CADERNOS DE CAMPO | REVISTA DE CIÊNCIAS SOCIAIS

unesp

SCIENCE DIPLOMACY AND ARTIFICIAL INTELLIGENCE: TOOLS FOR INTERNATIONAL COOPERATION[1]

DIPLOMACIA CIENTÍFICA E INTELIGÊNCIA ARTIFICIAL: FERRAMENTAS PARA COOPERAÇÃO INTERNACIONAL

DIPLOMACIA CIENTÍFICA E INTELIGENCIA ARTIFICIAL: HERRAMIENTAS PARA LA COOPERACIÓN INTERNACIONAL

Amâncio Jorge Silva Nunes de OLIVEIRA[2]
e-mail: amancioj@usp.br

Romeu Bonk MESQUITA[3]
e-mail: romeubonk@gmail.com

Rodrigo LYRA[4]
e-mail: roplyra@gmail.com

How to reference this paper:

OLIVEIRA, Amâncio J. S. N.; MESQUITA, Romeu B.; LYRA, Rodrigo. Science diplomacy and artificial intelligence: tools for international cooperation. **Rev. Cadernos de Campo**, Araraquara, v. 25, n. esp. 1, e025006. e-ISSN: 2359-2419. DOI: 10.47284/cdc.v25iesp1.19667

| **Submitted**: 16/09/2024
| **Revisions required**: 13/12/2024
| **Approved**: 17/12/2024
| **Published**: 12/09/2025

[1]This study was conducted with the support of CNPq, the National Council for Scientific and Technological Development – Brazil – Process No. 420879/2022-6.
[2] University of São Paulo (USP), São Paulo – SP – Brazil. Full Professor at the Institute of International Relations and Vice-Director of the Museu Paulista.
[3]University of São Paulo (USP), São Paulo – SP – Brazil. Postdoctoral Researcher at the Institute of Advanced Studies. CNPq Fellow – Brazil.
[4]University of São Paulo (USP), São Paulo – SP – Brazil. Postdoctoral Researcher at the Institute of Advanced Studies. CNPq Fellow – Brazil.

Editors: Prof. Dr. Maria Teresa Miceli Kerbauy
Prof. Me. Paulo José de Carvalho Moura
Prof. Me. Luana Estela Di Pires
Prof. Me. Lucas Barbosa de Santana
Prof. Me. Maurício Miotti

ABSTRACT: The article analyzes the impact of artificial intelligence (AI) on diplomacy and its integration into global innovation ecosystems, considering the tensions between cooperation and competition. It proposes tools through which Science Diplomacy can strengthen international cooperation on AI. The current state of these relationships is examined from the perspective of International Relations, discussing how AI is transforming diplomatic practice by optimizing traditional functions and creating new dynamics. Additionally, it highlights that the competition for control of AI technologies involves not only technical supremacy but also regulatory models adopted by key players such as the United States, the European Union, and China. Finally, the article introduces Science and Innovation Diplomacy, emphasizing how these areas can contribute to the development of evidence-based public policies, balancing innovation with effective governance.

KEYWORDS: Artificial Intelligence. Science Diplomacy. Innovation. International Cooperation. Digital Diplomacy.

***RESUMO**: O artigo explora o impacto da inteligência artificial (IA) na diplomacia e sua inserção nos ecossistemas globais de inovação, considerando as tensões entre cooperação e competição, e sugere ferramentas com as quais a Diplomacia Científica pode contribuir para o aprimoramento da cooperação internacional no tema da IA. Para isso, analisa-se o estado da arte dessas relações por meio de reflexões mais amplas, do ponto de vista das Relações Internacionais. Discute-se como a IA está transformando a prática diplomática, otimizando funções tradicionais e criando novas dinâmicas. Destaca-se também que a disputa pelo domínio das tecnologias de IA envolve não apenas a supremacia técnica, mas também os modelos de regulamentação adotados por polos como Estados Unidos, União Europeia e China. O artigo, por fim, introduz a Diplomacia Científica e a Diplomacia da Inovação, ressaltando como essas áreas podem contribuir para a criação de políticas públicas baseadas em evidências, equilibrando inovação e governança.*

***PALAVRAS-CHAVE**: Inteligência Artificial. Diplomacia Científica. Inovação. Cooperação Internacional. Diplomacia Digital.*

***RESUMEN**: El artículo analiza el impacto de la inteligencia artificial (IA) en la diplomacia y su integración en los ecosistemas globales de innovación, considerando las tensiones entre cooperación y competencia. Propone herramientas con las que la Diplomacia Científica puede fortalecer la cooperación internacional en IA. Se examina el estado actual de estas relaciones desde la perspectiva de las Relaciones Internacionales y se discute cómo la IA transforma la práctica diplomática, optimizando funciones tradicionales y generando nuevas dinámicas. Además, se destaca que la competencia por el control de las tecnologías de IA incluye no solo*

la supremacía técnica, sino también los modelos regulatorios adoptados por actores clave como Estados Unidos, la Unión Europea y China. Finalmente, el artículo introduce la Diplomacia Científica y la Diplomacia de la Innovación, subrayando cómo estas áreas pueden ayudar a desarrollar políticas públicas basadas en evidencia, equilibrando la innovación con una gobernanza adecuada.

