

FOURTH INDUSTRIAL REVOLUTION TECHNOLOGIES AS DECISION-MAKING SYSTEMS FOR INCLUSIVE AND SUSTAINABLE DEVELOPMENT

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Abstract

With the rapid adoption of Fourth Industrial Revolution technologies including AI-enabled advancement in computing systems, more and more services are now being automated using 'robo' or algorithmic decision-making systems. While these technological advances have tremendous potential and opportunities for mankind, they also raise societal challenges and questions in areas such as ethics, morality, privacy, human rights, intellectual property and economics. What recourse do we have when these automated decisions create significant legal effects or intrude on our rights, freedoms and legitimate interests? This article considers the concept behind the 'right to explanation' and the 'right to challenge' on the decision made by automated systems and algorithms. It explores whether the call for the opening of the algorithm 'back box' for evaluation and scrutiny is practical and realistic from a technological perspective.

Introduction

Since Sumerian times, mankind has been recording transactions of their business activities, first on stones, then clay tablets, papyrus, paper, computers and now on a myriad of digital devices. Over the period of human activities, institutions of one sort or another have been processing personal information and data. While the world is increasingly connected by Fourth Industrial Revolution technologies including cloud computing and the Internet of Things (IoT),¹ significant disruptions to long-standing business models are taking place — from online shopping, transportation using Uber drivers, musing in driverless cars to transacting with digital currencies, all energetically driven by data

with the aid of applications and networks. Data has become the catalyst for the 'data-centric age' creating a fusion of data with the collection of maturing Fourth Industrial Revolution technologies.

Financial institutions have been one of the early adopters of technology, much more so than other sectors— out of pure necessity to capture, store and to manage the deluge of transactions and data. In their endeavours to comply with money laundering legislation and 'knowing your customer', financial institutions have also discovered that they are sitting on a gold mine of data about their customers.

In the wave of innovation and with the rapid adoption of Fourth Industrial Revolution technologies including AI-enabled

(artificial intelligence) advancement in computing systems (processing and machine learning), advanced intelligent algorithms, big data and predictive analytics, more and more services are now being automated using 'robo' or algorithmic decision-making systems (Automated Systems).

The human species have been on a journey of 'inventive steps' (borrowing from the words used in the patent field), and the current disruption and transformation occurring are just another 'innovative' step — but with a difference — the speed at which these innovation and inventive steps are occurring are challenging our human capacity to sufficiently absorb, comprehend and traverse the ever-widening chasm.

The declining cost of storage devices are driving the creation and assembly of vast information databases for automated algorithm processing and information-value derivation. These Automated Systems are much more efficient (both in time and money) than humans and are gradually being deployed across all domains of our industry, government and community.

As these Automated Systems may be driven by real-time data which include publicly available data, data from social media, device sensors, mobile and smart devices, transactional data and audit logs, how do we ensure that these Automated Systems use correct and un-biased data, and are transparent? Current writers suggest that it may be difficult 'to trace the precise reasons for an algorithm's choices as they may be based on vast statistical computations or on real data used as input to the algorithm'² or that the data may have inherited the prejudices of the data collector.³

¹ A phrase coined by Kevin Ashton to describe the system where devices are connected through the Internet to transmit, compile and analyse data.

² Viktor Mayer-Schonberger and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think* (Houghton Mifflin Harcourt, 2013) 178.

³ Solon Barocas and Andrew D. Selbst, 'Big Data's Disparate Impact' (2016) 104 *California Law Review* 671.

What rights do we have when these Automated Systems create significant legal effects or intrude on our individual rights, freedoms and legitimate interests?

Often these Automated Systems and their algorithms are referred to as 'black boxes', as some of the technologies behind the 'black box' could be confidential and valuable.

While these technological advances have tremendous potential and opportunities for mankind, they also raise societal challenges and questions in areas such as ethics, morality, privacy, human rights, intellectual property and economics.

This article considers the emerging challenges posed by Automated Systems and algorithms, particularly in the context of the financial services sector. The objective is to identify the key regulatory implications and to examine how our existing legal framework might need to be amended to meet the challenges posed by Automated Systems and algorithms for greater transparency and to provide the consumer with the ability to question the process of automated algorithmic decision making.

