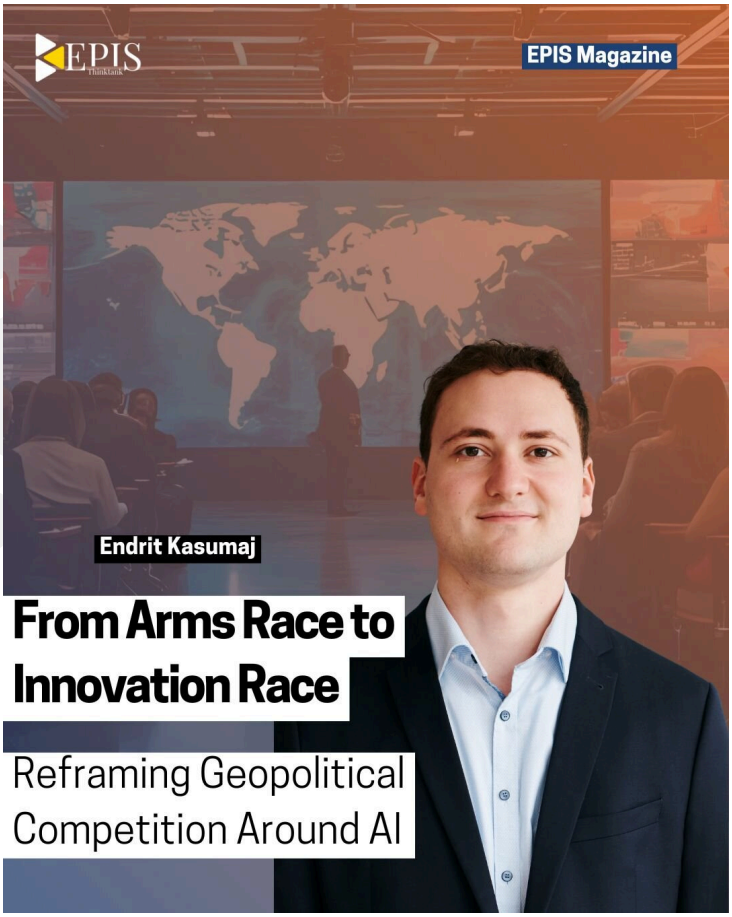
From Arms Race to Innovation Race

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Technological innovations have long been considered central to understanding geopolitical competition, giving rise to the concept of arms races. Especially since the 20th century, examples such as the naval rivalry between Britain and Germany or the nuclear arms race during the Cold War, the idea of an arms race has gained prominence (Mahnken et al., 2016). Artificial intelligence, as the latest general-purpose technology, has been touted as the newest technology that could revolutionise warfare through autonomous systems, cyber warfare and data-driven decision-making, causing speculations that the pursuit by the great powers to attain an edge

in this area will spark a new arms race (Johnson, 2019). The previous article has argued in favour of the reality of an AI arms race, but to what extent does the concept of an arms race apply to the current global AI competition? This article will provide a conceptual examination and delve into the notions of arms races and modern AI, and to what extent it is useful to synthesise these two into the concept of an "AI arms race".

2.1 Definition and History of Arms Races and the Role of Technology

Although armed conflict between groups has existed since ancient times, the concept of an arms race can be traced to the 19th century and the industrialisation of weaponry. However, the term began to be used more widely around the turn of the 20th century when referring to the naval competition between Britain and Germany. With the outbreak of the Cold War and the proliferation of nuclear arms, scholarship on this topic surged, leading to theoretical innovation by scholars like Lewis Richardson or Samuel Huntington, with the latter defining an arms race as "progressive, competitive peacetime increases in armaments by two states or coalition of states. (Mahnken et al., 2016)"

Glaser (2000), coming from an International Relations Realism perspective, divides the causes of arms races into external and internal. Regarding the first cause, rational state behaviour responds to threats or opportunities emanating from the international environment, leading to action-reaction dynamics causing states to bolster their armaments as a reaction to perceived threats from adversaries. Internal causes, on the other side, are those that are traced back to domestic factors such as bureaucratic politics, institutional drivers and economic interests, leading, for example, to a military-industrial complex which doesn't respond to any perceived threat.

