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The Future of International Arbitration in the Age of Artificial Intelligence

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This article postulates that there will be two stages for the implementation of Artificial Intelligence (AI). In the short term, the first stage will lead to a complementary relationship between predictive machines and humans. After the cost of prediction decreases, new players come to the arbitration arena and the flow of capital to finance AI's use in international arbitration is widely available, we will see the second stage's outset where predictive machines will assist in more sophisticated tasks. AI may assist counsel in crafting arguments, and arbitrators in comparing evidence submitted, and finding conflicting fact patterns in the evidence. AI may even decide some aspects of a case. This requires a new division of labour. Lawyers will have to adapt and learn to delegate to such machines while being aware of their limitations. In response, new arbitration specialties will inevitably emerge. However, flesh-and-blood arbitrators will not be eliminated. While predictive machines may be able to decide certain aspects of arbitrations quickly and at a lower cost, the amount of data, the lack of repetitive patterns, inconsistencies, and parties' agreement that the award shall remain confidential and state the reasons upon which it is based may hinder their capabilities. The current legal framework seems to require drastic changes to make way for AI.

'AI is probably the most important thing humanity has ever worked on. I think of it as something more profound than electricity or fire'. Google's CEO, SundarPichai, 2018

'Tomorrow's legal world … bears little resemblance to that of the past'.

Richard Susskind, *Tomorrow's Lawyers*, 2017

'The best way to predict the future is to invent it'.

Alan Kay, 1971

1 INTRODUCTION

The world is at a tipping point where Artificial Intelligence (AI) will allow us to see (1)
P 302 unique economic, social, and cultural changes. (2) In the future, arbitration will ● be different. This article postulates that there will be two stages. In the short term, the first stage will lead to a complementary relationship between predictive machines and humans. AI will assist arbitrators, arbitral institutions, and counsel, but in the end, humans will make the decisions. This human-technology complementarity will reduce routine activities, making the process of arbitration more efficient. In fact, we are living at the outset of this first stage. After the cost of prediction decreases, new players come to the arbitration arena and the flow of capital to finance AI's use in international arbitration is widely available, we will see the second stage where robot-arbitrators (3) or predictive machines will assist in more sophisticated tasks. However, flesh-and-blood arbitrators will not be eliminated. While predictive machines may be able to decide certain aspects of arbitrations quickly and at a lower cost, the abundance of data and parties' agreement that the award shall state the reasons upon which it is based (4) may hinder their capabilities.

New arbitral institutions and appointing authorities will emerge, and they will have AI as a pillar of their decision-making. Lawyers will then have to adapt and learn to delegate to such machines while being aware of their limitations. In response, new arbitration specialties will inevitably emerge, including lawyers with expertise in algorithm development, machine training, data interpretation, and responsible AI support to safeguard the integrity of the arbitration process. AI may assist counsel in crafting arguments, and arbitrators in comparing evidence submitted, and finding conflicting fact patterns in the evidence. AI may even decide some aspects of a case. While the future for AI is promising in making arbitration more efficient, the current legal framework seems to require drastic changes to make way for AI. Some will be hesitant and critical with well-founded fears, but we need to be prepared if we want to capitalize on the potential of AI in arbitration.

In the transition to subsequent stages, the arbitration world will become even more competitive. Gradually, as technology prices become cheaper, algorithms may replace a part of the workforce. (5) In 2020, McKinsey & Company estimated that 23% of lawyer's
P 303 work can be completed by automated technology. (6) Although ● AI will disrupt arbitration, lawyers will not disappear. In those areas where AI carries out certain activities better than humans, like document review or conflict checks, machines may take portions of current jobs.

Job displacement is due to the exponential pace of technology. Gordon Moore, one of the founders of Intel, postulated Moore's Law in which he projected that every two years the processing power of computers would double. (7) With this law, Google guru Ray Kurzweil predicts that at this rate, by 2050 the equivalent of a desktop computer will have more processing power than all the brains on Earth. (8) Others believe that machines will be able to perform professions as well as humans by 2075 or 2100. (9) However, others remain sceptical. (10)

The advances will be far more astonishing than science fiction writers imagined in certain sectors, but in arbitration, three factors will restrict these advances: (1) lack of data; (2) flaws in the data; and (3) lack of repetitive patterns and inconsistencies.

Today, AI is a reality, whether we realize it or not. AI filters spam emails, assists in contract analysis, legal research, and electronic document production (e-discovery). In arbitration, AI has been predicted to be used for a wide variety of tasks, including the appointment of arbitrators, legal research, proof reading briefs, translations, case management and document organization, cost estimation, stenographic services, simultaneous interpretation, and drafting standard sections of an arbitration award such as the procedural history. (11)

Considering what the future of arbitration will look like, we look at whether the results that arbitrators and lawyers produce today can be replicated with technology. (12) Where do machines outperform lawyers? Where do lawyers have advantages over machines? Where will arbitrators not be replaced by technology? (13) What new skills do lawyers require? What limitations does AI have? When will this happen?

No one has a crystal ball to reveal all the answers to these questions. No one can predict the future in detail. (14) However, current uncertainty gives rise to necessary questions. All we can do is try to understand an answer to the best of our abilities, (15) in this case
P 304 by bringing to light some of the broader trends emerging ● from the interaction of AI and lawyers. (16) As such, this article does not pretend to be an oracle of prediction but is the fruit of research, attempting to answer concrete questions, awaken interest in AI and its impact on arbitration, present potential applications of AI to arbitration, explore alternative futures, which may be possible, probable and preferable, and inspire the future development of AI in arbitration.

This article begins by exploring AI and its implementation through rule system and machine learning. Second, it explores the importance of data for AI and how the confidentiality of arbitration plays to the detriment of the capacity for AI to fully assist lawyers. Third, it explains the magic of AI for prediction in arbitration. Fourth, it addresses how, with the advancement of technology, the distribution of work will be revolutionized. Fifth, the work process is then broken down to analyse where and how AI can be implemented. This article also answers the question: when will it happen? Sixth, regarding the second stage, this article will assess what opportunities AI has to solve arbitrations, casting doubt on the viability of the current legal framework to fully exploit AI in the future. Then, the author proceeds to conclude.

2 AI AND MACHINE LEARNING

This section introduces AI, as well as the rule system and machine learning, which are the two ways of implementing AI.

United Nations Educational, Scientific and Cultural Organization (UNESCO) provides the following updated and comprehensive definition of AI:

> AI systems are information-processing technologies that integrate models and algorithms that produce a capacity to learn and to perform cognitive tasks leading to outcomes such as prediction and decision-making in material and virtual environments. AI systems are designed to operate with varying degrees of autonomy by means of knowledge modelling and representation and by exploiting data and calculating correlations. AI systems may include several methods, such as but not limited to: (i) machine learning, including deep learning and reinforcement learning; (ii) machine reasoning, including planning, scheduling, knowledge representation and reasoning, search, and optimization. (17)

AI is 'making a machine behave in ways that could be called intelligent if a human were so behaving'. (18) Also, AI is the theory and development of computer systems to perform tasks that require human intelligence, such as visual perception, speech recognition,
P 305 decision-making, and language translation. (19) ●

The first way to implement AI is through 'rule system' or 'expert system'. In this system, rules are encoded into the system as 'if x occurs, then y'. The main idea of this system is to capture the knowledge of a human arbitration expert lawyer and transfer that expert knowledge into a computer system; the knowledge is encoded as rules. Given that programmers set the code, they can easily correct flaws. This system is limited by the size of its rules, so it is said to have a rigid intelligence. The AI that the expert systems can implement is always narrow. (20)

The second way to implement AI is through 'machine learning', which refers to computer programs that learn from experience and improve their development over time. When we speak of 'learning' we are not referring to a cognitive process thought of as human learning, but to a parallel, functional sense of learning; that is, the ability to change behaviour through experience over time. (21) However, intelligence is not just a matter of acting or behaving intelligently. Behaviour is intelligence's manifestation but not the essential characteristic of being intelligent. (22)

Machine learning creates its own models or rules as if by magic. Machine learning programs extract and develop the algorithms from the data they process. Unlike expert models or rule systems, the programmer does not need to write the rules or code the algorithm, nor does it use logic as a normative principle. Machine learning, as neural networks, uses pattern recognition, and constructs probabilistic methods; there are no defined rules. Neural networks use massive amounts of data to 'learn' repeat patterns, relevant features, and continually improve with feedback. These networks use an inverse approach; i.e., they *extract* or *deduce* the hidden factors and patterns available in the data they process. The method is predictive, calculating the probability of a given outcome based on the extraction and continuous improvement of the algorithm. (23)

Machine learning has produced amazing results. One example is the use of predictive coding for document review. Attorneys frequently use predictive coding – a form of supervised machine learning – to classify documents. An algorithm identifies a relevant document or documents responsive to a document request or a tribunal order. Humans
P 306 train the algorithm by 'coding' or ● 'tagging' documents as relevant or not relevant, responsive or not responsive, privileged or not privileged. After tagging a sample, the algorithm will provide a result. (24)

Table 1 Differences Between Systems of Rules and Machine Learning

Type of System	*How the Machine Acquires Knowledge?*	*Coding?*	*Summary*
Rules or experts	The knowledge of an expert arbitration lawyer is transferred to a computer system	Knowledge is coded as rules (rigid intelligence)	If 'x' occurs, then 'y'
Machine learning	Computer programs learn from experience and improve their development over time	The rules are not written, and the algorithm is not coded. There are no hard and fast rules	It creates its own models or rules like 'magic'. The algorithms are extracted from the processed data: Google translate, DeepL spam mail

Another example of machine learning is the product of translation programs. Programmers do not need to code the rules or algorithm for the program to translate; the program uses massive amounts of available documents in various languages to 'learn' the relevant elements and continuously improve. (25)

These types of models are known as neural networks because they try to reconstruct the human brain, the premier demonstrator of intelligence as we know it. (26) Therefore, programmers of neural networks construct layers of artificial neurons to receive and transmit information in a structure similar to biological neurons. Nonetheless, 'unlike the rule-based approach, builders of neural networks generally do not give the networks rules to follow in making decisions. They simply feed lots … of examples of a given phenomenon' like pictures, emails, or sounds 'into the neural networks and let the networks themselves identify patters within the data'. (27) For example, when attorneys
P 307 ● feed a program with a large number of relevant or responsive documents, the program can develop the algorithm necessary to classify emails relevant or not relevant, responsive or not responsive, and privileged or not privileged. Repeated patterns of documents help to detect future documents with the same characteristics to classify them as relevant/not relevant and privileged/not privileged.

