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Artificial Intelligence: Adoption in Capital Markets

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Association for Financial Markets in Europe
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Executive Summary

The AFME AI Task Force

AFME has established an Artificial Intelligence (AI) Task Force with the objectives of increasing awareness of AI in capital markets and supporting the development of future policy. These objectives are intended to enable the continued successful adoption and utilisation of this technological capability for the industry.

This first paper by the AI Task Force:

- Explores capital markets use-cases and benefits of AI;
- Identifies areas where AI may impact the risks faced by financial institutions and proposes control principles for managing those risks; and
- Suggests considerations for future policy.

AI and Capital Markets

Over the last five years, the capital markets industry has increased research into, and the adoption of, AI technology.

- AI can be viewed as the ability for technology to 'understand' and 'learn'. However, it is a broad and complex term that is often misused or misunderstood. This paper seeks to set out an understanding of AI within capital markets and consider a framework within which this technology can continue to develop to the maximum benefit of all capital markets participants.
- While AI capabilities are not new to capital markets, it is important to acknowledge that the current focus and technological capability has evolved from previous, more traditional approaches to programming and AI.

The increased focus on, and adoption of, AI is closely linked to three broad trends impacting capital markets technology:

- Increased availability and sophistication of computing power that can support expanding technological developments;
- The availability of larger amounts of data and tools for analysis; and
- Improvements in, and broader access to, algorithmic technology and capabilities.

Findings of this white paper

AI is being developed for multiple uses across the capital markets industry and is bringing a range of benefits for all market participants.

- AI is helping to improve the efficiency and capacity of multiple functions, such as: client interaction; risk management and reporting; compliance; and back office processing.

We believe that there are a number of potential risks associated with the use of AI.

- While the majority of these risks are already familiar to capital markets participants through their adoption of other technologies, some may be amplified by the nature of AI technology.
- We have identified two key risk themes related to AI in capital markets, which will require further analysis. They are summarised in this paper as: data input; and understanding and control.

In response, we have identified five initial control principles for the continued use of AI.

- To establish a high standard of risk management across all market participants, we believe that five key control principles must remain at the centre of AI development in capital markets. These are summarised under the headings of: governance; education and awareness; standards and development methods; data quality and assurance; and operational control.

Just as with other innovations in capital markets, policymakers and regulators should remain technology-agnostic. Where a risk is inherent to a technology rather than a specific use case, or where legal uncertainties arise, it might be required to introduce new or adjust existing regulation, taking those specifications into account.

- AFME welcomes the decision of the European Commission to publish, in April 2018, a strategy that will define the first steps of an EU approach to AI. This will be an important initiative to consider how best to promote AI for the benefit of the people, businesses and economy of Europe.
- The industry should use its collective knowledge of the potential benefits and risks of AI to contribute to the development of a suitable, risk-based framework to promote the use of the technology both now and in the future.
- However, as with other innovations in capital markets, policymakers and regulators should remain technology-agnostic and focus on outcomes of the technology, rather than the technology itself.

We look forward to supporting future industry and policy initiatives and to realising the benefits of AI for Europe's capital markets participants.

1. Defining Artificial Intelligence

There are many different definitions of AI in use. For example, the 2017 Financial Stability Board (FSB) report Artificial intelligence and machine learning in financial services[1], defines AI as "the theory and development of computer systems able to perform tasks that traditionally have required human intelligence". The World Economic Forum interprets the term more broadly, noting that AI "…develops computers that can do things traditionally done by people…sense or perceive the world and collect data… and act independently – all underpinned by the ability to learn and adapt over time"[2].

The early use of 'AI' (or machine learning techniques) in capital markets can be traced back to the 1960s, where it was limited to highly specialised applications that required deep technical expertise. AI has continued to develop since this time, in parallel with developments in computing capabilities and increased investment in the technology[3]. Therefore in practice, the term 'AI' is often used to describe a broad range of terms that are sometimes even used interchangeably. For example, 'machine learning' and 'cognitive computing' are used in various ways to refer to aspects of AI. For this paper we have set out in Annex 1 a glossary of the most common terms used.