The article examines the recent regulatory and policy approaches adopted by the EU on automated processing and the regulatory approaches taken by the Australian Securities & Investments Commission (ASIC) to the regulation of automated financial product advice using algorithms (also referred to as 'robo-advice').

It considers the concept behind the 'right to explain' and the 'right to challenge' on the decision made by Automated Systems and algorithms. It explores whether the call for the opening of the algorithm 'black box' for evaluation and scrutiny is practical and realistic from a technological and legal perspective.

The article comes at a time of renewed interest into the financial sector with the publication of the final report of the Australian Royal Commission into Misconduct in the Banking, Superannuation and Financial Services Industry⁴ which addresses the misconduct in the financial services industry due to the imbalances of power between the institutions and consumers; and the inappropriate financial advice leading to the loss of consumers' confidence in the industry. It also comes at a time when the Australian government has introduced professional standards legislation setting higher competence and ethical standards for human financial advisers.⁵

The state of play of 'Robo-Advice' in the financial sector

As algorithm plays a central stage in our discussions on Automated Systems, it would be remiss of me to not include a definition of algorithm in this article. Cormen in his book, *Introduction to algorithms*, defines an algorithm as 'a computational procedure that takes some value, or set of values, as input and produces some value, or set of values, as output.'⁶ He also views 'algorithm as a tool for solving a well-specified computational problem.'⁷

In Australia, financial services companies, including largely technology oriented financial organisation (FinTech) start-ups are rapidly emerging to challenge the roles of the banks and the large financial institutions. These FinTechs are rapidly transforming and causing major disruption in the marketplace once monopolised by banks and large financial institutions with their deployment and provision of digital or 'robo-advice' to customers using highly sophisticated algorithms operating on the mobile and web-based environments.

In this context, these services using automated, 'robo' or algorithmic

decision-making systems are generally referred to as 'robo-advisers'.

In her address to the Harvard Law School, ex-Commissioner Kara M. Stein from the US Securities and Exchange Commission (SEC)⁸ alluded to the challenges pertaining to the rapid emergence of 'robo-advisers' in the United States and the state of flux in relation to their regulation. She added, 'Do investors using robo advisors appreciate that, for all their benefits, robo advisors will not be on the phone providing counsel if there is a market crash?'

In her remarks during her speech to the Securities Traders Association's 82nd Annual Market Structure Conference, the ex-US Commissioner added:

Who is responsible when algorithms go awry? ... In a world where programming errors are just as damaging to investors as improper sales practices, our regulatory approach may need to evolve.⁹

Although this article does not canvass the general fiduciary duty of a financial adviser, including the obligation to 'act in the best interests of the client in relation to the advice'¹⁰ or the licensing (or regulation) of financial advisers, the rapidly emerging 'robo' environment is already putting pressure on the government's professional standards legislation setting higher competence and ethical standards for human financial advisers.¹¹ Should we also be canvassing for the regulation of 'robo-advisers'?

Unfortunately, like many parts of our regulatory and legislative endeavours, the law is rapidly falling behind what Professor Klaus Schwab, Founder and Executive Chairman of the World Economic Forum describes as the Fourth Industrial Revolution phenomenon.¹²

⁴ <https://treasury.gov.au/publication/p2019-fsrc-final-report>.

⁵ *Corporations Amendment (Professional Standards of Financial Advisers) Act 2017*.

⁶ Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, *Introduction to algorithms* (Cambridge, Mass : MIT Press ; New York : McGraw-Hill, 2009) 1.

⁷ *Ibid*.

⁸ US Securities And Exchange Commission, Commissioner Kara M. Stein, 'Surfing the Wave: Technology, Innovation, and Competition – Remarks at Harvard Law School's Fidelity Guest Lecture Series' Nov. 9, 2015) <<https://www.sec.gov/news/speech/stein-2015-remarks-harvard-law-school.html>>

⁹ US Securities And Exchange Commission, Commissioner Kara M. Stein, 'Market Structure in the 21st Century: Bringing Light to the Dark' (Sept. 30, 2015) <<https://www.sec.gov/news/speech/stein-market-structure.html>>

¹⁰ *Corporations Act 2001* (Cth), s961B.