As was mentioned, the Cold War brought the concept of the arms race to the fore, with technological superiority being the main advantage the U.S. counted on in its rivalry against the Soviet Union which possessed the population numerical and resource advantage. As this conflict advanced, the U.S. bet on technological progress, aided by its dynamic and federally-funded research and development system which fused bottom-up innovation and top-down control, paid off. The Soviet Union gradually fell behind the U.S. until the 1980s, when it became clear that the Soviet Union would be unable to catch up, with many experts arguing that this realisation by state elites and citizens alike played a significant part in the collapse of the Soviet Union (Friedberg, 2006).

2.2 Artificial Intelligence Technology in Warfare

It is first useful to define Artificial Intelligence and its application to geopolitics and national security. Buchanan (2020) proposes the term "AI triad" to denote the three key components to explain modern AI systems: algorithms, data and computing power. Algorithms tell AI systems how to process information and can be divided into three main types which are supervised learning (learning from labelled data), unsupervised learning

(finding patterns in unlabeled data) and reinforcement learning (learning via trial and error).

Data is crucial in training machine learning systems but can also be detrimental to the system if it is biased or limited. Thus, larger and more representative datasets are crucial in ensuring that results are more solid and reliable. As AI systems grow more complex and encompass ever-growing datasets, computing power becomes instrumental in ensuring that this demand is satisfied. For example, OpenAI found that between 2012 and 2018, computing power required for major AI projects increased by a factor of 300.000. Thus, Buchanan summarises modern AI as "Machine learning systems use computing power to execute algorithms that learn from data" (Buchanan, 2020, p.3).

One major way in which AI is applied to military technology is Automated Weapon Systems (AWS). Lethal Autonomous Weapons (LAWs) are autonomous weapons capable of identifying, targeting and engaging enemies without human control, which yields quicker decision-making and precision. These complex manoeuvres performed without human oversight by these systems have been enabled by rapid advancements in AI, which can be seen in virtual dogfights and deployments of autonomous drones and weaponised swarms (Ueno, 2023).

While these advancements may enhance efficiency and reduce risk to soldiers, this delegation of lethal force to machines also bears the risk of potential errors, unaccountability and unintentional escalation. Furthermore, LAWs could potentially remove the political costs usually linked to troop deployment, thereby increasing the likelihood of leaders initiating conflicts. Moreover, AI is also innovating cyberwarfare by increasing the scale, speed and stealth of attacks on critical infrastructure (power grids, water supplies), by identifying vulnerabilities more efficiently and launching simultaneous and large-scale attacks (Chivvis and Kavanagh, 2024).

Lastly, decision-making could also be outsourced to automated systems which may be able to process battlefield information and provide rapid insights, thus leading to reduced human intervention, potential errors and the loss of accountability.

2.3 Key National Players

The key states in the international system that primarily compete for superior AI capabilities are commonly associated with the United States, China and the European Union. The United States is considered the earliest developer of AI and stands out in areas such as talent, research, development, hardware and venture capital funding. Research and development spending by American software firms significantly outstrip those from their competitors abroad, thus producing cutting-edge research and innovation output. Moreover, the U.S. start-up system is renowned for attracting billions in capital and greatly contributing to America's competitive edge. In addition to the robust advancements in the private sector, the U.S. Defense Department has launched the "Joint AI Center" with which it seeks to

coordinate AI initiatives and their application to the military and imposes comprehensive export controls that aim to limit the transfer of sensitive technology.

China has been gradually narrowing the divide between itself and the U.S. by relying on its "military-civil fusion" which is a strategic policy designed to integrate civilian technological innovation with military applications. While China still trails the U.S. in terms of talent and research quality, its firms boast nearly twice as many high-performance supercomputers and have shown dramatic increases in R&D spending by software firms and rapid deployment of dual-use AI technologies. Moreover, in 2017, China's State Council launched the "New Generation Artificial Intelligence Development Plan" which seeks to invest in China's AI ecosystem and thereby evolve into the global leader in AI by 2030.