A computer's search for hidden patterns is illustrated in the term *data mining*, which is one type of machine learning. The analogy alludes to miners digging through tons of earth in the mine to find precious material. In the context of AI, data mining programs remove large amounts of data in an attempt to develop a relevant and accurate model (28) to predict future cases. This may take the form of classifying documents as relevant, not privileged, and so forth. This is of particular interest in the legal context, (29) because it accelerates tedious legal tasks like document review, and decreases costs. However, there exists a problem for developing data mining in arbitration: data in arbitration is scarce. Of course, document review is the exception.

3 DATA AND ITS SCARCITY IN THE WORLD OF ARBITRATION

Data is vital for machine learning based on probability inference models. The programs develop the algorithms that solve the tasks by processing the data. The larger the data sample, the more accurate the predictive value of the model. Nonetheless, in the

arbitration world, there are multiple factors limiting the predictive value potential of machine learning models. As such, this article will explore the following four foundational problems: (1) lack of information; (2) the available amount of data; (3) lack of repeated patterns; and (4) flawed data.

The first problem lies in the lack of information. Arbitral awards, mainly commercial, are generally not public. Confidentiality of arbitral awards inherently limit the availability of data. Of course, there are some publicly available materials: procedural orders and awards in investment arbitration (30) ; maritime arbitrations by the Society of Maritime
P 308 Arbitrators (31) ; sports arbitration by the Tribunal Arbitral du ● Sport (32) ; international trade arbitrations by the World Trade Organization (33) ; as well as arbitrations with public law bodies. (34)

However, available commercial arbitral awards are generally limited to those cases that are enforced and become public or when parties publish them. Some institutions publish edited versions or abstracts of cases. The International Court of Arbitration of the International Chamber of Commerce (ICC), the International Centre for Dispute Resolution (ICDR), the Singapore International Centre for Dispute Resolution (SIAC), and the Stockholm Chamber of Commerce (SCC) publish versions of selected awards with permission of the parties excluding certain data. (35) The inability to constantly gain access to awards from different jurisdictions around the world is a real problem for AI and machine learning. In the absence of data at least Jus Mundi, (36) Kluwer Arbitration Practice Plus, (37) Arbitrator Intelligence, (38) and Global Arbitration Review Arbitrator Research Tool (GAR ART) (39) have developed methods and techniques to compile and organize some of the available information.

These four institutions provide foundations to solve AI's major problem because they compile, organize and make information available for lawyers. Additionally, Jus Mundi and Kluwer Arbitration Practice Plus have started to capitalize on data collection benefits and AI by developing the 'conflict checker' tool, proving how an algorithm can save time and costs for a client. These new players may revolutionize arbitration if they keep developing AI tools.

The second problem lies in the amount of data available. Areas of law with large numbers of accessible decisions on a given issue will be more suitable for AI models. While there is no minimum, the more data there is, the more accurate the model will be. But how much
P 309 data is needed? Certainly, more data will improve ● prediction. Conversely, when we deal with the *value* someone gets from a prediction, and how data improves this *value*, the amount of data is not so significant. From a statistical point of view, data have decreasing returns to scale: as you get more data each piece is less *valuable.* You get more marginal *value* from a third observation than from the hundredth observation. As observations are added to the training data, it becomes less useful for increasing the number of predictions. (40)

Agrawal, Gans and Goldfarb illustrate this with an example of how long it takes a person to go to the airport. If this person has never been to the airport before, the first time he or she goes will give a lot of useful information. The second and third times will give an idea of how long it normally takes to get to the airport. However, after a hundred times, this person will not learn much about how long it takes to get to the airport. Therefore, they argue that data has decreasing returns to scale, as you get more data, each additional piece is less *valuable.* This refers to the *value* you get from a prediction, *not how you improve the prediction.* (41) In law, this happens, for instance, when a Supreme Court renders a decision to resolve Circuit splits, i.e., when two or more Circuits reach opposite interpretations and Supreme Courts create a unified interpretation of the law which binds all lower courts. Then each additional decision is less valuable to the prediction, because all lower courts will at least theoretically 'rule the same way'. Subsequent decisions by the judiciary in the same sense are not going to substantially change the observations that a lawyer might make. Again, this assertion relates to the 'value' someone gets from the prediction, and how data improves this value, not how data improves the prediction; nor does it refer to when the judiciary seeks to unravel vague concepts, like the meaning of public policy that gives rise to an award's annulment. Depending on the breadth of the arbitral concepts, more or less decisions will be required to predict the outcome of future cases.

The third problem lies in the lack of repetition in arbitration patterns. As arbitration encounters more dissimilar, unique and non-repetitive cases, AI models will encounter greater hurdles in their development. (42) For example, in investment arbitration, while there exists recurrence of standards, there are also inconsistencies in cases mainly because there is no doctrine of precedent or *stare decisis.* (43) More generally, in international law, there exists no doctrine of binding precedent or *stare decisis* either.
P 310 'Most, if not all, statutes of international courts ● and tribunals provide that the decision is binding only for the parties to the dispute'. (44) Inevitably, therefore, there are inconsistent decisions regarding the jurisdiction *ratione materiae* of investment tribunals. For example, several cases apply the *Salini* test, (45) and numerous cases reject it. (46) As another example, there exist cases that are in favour of applying the most favoured nation clause to import more favourable dispute settlement provisions (47) and cases
P 311 that reject ● them. (48) This factor is compounded by the complexity and details of the cases; for example, the text of treaties may not be uniform across several languages.

Although the ICC leads the pathway of arbitration cases, the problem of lack of patterns from which to develop predictive models may be persistent. (49) Assuming that in all the 25,000 ICC cases tribunals rendered awards and procedural orders, one would have to consider that the awards (1) are issued in English, French, Spanish, Portuguese, and German, primarily; (2) the law applicable to the merits varies and has changed through the years; (3) the seats of arbitration are different; and (4) even the cases and awards are based on different version of the ICC Arbitration Rules. One constant appears in the New York Convention, which has remained unchanged since it entered into force in 1959, but case law has changed.

Fourth, the data taken from arbitration decisions can be tainted by human biases, and machine learning algorithms can perpetuate the bias. (50) Thus, those biases will form the base of algorithmic decisions, and they will possibly even exaggerate them by setting
P 312 them as 'truth' for their future decisions or predictive ● outcomes. (51) Suppose that in investment arbitration, there really is a bias in favour of investors. In that case, an AI model based on investment arbitration data would disproportionately perpetuate such investor favouritism. (52)

Therefore, it matters how systemic errors in algorithms are resolved. In rule systems, where a human programmer codes the algorithm, the error will be in the design of the algorithm itself and can easily be corrected when the error is detected. In contrast, in machine learning systems, where the algorithm is extracted from the data, the error is in the data. These errors are more difficult to detect and fix. (53)

Moreover, in machine learning, programs are influenced by both training data and continuous experience and input to improve over time. Microsoft's Tay provides an undesirable example. In 2016, Microsoft launched Tay, an AI-driven bot that appeared on Twitter. Tay was designed to personalize interactions with users while answering questions or mimicking user phrases. As it learned and responded to the community with tweets, the bot began tweeting racist and offensive comments. Tay was terminated within hours. (54) This led Microsoft to identify six AI principles, which should guide AI development and use: fairness; trustworthiness and safety; privacy and security; inclusion; transparency; and accountability. (55)

Mindful of the positive and negative impacts of AI on societies and human lives, interaction, and decision-making, in 2021, UNESCO adopted a Recommendation on the Ethics of AI that pays specific attention to ethical implications of AI regarding education, science, culture, and communication and information. (56)

Now understanding the relevance of data and its challenges in arbitration, it is time to understand how the magic of AI occurs.

4 THE MAGIC OF AI AND MACHINE LEARNING

Machine learning uses probabilities to solve problems. A program recognizes patterns through statistics and probability calculations. The program calculates the probability for each factor or combination of factors and observes that the probability leads to an outcome. Example: if the words 'sex' and 'Viagra' appear in an email the chances are high
P 313 that it is spam. (57) So why do we refer to machine ● learning as AI if it *does not entail intelligence per se*; that is, a human cognitive procedure? Because the output of machine learning, *prediction*, is a key component of intelligence. The accuracy of prediction allows machines to perform 'intelligent' tasks that were once associated with humans.