Over the last five years, AI (in all its forms) has gained both increased focus and application across many industries and has been accompanied by significant media coverage. By mid-2017 it was estimated that there were already 400+ AI recognised companies operating across Europe[4] with projections that the AI industry could increase the regions overall economic growth (GDP) by $2.5 trillion over the next 10 years[5]. Most commentators agree that AI will continue to be a major technological driver in 2018 and beyond.

[1] http://www.fsb.org/2017/11/artificial-intelligence-and-machine-learning-in-financial-service/
[2] http://reports.weforum.org/digital-transformation/artificial-intelligence-improving-man-with-machine/
[3] https://medium.com/cityai/the-european-artificial-intelligence-landscape-more-than-400-ai-companies-build-in-europe-bd17a3d499b
[4] https://medium.com/cityai/the-european-artificial-intelligence-landscape-more-than-400-ai-companies-build-in-europe-bd17a3d499b
[5] https://www.pwc.com/gx/en/issues/analytics/assets/pwc-ai-analysis-sizing-the-prize-report.pdf

2. Use Cases and Benefits of AI

Use cases

Today, AI is being used across businesses both to augment existing activities and to perform complex and intensive tasks which would otherwise be impossible to execute. By extension, the rate of development of this technology means that new use cases are currently emerging and there will be further use cases in the future of which we are, at this point, unable to conceive.

Our Task Force has identified the following non-exhaustive list of current use cases of AI in the capital markets industry that reflect this advancement:

Figure 1 – AI Use Cases in Capital Markets

AI use cases in capital markets	Example
Predictive data analytics to identify 'forecasting events'	*e.g. recognising potential triggers for 'flash crash' events*
Liquidity risk analysis	*e.g. multi-dimensional risk and exposure data analytics*
Visualisation of market risk	*e.g. using computer vision techniques to analyse volatility services*
Sentiment analysis to determine client needs/opportunities	*e.g. social media analytics*
Algorithms for stock selection	*e.g. development of client trading products*
Voice-to-text natural language processing	*e.g. systems that can respond to client enquiries*
Natural language document analysis services	*e.g. analysing and extracting key data from unstructured or semi-structured documents*
Natural language generation for document writing	*e.g. performance and financial data commentary reporting*
Smart matching for trades	*e.g. predicting manual intervention required to complete trades*
Market abuse and financial crime surveillance	*e.g. identification of complex trading patterns in large data sets*
Internal compliance for identifying patterns and behaviours	*e.g. analysis of trader activities for market abuse surveillance*
Identifying dataset anomalies and cleansing data	*e.g. recognising distinct categories from unstructured free text*
Rules-based and machine learning exception management	*e.g. processing interest claims on late payment*
IT support analysis on system outages and root cause	*e.g. detection of cyber attacks*

Benefits

AI can bring a range of benefits to the market itself, as well as to market participants, including regulators and end users. In most cases, AI is beneficial in situations where large amounts of data must be consumed and analysed: AI can perform such tasks with far greater speed and efficiency than humans would be capable of.

Our Task Force has identified the following six areas where impactful benefits of AI are most likely to be realised:

Figure 2 – Benefits of AI in Capital Markets

Area of use	Examples of benefits
Client Servicing	• Personalised products and services to meet individual client needs • Automated and predictive resolution of client service issues
Organisational Change and Operational Efficiency	• Enables existing staff to focus on high value efforts and activities • Improved decision-making based on increased data and simulations • Continuous performance improvements
Market Efficiency	• Reduced investment costs for market entry of new products

	• Reduced transaction breaks and exceptions and increasing data quality • More rapid entry into and development of new markets • Increased standardisation and commoditisation of existing products and services
Compliance and Reporting	• More efficient processing of information • Increased ability for firms to report and supervisors to evaluate large and complex data sets • Mining of both structured and unstructured data sets • Better use of data to prevent and detect fraud, money-laundering and market abuse
Cybersecurity	• Reduced time required to detect and respond to cyber threats
Risk Management	• Better assessment of financial and non-financial risks

3. AI Risks

While AI is certainly not new to capital markets, the capability and underlying technology continues to change at pace. As we have seen, AI also has the potential to impact many different market participants. It is therefore important and appropriate, at this time, to consider the key risks associated with AI and the control principles that may be required for financial institutions. This is particularly critical given the ultimate responsibility that financial institutions have in all aspects of their businesses to protect their clients and treat them fairly.