***PALABRAS CLAVE**: Inteligencia Artificial. Diplomacia Científica. Inovación. Cooperación Internacional. Diplomacia Digital.*

Introduction

Artificial intelligence (AI) is a broad term encompassing a wide range of computer programs. Within the scope of AI, there exists a universe of paradigms and specific techniques, such as machine learning, neural networks, and natural language processing, among others. Generally, however, all AI systems share the following fundamental elements: an objective, a dataset, the processing of that data through a series of algorithms, and an output. In summary, AI utilizes historical data to predict future outcomes (Feingold, 2023). The rapid development of these tools has been enabled by the convergence of five factors: the increased availability of large-scale data; enhanced computational power; algorithmic improvements; decades of accumulated knowledge; and the reduced cost of complementary technologies, such as the internet (Feijóo *et al.*, 2020).

The applications of these technologies are becoming increasingly diverse and flexible, offering numerous opportunities and representing a leading edge of contemporary technological development. However, as AI systems are implemented across various sectors, several critical questions arise: What are the security ramifications and legal implications of using these new technologies? Who may use them, and under what circumstances? How should they be regulated? How will these technologies impact the international political environment? How can diplomacy engage with this technological transformation?

Intersecting the emergence of the concept of Science and Innovation Diplomacy (S&I Diplomacy) as a tool for international cooperation with the opportunities and challenges presented by the use of AI in public policy, this study seeks to explore how students and professionals in S&I Diplomacy can engage in the transformative integration of AI in the diplomatic sphere. This integration can facilitate international cooperation, informed decision-making, and the responsible use of these technologies to address local and global challenges. The study is exploratory in nature and aims to reflect on the contributions that S&I Diplomacy, as well as related fields, can offer to policymakers and negotiators in the development of international cooperation initiatives related to AI. It is expected to examine how science diplomats can generate positive social impacts by advising decision-makers to better capitalize on the opportunities presented by these technologies, particularly by integrating scientific knowledge into policy-making and bridging gaps across disciplines and stakeholders.

The article is structured as follows: the first section presents the theoretical framework underpinning the study regarding the broader relationship between AI and diplomacy. For this

purpose, the categorization of the DiploFoundation is employed, which divides this relationship into three perspectives: AI as a diplomatic topic; AI as a tool for diplomacy; and AI as a transforming environment for diplomacy. The second section provides an overview of how AI fits within the international dynamics of global innovation ecosystems, highlighting the tension between cooperation and competition and the emergence of three distinct institutional models: the United States, Europe, and China. Finally, the study presents reflections on how concepts and tools from S&I Diplomacy can contribute to international cooperation in the context of the emergence of AI.

AI and Diplomacy: General Concepts

In recent years, the field of AI has advanced considerably, encompassing intelligent digital assistants, smart home devices, autonomous vehicles, intelligent buildings, and medical-focused robots. These developments are already significantly influencing various policy domains, including economics, society, education, and infrastructure, and have the potential to further expand their influence into areas such as diplomacy. Governments, technical communities, and the global private sector are increasingly attentive to the implications of these innovations.

Consequently, the intersection of diplomacy and AI has become a recurring topic in international diplomatic agendas. Countries that dominate advanced AI technologies possess greater capacity to exert military, economic, and social influence. In this context, AI has emerged as a central topic in international negotiations, with multiple agreements and treaties under discussion. For instance, in April 2021, the European Commission proposed the first comprehensive regulation for AI, known as the "AI Act." This regulation introduces a risk-based approach to governing AI usage, categorizing systems into different risk levels (low, limited, high, and unacceptable). The proposal seeks to ensure that AI is employed ethically and safely, addressing issues related to privacy, discrimination, and security. Another relevant example is the Convention on Certain Conventional Weapons, specifically the Group of Governmental Experts on Lethal Autonomous Weapon Systems (LAWS), which is dedicated to discussing the legal and ethical challenges involved in using such systems.

Against this emerging backdrop, the DiploFoundation, a cooperation initiative established in 2002 by the governments of Malta and Switzerland, developed a typology to map

the role of AI in the field of diplomacy. This typology aims to facilitate the understanding of how AI is transforming diplomatic practice and how states and diplomats can adapt to this new reality. The typology is divided into three categories: (a) AI as a tool for diplomacy; (b) AI as a diplomatic topic; and (c) AI as a transformative factor in the diplomatic environment (DiploFoundation, 2019). The following sections present these three categories, along with the considerations provided by the DiploFoundation for each.

AI as a Tool for Diplomatic Practice

The first aspect of the AI-in-diplomacy typology refers to AI as a practical tool that can be employed to enhance traditional diplomatic functions. AI offers significant potential to improve the efficiency and effectiveness of diplomatic activities by facilitating information gathering, data analysis, communication, representation, and negotiation processes. AI-based tools, such as natural language processing algorithms, can assist diplomats in managing large volumes of text and documents, enabling more effective preparation for negotiations and policy development. Furthermore, AI systems can support trend analysis and monitoring of global issues, helping diplomats make more informed and strategic decisions. For example, using AI to monitor social media and other open-source information can provide real-time data on political and social developments in a country engaged in negotiations. This capability is crucial for the early detection of crises and for formulating rapid and effective responses. Additionally, AI-equipped virtual assistants can automate administrative tasks, freeing diplomats to focus on more complex and strategic activities (Diplofoundation, 2019).