¹¹ *Corporations Amendment (Professional Standards of Financial Advisers) Act 2017*.

¹² Klaus Schwab, *The Fourth Industrial Revolution* (World Economic Forum, 2016).

The rapidly emerging ‘robo’ environments utilising smart phones and ‘apps’ appeal to the younger investors. The ‘Millennials’ with their smaller asset base are more willing and comfortable with their smart phones and apps to utilise these online services without the face-to-face meetings with their human financial advisers.

The following factors are driving the onset of ‘robo-advisers’:

- advisory service may be offered at a lower fee;
- millennials demanding a more convenient and cost effective way of receiving financial advice using apps and ‘robo-advisers’; and
- ‘robo-advice’ technologies are maturing rapidly and are increasingly being provided with enhanced features.

However, the SEC has issued an investor alert, highlighting several matters that consumers should consider in relation to the use of ‘robo-advisers’.¹³ The alert also queries whether there are any inherent limitations or assumptions in the algorithms used in ‘robo-advisers’. For example, a ‘robo-adviser’ may only be programmed:

- for a specific given situation;
- to consider investments from a given financial organisation; or
- to consider a limited number of factors such as time horizon for investing, age, financial and tax situation but may not take into consideration future changes in an individual’s circumstances.

The EU regulation on automated processing and decision-making

In 2016, the European Parliament finally adopted the General Data Protection

Regulation 2015 (GDPR)¹⁴ which replaced the 1995 Data Protection Directive when it came into operation in May 2018.

The EU has determined the benchmark for developments in the area of Automated Systems from the broader perspective of data protection and privacy law.¹⁵

Article 22 is the primary provision in the GDPR which provides for automated decision-making (including profiling). Article 22 prohibits a large range of algorithmic decisions based solely on automated processing unless the conditions stipulated in paragraph 2 of the Article are met. The conditions include receiving the explicit consent of the data user, authorisation under Union or Member State law, or for the performance of a contract between the user and the provider.

The Article grants an individual the right ‘not to be subject to any decision based solely on automated processing’, which would have legal consequences or significant for the individual.¹⁶

The text of Article 22 is reproduced below for the reader’s convenience:

1. *The data subject shall have the right not to be subject to a decision based solely on automated processing, including profiling, which produces legal effects concerning him or her or similarly significantly affects him or her.*
2. *Paragraph 1 shall not apply if the decision:*
 - (a) *is necessary for entering into, or performance of, a contract between the data subject and a data controller;*
 - (b) *is authorised by Union or Member State law to which the controller is subject and which also lays down suitable measures to safeguard the*

data subject’s rights and freedoms and legitimate interests; or

(c) is based on the data subject’s explicit consent.

3. *In the cases referred to in points (a) and (c) of paragraph 2, the data controller shall implement suitable measures to safeguard the data subject’s rights and freedoms and legitimate interests, at least the right to obtain human intervention on the part of the controller, to express his or her point of view and to contest the decision.*
4. *Decisions referred to in paragraph 2 shall not be based on special categories of personal data referred to in Article 9(1), unless point (a) or (g) of Article 9(2) applies and suitable measures to safeguard the data subject’s rights and freedoms and legitimate interests are in place.*

There is no apparent definition in the GDPR for ‘automated processing’, but references in the text suggests that it would be ‘processing’ (as defined) carried out without any human intervention. Recital 71 of the GDPR provides ‘automatic refusal of an online credit application or e-recruiting practices without any human intervention’ as examples of ‘automated processing’.¹⁷

Recital 71 further suggests implementation of ‘appropriate mathematical or statistical procedures and technical and organisational measures’ to minimise inaccuracies and errors.¹⁸

The individual is further granted ‘the right to challenge’ the decision made by automated system and the right ‘to express his or her point of view’.¹⁹

In addition, the organisation providing the automated system is required to provide the individual with ‘meaningful information about the logic’ of an algorithmic decision and the significance and the envisaged con-

¹³ US Securities And Exchange Commission, ‘Investor Alert: Automated Investment Tools’ (May 8, 2015) <<https://www.sec.gov/oiea/investor-alerts-bulletins/autolistingtools.htm>>

¹⁴ Regulation (EU) 2016/679 of the European Parliament and of the Council on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (‘EU General Data Protection Regulation 2015’).