For this paper, our Task Force identified 14 risk categories for AI (see Annex 2). Many of the risks identified are familiar to financial institutions in their existing use of technology. However, some could be amplified by the nature of the technology, which is further noted under 'controls' below.

The risk categories, and the risks identified for each, have been summarised below into two key themes which we see as those most commonly associated with AI in capital markets today. Each is a combination of technology and conduct risks, and both should be viewed as interconnected. The two risk themes are:

1. Data input
    - AI relies on large data sets which are sampled from a wider population. The sampled data set may be unrepresentative of the population as a whole, or conscious or unconscious bias may exist in the population, which we would not necessarily want the AI system to reproduce. Unless possible sources of bias are identified and corrected, there may be unintended consequences. For example, incorrect programming of risk tolerances could lead to products being sold inappropriately. Alternatively, where AI models are trained predominantly on historical data, there is a risk that models drift from their original purpose due to changes or errors in new input data, if the appropriate controls and tolerances are not designed and implemented
    - Although not unique to AI, the use of data by AI may also infringe on the rights and privacy of data subjects when consent for this manner of use has not been explicitly given.
2. Understanding and control
    - AI may reduce the transparency of decision-making for financial institutions and clients. It may become more difficult to understand why certain decisions have been made by the AI (for example, if the processes take place within a 'black box'), and for institutions and authorities to monitor, evaluate and correct decisions in an appropriate timeframe.
    - Where the AI process is not understood or subject to suitable controls, there may be an increased risk of unintended consequences. For instance, in an environment where multiple models are implemented by multiple institutions, it may be very difficult to predict the interactions between models or the impact on markets. This may be particularly acute given the potential size and scale of the AI operation and the associated risk of contributing to or even causing disorderly market behaviour.

4. AI Control Principles

Many institutions in capital markets already use a wide range of technologies to service their clients and run internal processes and have in place proven management and oversight structures. This includes monitoring for new technological developments, opportunities and risks. Supervisors have already established specific requirements and controls for model risk management (including management of algorithm risks), which is one of the building blocks of the risk framework of financial institutions. It is under this framework that specific controls for AI should be considered.

Based on the risk themes observed above, the AI Task Force has initially identified the following five control principles, which we believe are important for addressing the risk themes and supporting the continued effective use of AI in the capital markets industry:

- Governance: The institution's framework of governance and risk management should ensure accountability for the establishment of, and decisions involved in, each use of AI and for setting principles for implementation of policies, procedures and the allocation of responsibilities.
- Education and awareness: An understanding of uses, risks and opportunities of AI should be promoted throughout the institution and championed at a senior level. Investment should be made to retain and develop the employee skills needed for continued use of AI within the institution.
- Standards and development methods: The implementation of principles and high-level standards and development methodologies should be championed and followed for both technical (AI model development) and ethical (client interaction) aspects.
- Data quality and governance: For AI related activities and decisions to be accurate, appropriate and relevant, high-quality input data should be used, together with provisions to identify and minimise sources of potential bias and inaccuracies. The institution should comply with all relevant data protection regulation.
- Operational control: Comprehensive and continuous testing and monitoring capabilities should provide the assurance of inputs, decision-making and outcomes from AI. This should include unique factors such as ethical norms and a lack of bias in decision making, which should take into consideration any material changes and developments in the institution's use of AI. Fall-back and recovery plans should also be also in place.

These control principles focus on AI activities and the risks they generate and should therefore be applicable to every institution that leverages AI to provide financial services within capital markets and beyond. The aim of these control principles is to ensure customer protection, financial stability and fair competition.

5. AI Regulation and Policy

AI, like many emerging technologies across capital markets today (such as distributed ledgers or Cloud computing), can impact the industry on a global scale. Many jurisdictions are now beginning to look at their current and future policy approach to AI, for example the USA's establishment of an AI congress advisory committee under the 2017 FUTURE of AI Act[6].

