HCSS SECURITY

Macro Implications of Micro Transformations

An Assessment of AI's Impact on Contemporary Geopolitics

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An Assessment of AI's Impact on Contemporary Geopolitics
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Executive Summary

The threats and opportunities associated with Artificial Intelligence (AI) technologies force liberal societies to grapple with a range of fundamental issues, many of which directly affect the existing economic, social, political, and even the security fabrics that underpin the domestic and global orders. Both the commercial use of Machine Learning (ML) algorithms to cluster user profiles and optimize advertisement targeting,[1] as well as political applications of such techniques – such as the introduction and export of AI-powered social surveillance systems – constitute early harbingers of this reality. As the nature of geopolitics continues to shift from competition over the control of territory to strengthen material power capabilities to broader forms of contest involving states vying over power and influence, prosperity, and competing world perspectives, the technology is set to play an increasingly central role within interstate competition. Owing to its role as a core enabler, AI's impacts will manifest themselves across the economic, sociopolitical, and military-security domains; and through the creation of economic value, the lubrication of societal interaction, the modification of polities' relationships with citizens, and the transformation of the way in which future wars will be fought.

This study seeks to attain a better understanding of threats and opportunities associated with this rapidly evolving technology. It conducts an in-depth analysis of the AI profiles, programs and initiatives within the **economic** ($), **sociopolitical** (🏛), and **military-security** (🚜) domains of China, the European Union, the Russian Federation, and the United States. In doing so, it maps the degree to which these influential actors have applied **strategic coherence** to develop their **digitization**, **data processing**, and **innovation** infrastructures, and it assesses the extent to which this enables them to realize their geopolitical ambitions. On that basis, it identifies the most important threats and opportunities associated with AI. This paper formulates a policy agenda that frames the most critical challenges for liberal democracies in harnessing opportunities and mitigating threats in the service of national security, economic prosperity and societal welfare, all of which are rooted in the protection of core liberal democratic values.

1 This introduces socio-politically relevant considerations by opening the door to the exacerbation of political polarization through foreign influence campaigns.

AI Profiles and Programs: China, EU, Russia and the US

China presides over an exceptionally competitive AI ecosystem, the relative (geopolitical) impact of which is furthered by the government's active commitment to leveraging it towards the realization of impacts within the **economic**, **sociopolitical** and **military-security** domains. In the Chinese case, these efforts respectively transpose into initiatives such as the country's social control system, the propagation of 'digital totalitarianism' externally and the intelligentization of the battlefield through the introduction of AI applications throughout the 'observe, orient, decide and act' (OODA) loop. This includes, but is not limited to, unmanned systems and the progressive integration of algorithms in targeting processes. The core objective sought by the PLA's brass is to attain punctuated military competitive advantage, in part through the introduction of AI technologies. China is also remarkably active within the economic domain, though the diversity of its (and actors affiliated with its) efforts are generally endemic of a catch-all approach aimed at improving prosperity. China's AI exports are jointly propagated by its public and private sectors. A high degree of integration between these sectors is characteristic of the Chinese approach to growing the country's AI ecosystem.

The European Union possesses a relatively competitive (more so than the Russian Federation, less so than the US and China) AI ecosystem, the likely geopolitical impact of which can generally be conceptualized as being hamstrung by fragmentation between Member States. The European Union performs well within theoretical and advanced research, but generally fails to apply this research in practice. This is partially due to the bloc's general lack of large tech firms, meaning its exceptionally productive universities are essentially educating individuals to work for American enterprises. This is also partially the case due to a lack of EU and/or Member State-sponsored initiatives to incentivize the private sector to engage in such activities. Shortcomings in the EU **innovation infrastructure** are partially exacerbated by the lack of a world-competitive semiconductor industry, which in turn limits **data processing** possibilities. The EU performs exceptionally strongly within the **digitization** component, due to its exceptionally high smartphone saturation rate, high bandwidth speeds, and high utilization of Internet of Things (IoT) technologies. Member States' performance vis-a-vis **strategic coherence** varies, with the result being that – though the EU performs well (on paper) within various country profile components – there exist (in practice) barriers such as data format incompatibilities which hamper the development of EU-specific algorithms. Though the European Commission has published and allocated funds towards a relatively coherent EU-wide strategy for improving the EU's AI ecosystem which addresses many of the aforementioned shortcomings, the bloc's future competitiveness is likely to depend entirely on Member State engagement therewith. The EU's foremost AI-related export and impact is in the form of regulations such as the GDPR, which – in limiting

the range of AI applications by regulating private entities' data harvesting rights – serve to (positively) impact the **sociopolitical** domain. EU efforts at impacting the **economic** and **military-security** domains through the introduction of AI-related technologies remain limited, with small-scale, niche initiatives being propagated largely by individual Member States. Due to its economic importance as well as its role as an international norm-setter, the EU is nonetheless well-placed to impact the international regulation of these domains in the near future.