Despite these potential benefits, several challenges must be addressed. The accuracy of AI systems critically depends on the quality of the data used for training. Biased data can lead to distorted outcomes, which is particularly problematic when decisions with far-reaching implications rely on such results. For instance, pattern analysis and image recognition performed by AI are only as accurate as the data on which they were trained. Moreover, the use of large datasets raises additional concerns regarding access, interpretation, protection, and security, especially in diplomacy, where sensitive and confidential information is frequently handled. In such cases, safeguarding against leaks and unauthorized access is crucial to ensure that confidential information remains secure.

Furthermore, Bjola (2020) highlights that the likelihood of successfully integrating AI into diplomatic operations is higher for highly structured routines, whereas tasks involving

unstructured decision-making, adaptive knowledge, and complex predictive analyses are currently less amenable to AI utilization.

AI as a Topic of Diplomatic Negotiations

The second aspect of the typology emphasizes AI as a central topic in diplomatic negotiations. Beyond integrating AI into diplomatic practice, diplomats must address emerging issues on the international agenda related to AI. This includes debates on the development of new technologies, such as Lethal Autonomous Weapon Systems (LAWS), as well as ethical and regulatory considerations surrounding AI. The increasing prominence of AI on the international agenda can be traced through key topics such as economics and business, security, democracy, human rights, and ethics (Diplofoundation, 2019).

In the economic sphere, concerns arise regarding potential displacement and concentration of economic power, but there are also opportunities for developing countries to leapfrog stages of development through AI adoption. In terms of security, AI advancements may alter the balance of power among nations and create asymmetric advantages, raising concerns about the use of AI technology in terrorism and cyber warfare. Regarding human rights and ethics, the potential misuse of technology to restrict rights and freedoms represents a real concern, particularly when algorithm-driven automated decisions may result in discrimination and exacerbate existing inequalities.

Another relevant aspect of the relationship between AI and diplomatic negotiations concerns issues related to its governance, regulation, and ethical impact. Diplomats and international treaties must address concerns regarding AI security, data privacy, algorithmic bias, and the potential militarization of the technology. These challenges require the establishment of international norms and regulations that promote the safe and ethical use of AI. Debates in forums such as the United Nations and other international organizations highlight the need for a multilateral approach to managing AI-related challenges. Diplomacy plays a critical role in these processes by facilitating dialogues among states, the private sector, academia, and civil society to develop governance frameworks that are inclusive and reflect global values and interests.

AI as a Factor Shaping the Diplomatic Environment

The third and final part of the typology proposed by the DiploFoundation examines AI as a factor transforming the environment in which diplomacy is conducted. The rise of AI is redefining the global landscape, influencing the balance of power among nations and altering economic and social dynamics worldwide. Countries that lead in AI development have the potential to exert greater international influence, leveraging advanced technological capabilities to strengthen their economies, national security, and soft power. Dominance in the AI domain by a single nation can reshape the global landscape, creating new power asymmetries and consolidating the influence of AI-leading countries (Diplofoundation, 2019).

Moreover, the development of AI technologies is driving significant changes in the ways countries interact with one another and with non-state actors. Technology companies and international organizations are emerging as key players in global AI discussions, requiring diplomats to adapt their strategies to engage effectively with these new actors. The impact of AI on the economy, labor markets, and social structures also challenges countries to develop domestic and foreign policies that minimize negative effects while maximizing opportunities for growth and innovation.

It is important to note that these transformations in the diplomatic environment are not always solely the result of AI advancement, but often stem from a broader set of changes arising from the evolution of new digital technologies in general. As will be discussed in the following section, AI development cannot be understood in isolation from innovation ecosystems and other complementary technologies. Nonetheless, while AI is part of this broader set and shares many of its impacts on international politics, certain elements distinguish it and justify an individualized analysis.

First, the popularity and scope of the term “artificial intelligence” stand out, as it has become a kind of symbol, or “umbrella” term, for new digital technologies more broadly. This popularity is evident across different contexts—market, academic, and governmental—but often results in its improper or inaccurate use. This issue is linked to the inherently unstable and contested definition of AI, which varies according to different technical or political paradigms (Bjoula, 2020). In any case, the term’s widespread recognition justifies addressing it individually.

A second factor distinguishing AI from other digital technologies is the degree of uncertainty surrounding its future impacts. Unlike other technologies, the future relationship

between society and AI is particularly unpredictable. The concept's popularity has fueled high levels of speculation about its actual and potential effects—recently illustrated by the surge in investments in big tech companies, to the point where some experts have warned of a possible speculative bubble (Floridi, 2024). Beyond this, what truly sets AI apart is that this uncertainty extends beyond technical or economic aspects, encompassing ethical, moral, and anthropological dimensions. Ultimately, AI challenges the very meaning of humanity, which explains the distinct attention it has received.