In contrast to the previous two countries, the European Union lags in all measures of AI capabilities, such as talent, research, development and hardware, mostly due to its focus lying in creating a "human-centric" regulatory framework. This framework aims to set ethical standards and establish robust governance mechanisms for AI, such as the Ethical Guidelines for Trustworthy AI and the EU AI Act. Critics argue that while this approach seeks to foster transparency, accountability and digital sovereignty, it might also, as a byproduct, stifle innovation and thus undermine the EU's competitive edge. Furthermore, the national-focused investment landscape and regulatory caution hamper the development of strong R&D funding and private-sector innovation that can be found in the U.S. and China (Carrozza et al., 2022).

Strategic AI Capabilities of Major Powers Across Key Dimensions

After having laid the groundwork for the proper discussion on an AI arms race, we now delve into the different perspectives concerning this very idea, more specifically the ascription of the concept of "arms race" to AI when describing the current state of global AI development. Far from a unanimous opinion about whether this novel idea is accurate, the current research landscape presents divergent perspectives. In this section, these will be presented and roughly categorised into the following concrete stances.

3.1 Rejection of the "AI Arms Race" Narrative

One dominant stance that is critical of the framing of an "AI arms race" argues that AI is fundamentally different from traditional arms. Scharre (2021), for example, views AI first and foremost as a general-purpose technology without an inherent purpose to be deployed as a weapon, similar to electricity whose applications are multifaceted. He argues that AI lacks the "abnormal" increases in defence spending among at least two rival nations which is characteristic of the traditional arms races of the past. Instead, the real risk lies in the deployment of unsafe AI systems resulting from a security dilemma which leads to the gradual loss of human control in the face of ever-more potent AI. Likewise, Roff (2019) argues that the framing

of an arms race is oversimplified, singling out the military aspect of AI development and disregarding the other crucial domains such as societal and economic. She views this framing as a diversion away from the urgent need to establish robust and ethical governance frameworks in order to reduce risk.

Similarly, Diehl and Lambach (2022) contend that the terminology is flawed and echo Scharre's point that AI is not inherently a weapon, thus failing to meet the criteria of a traditional arms race. Rather, the idea of an "AI arms race" is largely seen as a product of media hype and political rhetoric which aims to promote increased investment into AI research under the pretext of national security. In this context, Asaro (2019) reinforces this particular critique by emphasising how media coverage creates sensationalism without addressing the nuances inherent in the debate. He regards this framing as overly simplistic and fails to account for the multifaceted nature of the geopolitics of AI.

Cave and ÓhÉigeartaigh (2018) echo the grave danger the great powers can enter if they don't transform the framing from competition towards collaboration. Due to the nature of this AI arms race being constructed as narratives and framing, societies and states are able to shift this constructed framing and embrace a cooperative approach and therefore more effectively harness the benefits of AI while formulating global frameworks to mitigate the potential negative consequences thereof.

3.2 Affirmation of the "AI Arms Race" Narrative

The other dominant position within this debate regards the framing of the geopolitical dimension of AI as an arms race as meaningful. Among these, the eminent scholar Graham Allison (2020) argues that particularly the U.S.-China rivalry concerning AI resembles the nuclear arms race during the Cold War. He posits that the U.S. and China are in an unequivocal competition for AI dominance in the areas of economics, military and society. Due to the grand strides China has made on this front, Allison advocates for increased efforts to match China's capabilities.

Geist (2016) reinforces the notion that an arms race is not only probable but is already taking place and is unstoppable. The author traces the militarisation of AI back to the Cold War during which the two rival superpowers began pursuing AI-related technologies to gain a strategic advantage. Thus, instead of relying on traditional diplomatic means, efforts should be made using Track II diplomacy to devise arms-control agreements. Lastly, the former CEO of Google Eric Schmidt (2022) echoes the the view that the U.S. and China are engaged in an AI rivalry with both powers whose ambition to gain technological dominance results in profound security implications. Specifically, Chinese dominance of global network platforms could create digital infrastructure which would enhance Chinese influence worldwide. For this reason, he advocates for a hybrid approach with selective decoupling in sensitive areas and simultaneous cooperation. Ding (2021) further shows the growing influence of China in international

standard-setting organisations, specifically concerning emerging technology such as AI, which could enable China to "lead in the formulation of new systems of standard".