The Russian Federation has a limited-scope AI ecosystem, which the state largely steers towards manifesting within the **sociopolitical** and **military-security** domains. The Russian Federation's relatively unproductive AI ecosystem, the application and development of which remains largely contingent on state-sponsored initiatives, does not closely compete with (or supersede) China's, the EU's, or the US' within any of the country profile components. The country's most concrete strengths are present within the **digitization** and **innovation infrastructure** components, which are respectively bolstered by state-sponsored efforts at the introduction of an expansive IoT (surveillance) infrastructure and by Russian universities' continued ability to produce well-educated graduates. While Russian **strategic coherence** is clearly exhibited in the country's **digitization** component, it is absent within the **innovation infrastructure** and **data processing potential** components. This manifests in the country's challenge in addressing the brain drain, whereby Russia's universities produce graduates that increasingly seek to work abroad, and in its virtually nonexistent semiconductor industry. Russian sociopolitically-oriented AI use-cases are predominantly geared (as is the case with China) towards maintaining a degree of societal control. Though these systems are far removed in terms of their sophistication from their Chinese counterparts, they nonetheless fit within a larger trend of state-sponsored initiatives geared towards realizing digital totalitarianism. Russian military-security initiatives are more advanced than the country's efforts within the sociopolitical domain and focus on the development of (semi-)autonomous military systems. Russian private entities have engaged in niche use of AI elements within their day-to-day activities, meaning there is some activity within the **economic** domain, but these algorithms' narrow use cases do not match those under development in the US and China.

The United States presides over arguably the most productive AI ecosystem in the world. However, the government's general lack of engagement with and within this ecosystem is an important shortcoming. The United States' remarkably advanced AI ecosystem derives – as a result of exceptionally competitive universities, an aggressive and competitively funded private sector, and a world-leading semiconductor industry – a lead over its Chinese competitor within the **data processing** and **innovation infrastructure** components. The country's shortcomings are most evident within the **digitization** and **strategic coherence** components. Under **digitization**, the US suffers from a high degree of asymmetry vis-á-vis rural-metropolitan data availability and

underutilization of IoT technologies. Under **strategic coherence**, there is a general lack of government 'vision'. Government support for free-market practices means that – while US-based companies are exceptionally active within the **economic** dimension – the negative externalities associated with their work are not well contained. A concrete example presents within the **sociopolitical** domain, where the activities of companies such as Facebook and Google have contributed to societal polarization, as well as to the success of foreign influence campaigns aimed at promoting polarization. The US government emphasizes on developing AI technologies for use within the **military-security** domain. Among others, the Defense Advanced Research Project Agency (DARPA) invests vast sums into developing these technologies for integration into the armed forces' daily activities. US activities within the military-security domain – though they incorporate programs geared towards the development of autonomous military applications – generally continue to focus on keeping the 'human in the loop', whereby a human operator is still engaged in the operation of the system.

These results are further summarized in Figure 1.