A final factor justifying an individualized analysis of AI is its recognition today as one of the technologies with the greatest potential impact on international politics in general, and diplomacy in particular (Buch; Eagleman; Grosenick, 2022). These impacts range from the transformation of global economic dynamics through the automation of productive processes to the redefinition of cybersecurity and national defense strategies. Consequently, AI has become a central political issue, encompassing matters of international governance and necessitating discussions on ethics, regulation, and technological sovereignty, while simultaneously creating new opportunities for inter-state cooperation.

Innovation, Cooperation, and Competition

Although often treated in isolation, AI cannot be understood except as a component of broader innovation ecosystems, as its operation is essentially integrated with the development of complementary technologies. Innovation ecosystems can be conceptualized as networks of interdependent and interconnected actors who cooperate and compete in value creation, including developers, suppliers, complementary innovators, regulatory authorities, standardization agencies, the judiciary, research institutions, funding agencies, distributors, subcontractors, and technology providers, among others (Bernat, 2023).

Facilitating such environments is now considered essential for economic development, which is why governments worldwide seek to design public policy guidelines that encourage the creation of innovation-friendly environments, commonly referred to as "national innovation systems." These strategies explore the strategic value of national innovation systems in achieving national objectives, including foreign policy goals, such as the projection of power.

At the international level, the relationship between different national innovation systems is characterized by a tension between cooperation and competition. This tension is natural, as

national innovation systems are not independent but interdependent, inherently transnational in nature. Large innovation ecosystems result from the complex interaction between local, regional, and global actors. Consequently, there is a dynamic whereby participation in global technology markets is essential for fostering these environments domestically, while mastery of cutting-edge technologies carries inherent strategic value in balancing the relative capabilities of nations.

The development of AI tools constitutes a significant component of this dynamic, and through it, we can also observe international trends in both cooperation and competition (Tilovska-Kechedji; Kolakovic, 2022). On the cooperation side, several initiatives have sought to promote the integration and joint development of technologies and regulatory frameworks. Specifically in Latin America, one notable example is the Latin American Artificial Intelligence Index, developed by the National Center for Artificial Intelligence (Cenia) in Chile, in collaboration with other universities, governments, and research centers across the region (Cenia, 2023). This international effort aims to consolidate the analysis of various metrics and indicators regarding the extent of AI usage and the level of technological development in the region, with a particular focus on identifying opportunities for international cooperation. In Europe, the previously mentioned DiploFoundation stands out as an initiative led by the governments of Switzerland and Malta, dedicated to research and training of specialized personnel at the intersection of technology and diplomacy—an intersection widely known as Digital Diplomacy. Moreover, many leading international organizations have already established platforms for discussion, knowledge sharing, and cooperation on the topic. Examples include the OECD AI Observatory, the Inter-American Development Bank's fAIr initiative, and UNESCO's Artificial Intelligence Ethics Forum.

From a competitive standpoint, several authors, such as Feijóo *et al.* (2020) and Kļaviņš (2021), emphasize that the development of new AI technologies has evolved into a genuine technological race, primarily involving the United States, the European Union, and China, with secondary participation from other nations such as Russia, South Korea, Japan, and India. There is a widespread perception that mastery of AI technologies will be critical in determining the leading economic and geopolitical powers in the coming decades.

As previously noted, advancements in cutting-edge technologies such as AI have the potential to significantly reshape the balance of power and the relative capabilities of nations within the international arena. These impacts extend across economic, military, and institutional domains (Kļaviņš, 2021). Economically, AI can enhance comparative advantages in the

production of high-value-added goods, thereby positioning countries more favorably within global value chains. Militarily, the development of autonomous weapons and security systems is already considered essential in strategic calculations, representing a substantial leap in relative military capabilities, as evidenced by the ongoing war in Ukraine.

Another crucial aspect of this technological race is that each of the three major AI development hubs reflects a distinct institutional model regarding the relationship between technological advancement and regulation. The United States operates under a relatively deregulated federal framework (despite numerous state-level regulations focusing on data protection), where AI technologies primarily evolve through free-market mechanisms. The European Union, by contrast, has pioneered a highly regulated market model, enacting specific legislation on AI in 2021. This regulatory approach prioritizes human rights and employs a risk-level scale as its central parameter. Finally, China has adopted an interventionist model, with specific legislation passed in 2023, wherein the state plays a central role in coordinating AI development in alignment with government-defined national objectives, consistent with its traditional approach to other industries.

Thus, competition among leading nations is not limited to the supremacy of the technology itself but extends to the institutional models governing its integration and developmental chain. These models reflect the political systems from which they originate and entail differing cost-benefit relationships between regulation and innovation incentives. Naturally, as Feijóo et al. (2020) suggests, these models may converge in the future, potentially leading to a form of international consensus on the matter. Alternatively, they may continue to diverge, creating obstacles for integration among innovation ecosystems that adopt different frameworks, thereby rendering the establishment of a broad, formal, or informal global governance of these technologies increasingly unlikely.

Scientific Diplomacy, Innovation Diplomacy, and Artificial Intelligence

Bringing together the findings from the previous sections, it becomes clear that AI is a highly transformative tool, with the potential to impact diplomacy in at least three dimensions: its practice, its agenda, and its environment. The conditions for AI technology development form part of international innovation ecosystems, which are characterized by a persistent

tension between cooperation and competition, as well as by the overlapping of local, national, regional, and global levels.