Prediction, the main function of the neocortex, is the basis of human intelligence. (58) The neocortex, neopallium, or isocortex is the name given to the most evolved areas of the cerebral cortex. The neocortex areas constitute the most recent neuronal mantle (pallium) that covers each cerebral lobe of mammals. The neocortex occupies around 70% of a human brain's volume and 'is responsible for everything we associate with intelligence from our senses of vision, touch and hearing, to language in all its forms, to abstract thinking'. (59) In fact, your neocortex is reading this article and making sense of it. (60)

Our neocortices learn a model of the world through memory and make predictions based on that model. As such, lawyers' brains can create a predictive model of the arbitration field. (61) Attorneys' brains build a model of the world using thousands of maplike reference frames from memory that the brain uses to plan and think. (62) Thus, lawyers recall provisions of the New York Convention or the *lex arbitri* and use that reference frame to craft an argument supporting the jurisdiction of the arbitral tribunal.

We refer to the word 'prediction' from two perspectives. First, 'predict' comes from the Latin '*praedicere*' which means to make known in advance. Our understanding of prediction emphasizes the possibility of seeing hidden information, whether in the past, present, or future. Thus, prediction takes available information known as data, and uses it to generate information that is not available. (63) Second, in espionage, prediction is also 'intelligence' because the machine obtains useful information. The better the prediction, and the better the information: the better the decision-making. (64)

Lawyers may not realize it, but our lives and their practices are full of predictions. The ability to make predictions is a central contribution to legal decision-making. When a

P 314 client seeks legal advice to initiate an arbitration, the client seeks to assess the case's chances of success. To that end, the lawyer will make predictions about opposing party's defences and objections, or whether to advise settlement. (65) It is unlikely that a lawyer will initiate arbitration if he or she sees unsuccessful odds against the client. Even in such cases, arbitral institutions have set a screening process that filters out, by initial review, arbitrations manifestly outside the institution's jurisdiction. (66) There are also expedited procedures for 'raising an objection concerning the manifest lack of legal merit of a claim'. (67)

In turn, arbitrators make predictions and act accordingly so as to render an enforceable award. That is why the 'Tribunal's obligation as guardian of the legitimacy of the arbitral process is to make every effort to ensure that the Award is soundly based and not affected by procedural imperfection'. (68) The arbitrator constantly assesses how best to safeguard the integrity of the proceedings against a party who wants to sabotage them. There is even a paranoia of due process that has led arbitrators to grant unreasonable procedural motions, thus, prolonging the proceedings. (69)

As arbitrators and lawyers age, their ability to predict becomes more accurate and their predictions become more realistic. However, when the predictions are incorrect and do not accurately anticipate the future, we notice the anomaly and this information feeds into our brain, which updates the algorithm to learn by improving the model. (70)

'At this point, we should remember that the aim of machine learning is rarely to replicate the training data but the correct prediction of new cases'. (71) The first step in supervised learning is to create a labelled dataset. We may acquire a file containing thousands of court decisions confirming or enforcing awards, and thousands of decisions vacating awards, with each decision labelled appropriately. The data is then split between training and validation data. Training data is used to determine the parameters of the model that generates the prediction of the outcome: whether a given decision depicts a confirmed or annulled award. After the model is trained, the validation data is used to
P 315 test the model's accuracy. The model makes its predictions on the validation data; we can then compare these predictions to the expert prediction and assess the model's quality. (72)

Models predict by calculating the average from past data. For example, to find out if an arbitrator incurs a conflict of interest that would result in a vacated award, you can look at what the judiciary has ruled recently. An average of those decisions will be the most accurate indicator. If a judge has vacated an arbitration award on these grounds in the past, you can predict that the probability of another court vacating the case is that percentage.

Information can be adjusted to consider different approaches from distinct jurisdictions (73) by predicting the outcome of a case in a particular jurisdiction or by a particular court. Thus, we may create a labelled dataset with the distinct decisions for a model to predict by calculating the average from past data. Of course, to improve accuracy, we would need thousands of decisions. This model would help arbitral institutions to determine the existence of conflicts and its effects. The model could also serve counsel and parties to assess the chances to vacate an award.

With this, it is worth studying where it is more efficient to replace humans with machines.

5 NEW DIVISION OF LABOUR IN ARBITRATION

AI has the potential to change the way cases are prepared, including selecting arbitrators based on their performance; making arguments that are more persuasive to those arbitrators; reducing the time and cost of legal research; and preparing more realistic fee arrangements. In the immediate future, arbitral institutions and arbitrators will be assisted by rule systems and machine learning systems that will enable them to conduct arbitrations faster and at a lower cost. Likewise, law firms will have greater support in predictive machines that allow them to analyse data.

5.1 Division of skills between machines and lawyers

To address the division of labour, it is necessary to determine in which areas humans have better predictions and in which areas machines are stronger. Therefore, it will be foundational to segment the areas of work in arbitration to detect where humans are still indispensable and where machines can help us. To address this issue, Agrawal, Gans and Goldfarb have structured the subject from four approaches, which this article adopts. (74)
P 316

First, what Agrawal, Gans and Goldfarb deem as 'known knowns' occur when we have a wealth of data, so we *know* we can make good predictions. With abundant data, machines know the situation and can predict accurately. (75) For example, Lex Machina does litigation data mining through court dockets to reveal knowledge of judges and counterparties. Lex Machina can show how likely a judge is to grant or deny a motion for summary judgment. (76) Databases analysing document review can also produce known knowns.

Regarding known knowns, predictive machines are very valuable because (1) they can

produce predictions faster, better, and cheaper than humans; (2) their prediction is key in making decisions under uncertainty; and (3) decision-making is ubiquitous in our economic and social lives as long as data are abundant. (77) Two examples illustrate this:

(1) A machine can tell if a person is lying in court with 90% accuracy, while humans can tell with 54% accuracy. (78)

(2) Predictive machines now exist that can predict how judges will vote. One program proved that it outperformed humans in predicting the voting of US Supreme Court justices. The program achieved a 75% correct predictability rate, while eminent lawyers and professors could only achieve 59.1%. (79) Another recent model achieved 79% accuracy in predicting all cases of the European Court of Human Rights. (80)

Second, 'known unknowns' occur when there is very little data, which makes prediction difficult. The little data places machines at a disadvantage. As noted, the best prediction models require large amounts of data. Although scientists are working on techniques such as 'one-shot learning' to make machines learn well after observation, thereby reducing the need for data, these techniques are not yet effective. Here, lawyers have a niche opportunity. Unlike machines, humans are good at predicting with little data. We can
P 317 recognize the face of a classmate ● from fourth-grade forty years later, having never seen him or her before despite the changes. (81)

However, little data for a machine leads to a poor prediction because we know what we do not know. In some cases, we do not have data because we deal with sporadic events (82) ; one arbitration example relates to security for costs. In investment arbitration, tribunals have consistently ruled that exceptional circumstances are required to grant security for costs. (83) To date, only few published cases exist in which tribunals have ordered claimants to provide security for costs in favour of the respondent, (84) and one court judgment. (85) If a machine cannot observe enough human decisions to determine those exceptional circumstances needed to obtain security for costs, it cannot predict the underlying judgment of those decisions.

In practice, lawyers solve known unknowns with analogies because they are useful tools for filling in gaps. In fact, the author has constructed this article with analogies. By drawing similarities or differences between cases or rules, lawyers apply a rule designated for a similar situation to a case that is not specifically regulated, (86) i.e.,
P 318 'because A and B are analogues, a rule X which ... is applicable to ● A is also applicable to B'. (87) With analogies, attorneys compare similar patterns. During their process, lawyers transfer meaning (X) from context A (the source), which is a familiar situation viewed as parallel, to the context B (the target). In doing so, lawyers learn about this new situation, which is supposed to be incomplete and in need for completion using the source A. (88) In some instances, lawyers may use analogies as tools to predict where gaps exist or to fill the gaps.

Considering that machines have limited capabilities to deal with known unknowns, attorneys may exploit this niche by relying on comparative reasoning and analogies. As such, lawyers can understand the forces that shape the development of international arbitration. Moreover, the use of comparative reasoning to solve known unknowns makes sense given that in practice law-makers elaborate common standards, and courts ensure consistency and coherence based on comparative reasoning. (89)

As long as lawyers are better at deciding known unknowns than machines, human assistance will be necessary. A lawyer using a predictive machine may foresee known unknowns that a machine cannot, and can fill those gaps with analogies and comparative reasoning. (90)

Third, the 'unknown unknowns' are those events that are not recorded by experience or are not present in the data but are possible to happen, even if we are not aware of them, so prediction is difficult. To predict, you need to tell the machine what you need to predict. If something has never happened before, a machine cannot predict it. (91) We cannot predict true new events from past data. (92) For example, *Abaclat v. Argentina* was the first International Centre for Settlement of Investment Disputes (ICSID) case involving mass claims in an investment arbitration. In 2006, more than 180,000 Italian bondholders initiated an ICSID arbitration claiming that the Emergency Law violated the principle of fair and equitable treatment and constituted an expropriation of their investment. Thus, it was uncertain in that first case whether an ICSID tribunal had jurisdiction to adjudicate collective mass claims. (93) While the arbitration rules were the same prior to and after *Abaclat*, until this case, there was no ICSID precedent that raised the question.