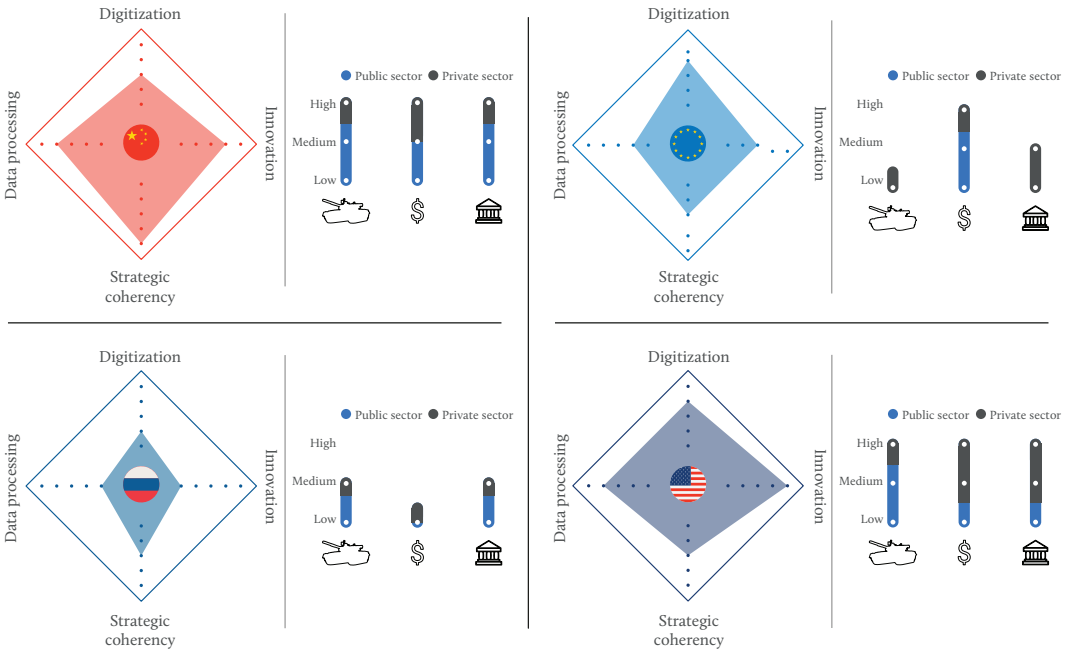

Figure 1: AI Profiles and Programs: China, EU, Russia and the US.

Threats and Opportunities

An in-depth per-domain analysis has identified the following threats and opportunities:

Economic. AI-related technologies will have substantial ramifications for domestic, regional (European Union) and international economies, with some figures estimating a global GDP rise of as much as $13 trillion by 2030 – or about 1.2 percent additional GDP growth per year – as a result of the inclusion of AI in production and service processes. However, these gains are unlikely to be equally distributed. AI's added value within the economic domain derives almost entirely from the technology's ability to automate processes, both basic and complex. This spans manufacturing tasks (particularly those in unsafe environments), quality testing, logistics, theft detection, and routine business processes, among others, and is associated with increased productivity on the part of actors which succeed in these technologies' implementation. Aside from **gains in supply-side efficiencies**, the introduction of AI is leading to the **personalization of goods and services** and **stimulation of the economy**. The gains, which can be derived from economic AI use cases – as well as the job losses they propagate – will at the same time lead to increased (inter)national inequality. This is because AI affects the ways in which value is created in economies, and – in the process – shapes how markets are structured, meaning that companies and/or countries that are able to leverage and exploit AI in their operations are likely to significantly outperform competitors.

The high costs of implementing these tools – as well as the benefits which range from improved financial prospects to greater reach and/or data access associated therewith – results in **winner-takes-all dynamics**, and (indirectly) in the emergence of **oligopolistic market structures**, within which an increasingly small number of corporations dominate (inter)national markets. This phenomenon is likely to result in significant disparities between **AI haves and have-nots**, and – by extension – exacerbate inequality at both the global and domestic levels. This so-called digital divide will be further exacerbated by AI ecosystems' reliance on high-skilled workers, which deepens demographic divides at the domestic (urban vs. rural) and international levels. The digital divide is likely to drive laggard countries to enact **protectionist regulatory frameworks** and as a result**, impact economic security**.

Sociopolitical. The rise of **AI-enforced governance models** and the **export of digital totalitarianism** are intimately linked, largely because the implementation of AI-enforced governance models depends on the development of easily exportable technologies. Within the context of this study, these phenomena have been predominantly observed in the Russian and Chinese case studies. The technologies underlying these control systems serve to consolidate the regimes which implement them. A linkage is also evident between **societal polarization in liberal democracies**

and increases in the impact of **foreign influence campaigns**. Though autocrats take an active role to propagating 'threatening' AI-related applications, several of the liberal democracies included within this study, with the United States in particular, also facilitate and/or allow the propagation of socio-politically relevant AI technologies. These derive largely from big tech companies' **centralization of data** and the use of clustering models to maximize advertising revenues. This, in turn, can be universally associated with the exacerbation of political polarization in liberal democracies. These algorithms impact the health of the discourse in liberal democracies as they separate significant cohorts of populations who are led to perceive the world in largely segregated media ecosystems with few overlapping cleavages between them. The creation of these so-called 'echo-chambers' undermines social cohesion and breeds societal polarization by cementing identities.