However, both as an existing technology and via its underlying processes, we believe that AI is already included in current and forthcoming regulations in the EU. This is part of a wider framework of outcomes-based requirements, covering numerous aspects of business, from a duty of care for customers to the obligations to detect and prevent market abuse. These requirements apply to institutions regardless of the processes used internally, which increasingly involve AI. Specific examples include:

- MiFID II/MiFIR (effective January 2018) established closer regulation and monitoring of algorithmic trading, which can involve AI, by introducing requirements for effective system controls and resiliency.
- GDPR[7] (effective May 2018) introduces the right for individuals to understand how automated decisions have been made based on their data.

This view has also been taken by the Joint Committee of European Supervisory Authorities in their recent report on the use of Big Data[8].

Parallel to adjusting the regulatory framework to make it fit for evolving technologies, the Commission has long been supporting and investing in new developments, including AI. The European Commission's public-private partnership initiative for robotics and AI has committed 700M EUR of funding between 2014-20. This is further bolstered by an extra 2.1BN EUR of investment committed by industry. Further public sector-led initiatives on new technologies, such as 'Innovations Hubs' have also proven successful, bringing together policymakers, regulators, technology developers and industry participants for education and exploration of new opportunities.

The Commission is now expected to publish a strategy for an EU approach to AI in April 2018. This will be an important proposal that can look at how best to promote AI for the benefit of Europe and its capital markets, and to encourage collaboration. Equally, the Commission is planning, by Q2 2019, a review of the current financial services regulatory framework, to determine its future fitness for emerging technologies such as AI and distributed ledgers. Both these initiatives will be important for the continued development of regulation and policy that allow the benefits of AI to be realised for all industry participants.

However, just as with other innovations in capital markets today, it remains important that policymakers and regulators focus on outcomes, rather than seeking to regulate the individual technologies. As discussed above, the impact of AI could be extensive and potentially beneficial for both market participants and supervisors. Any future policy approach must not implicitly constrain the development and innovative uses of this technology.

AFME therefore proposes using a technology agnostic, risk-based and principle-based approach, focusing on addressing the potential risks to clients or to financial stability. However, we recognise that although a technology-neutral approach is preferred, a technology might sometimes require targeted guidance in order to minimise regulatory and legal uncertainties or address risks that are inherent to the specifications of a technology. The development of AI Ethics Guidelines, setting (among others) the principles for the assumptions on which an AI algorithm should be based, is a highly appreciated step towards addressing the risks stemming from AI. Other areas to look at might refer to questions of accountability and liability for decisions made by a (potentially self-learning) AI.

[6] https://www.congress.gov/bill/115th-congress/house-bill/4625/text
[7] Markets in Financial Instruments Directive (MiFID II) and Regulation (MiFIR), and the General Data Protection Regulation (GDPR)
[8] http://www.eba.europa.eu/-/esas-weigh-benefits-and-risks-of-big-data

Conclusion

AFME and its members welcome increased focus on, and understanding of, AI within the capital markets industry by all market participants. The applications are diverse and are already transforming many aspects of business, from trading and client interaction to risk management and operational processing.

As with any new and developing technologies, it is important that the risks are considered and actively managed. A robust control framework, similar to those that are already in place for other technologies in capital markets, should be a priority for any capital markets institution investing in the many forms of AI.

The commitment from the European Commission (as well as from other policymakers and regulators) to support, understand and invest in new technologies such as AI, is extremely important to the capital markets industry and the economy as a whole. Regulation should not be directed at the technology itself but should assist the industry in addressing the risks. This collaborative approach will allow the technology to develop to the maximum benefit of all market participants, while safeguarding clients and market stability.

AFME and its members look forward to working with all sectors of the capital markets industry to achieve this aim.