¹⁵ Contrast the Australian perspectives where the developments in areas of automated processing and algorithms are led by the Australian Securities and Investment Commission. See *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016.

¹⁶ EU General Data Protection Regulation 2015 art 22.

¹⁷ *Ibid* recital 71.

¹⁸ Refer to the comparative measures outlined in the Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016, 21.

¹⁹ EU General Data Protection Regulation 2015 art 22.3.

sequences of such processing²⁰ to 'ensure fair and transparent processing' to provide safeguards to protect the individual's rights, 'freedoms and legitimate interests'.²¹

How does one go about to explain the logic behind an algorithmic decision in human intelligible terms upon a challenge? What does it mean to challenge and how does one explain a decision made by an Automated System?

The answers to the above questions are not easy, may be highly complex and technical. An individual would reasonably require some understanding of the logic behind an algorithmic decision in reasonably human intelligible terms to undertake such a challenge.

Reading and comprehending the code of an algorithm require specialised computational skills which are not readily available amongst non-technical circles. There is also added complexity in the dimension, as algorithms may operate alongside input data which one may not have much control over. In the context of the rapidly evolving learning machine algorithm, the internal logic of an algorithm may also be altered as it 'learns' from the training data.²²

In situations through machine learning – where algorithms and decision rules are "trained" using data and historical examples to recognize patterns in the data and to learn to make future decisions based on these observations, regulators and consumers may not easily discern about the properties of these algorithms.

We have a maxim in computing: garbage in; garbage out. We have to be careful about which data is being fed to machine-learning algorithm, as any data bias/statistical distortion will be learned and amplified. As machine learning develops,

algorithms often become even more complex over time, to the point where it can become difficult to articulate and understand the inner workings- even to people who created them.

If the decision rules are not explicitly programmed by a human but rather inferred from data, how do we build in checks and balances – to hopefully ensure, a future of ethical design?

The UK Information Commissioner has provided an overview of the General Data Protection Regulation (GDPR).²³ The Information Commissioner has provided guidance as to what is required to ensure that the appropriate measures are in place under Article 22(3) to safeguard the data subject's rights, freedoms and legitimate interests and the ability of the data subject to 'challenge' the automated decision making. The measures as stated include:

- the provision of meaningful information about the logic involved with the algorithmic automated processing, as well as the significance and the envisaged consequences to ensure fair and transparent processing;
- the adoption and use of appropriate mathematical or statistical procedures for the profiling;
- the implement of appropriate technical and organisational measures to enable inaccuracies to be corrected and minimise the risk of errors; and
- securing personal data in a way that is proportionate to the risk to the interests and rights of the individual and prevents discriminatory effects.²⁴

The GDPR is now approaching its first anniversary, and it would be interesting as to how the EU courts would interpret the

requirement under Article 13 to provide the individual with 'meaningful information about the logic' of an algorithmic decision.²⁵ While novel and honourable in its approach, the EU perspective may require the assembly of specialists to decipher and explain algorithmic code which might be highly technical and complex.

I am not personally persuaded that the automated processing provisions outlined by the EU could be easily complied with without much fear and anxiety after my analysis of the subject. From my technical reading of Jenna's article on 'How the machine "thinks": Understanding opacity in machine learning algorithms'²⁶ and Goodman's article²⁷ on 'EU regulations on algorithmic decision-making and a "right to explanation"', further research would be needed before one may draw any satisfactory conclusion on the matter.

Driven by the recent EU developments, volumes of literature have and are being written on the subject in recent times – ranging from articles in scientific magazines such as *New Scientist* to serious technical academic journals. The debate has accelerated since the EU General Data Protection Regulation came into effect.

Regulatory approaches taken by ASIC to the regulation of automated financial product advice using algorithms (also referred to as 'Robo-Advice')

Unlike the EU position, the Australian ecosystem has not matured to the extent to consider automated decision-making and processing in the context of privacy and data protection laws. Developments in automated decision-making and processing have largely been confined to the financial sector.

²⁰ Ibid art 13.2(f).