On the other hand, with AI being a dual-use technology, it is also a driver for positive social implications. AI is enabling companies and governments to better understand their citizens for the **improvement of the quality of life**. Examples are numerous, and span improvements in critical domains, from law enforcement and justice institutions, to medicine and nursing, where the use of AI is leading to improved delivery of care. Beyond the impact on basic societal functions, introduction of AI is enabling **enhancements of online experience** for internet users and is leading to an **augmentation of social interactions**, particularly from AI's ability to bring together individuals with common interests.

Military-security. There are a number of threats associated with the inclusion of AI in existing military capability portfolios. The first is that new AI powered systems can **upset the existing military balance of power** by making traditional systems and doctrines obsolete. This is because these systems are small, cheap, voluminous, disposable, and capable of agile decision making. Military AI systems can be associated with **increased friction** and/or escalation potential within the military-security domain. Because autonomous ('human-out-of-the-loop') weaponry can operate independent of human oversight,[2] these systems' use can also **escalate the pace of conflict** operations to such a degree that human intelligence can no longer keep up, resulting in the **advent of hyperwars**.

Military AI applications offer many opportunities, both within military planning and logistics, as well as combat operations. AI can improve the quality (and speed) of military planning, analysis, forecasting and decision-making. The speed at which AI systems can process information is particularly vital in the military-security domain, as time-sensitive decisions present a critical challenge to successful military

2 Vincent Boulanin and Maaike Verbruggem, "Mapping the Development of Autonomy in Weapon Systems" (Stockholm International Peace Research Institute, November 2017), https://sipri.org/sites/default/files/2017-11/siprireport_mapping_the_development_of_autonomy_in_weapon_systems_1117_1.pdf.

operations. The resulting **gains in operational efficiency** are also presenting **cost-reduction opportunities** in the procurement of military equipment and training of personnel. AI-related technologies further have the potential to reduce combatant attrition rates, resulting in the **preservation of life** of both soldiers and civilians.

The threats and opportunities associated with AI-related technologies are visualized in Figure 2 on a domain-by-domain basis.

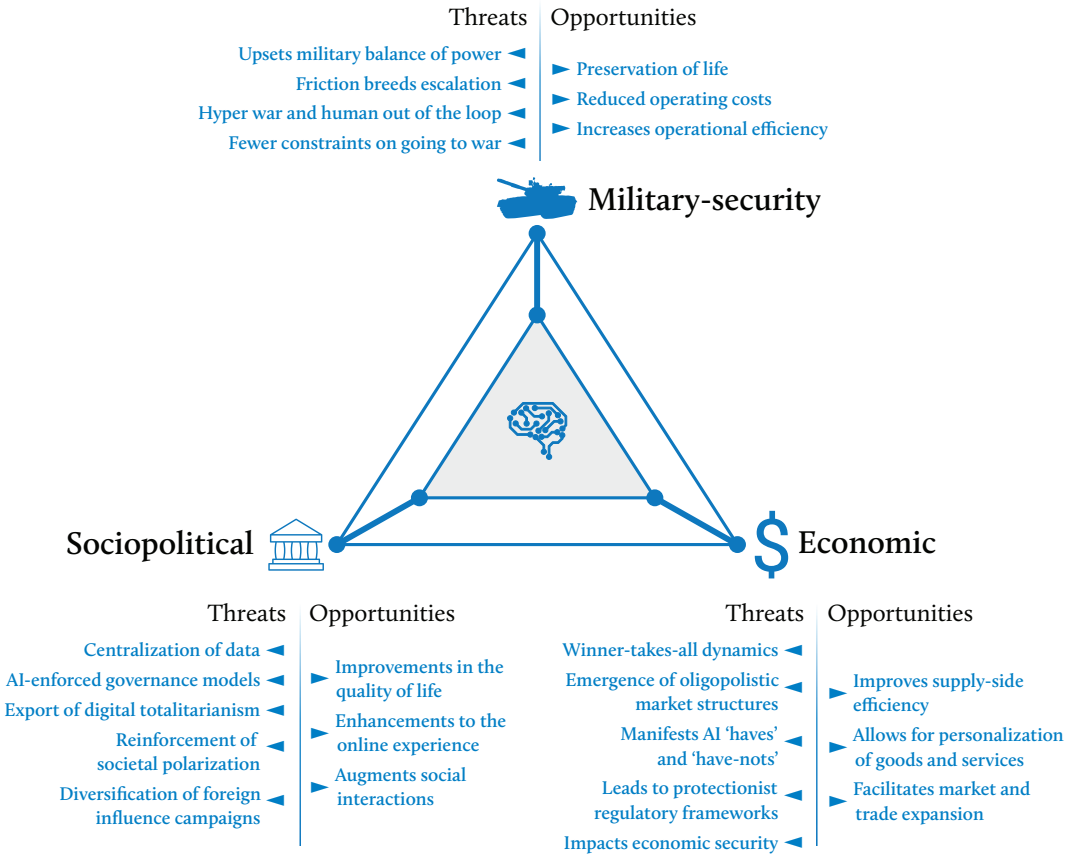

Figure 2: Threats and Opportunities associated with AI.