Annex 1: Glossary of Terms

Glossary of common terms related to artificial intelligence (AI)	
Artificial intelligence (AI)	**The theory and development of computer systems able to perform tasks that traditionally have required human intelligence.** AI is a broad term that incorporates all terms listed below.
Algorithms	A set of rules that allow a computer to perform activities or processes to get insights from input data or to solve problems.
Black Box	A system where the internal workings are unknown or cannot be determined *(for example, a platform used to decide on a client's credit worthiness where only the broad data inputs and final decision are visible).*
White Box	A system where the decision logic is understood *(for example, a platform used to decide on a client's credit worthiness where the data inputs, decision logics and final decision are visible).*
Deep Learning	A form of neural network which is structured into a large number of processing units (normally arranged into layers).
Explainable Artificial Intelligence (XAI)	A model for AI processing, through which the decision-making process that results in specific outcomes can be explained and described in detail.
Machine Learning (ML)	An application of Artificial Intelligence that provides systems with the ability to automatically learn and improve from experience without being explicitly programmed. In short, it is a set of algorithms that allow machines to learn from data. Machine learning is typically sub-divided into three categories: supervised, unsupervised, and semi-supervised learning.
Neural Networks	"A neural network is a ML system that consists of simple interconnected processing units that are loosely modelled on neurones in the brain" *(for example, an image recognition system that learns to identify a type of image by associating certain features over time).*
Predictive Analytics	The use of current and historical data to make future predictions.
Semi-Supervised Learning	A form of 'machine learning', where an algorithm is trained on unlabelled data but receives feedback on actions taken *(for example, a surveillance platform trained on a set of transactions where some are identified as fraudulent, and a human tells the system when is has identified one correctly or incorrectly).*
Semantic Search	A system which seeks to understands the intent of search activity to improve the relevance of results *(for example, a search engine that returns results on all interest rate derivatives when asked about interest rate swaps).*
Supervised Learning	A form of 'machine learning' where an algorithm is trained on labelled data *(for example, a surveillance platform trained on a set of transaction data where areas of fraud are identified).*
Unsupervised Learning	A form of 'machine learning' where an algorithm is trained on unlabelled data *(for example, a system that learns to detect anomalies in some data without having those anomalies labelled as such).*

Annex 2: Risk Catgories for AI

A summary of the risks we identified for each of the 14 categories is tabled below:

Risk categories	Examples of risks associated with AI
Governance	• Reduced transparency and ownership of decisions based on 'black box' outcomes • Increased uncertainty on how to govern AI capabilities reduces oversight and control
People	• Shortage of future technical skills to develop and support AI capabilities
Operational	• Increased reliance on AI business as usual and risk for business continuity (fall back) • AI may reduce staffing requirements at lower levels, eventually limiting numbers of senior staff
Financial	• Increased number and impact of financial losses resulting from erroneous AI decisions, due to increasing speed and volume of decision making
Market	• Increasing systemic risk if market-wide trends or risk-taking is propagated by AI
Compliance & Regulatory	• A lack of relevant standards will reduce the ability to evaluate AI development and use
Ethical	• Data-set bias that reduces the fairness and equality in the distribution of products and services • Poorly designed objectives for machine learning systems might lead to unintended consequences
Cyber Security	• Use of AI for advanced criminal activity such as the obtaining (phishing) and subsequent automated use of information (login and transacting) for customer impersonation • Increased cyber risk due to scale of reliance on data
Third party	• Increased reliance on third-party providers that would cause disruption in the event of a failure
Change & Implementation	• Increased rate of complex change introduced to an organisation that impacts performance • Inadequate or incomplete testing could result in faulty behaviour in unexpected circumstances
Organisational	• Lack of education and understanding of AI throughout an organisation
Technology	• Limited understanding of AI in use and the implications of any changes or impacts on other systems • AI systems are introduced too quickly and reduce technology resiliency and failover
Reputational	• Unintended consequences of AI leading to reputational damage
Strategic	• Too much confidence and reliance on AI for revenue generating activities

Notes

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Contributors to this Paper

We are grateful to our member firms and the individuals who contributed their time and thoughts in producing this report.

AFME Technology and Operations

AFME's Technology and Operations Division brings together senior technology and operations leaders to influence and respond to current pan-European market drivers and policy.

The Artificial Intelligence: Adoption in Wholesale Capital Markets paper was led by the AFME AI Task Force as an initiative within the broader Technology and Operations Division.

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The Association for Financial Markets in Europe (AFME) is the voice of all Europe's wholesale financial markets, providing expertise across a broad range of regulatory and capital markets issues.

We represent the leading global and European banks and other significant capital market players.

We advocate for deep and integrated European capital markets which serve the needs of companies and investors, supporting economic growth and benefiting society.

We aim to act as a bridge between market participants and policy makers across Europe, drawing on our strong and long-standing relationships, our technical knowledge and fact-based work.

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