²¹ Ibid art 22.2(f).

²² For a good exploration of the issues and the complexity arising from machine learning algorithms including neural networks refer to Jenna Burrell, 'How the machine "thinks": Understanding opacity in machine learning algorithms' (2016) *Big Data & Society* 5.

²³ UK Information Commissioner's Office, *Overview of the General Data Protection Regulation (GDPR)*. Accessed online April 2019 at <<https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/rights-related-to-automated-decision-making-including-profiling/>>.

²⁴ Ibid.

²⁵ EU General Data Protection Regulation 2015 art 13.2(f).

²⁶ Jenna Burrell, 'How the machine "thinks": Understanding opacity in machine learning algorithms' (2016) *Big Data & Society* 5.

²⁷ Bryce Goodman and Seth Flaxman, 'EU regulations on algorithmic decision-making and a "right to explanation"' (Paper presented at the ICML Workshop on Human Interpretability in Machine Learning)

In March 2016, ASIC released a consultation paper 254²⁸ seeking the views of the financial services industry as to how 'robo advisers' should be regulated. Following a short consultation period, ASIC released its regulatory guidance in August 2016, pertaining to the provision of automated financial product advice using algorithms and technology without the direct involvement of a human adviser.²⁹ The guidance defines 'robo-advice' as the "provision of automated financial product advice using algorithms and technology without the direct involvement of a human adviser.

ASIC consulted with stakeholders in relation to the practicality of requiring expertise to explain on the scope, design, rules and risks behind the algorithms used to provide the automated digital financial advice.

The ASIC regulatory guide maintains that the law is technology neutral and requires a FinTech providing financial advice services under the Corporations Act to hold an Australian financial services licence or become an authorised representative of a licensed holder, unless exempted.³⁰ It also expands on how the 'organisational competence obligation'³¹ would apply to 'robo advisers' and how the algorithms deployed in 'robo-advisers' should be tested and monitored.

The guidance requires that a business carrying out 'robo advice' must have at least one person within the business who understands the 'rationale, risk and rules' utilised in the algorithms and the technology³² and with the skills to review the resultant 'robo advice'.³³

ASIC laid down 8 guidelines in relation to the monitoring and testing of algorithms.³⁴

The extend and applicability of these measures would ultimately depend on the complexity, scale and nature of the financial services provided.³⁵

These measures stipulated include:³⁶

- keeping appropriate records of changes to the algorithms for seven years;
- maintaining algorithms currency in conformance with legal and market changes;
- documenting the decision rules including the scope, design and purpose of the algorithm displaying possible results and decisions;
- documenting the strategy and scope for the testing of the algorithms;
- managing changes to the algorithm including security and access to the algorithm;
- ability to suspend the 'robo-advice' using algorithm in the event of an error;
- maintaining appropriate human and technological resources, to supervise and monitor the operation of the algorithms; and
- processes to ensure that the appropriate measures are followed.

The above compliance measures are more extensive than the UK Information Commissioner's guidance³⁷ provided under the EU General Data Protection Regulation (GDPR).

However, the ASIC position does not go as far as the EU position in providing an explicit 'right to explain' and the 'right to challenge' on the decision made by automated systems and algorithms. The ASIC regula-

tory guidance does not place an explicit onus on the algorithmic provider to explain the logic behind an algorithmic decision in human intelligible form. Unlike the EU position, this may be largely intentional as the coding and design in the algorithm as expounded above, may pose highly complex and technical considerations which may be beyond the skillset of an average person working in the financial sector.

In addition, the logic behind an algorithm may comprise confidential trade secrets and other legal concerns. A forced disclosure of the logic behind an algorithm would be problematic for FinTech startups as they might lose their competitive advantage and the confidential protection of their trade secrets due to the disclosure.

On the other hand, there could be looming issues on concealment or non-disclosure in line with the concerns raised by Pasquale in his book, *The Black Box Society: The Secret Algorithms that Control Money and Information*, if we would allow 'robo-advisers' and their organisation to 'keep [their] doings opaque on purpose, precisely to avoid or to confound regulation'.³⁸

Hodson in his article 'Taming the tech giants' in *New Scientist*³⁹ raised concerns on the ability of society to hold global companies to account. He intimated that 'technically minded people' who understand the impacts of technology platforms on the autonomy of individuals should be recruited into regulatory bodies such as ASIC as a priority. However, I believe that the above may be an interim solution until the average financial advisers are

²⁸ Australian Securities & Investments Commission, *Regulating digital financial product advice*, Consultation Paper 254, March 2016 ('ASIC CP 254').