Finally, we have the 'unknown knowns' which occur when there is a seemingly strong
P 319 association in the past resulting from some unknown or ● unobserved factors that change over time and make prediction difficult, and unreliable. Prediction machines fail precisely when it is difficult to predict based on the well-understood limits of statistics. (94) With the unknown knowns predictive machines can give very accurate answers but they can be wrong. If the machine does not understand the decision process that generated the data, its predictions may fail. (95)

Chess grandmaster Garry Kasparov comments on a funny anecdote when he and other colleagues wrote a program based on experiential learning in the early 1980s. They fed

the machine thousands of positions from Grandmaster games in the hope that the machine would be able to work out what worked and what did not. At first, the experiment seemed to work. Its evaluations of positions were more accurate than conventional programs. (96)

The problem came later when they let the machine start playing chess. The program would launch an attack and immediately sacrifice the queen. It lost in a couple of moves giving up the queen for nothing. Why did this happen? Grandmasters sacrifice the queen to deliver a masterstroke. However, for the machine, schooled in the moves of the grandmasters, giving up the queen was clearly the key to success. The machine was reversing the causal sequence. Not understanding that the Grandmasters sacrificed the queen only when there was a short and clear path to victory, the machine learned that chess is 'won' after giving up the queen. So, sacrificing the queen was the wrong way to success. Today this has been resolved; however, reverse causality is a challenge for prediction machines. (97)

In the arbitral world, we could feed the machine two investment arbitration cases to calculate the costs of arbitration and find a similar challenge. For the purposes of our example, we will first feed the machine the *Yukos v. Russia* case, including its three awards where the arbitral tribunal ordered Russia to pay over USD 50 billion in damages and to pay arbitration costs of EUR 4.2 million and representation costs of over USD 60 million. The plaintiffs claimed USD 80 million and the defendant USD 27 million. (98) We will also feed the machine with a second case: *David R. Aven and others v. Costa Rica*, (99) where the arbitral tribunal upheld its jurisdiction but dismissed all of the claimants' claims. The costs and fees claimed by the respondent were USD 2,641,747.58, of which USD 970,000 were the fees of the law firm, the tribunal ordered the claimants to pay USD
P 320 1,090,905.10.

If we feed in that data, the machine may suggest that fees are high when damages awarded are high and fees are low when damages are low or none. An innocent prediction might suggest that increasing the price of fees would increase the amount of the award or that increasing the amount of the award would necessarily increase the amount of fees. A human with knowledge of arbitration would understand that arbitration costs and fees depend on multiple factors such as the litigiousness of the parties, the complexity of the facts, and the number of witnesses and experts. A higher award of damages does not necessarily mean higher arbitration costs or counsel fees. Nor does estimating higher fees automatically increase the amount of the award. This known correlation would not indicate a causal prediction from which a machine could provide accurate intelligence.

Here, the human can work with the machine to develop models that improve the prediction of counsel fees and arbitration costs. For the machine, this prediction would be an unknown known, but for a human with the understanding of arbitration it will be a known unknown, or even a known known if it can model arbitration costs and fees. Ultimately, humans can find solutions to generate good predictions, so that, between machine and human insight, there are maximized known knowns. This will require machines and humans to work together.

Table 2 Strengths and Weaknesses of Machines and Humans in Arbitration Prediction

Ranking	*Abundance of Data?*	*Can the Machine Make Good Predictions?*	*Example*	*Opportunities for Humans*
known knowns	Yes	Yes	Jus Mundi, Arbitrator Intelligence, GAR ART, Lex Machina, iFlyTek. Document production or review: BrainSpace, Relativity	No
P 321 known unknowns	No	No	Orders to secure costs in arbitration: *RSM v. Saint Lucia, Garcia Armas v. Venezuela, Dirk Herzig v. Turkmenistan, Kazmin v. Latvia*	Yes
unknown unknowns	No Unrecorded events, or events that are possible but have not yet occurred	No	In 2006, *Abaclat v. Argentina* was the first ICSID case involving collective claims in an investment arbitration. At the time, the jurisdiction of the ICSID tribunal was doubtful	Yes

Ranking	*Abundance of Data?*	*Can the Machine Make Good Predictions?*	*Example*	*Opportunities for Humans*
unknown knowns	No	No	Calculation of costs and damages under the *Yukos* and *David R. Aven* cases	Yes

To recap, machine prediction is powerful, but it has its limitations. It does not work well when there is little information. Some well-trained lawyers can (1) improve the machine's predictions, and (2) recognize these limitations either because the events are sporadic or because they are causal inference problems. To do so, these lawyers need to understand the machine's limitations. Humans and machines are good at different aspects of prediction. By recognizing where their capacities and abilities differ, a complementary combination of human and machine prediction can help reduce the weaknesses that both have, as well as the error rate. (100) With that, we proceed to meditate on the strengths and weaknesses of humans and machines.

5.2 Strengths and weaknesses of machines and humans

Today, AI falls short of human intelligence. As long as prediction in arbitration relies on data (known knowns), humans will have, at least, three advantages over machines and their jobs will be secure regarding known unknowns, unknown unknowns, and unknown knowns. Lawyers know things that machines do not, at least for now; and we are better at deciding what to do in the face of data scarcity. (101) These ideas are developed below.

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First, human senses are powerful. In many ways, today, human eyes, ears, noses, and bodies surpass the capabilities of a machine. (102) While robots can assemble a vehicle or an airplane, they cannot currently pick up an object in an Amazon warehouse and put it in a box. But robotic start-up Kindred has trained a robotic arm to predict how humans pick up objects. (103) Robots can assemble a vehicle because the components are highly standard and the process routine; in Amazon's warehouse there are infinite shapes, sizes, weights, firmness of objects that are placed on shelves with different positions and orientations for objects that are not rectangular. Kindred, however, uses an arm with a mix of automated software and human control. The automation identifies the object and where it goes, the human wearing a virtual reality headset guides the robotic arm to pick it up and move it. In the long term, Kindred hopes to use a predictive machine trained in many observations of how the human picks things up through teleoperation to teach the robot to do its part. (104)

Second, humans learn continuously; in contrast, deep learning networks must be completely trained before being deployed. And once deployed, they cannot learn new things on the go. To teach a vision neural network to recognize an additional object, the network must be trained from the ground up, which takes days. But for Hawkins, the main reason that today's AI systems are not truly 'intelligent' lies in the fact that they can only perform their trained function; humans, by contrast, can do many things. (105) We are flexible in our ability to learn; we can play chess, farm, write poetry and software, sail a boat, and play the piano. Unlike humans who can learn thousands of skills depending on their experience, deep learning AI systems exhibit almost no flexibility. The future of AI, if it ever occurs, will be to continue to develop machines that exhibit increasingly human-like intelligence more efficiently: machines that can rapidly learn new tasks, draw analogies between tasks, and flexibly solve new problems. (106) This next level of AI is known as artificial general intelligence (AGI).

Third, confidentiality in arbitration restricts the availability of data to machines. As long as parties continue to keep their awards confidential, machines will have insufficient data to predict many types of conduct in arbitration. However, arbitral institutions can capitalize on all their databases for their own benefits by creating a special software that allows them to compile and process all relevant information. Additionally, they can create partnerships with Jus Mundi as the ICC did. The ICC and Jus Mundi 'have joined forces to make ICC arbitral

P 323

awards freely available to the global legal community'. (107) In the absence of data, our understanding of the human experience makes human analysis indispensable. Such situations necessarily make it imperative for humans to fill in gaps and make the very judgments that machines cannot learn to predict. Now we can move to understand how to maximize the division of machine and human labour to make the most use out of human labour hours. Finally, we humans are the ultimate arbiters of our own preferences. (108)

5.3 Humans and machines will work in a complementary way

With the above analysis of strengths and weaknesses, humans can employ their time where it is really needed; i.e., to continue understanding, and developing known unknowns, unknown unknowns, and unknown knowns. These three areas of work will continue to require a consistent human contribution. In light of these developments, for the immediate future of arbitration, a division of labour is most likely where humans and

predictive machines work together. This is based on Wilson's and Daugherty's study of 1,500 companies, where they found that firms achieve significant performance improvements when humans and machines work together. (109) For now, in arbitration, the use of rule-based and supervised learning is most promising, especially where data is not abundant or where causal inference may require revision. I explore these ideas in turn.

First, humans and predictive machines should work together. In a first stage, machines can give recommendations in arbitration, rather than taking final decisions. Humans will keep taking final decisions. (110) Two examples illustrate the point:

(1) ICSID may develop an algorithm to find the best candidate(s) to decide an ICSID arbitration arising out of a mining dispute. *See* Table 3. The algorithm may suggest the name of individuals as the best candidates to act as arbitrator, but at the end the President of the World Bank, who is the Chairman of the Administrative Council, will determine whether to appoint him or her. (111)

(2) The 206 System, an AI-based trial assistance system developed by the company iFlyTek and Shanghai People's High Court, exemplifies a
P 324
similar relationship between humans and AI, as the software assists judges with evidence and sentencing criminal cases. (112) A cross-referencing system uses language recognition and natural speech processing to compare all the evidence presented – testimonial and documentary evidence – to look for conflicting fact patterns. The machine alerts the judge about inconsistencies, allowing the judge to investigate further. Once sentencing is about to take place, the judge can use another AI tool. The machine starts with a fact pattern – the detainee's criminal record, age, damages – then, the algorithm scans millions of court records. With this data, the machine recommends to the judge the years of imprisonment or fine to be paid. (113)

Second, counsel and machines are working together using rule-based and supervised learning in an environment with limited data or where causal inference may require revision.

Supervised learning requires human interaction; a lawyer and an engineer must train the machine to define a set of desired outcomes. (114) iFlytek sent their programmers to work with judges and court staff as part of a research and development team. The judges told the technicians their needs and the technicians sought algorithmic solutions to solve judicial problems. (115) In arbitration, counsel points the engineer towards the type of documents that prove breaches to the contract for a range of input. In sizeable arbitrations where attorneys need to review or produce large numbers of documents and other information in preparation of their case, (116) technology assisted review can outperform young associates in terms of accuracy, speed and memory. Such products include Brainspace (117) and Relativity. (118) Lawyers prepare a protocol with search terms and then select documents to create a sample, which serves as the basis for the machine to predict which documents are useful for the case. The lawyer, of course, will review the documents to determine whether they are relevant and useful. In this way, supervised learning systems predict which documents lawyers would select as relevant
P 325
and not privileged. (119) This is extremely effective as long as the training
sample data is properly labelled. When the program incorrectly classifies a test as relevant, supervised learning does require further human feedback.