Within this complex and challenging context, several subfields of diplomacy have emerged, seeking new theoretical and practical tools to equip diplomats to address these challenges. Among them, Scientific and Innovation Diplomacy (S&I) stands out. Although not originally designed to address any specific technology, it provides a set of concepts and practices that can enhance the quality of public policies related to AI, both in terms of developing more effective national strategies and fostering deeper international cooperation. Given the increasing relevance of AI tools, this technology is likely to become an ever more prominent topic in this literature and among its practitioners. As we argue below, the S&I literature has much to contribute to this debate—not only in terms of designing cooperation and development strategies but also in creating approaches to address the profound disparities in the pace of development, regulation, and integration of these technologies across different states and societies.

The relationship between Scientific Diplomacy, Innovation Diplomacy, and AI is neither necessary nor self-evident; however, as we seek to argue, it represents an opportune convergence for the following reasons: AI is a contemporary topic of high technical-scientific complexity, with significant potential for both positive and negative economic impacts, a wide range of real and potential effects on social and political organization, and, most importantly, it is a field marked by intense international tension. It is, therefore, by its very nature, a scientific, interdisciplinary, and political topic par excellence.

Scientific Diplomacy, in turn, constitutes a set of concepts and practices particularly suited to addressing the characteristics of AI, owing to its hybrid nature that bridges theory and practice. Its conceptual foundations are intrinsically interdisciplinary, as they address the intersection between science, technology, and International Relations, thereby enabling a comprehensive and integrated perspective on the subject. Furthermore, its political execution takes place within the diplomatic arena—namely, in international negotiations where complex and globally significant issues, such as AI, can be addressed in a coordinated and multilateral manner. As such, Scientific Diplomacy provides a holistic and effective prism for the analysis and formulation of policies related to AI.

Innovation Diplomacy, on the other hand, offers an equally relevant lens for examining the emergence of AI, as it focuses on the strategic role of technological innovation as a driver of economic and social transformation. Innovation Diplomacy encompasses the creation of

national and subnational strategies that employ diplomatic tools and processes to strengthen innovation capacities, including research and development, technological entrepreneurship, innovation ecosystems, high-technology production and trade, venture financing, and skilled human capital (INNSCIDSP, 2019). When addressing AI—one of the most disruptive technologies of our time—Innovation Diplomacy enables the exploration of cooperation and competition dynamics among states, corporations, and academic institutions.

Although they are distinct concepts, there is a significant intersection between Scientific Diplomacy and Innovation Diplomacy. In brief, Scientific Diplomacy focuses on the intersection of science, technology, and International Relations, fostering cooperation to address global challenges. Innovation Diplomacy, in contrast, centers on the strategic use of emerging technologies to drive economic transformation, competitiveness, and sustainable development. In this regard, Innovation Diplomacy complements Scientific Diplomacy by incorporating elements of competitiveness and economic development.

The convergence of these fields is of substantial strategic interest, as AI currently represents one of the most advanced technological frontiers, making it imperative for developing countries to invest in training professionals capable of engaging in this strategic market. This preparation must go beyond the technical education of computer scientists, encompassing also the training of policymakers and humanities specialists equipped to understand and address the complex legal, economic, and political implications of AI. Without such a broad and interdisciplinary approach, these countries risk being marginalized in the technological revolution, particularly within an asymmetrical international context.

In this respect, a vast body of literature on Scientific and Innovation Diplomacy reinforces the fundamental role of governments, businesses, and civil society in shaping international policies grounded in empirical and scientific evidence. Works such as those by Ruffini (2017), Gluckman *et al.* (2017), and Flink and Schreiterer (2010) highlight how Scientific Diplomacy can facilitate transnational collaboration and mutual understanding, using science as a tool to promote peace and international cooperation. Well-known examples include the involvement of scientists in the signing of the Treaty on the Non-Proliferation of Nuclear Weapons (1968) and the establishment of the United Nations Intergovernmental Panel on Climate Change (1988). More specifically, Scientific Diplomacy is often understood within three spheres of action: diplomacy for science, science for diplomacy, and science in diplomacy (Royal Society, 2010).

It is important to note, however, that the literature presents several limitations to this original definition, and some authors have sought to explore the duality between cooperation and competition within the discourse of Scientific Diplomacy. For instance, Ruffini (2020b) presents several important arguments regarding the dual nature of scientific diplomacy. According to this author, the dominant discourse on scientific diplomacy tends to emphasize international cooperation and shared interests, often overlooking the competitive aspects that also play a significant role. He argues that, while collaboration is essential, competition among nations for scientific and technological advantages is equally predominant and must not be ignored. Thus, cooperative scientific efforts often intertwine with the pursuit of competitive advantage, creating a complex dynamic that shapes international scientific relations.

For this reason, the author advocates for a broader definition of scientific diplomacy—one that recognizes its dual nature as both collaborative and competitive. He posits that this duality is essential for understanding the full scope of scientific diplomacy and its impact on international relations. This duality involves recognizing the national interests that drive scientific research and technological innovation. In this sense, we argue that incorporating the concepts and strategies of Innovation Diplomacy, together with the conceptual framework previously outlined regarding innovation ecosystems, responds to Ruffini's call to broaden the theoretical horizon of Scientific Diplomacy.