Policy Challenges and Implementation Guidelines

The threats and opportunities expected to derive from the included actors' approaches to fostering and utilizing AI in the next 5-10 years generate an assortment of important challenges for liberal democracies. These challenges need to be addressed by these societies in order to defend national security, promote economic prosperity and protect the values that lie at the heart of liberal democratic societies, including good governance, economic equality, societal cohesion, and respect for individual rights.

Challenges and Guidelines in the Economic Domain

The winner-takes-all dynamic in the market for AI is in part a result of restrictive market conditions that stifle competition. AI's reliance on mass data generation potential acts as a barrier to entry and thus obstructs market access for new companies. Within the market, leading firms in data-generation potential enter virtuous cycles, which propel them further ahead of the rest of the competition. The resources generated through this dynamic empower leading firms to reinforce their position through predatory behavior against other market players, by buying or forcing out competing firms through legal challenges. The behavior is reinforced by lax antitrust enforcement, which has greenlighted mergers and acquisitions (M&A) that have since been deeply criticized or has failed to adequately challenge and reverse M&A activity that stifles competition. The winner-takes-all dynamic of AI leads to different types of inequality at the individual, enterprise and state levels. At the individual level there is a growing 'digital divide', which propels forward those with digital skills, while leaving the less educated workers behind. Moreover, those working with repetitive tasks, usually associated with low-skilled professions, are at the highest risk of being displaced by AI. At the enterprise level the divide will manifest itself between the early adopters and non-adopters of AI, leading to the closure of a number of business that will not be able to keep up with technologically advanced competitors. At the international level, the dynamic is similar; industrialized economies will reinforce their leading position and erode the cost-advantage of low-income economies as they reap the benefits of commercial automation. Finally, at both domestic and international levels, the innovation infrastructure is at risk, largely due to predatory business practices in foreign markets, corporate espionage, unfair or illegal transfers of intellectual property and market distortions caused by state-backed companies. This leaves companies vulnerable in both domestic and international markets, as well as requiring government support, particularly on issues relating to illicit acquisition of technology, market manipulation and unfair trade practices.

Challenges identified within the economic domain are the introduction of **winner-takes-all dynamics**, the rise of **oligopolistic market structures**, the emergence of **AI 'haves' and 'have nots'**, and the **erosion of economic security**. The mitigation of negative externalities associated with the introduction of winner-takes-all dynamics revolves around policies which are geared towards maintaining a healthy SME infrastructure, which is facilitated by reducing barriers to entry and by policies which actively support their ongoing activities. The mitigation of challenges associated with the emergence of oligopolistic market structures, revolves almost entirely around inhibiting market leaders from taking active steps to stifle competition, the implementation of which is reliant on robust antitrust policies and the active review of previews mergers and acquisitions. Policies geared towards mitigating negative

externalities associated with the emergence of AI 'haves' and 'have nots' universally relate to the emergence of a 'digital divide' between groups at the individual, company, and state levels. These take the form of policies which address large-scale labor displacement (individual), government support of AI-laggards (company), and revision of foreign aid and trade policies (state). Challenges relating to economic security present at both the national (domestic) and international levels, and can be mitigated through the introduction of policies which safeguard Dutch and/or European innovation outputs.