Unsupervised learning juxtaposes supervised learning in that it requires no or virtually no human interference. In this type of machine learning, there are no pre-set assumptions or predefined outcomes; the program detects the concurrent elements that generate the expectation that will occur in the future. This happens with modern translation programs. (120)

Through the collaboration of algorithms developed with rule systems and supervised learning, humans and AI can enhance their respective complementary strengths. To take advantage of this collaboration, the arbitration community must understand how machines enhance the work that lawyers can do to achieve this symbiosis. (121) To further illustrate this point, the following seven examples are proposals for the development of a complementary human-AI relationship in the context of arbitration.

5.4 Concrete proposals for the development of a complementary human-AI relationship in arbitration

The following section presents six proposals for the development of a complementary human-AI relationship in arbitration. First, Jus Mundi, Kluwer Arbitration Practice Plus, and others provide tools that facilitate this collaboration. Normally, a lawyer needs to invest hours to research conflicts of interest, but for an algorithm this same task takes seconds. The author has spent days searching for information about an arbitrator and the arbitrator's appointing counsel to find the existence of conflicts of interests and determine whether to challenge the arbitrator. By contrast, in a matter of seconds, Jus Mundi's *Conflict Checker* tool presents conflict of interest research putting forward relationships between the arbitrator and the appointing counsel, detailing the cases in which the arbitrator and counsel have been together. Kluwer Arbitration Practice Plus has an added value because it links arbitrators', experts' and counsels' profiles with related

publications and awards. (122)

Second, with software such as TreeAge Pro, lawyers can create decision trees, as shown in Figure 1, to represent a case problem, evaluate and compare legal strategies, and study
P 326 certain outcomes. TreeAge Pro provides basic tools for model ● building and analysis. Once the tree is created, TreeAge Pro helps to calculate the value of each option, considering probabilities. With the Tree Diagram Editor, a program embedded in TreeAge Pro, lawyers can create model structures to represent the legal problem, including decision points and expected events. In a case, decision trees can help map options on how to settle a case, or evaluate different damage awards and the probability of success. (123)

Third, another useful program is Dispute Resolution Data (DRD) (124) which has a database of 3,500 arbitration cases. (125) The global database collects and reports data relating to international commercial arbitration and mediation dispositions. According to DRD, 52% of these cases ended with a settlement. With DRD, a party with a strong position could try to predict, depending on the particulars of the case, when it should settle. (126)

Fourth, Ross helps law firms research case law. (127) Ross works with International Business Machines Corporation's (IBM) Watson technology, the robot that won the *Jeopardy* contest. (128) Ross tries to emulate the legal research of a lawyer. Ross uses AI to understand natural language questions, analyses unstructured information, and provides analytical answers to specific cases from case law. Ross reads hundreds of databases, processes the information, evaluates the relevant data, and delivers an answer. (129) Ross can also assist in the preparation of briefs by extracting citations and key points from precedent. Similarly, Ross can currently serve in those cases where judicial assistance to arbitration is sought.

But this AI tool may further assist arbitrators and counsel by having access to an unlimited universe of databases. In other words, when Ross reads hundreds of databases, it could evolve by having access to arbitration databases such as Clout, DRD, Jus Mundi, Investor State Law Guide, Kluwer Online, Oxford Online, Juris Legal, and produce fast results decreasing the time invested in research. Nonetheless, if the user would have to pay for access to each of these platforms, this could create a gap in information sharing. In this regard, law schools that have access to many of these databases will be better positioned to cooperate in the process to allow the machine learning to better and more accurately function and predict, as well as to assist law firms and arbitrators with this
P 327 specialized research. ● However, humans will always be necessary when they can access information that AI cannot, where there exists an unknown known human experiential element, or because the scope of the input information is limited to some but not all paid subscription services collection tools.

Fifth, with the information that Ross obtains, IBM could develop a machine similar to IBM's Project Debater that could develop legal arguments for arbitration. Today, Project Debater is the first AI system to debate complex issues with humans. IBM aims to help humans construct persuasive arguments to make well-informed decisions by providing evidence-based arguments and limiting emotions. Project Debater digests large amounts of information and builds a structured discourse on a topic to refute its opponent. (130) With further development, technology such as Project Debater or ChatGPT can assist lawyers in drafting a brief or arbitrators in developing the rationale for an award.

Finally, there exist legal analytics programs such as Lex Machina, which can help counsel structure their arguments, and iFlyTek, which can assist arbitrators in detecting inconsistencies in evidence. (131) Through mining data from court dockets, Lex Machina shows counsel how likely a judge is to grant or deny a motion for summary judgment by using the most persuasive language. (132) iFlyTek may assist arbitrators to better compare the testimonial and documentary evidence submitted to look for conflicting fact patterns, and alerting the arbitrator about inconsistencies.

For the sake of clarity regarding human-machine interaction, the activities of a human in arbitration are broken down in the next section. (133)

6 FRAGMENTATION OF WORK IN ARBITRATION

By breaking a decision into its elements, we can think about which parts of the lawyers' activities will decrease in value and which will increase as a result of improved machine prediction. As machine prediction gradually replaces human prediction, the human prediction's value will decay. While prediction is a key component of a decision, it is not the only component. The other elements of the decision (judgment, data, action), and explanation to the client remain, for now, in the realm of lawyers; they are complements
P 328 to prediction, i.e., they increase in value as prediction becomes cheaper. (134) ●

When referring to decision-making in arbitration, we immediately think of awards or procedural orders. Given the current data availability challenges in arbitration, it is useful to start with less complex activities. The appointment, confirmation and challenge of an arbitrator are activities in which arbitral institutions and law firms are most often involved; regardless of the subject matter of the dispute, they are routine activities; they follow the well-known repetitive processes that can most easily be codified and

performed by algorithms. (135) With two case studies below, the author analyses to what degree it is feasible to use AI in arbitration and how AI could assist in the confirmation of an arbitrator based on a system of rules.

6.1 Can we use AI to find the best candidate?

To determine whether we should use AI for certain activities in arbitration, it is necessary to analyse the set of decisions for a certain degree of predictability. For example, let us consider a scenario where we had to identify the best candidate to arbitrate a mining investment arbitration. (136) For this, the workflow of activities needed to identify the candidate is broken down to find whether AI could play a role.

Table 3 is an AI canvas (137) proposed by Agrawal, Gans, and Goldfarb that allows separating the workflow into tasks. It could be used by an arbitral institution or a law firm to find the best candidate and appoint him/her as an arbitrator. The appointment of an arbitrator requires prediction. Who will be the best arbitrator for this case? This may be easy, but first we need to define what is meant by the 'best arbitrator'. The strategy of an arbitral institution or law firm can help identify this. Arbitral institutions will have multifaceted missions, such as considering nationality, diversity, proficiency in certain
P 329 languages, including young arbitrators, among others.

Table 3 AI Canvas for Appointing an Arbitrator

Prediction	*Judgment*	*Action*	*Outcome*
Predict whether an arbitrator will be the best candidate among the ten candidates to resolve an ICSID arbitration in a mining dispute against Costa Rica initiated by investors from Canada and the Netherlands.	Determine the relative value of accepting the best arbitrator versus the cost of a false positive (accepting a non-top ten arbitrator) versus the cost of a false negative (losing a top ten arbitrator) versus not identifying a top ten arbitrator.	Find the best candidate to appoint as an arbitrator	An exceptional arbitrator with experience in mining, international law, and investment law measured by his or her efficiency in reducing the costs of the arbitration while conducting it efficiently with great knowledge of the merits who is fluent in Spanish and English and who is not a national of either the Netherlands or Canada.

Input	*Training*	*Feedback*
– Nationality	– Nationality	Update with the results of how he or she conducts the arbitration proceedings, the decisions he or she issues and the resistance of the awards to support the nullity of awards rendered.
– Diversity	– Diversity	
– The arbitrator's CV	– The arbitrator's CV	
– Career Analysis	– Career Analysis	
– All cases in which he or she has been involved either as counsel or arbitrator	– All cases in which the arbitrator has participated	
– Exhaustive internet search	– Exhaustive internet search	
– Publications and conferences	– Publications and conferences	
– Academic Positions	– Academic Positions	
– Member of organizations	– Member of organizations	

Arbitral institutions and lawyers have many strategies that implicitly or explicitly define who the 'best arbitrator' is. They may be simple like mining arbitrations and awards, or broader goals such as an arbitrator who has conducted many cases or their proclivity to allow for extensive document production. They may want an arbitrator who has a mix of
P 330 qualitative or quantitative skills to decide.

Table 3 assumes that the strategy of the arbitral institution is for the 'best' arbitrator to have the greatest impact on the arbitral proceedings globally. This subjective notion is strategic; it is international rather than local and seeks impact rather than maximizing diversity or creating diversity, although it does consider diversity. For AI to predict global impact in arbitration, we need to measure it. What training data do we have that allows us to be an agent of global impact in arbitration? One option would be to identify the arbitrator who does not have a single award vacated in any jurisdiction around the world. This choice would be subjective.

While the arbitral institution may set an overall impact on the arbitration as a goal for a particular machine, the value of accepting a particular arbitrator is a matter of judgment. How costly would it be to accept a weak arbitrator about whom we had mistakenly

predicted that his or her award would not be set aside? How costly would it be not to appoint a highly qualified arbitrator whom we had mistakenly assessed as weak? The evaluation of the *trade-off* is an element of the AI. (138)

Once we specify the objective of the prediction, identifying the necessary data is easier. We need the arbitrator's CV, his or her nationality, whether he or she speaks Spanish and English, and experience in mining and international law, to predict how he or she will do in the arbitration. We can also use their publications, review previous awards they have rendered or cases they have been involved in, review Arbitrator Intelligence Reports, call acquaintances or other lawyers, and use the feedback to improve the predictions. The predictions will tell us which arbitrator to appoint but only after judging the cost of making a mistake.