3.3 The AI Innovation Race

I am now going to weigh in and lay out what I think is the most accurate way of viewing this debate. To this end, I will consult the article "Arms Race or Innovation Race? Geopolitical AI Development" by Schmid et al. (2025). In it, they build on the aforementioned article by Diehl and Lambach and propose the term "AI innovation race" which aims to capture the multidimensional nature of global AI competition.

From Schmid et al. (2025, p. 11)

More specifically, they propose four key features of this geopolitical innovation race which set it apart from a traditionally understood arms race. The first involves a departure from the notion characteristic of an arms race that competition is necessarily a negative- or zero-sum game. The authors argue instead that in AI innovation has the inherent potential of a positive-sum game, meaning that advancements in AI can result in benefits across the board.

Secondly, as opposed to a traditional arms race, which features state-military industrial complexes, the AI landscape features elements of domestic centres of innovation and transnational cooperation. The authors make use of the concept of "technopoles" by which regional innovation hubs are meant which are simultaneously concentrated but are integrated into a global web, thus exhibiting signs of both competition and collaboration. A third way in which the innovation race sets itself apart from an arms race concerns the different motivations driving AI development. While security interests dominate traditional arms races, economics and prestige are equally as important in the innovation race. This leads to different formulated interests behind AI development among the major players, with the U.S. emphasising the combination of national security with economic growth, China focusing on deepening economic integration and the EU setting global standards for regulation. Lastly, the authors highlight the socially constructed nature of AI (see Cave and ÓhÉigeartaigh) through which a certain arms race framing has emerged, thus going beyond mere technical capabilities.

Although the authors convincingly point to the different nature of AI innovation from a traditional arms race which could potentially lead to fruitful cooperation, it is also pointed out that there exist strong pressures for national competition which could lead to the erosion of safety standards in the pursuit of the upper hand. This is where Armstrong et al. (2015) offer a helpful game-theoretical model of how such a trajectory could materialise. Their model outlines how the drive to gain an early advantage can lead to cutting safety standards, thus increasing the odds of harmful outcomes. Moreover, it highlights the potentially paradoxical trajectory of purely competitive AI development, in that these competitive pressures undermine

the potential benefits brought about by rapid innovation. Therefore, both Schmidt et al. and Armstong et al. urge for a shift in consciousness from a purely competitive framing of AI development to a collaborative one which could adequately account for the harnessing of this breakthrough technology without letting it threaten the very foundations of global stability, ethical norms and social development.

Conclusion

In this review article, I analysed the notion of an "AI arms race" and its relevance to the geopolitical rivalry in AI development today. I concluded that the idea of an "arms race" does not serve as an adequate framework for understanding the complex nature of AI development. Alternatively, the idea of an "AI innovation race" provides this framing which encompasses this multifaceted nature, in that it accounts for the socially constructed nature of AI innovation narratives, the wide-ranging motivations behind national strategies, the existence of domestic innovation clusters along with transnational collaboration and the rejection of purely zero-sum outcomes.

At the same time, the risk of unbridled competitive pressures making AI developers turn a blind eye to safety standards is nevertheless existent. The game-theoretical approach presented in this article, based on Schmidt et al. and Armstong et al., further points to the paradox of competitive forces and their undermining effect on fruitful and beneficial innovation. Therefore, increased international cooperation will be increasingly necessary in order to create internationally binding safety standards aimed at fostering AI development which mitigates risk while bringing out the benefits.

Thus, by overcoming the arms race analogy and recognising the potential for a shared vision which benefits the global community, the great powers have the chance to adequately address the novel and paradigm-shifting challenge of AI. Ultimately, this critical reframing of the debate might greatly contribute to deciding the fate of this technology, specifically whether it will become the hitherto highest accomplishment of humanity or a risk factor for it.

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