Thus, scientific diplomats will need to learn how to operate within this complex dynamic, observing the multiple layers at which AI intersects with diplomacy and working to balance the pursuit of national objectives with the promotion of international cooperation. Most importantly, this entails anticipating the impacts of rapid technological change and providing guidance to decision-makers on how to formulate national and global policies in ways that maximize benefits while mitigating negative consequences (Colglazier, 2018).

Below, we outline some of the tools commonly identified in the literature on Scientific Diplomacy and Innovation Diplomacy, as well as in related fields, which we consider suitable for more systematically incorporating the topic of AI into international cooperation initiatives, while also supporting the creation of strategic positions regarding the social and economic impacts of these technologies.

Bilateral and multilateral agreements. Scientific cooperation is an arena in which AI can serve as a bridge for strengthening international relations. Authors such as Colglazier (2018), Ruffini (2017), and Turekian *et al*. (2015) highlight that international scientific cooperation tends to be of a win–win nature. Regarding globally significant topics, such as AI,

the scientific field often provides fertile ground for enhanced cooperation between nations, given the universal character of scientific discourse. This cooperative stance may, in turn, generate spillover effects in other domains. In this regard, at the diplomatic level, scientific diplomats can work to establish bilateral and multilateral agreements, harmonize understandings, create joint working groups, promote academic exchange programs, and facilitate cooperation in major scientific projects. Such agreements hold the potential to strengthen global scientific infrastructure, increase data and publication sharing, and reduce international tensions surrounding AI tools.

Platforms and cooperation networks. At the academic level, international networks of science and technology—comprising both online platforms and recurring in-person meetings—can serve as mechanisms for fostering social bonds between scientists and diplomats specializing in AI. Due to the sensitive and strategic nature of AI, these platforms and networks tend to enhance transparency, harmonize ideas and concepts, promote the sharing of challenges and solutions, strengthen interpersonal ties among developers, researchers, and decision-makers, and foster interdependence within collaborative networks. As a result, they can discourage excessively aggressive or competitive positions on the international stage, contributing instead to a more predictable and cooperative environment for future negotiations.

Public engagement and cultural diplomacy. To ensure that the integration of AI technologies addresses the social, ethical, and political concerns raised in recent years, the active involvement of civil society is essential. This requires a sustained effort in transparency and scientific communication. In this context, scientific diplomats must also act as science communicators, aiming to facilitate dialogue among developers, policymakers, and society at large. Accurately understanding AI and related technologies, as well as communicating their capabilities and limitations to the public, is a challenging task given their scientific complexity. Despite their widespread presence today, there remains a general misunderstanding about what AI is, how it works, and what its real potential and constraints are. Consequently, poorly informed policymakers may overestimate or underestimate its effects. Scientific diplomats, however, can play a critical role in bridging this gap through informed assessments and guidance (Montgomery, Colglazier, 2022). This objective may be pursued through the creation of recurring spaces and opportunities for interaction among all stakeholders, including, for example, international scientific events, exhibitions, fairs, and the use of public diplomacy as a tool for scientific outreach.

Scientific advisory. One of the most relevant aspects of Scientific and Innovation Diplomacy is the provision of advisory services to decision-makers. In such cases, the participation of scientific diplomats aims to improve the technical quality of decisions, which must simultaneously promote innovation, regulate the use of technologies within responsible, democratic, and transparent frameworks, and remain technologically and economically viable. This can be achieved not only by including scientific diplomats in negotiation delegations but also by establishing multidisciplinary science and technology committees within national institutions and agencies, as well as in international organizations, to closely monitor decision-making processes and provide evidence-based recommendations. Conversely, this should be a two-way process: skilled scientific diplomats must not only be able to inform policymakers about the technical aspects of AI but also advise developers on issues of political legitimacy, accountability, transparency, responsiveness, individual rights, and the importance of incorporating these aspects into the AI technology development process (Gluckman *et al.*, 2017).

Education and Training. To enable the use of Scientific Diplomacy strategies in the field of AI, it is crucial to provide training aimed at developing high-level scientific diplomats. This includes equipping them with a deep understanding of the technology, its various forms, its impacts, and its development model. More importantly, these professionals must possess the ability to translate these elements into comprehensible and relevant information for decision-makers. Additionally, scientific diplomats must have critical knowledge of Scientific Diplomacy itself. Such knowledge is essential for recognizing both the strengths and limitations of the tools at their disposal. For instance, it is important to acknowledge that Scientific Diplomacy encompasses both an analytical-theoretical framework and a diplomatic practice, and that its application simultaneously generates effects of international cooperation and strategic value for states seeking to enhance their comparative advantages in a competitive environment (Ruffini, 2020a).