This is the first stage, short-term future we will see or are already experiencing with tools like GAR ART. Next, we delve a little deeper into more complex decisions such as the confirmation of an arbitrator.

6.2 Confirming an arbitrator through the rules system

For the analysis of whether to confirm an arbitrator, it is useful to specify that such decisions have six elements. When someone or something decides, it takes *data* from the world that allows *prediction.* Prediction is possible because there has been *training* about relationships between different types of data and what data will be most associated with
P 331 a situation. By combining prediction with *judgment* about what matters, a decision can be made. The decision leads to a consequence, called a *result*, which can be fed back to improve the prediction. (139)

To explain what judgment is and to illustrate a practical application of AI to arbitration, we introduce a decision tree, using a routine activity that requires a complex decision: the confirmation of an arbitrator. In an arbitration seated in Cairo, Egypt, the claimants ask the arbitral institution to confirm Arbitrator X; the defendant opposes such confirmation arguing that Arbitrator X served as party counsel against them in another arbitration unrelated to this dispute more than five years ago.

Figure 1 represents this example using a decision tree. At the root of the tree there are two branches representing decisions that can be made to 'allow the arbitrator, i.e., confirm' or 'not to confirm'. Extending branches are branches representing the prediction that the arbitral institution is unsure: 'annulment' versus 'enforcement'. Let us remember that the arbitration is seated in Cairo, Egypt. Following Shehata, an award in Egypt is 77.3% more likely to be enforced than to be set aside (22.7%) (140) ; based on the above, the arbitral institution may predict that courts in Cairo will enforce the award with a 77.3% chance against a 22.7% chance of setting it aside. (141) This is the prediction. The consequences are at the end of the branches.

What decision should the arbitral institution make? Here comes the judgment; that is, the process of determining the reward of a particular action in a particular environment, for purposes of the example the reward would be to have courts enforcing the award and denying its annulment. It is about exercising the objective that the arbitral institution is seeking, such as avoiding potential grounds for setting aside the award. Judgment involves determining the 'reward function', the relative reward and punishment associated with taking certain actions that produce a certain result: to confirm or not to
P 332 confirm the arbitrator. (142)

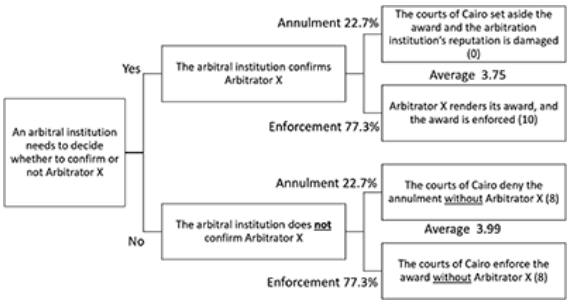

Figure 1

Average payoff from confirming or not confirming Arbitrator X

Suppose the arbitral institution decides to confirm the arbitrator, who renders an award, and the courts enforce this award (this decision is rated 10 out of 10), but not to confirm Arbitrator X (as 8 out of 10) rather than annulment of the award (a big, fat 0). These alternatives give the arbitral institution a framework for deciding. If, based on data, we predict that the judiciary in Egypt annuls awards at a rate of 22.7%, and the judgment of the payoffs is having an award set aside or not confirming Arbitrator X, an arbitral institution can work out its average payoff from confirming versus not confirming Arbitrator X. Based on this, the arbitral institution will be better off not confirming Arbitrator X (an average payoff of 3.99) than confirming the appointment (an average payoff 3.75).

This predictability of the rules system could be improved if arbitral institutions had a database with all the case law of the world's jurisdictions that would allow them to aggregate more data to incorporate in their decisions.

A few questions about the time and new skills needed by lawyers and arbitral institutions to work better with AI are next addressed.

7 WHEN WILL THIS HAPPEN AND WHAT NEW SKILLS ARE NEEDED?

When the price of a fundamental good or service drops dramatically, the population uses
P 333 it more. (143) This is a basic principle of economics, and it is happening ● today with AI. Technological change makes things that were once expensive cheap. When prediction becomes cheap, there will be more applications and complements to predict in arbitration. Prediction will be used to make decisions. But at some point, the prediction machine may become so accurate and reliable that it may change the way arbitral institutions and law firms make decisions. (144) Three aspects merit attention.

First, there is a difference between humans and software: scale. A single lawyer cannot draft all the briefs or compile and organize all the evidence required for a case like *Abaclat,* where 180,000 bondholders initially appeared before the arbitrators. Unlike arbitrators, law firms and arbitral institutions are structured to provide services more efficiently than a single lawyer. Managing work at scale involves designing an operating model to deliver the greatest value to as many users as possible, or involves delivering services of increasing complexity. Improving the scale model allows the volume of clients to increase. (145) Once AI is better than humans at activities such as *screening and registration* of requests for arbitration, confirmation of arbitrators, finding the best candidate to arbitrate a case, ruling on challenges, document review, and document production, among others, lawyers will rely more on predictive machines and new opportunities will arise. For example, arbitral institutions and other providers such as Jus Mundi, Kluwer Arbitration Practice Plus, Arbitrator Intelligence, GAR ART, DRD will need more lawyers who can train the AI; they must equip themselves with specialized skills to classify arbitral decisions, fragment tasks, design decision trees, collaborate with engineers to develop data mining, train the machine, and interpret counterintuitive results. Lawyers will have to learn to delegate to machines. Secretaries General of arbitral institutions will now have to address issues of AI implementation through rule systems and machine learning, as well as accessibility and sustainability of AI. More than a simple reassignment of responsibilities, a new architecture is required for the operating model that involves building the arbitral institution on a new foundation embedded in data analytics and AI, from the review of the request for arbitration to the annulment of an award. (146)

Second, change will come not only from technology *per se* but from new players, i.e., from the liberalization of legal services. When systems such as Jus Mundi, Kluwer Arbitration Practice Plus, Arbitrator Intelligence, GAR ART are able to make better predictions, it is worth asking whether in the decades ahead these providers will take on a greater variety of work than they do today. (147) For example, Jus Mundi and other providers could not
P 334 only be consulted by judges ● when they have to appoint an arbitrator, (148) but could even serve as appointing authorities. (149) Perhaps they will evolve into dispute resolution platforms and arbitral institutions.

Third, we cannot ignore the role of financing in technological development. Technology requires not only genius, but capital. Just as the financial system was an essential factor in the industrial revolution, so too it will be for AI. The financial system that rewards investors with profits will generate greater investment and technological development. Therefore, arbitral institutions and law firms will invest in these developments in the face of future profits or savings to arbitration users or their clients. (150) If lawyer labour is expensive and predictive machines produce cheaper high-quality results, what interest would arbitration users, law firms, and arbitral institutions have in continuing to use humans? It is more economical to use a prediction machine, especially if the machine is more productive and accurate than the human.

In the second stage, the use of these predictive machines will naturally cause loss of jobs, and consequently a loss of meaning in the lives of some humans. (151) Regardless of how much more vigorous technological advancement takes place, regulation can prevent the use of AI. The following section explores the second stage, where AI will have the freedom to decide cases dependent on the degree of regulation of it.

8 SECOND STAGE: AI MAKING ARBITRAL AWARDS

Machine learning can reach conclusions or perform tasks at a high level but, today, it cannot explain or justify its behaviour. The resulting questions are (1) whether this so-called *black box decision-making* problem is of concern to users of international arbitration; and (2) whether current arbitration rules will be able to withstand the future development of AI, or act to their detriment. Figure 2 illustrates how the New York Convention would look if it were a computer. Over seventy years old, the New York Convention exists as one of the pillars of arbitration. (152) At its inception in the 1950s, predictive machines were in their infancy: the Universal Automatic Computer I (UNIVAC I), the first commercial computer, was used as a predictive machine for the US presidential

P 335 election.

Figure 2

Universal Automatic Computer I

Source: *Time*, *The Story Behind America's First Commercial Computer*, https://time.com/4271506/census-bureau-computer-history/

Despite the precision of machines and their future development over time, in law, predictive machines still maintain a major problem today: they cannot reason. Instead, they simply analyse probabilities. Legal analysis, providing a reasoned decision outlining the premise on which a prediction is based, is one of the fundamental elements of legal decision-making. The Inter-American Court of Human Rights has held that reasoning safeguards due process; provides credibility to the decision; justifies conclusions; makes it possible to know the facts, motives, and norms on which the judge based his or her decision; and indicates that the court analysed parties' arguments. (153)

Scherer has identified three goals for providing a reasoned decision. First, goals of legitimacy underlie reasons; they help the losing party understand why he or she lost and make the decision more acceptable to him or her. Second, there are incentives. If the decision is published, this not only helps the parties but also third parties in similar situations to adapt their conduct in the future. Finally, reasons support the consistency that allows the same holding to be followed; otherwise, reasons also help to understand why the arbitrator has departed from a prior pattern. (154)

Notwithstanding the above, programmers have great difficulty in instructing or
P 336 programming machines to be able to issue reasoned legal decisions and describe the logical basis that a human could produce. This is true outside of the legal sector as well, since AI programs generally are unable to explain the results they obtain. This is due to the AI models' nature: either they follow the instructions coded in a system of rules or they use probabilities to solve problems in machine learning models. Decision trees like (155) Figure 1 follow pre-established rules. Therefore, one can identify the causes that lead to a certain outcome based on such rules and explain the model. In contrast, machine learning models, such as document production using Brainspace, do not have predefined rules, they look for a hidden pattern recognition to extract the required algorithm. (156) Therefore, the process by which they obtain results and make decisions, in most instances, is a 'black box' that cannot be explained.