²⁹ Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016. Accessed online April 2019 at <<https://asic.gov.au/regulatory-resources/find-a-document/regulatory-guides/rg-255-providing-digital-financial-product-advice-to-retail-clients/>>.

³⁰ Ibid [RG255.18].

³¹ *Corporations Act 2001 (Cth)*, s912A.

³² Australian Securities and Investment Commission, *ASIC Regulatory Guide 255: Providing digital financial product advice to retail clients*, August 2016, [RG255.62].

³³ Ibid [RG255.61].

³⁴ Ibid [RG255.74].

³⁵ Ibid [RG255.73].

³⁶ Ibid [RG255.74].

³⁷ UK Information Commissioner's Office, *Overview of the General Data Protection Regulation (GDPR)*. Accessed online April 2019 at <<https://ico.org.uk/for-organisations/guide-to-data-protection/guide-to-the-general-data-protection-regulation-gdpr/individual-rights/rights-related-to-automated-decision-making-including-profiling/>>.

³⁸ Pasquale F, *The Black Box Society: The Secret Algorithms that Control Money and Information* (Cambridge, MA: Harvard University Press 2015) 2.

³⁹ Hal Hodson, 'Taming the tech giants', (3 September 2016) *New Scientist* 16.

educated and trained in the new art of 'explaining the logic behind an algorithmic decision in human intelligible terms'.

Should regulators hold developers and providers of Robo-advice to comparable competency standards demanded from human actors? What should be the background and competence of designers and developers of Robo-advice? For instance, should it be a group comprising only of expertise in computer science, maths and statistics or an interdisciplinary group composed by financial advisers, social scientists, lawyers and expertise in computer science, maths and statistics?

Should Australia follow the lead taken by the EU, by expanding the penalty provisions in the Australian Privacy Act 1998 for serious or repeated interference with privacy? The GDPR now sets out new maximum fines of the greater of €20 million or four percent of an undertaking's worldwide turnover. The Australian Privacy Act already provides for the Australian Privacy Commissioner to issue million-dollar fines for serious and repeated privacy breaches. Would raising the stakes focus the mind, especially amongst multinationals?

Conclusion

'Digital disruption' is here to stay and is transforming our economies, businesses, industries, governments and communities including the financial advisory sectors. Many of our laws were drafted at a time before the onset of automated, 'robo' or algorithmic decision-making systems.

As we grapple with the transition from the 'bricks and mortar' to the digital economy, we discover that the old ways of doing things and the regulatory framework supporting them are no longer appropriate and applicable to safeguard our interests and relationships. Clearly the times ahead are both interesting and challenging, as we come to grips as to that it means to legislate and to regulate in the new world of automated, 'robo' or algorithmic decision-making systems.

For the first time, technology innovation is not only automating the repetitive and the manual aspects of our labour but also gradually supplementing, enhancing and replacing our 'minds' and our advisory services with the evolving introduction of the learning algorithmic machines.

In this short article, I have drawn on but some of the difficulties in this new endeavour. The chapter is but no means closed, but computational skills including design, coding and deciphering of algorithms may be useful skills to have in all walks of life moving into the future.

To overcome the loss of confidential trade secrets on a forced disclosure of the logic behind an algorithm, perhaps a middle ground could be adopted by deploying independent 'trusted auditor' as suggest by Parquale.⁴⁰

Recently, one commentator indicated that innovation is putting 'the power in the user's hands, without the need for a human advisor.'⁴¹ However, as indicated by Steiner, 'algorithms can and will do strange things. As ...we can lose track of who or what is pulling the strings.'⁴²

When things go wrong and investments are not realised, would 'robo-advisers' be called upon to 'account at the end of the telephone line to answer the hard questions'. We are at the precipice, and this article only captures the tip of the iceberg in a world undergoing rapidly disruptive change.

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