Digital Diplomacy Tools. Within the scope of how AI tools may impact diplomatic practice, as discussed in the first section of this article, several concepts highlight the connection between AI, emerging technologies, and diplomacy. For example, the coordinated use of digital technologies—including IT solutions, software, big data, and AI—to support traditional diplomatic functions such as representation and negotiation is currently referred to as Digital Diplomacy (Robertson, 2018). This includes, for instance, leveraging platforms such as X (formerly Twitter) and other social media networks to expand and optimize the communication

and political strategies of diplomatic institutions. Data Diplomacy is recognized as an emerging field that links diplomatic activities with data production, providing training for the use of such data to address the specific challenges of international relations. In this regard, Silva and Meireles (2015) identify a significant challenge: the conversion of data into actionable knowledge. They emphasize the importance of having organized and readily accessible data, which is often scarce in the political context, where data may be disorganized or unavailable for direct download. Ashbrook (2020) suggests that digital tools have the potential to enhance diplomatic practices by empowering diplomats to manage complex and multilateral negotiations while improving crisis forecasting. This evolution is closely associated with the concept of Data Diplomacy, a term that, according to Ashbrook, is gaining prominence as digital diplomacy expands. Boyd *et al.* (2019) describe Data Diplomacy as a comprehensive interaction between data and diplomatic processes, linking it to scientific approaches within the field of diplomacy. The availability of data—particularly governmental data—is essential, although frequently problematic, as much operational government data is online but neither systematized nor available for direct download (Silva; Meireles, 2015). Overcoming these limitations is crucial to fully harnessing the potential of information and to effectively supporting international collaboration efforts.

Final considerations

AI currently represents one of the main technological frontiers, and it is imperative that developing countries train qualified personnel to integrate into this market. This entails not only the technical training of computer scientists but also the preparation of decision-makers and humanists capable of understanding its legal, economic, and political implications. The convergence between diplomats and scientists has increasingly emerged as a topic of interest in International Relations, as well as a key element of political strategy for improving countries' international positioning. Furthermore, the conjunction of diplomacy with national innovation systems—broadly composed of the entire research and development ecosystem, including government, universities, markets, and civil society—constitutes innovation diplomacy, which is considered essential for achieving long-term social and economic development, including in the field of AI.

This article presented a general conceptual framework of the broader relationship between AI and diplomacy; it then provided an overview of AI's integration within international innovation ecosystems, emphasizing the dynamics between competition and cooperation; and finally, it offered reflections derived from the intersection between the literature on Scientific and Innovation Diplomacy and the issues discussed in the previous sections, proposing tools through which this body of knowledge can contribute to a better understanding and strategic formulation in the current landscape.

ACKNOWLEDGMENTS: This study was conducted with the support of the Brazilian National Council for Scientific and Technological Development (CNPq) – Process No. 420879/2022-6.

REFERENCES

ASHBROOK, C. C. From digital diplomacy to data diplomacy. **IPS**, 2020. Available at: https://www.ips-journal.eu/regions/global/from-digital-diplomacy-to-data-diplomacy-3993/, 2020. Accessed in: 16 Sep. 2024.

BERNAT, S. Dynamics of Innovation Ecosystems: Orchestrating Actors and Interactions in Emerging Economies. **IntechOpen**, 2024.

BJOLA, D. C. **Diplomacy in the Age of Artificial Intelligence**. [*S.l.*]: EDA Working Paper, 2020.

BOYD, A. *et al*. Data Diplomacy. **Science & Diplomacy**, 2019. Available at: https://www.sciencediplomacy.org/article/2019/data-diplomacy. Accessed in:16 Sep. 2024.

BUCH, A. M.; EAGLEMAN, D. M.; GROSENICK, L. Engineering Diplomacy: How AI and Human Augmentation Could Remake the Art of Foreign Relations. **Science & Diplomacy**, 2022. DOI: 10.1126/scidip.ade6798. Available at: https://www.sciencediplomacy.org/perspective/2022/engineering-diplomacy-how-ai-and-human-augmentation-could-remake-art-foreign. Accessed in: 10 Mar. 2023.

CENIA. **Índice Latinoamericano de Inteligencia Artificial**. 2023. Available at: https://indicelatam.cl/. Accessed in: 16 Sep. 2024.

COLGLAZIER, E. W. Science Diplomacy and Future Worlds. **Science & Diplomacy**, v. 7, n. 3, 2018. Available at: http://www.sciencediplomacy.org/editorial/2018/science-diplomacyand-future-worlds. Accessed in: 16 Sep. 2024.

DIPLOFOUNDATION. **Mapping the challenges and opportunities of artificial intelligence for the conduct of diplomacy**. 2019. Available at: https://www.diplomacy.edu/AI-diplo-report. Accessed in: 16 Sep. 2024.

FEIJÓO, C. et al. Harnessing artificial intelligence (AI) to increase wellbeing for all: The case for a new technology diplomacy. **Telecommunications Policy**, v. 44, n. 6, p. 101988, 2020. DOI: 10.1016/j.telpol.2020.101988. Available at: https://www.sciencedirect.com/science/article/pii/S030859612030080X?via%3Dihub. Accessed in: 17 Jan. 2023.

FEINGOLD, S. **What is artificial intelligence**—and what is it not? 2023**.** Available at: https://www.weforum.org/agenda/2023/03/what-is-artificial-intelligence-and-what-is-it-not-ai-machine-learning/. Accessed in: 10 Nov. 2023.