Just as expressing sufficient reasoning for a decision may be a concern for the human rights world, so too is it in the arbitral world for certain types of arbitration. Regarding investment arbitration, the ICSID Convention demonstrates the importance of reasoning by allowing a party to seek the to annul an award based on the grounds 'that the award has failed to state the reasons on which it is based'. (157) Along the same line, in commercial arbitration, the ICC Rules of Arbitration provide that the 'award shall state the reasons upon which it is based'. (158) However, for the 118 jurisdictions (159) that have implemented the United Nations Commission on International Trade Law (UNCITRAL) Model Law on Commercial Arbitration, there is a caveat to the necessity to provide reasoning. Article 31.2 of the Model Law states that '[t]he award shall state the reasons upon which it is based, unless the parties have agreed that no reasons are to be given'. (160) Similar provisions exist in the ICDR (161) and London Court of International Arbitration (LCIA) (162) Arbitration Rules.

In drafting the Model Law, the UNCITRAL Working Group considered that reasons may improve the quality of the arbitral decision. However, it also noted that awards that did
P 337 not state reasons could be rendered more quickly and were subject to fewer challenges. It also noted that in arbitration of goods, where the quality of the goods complied with industry or contractual standards, awards were generally sufficient without reasons. (163) The Working Group decided to adopt the solution contained in Article 32(3) of the 1976 UNCITRAL Arbitration Rules which allows parties to waive the reasons requirement. Scherer comments on her experience that clients do not care about reasons, they care about whether they are going to win or lose and they want to know the answer as soon as possible. (164) Companies (the main users of arbitration) and business people do not have in their minds the objectives of reasons: legitimacy, consistency, moral concerns, or the development of law. (165) Companies and business people tend to keep their disputes confidential; therefore, objectives of legitimacy, incentives, and consistency seem of more limited application in international commercial arbitration.

We observe that in the 118 jurisdictions that follow the UNCITRAL Model Law, there is a narrow window of opportunity for machines to decide disputes. The proliferation of algorithms that supplant mediators, arbitrators and judges in disputes arising from electronic commerce allow us to infer that soon computer programs will be able to resolve more complex cases.

Today, legal services platforms offer to resolve disputes without humans or with limited human assistance. In 2011, Colin Rule, former director of dispute resolution at eBay and PayPal, founded Modria.com. Mondria uses algorithms to analyse case information and issues a decision. If the consumer is dissatisfied with the decision, eBay offers an appeal that works without humans. According to Colin Rule, Mondria.com has already resolved 400 million disputes between consumers and sellers. Already, three times more legal disputes are resolved with virtual platforms on eBay than all the lawsuits heard in US courts. (166)

In principle, it will be those fewer complex disputes that can be resolved without human intervention in arbitration. But, today, arbitration laws may be an impediment. The French *lex arbitri* expressly requires the arbitrator to be a natural person: 'La mission d'arbitre ne peut être exercée que par une *personne physique jouissant du plein exercice de ses droits*'. (167) The English Arbitration Act states: 'The authority of an arbitrator is
P 338 personal and ceases on his death'. (168) Similarly, the ● UNCITRAL Model Law refers to 'When a *person* is approached in connection with his possible appointment as an arbitrator'. (169) Arbitration was designed for an era where technology had a role much more limited than its developing capacity today. For example, the New York Convention refers to 'telegrams', a service no longer available in countries such as Belgium, India, the United Kingdom, and the United States. (170)

If we want to capitalize on AI's benefits, we need new rules. (171) This section will not exhaust the subject, but will explain some proposals for consideration. In the absence of data, it will be necessary that 'all' arbitrations adopt provisions such as the UNCITRAL Rules on Transparency, (172) notwithstanding parties redacting confidential data. Data should be sanitized; i.e., anonymized data. All personal details should be redacted to make the award anonymous, if needed. We expect arbitration users to be aware of the advantages of data collection, and the benefits they may bring to the use of AI in arbitration. (173) The fact that a decision is dictated by a machine will not be a ground for annulment, unless biased algorithms are demonstrated. To detect bias in algorithms, the lawyer will have to understand whether the algorithm was developed in a system of rules or through machine learning; this will be needed to identify whether errors are attributable to the programmer or to the data *per se*.

The new rules should allow the parties to comply with due process, but their conception will evolve. In UNCITRAL Model Law jurisdictions, if a party requests a hearing, the tribunal must hold the hearing. (174) But perhaps a hearing will not be useful for an algorithm ruling the case, and therefore, the hearing will be unnecessary. Rules may support that when an algorithm is ruling a case, due process will not be breached if a hearing is not held after being requested by a party. To start, parties and lawyers will need to accept and recognize the legitimacy of the machine's discretion. Additionally, new rules will certainly require the support of the state for judiciaries to recognize the awards in their various jurisdictions, because today, only the determinations of judges are binding and can be enforced by the coercive power of the state to deprive people legitimately of their money, and property. (175) Of course, the parties will be able to submit to the jurisdiction of platforms where the enforcement of virtual decisions is self-
P 339 ● executing without the need of the state. Nonetheless, if the arbitration requires the assistance of the judiciary, then, UNESCO's recommendations for Member States:

> [come at issue to] enhance the capacity of the judiciary to make decisions related to AI systems as per the rule of law and in line with international law and standards, including in the use of AI systems in their deliberations, while ensuring that the principle of human oversight is upheld. In case AI systems are used by the judiciary, sufficient safeguards are needed to guarantee inter alia the protection of fundamental human rights, the rule of law, judicial independence as well as the principle of human oversight, and to ensure a trustworthy, public interest-oriented and human-centric development and use of AI systems in the judiciary. (176)

9 CONCLUSION

It is a privilege to live in this era, observing and experiencing the existing AI as we develop a future fourth industrial revolution that will impact arbitration. The arbitral community can play a central role in shaping the future of law and human-machine relationships. (177) In the arbitration world, our direction will be determined by our ability to capitalize on the potential of AI. (178)

We have laid the foundations of AI through rule or expert systems and machine learning. The main problem facing AI in arbitration today is the lack of data. Even with the information available, there are other problems, such as the amount of data available and flaws in the data, lack of repetitive patterns and inconsistencies, such as in investment arbitration where there is no doctrine of precedent or *stare decisis*.

The magic of AI is prediction. From the beginning of a case, a lawyer gauges his risks and chances of winning or losing an arbitration. For this, there exist arbitration mechanisms that discourage the filing of frivolous claims outside the jurisdiction of the centre or manifestly without merit. Here, predictive machines will help the development of arbitration by making it more efficient.

Taking advantage of this technology requires a revised division of labour. Before using AI, lawyers need to understand machines' and humans' strengths and weaknesses. Machines are accurate when there exists an abundance of data but may have trouble explaining the decision-making process. Humans are skilled at interpreting data and predicting when data is scarce, for example, decisions on security for costs in investment arbitration, or novel cases.

Faced with this scenario, in a first stage, lawyers and machines will work in a
P 340 complementary way. Predictive machines can give recommendations such as iFlyTek, ● Lex Machina and Ross, but it will be the lawyer, the arbitrator or the Secretary of the institution who will take the ultimate decision. Tools such as Jus Mundi, Kluwer Arbitration Practice Plus, Arbitrator Intelligence and GAR ART can streamline the search for conflicts of interest between an arbitrator and the appointing counsel. In the coming years, these tools can be optimized by enabling lawyers to train them. Through machine learning, a sample of relevant data that may represent a potential conflict of interest can be created in a matter of seconds. TreeAgee Pro and DRD provide insight into when it makes the most sense to make an offer to end arbitration through a settlement agreement. IBM could devise predictive machines like Ross and Project Debater to reduce time and costs in researching law and crafting arguments, given that machines can process far greater amounts of data than a human.

To determine the feasibility of using AI in the tasks involved in arbitration, lawyers need to analyse the set of decisions through a method and see the degree of predictability. We can set a strategy to see who the best arbitrator for an investment arbitration would be, considering factors such as language, nationality, diversity, experience, among others, and certain subjective goals. Likewise, arbitral institutions can develop algorithms with the system of rules to perform tasks such as confirming an arbitrator.

The big question is when AI will disrupt arbitration. This question hinges on three factors. First, there is a consideration as to how these predictive machines work at scale, i.e., they can easily be downloaded from a cloud and serve hundreds of law firms. Jobs will not disappear immediately but, when they do, new ones will emerge that will require classifying arbitral decisions, fragmenting arbitral tasks to identify the best arbitrator for a case, training the machine, detecting errors in the algorithms, collaborating with engineers for data mining, explaining the results, especially when they are counterintuitive or controversial, and sustaining the responsible use of AI so that the machines do not make a mistake that overturns an award. Secretaries of arbitral institutions will need to attend to issues of AI's implementation through rule systems or machine learning, as well as AI sustainability. (179) Lawyers will have to learn to delegate to the machine while being aware of its limitations. The future demands restructuring arbitral institutions based on use of AI to make decisions more efficiently. In this way, AI may become a pillar of arbitration. Second, change will not only come from technology but from new players such as Jus Mundi, Kluwer Arbitration Practice Plus, Arbitrator Intelligence, GAR ART, that today help to identify an arbitrator or to detect ● conflicts of
P 341 interest. In the future, these institutions may evolve and become appointing authorities or even dispute resolution platforms. Finally, technology develops because funding is available. Given that the labour of a lawyer dedicated to arbitration is specialized and expensive, there are incentives to invest in machines to replace humans.

