allow an organisation to react quickly if an incident occurs.

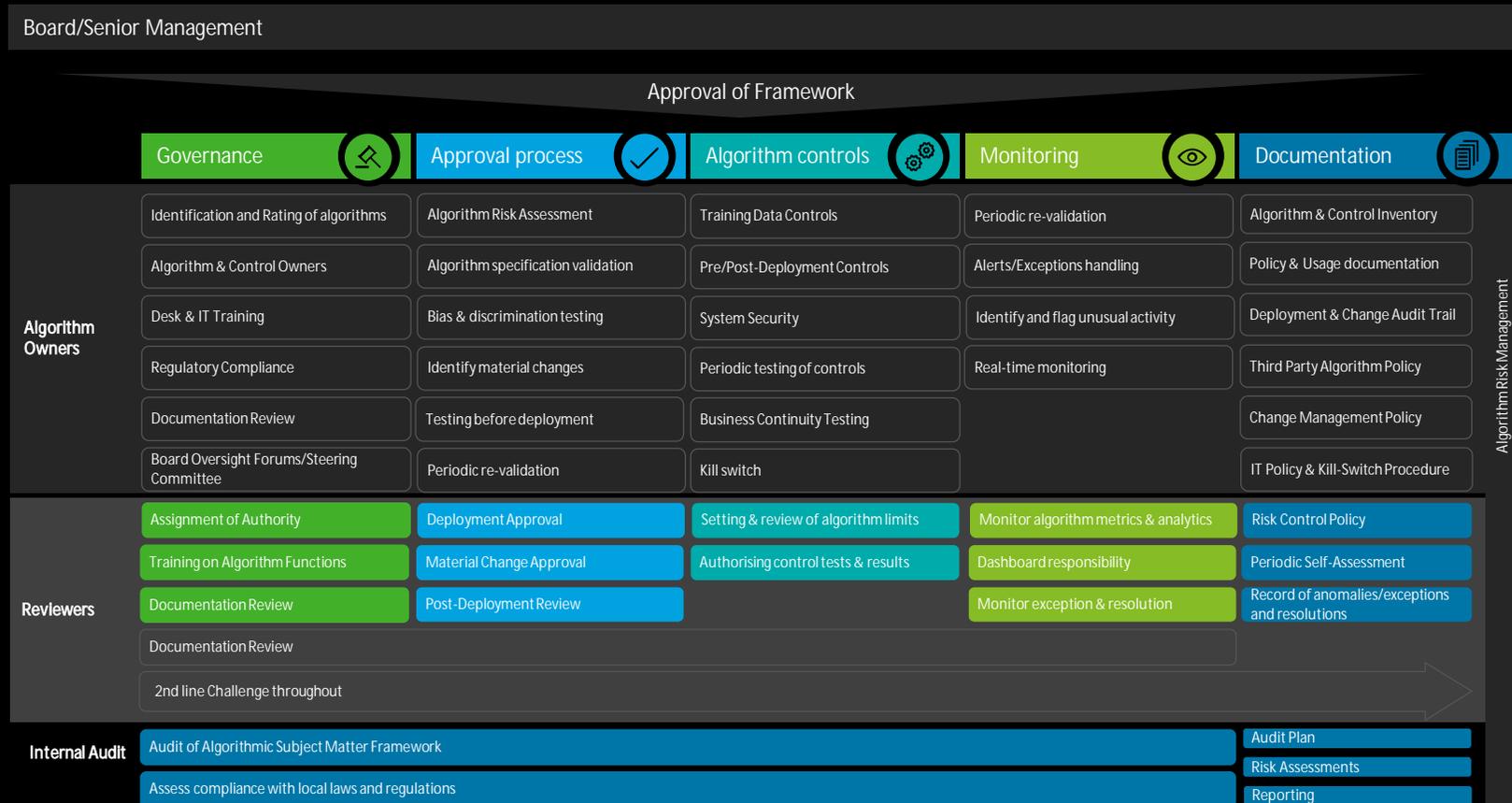


Documentation

Clear documentation and a detailed audit trail are increasingly being demanded by regulators. Internal Audit plays a key role in this respect, helping to challenge that policies, procedures and documentation are sufficient and being adhered to.

The Algorithm Risk Management Framework

Below is an example of best practice 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.



Algorithms are becoming more prevalent and complex:

Algorithms are being developed and deployed with increasing frequency across the financial services industry.



Algorithms present a multitude of risks to organisations:

These risks include reputational, financial, operational, legal/regulatory, technology and strategic and their impacts can be severe, even including business failure.



Algorithm regulation is already here and more is on the way:

A regulatory landscape is developing that is global and cross-sector in nature.



Organisations need to develop an appropriate governance structure and control framework to manage algorithm risk:

This includes policies and procedures to manage the risks, with new controls, algorithm owners and internal governance structures.

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

Next Steps

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, then please get in touch with us.

Australian Representatives



Lucy Peng
Algorithm Validation
Lead Partner
T: +61 2 9322 5849
fpeng@deloitte.com.au



Mark Lumsden
Algorithm Governance
Lead Partner
T: +61 2 9322 7974
mlumsden@deloitte.com.au



Jonathan Sykes
Algorithm Regulatory Lead
T: +61 2 8260 4204
jonsykes@deloitte.com.au



Ali Mirzaei
Senior Manager
Audit and Assurance
T: +61 3 8486 1280
amirzaei@deloitte.com.au

Global Representatives



Mark Cankett
Global Algorithm Assurance Lead Partner
+44 20 7007 5150
mcankett@deloitte.co.uk



Barry Liddy
Global Algorithm Assurance Lead Director
+44 20 7303 6430
bliddy@deloitte.co.uk



Scott Jermy
Algorithm Assurance Global Project Lead
T: +61 2 9322 7558
scojermy@deloitte.com.au



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