FLINK, T.; SCHREITERER, U. Science diplomacy at the intersection of S&T policies and foreign affairs: toward a typology of national approaches. **Science and Public Policy**, v. 37, n. 9, p. 665–677, 2010. DOI: 10.3152/030234210X12778118264530. Available at: https://academic.oup.com/spp/article-abstract/37/9/665/1651647?redirectedFrom=fulltext. Accessed in: 13 May 2023.

FLORIDI, L. Why the AI Hype is Another Tech Bubble. **Philosophy & Technology**, v. 37, n. 4, p. 128, 2024. DOI: 10.2139/ssrn.4960826. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4960826. Accessed in: 10 Jan. 2025.

GLUCKMAN, P., TUREKIAN, V., GRIMES, R. W., & KISHI, T. Science diplomacy: A pragmatic perspective from the inside. **Science & Diplomacy**, v. 6, n. 4, 2020.

INNSCIDSP. **São Paulo framework of innovation diplomacy.** São Paulo: IRI-USP; IEA-USP; FAPESP, 2019.

KĻAVIŅŠ, D. Diplomacy and Artificial Intelligence in Global Political Competition. *In*: STAFFORD, D.; RUSS, J. (Eds.), **Competition in World Politics**. [*S.l.*]: Global Studies, 2021. Available at: https://library.oapen.org/bitstream/handle/20.500.12657/50140/1/9783839457474.pdf#page=214. Accessed in: 16 Sep. 2024.

MONTGOMERY, K.; COLGLAZIER, E. W. Emerging Technologies and Science Diplomacy. **Science & Diplomacy**, 2022. DOI: https/10.1126/scidip.ade6810. Available at: https://www.sciencediplomacy.org/editorial/2022/emerging-technologies-and-science-diplomacy. Accessed in: 23 May 2023.

ROBERTSON, J. Organizational culture and public diplomacy in the digital sphere: The case of South Korea. **Asia & the Pacific Policy Studies**, v. 5, n. 3, p. 672–682, 2018. DOI: https: 10.1002/app5.256. Available at: https://onlinelibrary.wiley.com/doi/10.1002/app5.256. Accessed in: 23 Jun. 2022.

SILVA, D.; MEIRELES, F. Ciência Política na era do Big Data: automação na coleta de dados digitais. **Revista Política Hoje**, v. 24, n. 2, p. 87–102, 2015. Available at: https://periodicos.ufpe.br/revistas/politicahoje/article/view/3721. Accessed in: 16 Sep. 2024.

ROYAL SOCIETY. **New frontiers in science diplomacy: Navigating the changing balance of power**. RS Policy document 01/10. Science Policy Centre London, 2010.

RUFFINI, P.-B. **Science and Diplomacy**. Cham: Springer International Publishing, 2017. DOI: 10.1007/978-3-319-55104-3

RUFFINI, P.-B. Conceptualizing science diplomacy in the practitioner-driven literature: a critical review. **Humanities and Social Sciences Communications**, v. 7, n. 1, p. 124, 14 out. 2020a. DOI: 10.1057/s41599-020-00609-5. Available at: https://www.nature.com/articles/s41599-020-00609-5#citeas. Accessed in: 8 Jan. 2023.

RUFFINI, P.-B. Collaboration and Competition: The Twofold Logic of Science Diplomacy. **The Hague Journal of Diplomacy**, v. 15, n. 3, p. 371–382, 5 ago. 2020b.

TILOVSKA-KECHEDJI, E.; KOLAKOVIC, A. Artificial intelligence influence on diplomacy. Em: Towards a Better Future: Visions of Justice, Equality, and Politic. **Anais**[...] Faculty of Law - Kicevo, University “St. Kliment Ohridski” - Bitola: 2022. Available at: https://eprints.uklo.edu.mk/id/eprint/9362/ Accessed in: 16 Sep. 2024

TUREKIAN, V. C. et al. The Emergence of Science Diplomacy. Em: DAVIS, L. S.; PATMAN, R. G. (Eds.). *In*: DAVIS, L. S.; PATMAN, R. G. (Eds.). **Science Diplomacy**. [*S.l.*]: World Scientific, 2015. p. 3–24.
DOI: 10.1142/9789814440073_0001. Available at: https://www.worldscientific.com/doi/abs/10.1142/9789814440073_0001. Accessed in: 11 Sep. 2021.

CRediT Author Statement

- **Acknowledgements**: We express our gratitude to Professor Janina Onuki (IEA-USP) and all members of the Center for the Study of International Negotiations (CAENI-USP) for their ongoing contributions.
- **Funding**: This study was supported by the National Council for Scientific and Technological Development (CNPq) – Brazil – Process No. 420879/2022-6.
- **Conflicts of interest**: None.
- **Ethical approval**: N/A.
- **Data and material availability**: All data and materials are contained within the article.
- **Authors' contributions**: Amâncio J. S. N. de Oliveira: conceptualization, supervision, project administration, funding acquisition; Romeu B. Mesquita: conceptualization, investigation, writing (all stages); Rodrigo Lyra: conceptualization, investigation, writing (all stages).

Processing and editing: Editora Ibero-Americana de Educação
Proofreading, formatting, standardization and translation