In conclusion, today, from the distance, we greet the second stage of AI where machines will be able to decide cases. Regulation can be a detriment. Arbitration is underpinned by the New York Convention with provisions that are over seventy years old, and it is worth asking whether those provisions make sense in the face of AI. True, all 118 jurisdictions that have implemented the UNCITRAL Model Arbitration Law have accepted that the parties may agree to the making of an award without reasons. This solves the black box problem, i.e., the impossibility of the machine to issue a reasoned award. However, other limitations cast doubt on whether a machine can decide a case. Therefore, we propose the development of new rules that (1) solve the lack of data with transparency provisions similar to the UNCITRAL Rules on Transparency in Investment Arbitration; and (2) establish that it will not be a ground for annulment if the award is issued by a machine, algorithm or robot unless it is proven that the algorithms are flawed. Any emerging regulations will require due process and support from the judiciary in each country.

Again, this article is not intended to be an oracle of prediction, but a source of collected research from which we can outline, explore and assess alternative futures, which may be possible, probable and preferable. Regardless of the direction in which AI evolves, I can confidently conclude by making Susskind's words my own: 'Tomorrow's [arbitration]
P 341 world … bears little resemblance to that of the past'. ●

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83) *Ipek Investment Ltd v. Turkey,* ICSID Case No. ARB/18/18, Procedural Ord. 7 (14 Oct. 2019), paras 3–4; *Libananco Holdings Co. Ltd v. Turkey*, ICSID Case No. ARB/06/8, Preliminary Issues Decision (23 Jun. 2008), para. 57; *RSM Production Corp. v. Grenada,* ICSID Case No. ARB/05/14, Decision on Security for Costs (14 Oct. 2010), para. 5.20; *Lighthouse Corp. Pty Ltd v. East Timor,* ICSID Case No. ARB/15/2, Procedural Ord. 2 (13 Feb. 2016), para. 61; *South American Silver Ltd v. Bolivia*, PCA Case No. 2013-15, Procedural Ord. 10 (11 Jan. 2016), para. 59.
84) *RSM Production Corp. v. Saint Lucia,* ICSID Case No. ARB/12/10, Decision on the Application for Security for Costs (13 Aug. 2014), para. 90; *Manuel García Armas* et al. *v. Bolivarian Republic of Venezuela,* Case CPA No. 2016-08, Procedural Order No. 9 (20 Jun. 2018), para. 261; *Dirk Herzig as Insolvency Administrator Over the Assets of Unionmatex Industrieanlagen GmbH v. Turkmenistan*, ICSID Case No. ARB/18/35, Decision on the Respondent's Request for Security for Costs and the Claimant's Request for Security for Claim (27 Jan. 2020), para. 84; *Eugene Kazmin v. Republic of Latvia*, ICSID Case No. ARB/17/5, Procedural Order No. 6, Decision on the Respondent's Application for Security for Costs (13 Apr. 2020), para. 68.
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122) Kluwer Arbitration Blog, *Wolters Kluwer Launches Data-Driven Enhancements to Arbitrator Tool Within Kluwer Arbitration Practice Plus* (19 Nov. 2021), http://arbitrationblog.kluwerarbitration.com/2021/11/19/wolters-kluwer-launches-data-driven-enhancements-to-arbitrator-tool-within-kluwer-arbitration-practice-plus/ (accessed 5 Mar. 2023).
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126) *Ibid.*
127) Andrés Oppenheimer, *¡Sálvese Quien Pueda!* 200 (Vintage Español, New York 2018).
128) Jeopardy is a TV game show featuring a quiz competition that reverses the traditional question-and-answer format. A television presenter provides contestants with general knowledge clues in the form of answers. Contestants must respond with a question identifying the person, place, thing, or idea that the clue describes.
129) *Ibid.*
130) IBM, AI Research, www.research.ibm.com/artificial-intelligence/project-debater/about/ (accessed 2 Jun. 2019).
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134) Agrawal, Gans & Goldfarb, *supra* n. 5, at 76.
135) D. Acemoglu & David Autor, *Skills, Tasks and Technologies: Implications for Employment and Earnings*, 4 Handbook Lab. Econ. 1076 (2011), doi: 10.1016/S0169-7218(11)02410-5.
136) Agrawal, Gans & Goldfarb, *supra* n. 5, at 134.
137) An AI Canvas is a tool to decide whether employing a prediction machine will improve matters. An AI Canvas maps out an AI strategy. It helps to organize what is needed to know into seven categories in order to systematically make an assessment. *See* Agrawal, Gans & Goldfarb, *A Simple Tool to Start Making Decisions with the Help of AI,* HBR (17 Apr. 2018), https://hbr.org/2018/04/a-simple-tool-to-start-making-decisions-with-the-help-of-ai#:~:text=The%20AI%20Canvas%20is%20a,you%20are%20trying%20to%20predict (accessed 5 Mar. 2023).
138) Agrawal, Gans & Goldfarb, *supra* n. 5, at 139.
139) *Ibid.*, at 74.
140) Ibrahim Shehata, *Arbitration in Egypt: A Practitioner's Guide*, 326 (Kluwer Law International 2021).

141) Of course, we could have different assessments if we only use cases dealing with appointment of arbitrators, challenges to arbitrators, and impartiality of arbitrators.
142) Agrawal, Gans & Goldfarb, *supra* n. 5, at 79.
143) *Ibid.*, at 9–15; Agrawal, Gans & Goldfarb, *Power and Prediction,* 36 (HBR 2022).
144) Agrawal, Gans & Goldfarb, *supra* n. 5, at 9–15.
145) Iansiti & Lakhani, *supra* n. 54, at 30.
146) Wilson & Daugherty, *supra* n. 109, at 142.
147) Susskind, *supra* n. 7, at 274.
148) UNCITRAL Model Law, Art. 11.3.b.
149) UNCITRAL Arbitration Rules, Art. 6.1.
150) William N. Goetzmann, *Money Changes Everything* 197–198 (Princeton University Press 2016).
151) Lee, *supra* n. 10, at 173.
152) The New York Convention refers to the Convention on the Recognition and Enforcement of Foreign Arbitral Awards, signed in New York on 10 Jun. 1958, entered into force on 7 Jun. 1959.
153) *Case of Hernández v. Argentina,* Preliminary Objection, Merits, Reparations and Costs, Judgment [2019] Series C No. 395, I/A Ct HR, para. 122.
154) Scherer, *supra* n. 11, at 22.
155) *Ibid.*
156) *Ibid.*
157) ICSID Convention, Art. 52.1.
158) ICC Rules of Arbitration, entered into force on 1 Jan. 2021, Art. 32.2.
159) UNCITRAL, *Current Status UNCITRAL Model Law on International Commercial Arbitration, 1985 With Amendments 2006*, https://uncitral.un.org/es/texts/arbitration/modellaw/commercial_arbitration/status (accessed 5 Mar. 2023).
160) UNCITRAL Model Law on International Commercial Arbitration 1985 with amendments as adopted in 2006, Art. 31.2.
161) ICDR International Arbitration Rules, amended and effective 1 Mar. 2021, Art. 33.1 ('The tribunal shall state the reasons upon which an award is based, unless the parties have agreed that no reasons need be given').
162) LCIA Arbitration Rules, effective 1 Oct. 2020, Art. 26.2 ('The Arbitral Tribunal shall make any award in writing and, unless all parties agree in writing otherwise, shall state the reasons upon which such award is based').
163) Howard M. Holtzmann & Joseph Neuhaus, *A Guide to the UNCITRAL Model Law on International Commercial Arbitration: Legislative History and Commentary* 838 (Kluwer Law International 1989).
164) Maxi Scherer, *The Future of International Arbitration: Virtual Hearings and AI-Arbitrators?*, Mexican Bar Association (16 Apr. 2020).
165) Charles Mitchell & Steve Odland, *Survey: CEOs Are Worried About 3 Things this Year – and No. 1 Is Whether You Plan to Quit*, www.cnbc.com/2019/01/28/the-3-biggest-challenges-facing-ceos-in-2019-and-how-to-solve-them.html (accessed 28 Jan. 2019).
166) Oppenheimer, *supra* n. 127, at 206–207.
167) Code de procédure civile, Art. 1454 ('The arbitrator's mission can only be exercised by a natural person in full exercise of his or her rights').
168) Arbitration Act 1996 UK, s. 26.
169) UNCITRAL Model Law, Art. 12.
170) Kevin Connolly, *Belgium Ends 19th-Century Telegram Service,* BBC News, www.bbc.com/news/world-europe-42359914 (accessed 5 Mar. 2023).
171) Susskind, *supra* n. 7, at 101.
172) *UNCITRAL Rules on Transparency in Investor-State Arbitration under a Treaty* (2013).
173) Alpaydin, *supra* n. 28, at 157–158.
174) UNCITRAL Model Law, Art. 24(1).
175) Susskind, *supra* n. 77, at 78, 83.
176) UNESCO, *supra* n. 17, at 63.
177) Susskind, *supra* n. 7, at 45.
178) Schwab, *supra* n. 2, at 112.
179) Sustainability of AI is focused on sustainable data sources, power supplies, and infrastructures as a way of measuring and reducing the carbon footprint from training and/or turning an algorithm. Addressing these aspects gets to the heart of ensuring the sustainability of AI for the environment'. Aimee van Wynberghe, *Sustainable AI: AI for Sustainability and the Sustainability of AI*, 1 AI Ethics 213–218 (2021), doi: 10.13039/501100008131