Challenges and Guidelines in the Sociopolitical Domain

AI reinforces existing sociopolitical structures, whether liberal or authoritarian. In parts of the world, AI is leading to the rise of AI-enforced governance models, which are cementing the position of authoritarian regimes through the ability to exercise more effective and targeted population control. This trend is spilling across borders as the most tech-savvy authoritarian regimes are exporting the know-how to authoritarian and pivot states around the world. The issue is exacerbated by the culpability of Western companies, which willingly distribute enabling technologies to offending states, thus reinforcing the propagation of authoritarianism around the world. On the demand side, authoritarian states are seizing the opportunity to consolidate their control, while pivot states are tempted by the improvements in regime security, derived from the increased control of the population and identification of dissent. However, the issue of AI in society is prolific in liberal states as well. In recent years, algorithms have promoted societal polarization by directing internet users into echo chambers that reinforce their views, in turn bolstering the prominence of groups with extreme views that are challenging sociopolitical stability in liberal states. Once again, major technological corporations are complicit in the trend, as clustering users into market segments and presenting them with content that retains them on the platforms has affected societies beyond the commercial purposes. Due to the lucrative nature of AI-driven persuasive technologies, companies have been reluctant to alter their approach and government regulation continues to lag behind. The issue is becoming more critical with the increased dissemination of false information through organized, often state-sponsored campaigns to destabilize the social fabric in liberal democracies. As states scramble to address semantic disinformation, AI is enabling a more powerful mode of disinformation – deepfakes, artificially augmented videos that can be used to present false information in an easily distributed and 'viral' format. Governments are yet to determine effective means to curb the dissemination of false audio and video content becoming readily available on the internet.

Challenges identified within the sociopolitical domain are the **rise of AI-enforced governance models**, the **export of digital totalitarianism**, **societal polarization**

in liberal societies, and **increases in the stopping power of foreign influence campaigns**. AI-specific policy options for addressing the **rise of AI-enforced governance models** present in the adoption (at the EU level) of regulations with normative international stopping power, such as the GDPR. Meanwhile, the circumvention of state efforts to export **digital totalitarianism** relies partially on the regulation of Dutch and/or EU export of key 'enabling' technologies, and partially on outreach efforts geared towards outlining alternative governance models. AI's contribution to **societal polarization** derives from changes in the media landscape, with the emergence of several forms of 'new media' facilitating the proliferation of sensationalist content. This phenomenon can be mitigated through the combination of policies which aim to build understanding within vulnerable groups on the one hand, and to incentivize media providers to adequately filter and/or label content online on the other. Finally, mitigation strategies pertaining to the phenomenon of **foreign influence campaigns** revolve almost entirely around the adoption of policies which increase media transparency, and which facilitate the development of tools which automate the identification of doctored photos and disproportionately sensationalist text.

Challenges and Guidelines in the Military-Security Domain

AI is rapidly fueling a new arms race among the world's leading military powers. As countries scramble to integrate AI-technologies into their military capabilities, the current military balance of power is at stake. Countries that lag behind in the development of military AI risk weakening their deterrence capabilities, as AI early adopters use the shifting balance of power to challenge the status quo in international military dominance, meaning primarily confronting the US and its allies. The pursuit to challenge or maintain one's strategic position may generate escalating conflicts, due to the deployment of immature systems and the shrinking decision-making timelines, resulting from the omnipresence of robotic and autonomous weapons systems in combat. Furthermore, the replacement of soldiers by unmanned systems in combat increases the propensity to engage adversaries, as the cost of human lives is significantly reduced, but leads to an incremental escalation. The narrow decision-making timeframes introduced by human-out-of-the-loop systems, combined with the deployment of possibly immature autonomous systems, may lead to an increased chance of conflicts arising from miscalculations. Finally, the reduction of meaningful human control in military operations may affect the sense of responsibility felt and employed by human decision makers. There is currently a lack of international principles and arms control norms that ensure there is responsible procurement of (semi-)autonomous weapon systems and established processes for ensuring accountability.

Challenges identified within the military-security domain are **upsets in the military balance of power**, contributing to **friction which breeds escalation**, increased **risk of hyperwars** as a result of human-out-of-the-loop use cases and **fewer restraints on escalation**. Mitigating AI-related technologies' contribution to upsetting the military balance of power requires the Netherlands to integrate AI into its force structure and be better equipped against asymmetric warfare. **Conflict escalation** can be understood as a byproduct of state engagement in a 'race to the bottom,' and is grounded in the rollout of immature (semi-)autonomous technologies. This phenomenon can be addressed by increasing **barriers to escalation** - an area in which international regulations governing systems explainability are of particular interest. AI's contribution to hyperwars presents itself in the erosion of existing arms control regimes and in an over-reliance on computerized decision-making systems. Outside of reviewing existing arms control regimes, addressing this challenge requires the development of a differentiated (shared) understanding of autonomous systems at the international level on the one hand, and the adoption of standards vis-a-vis systems explainability on the other.

Conclusions and Recommendations

As evidenced by the efforts undertaken by the countries included within this analysis, the race for AI is on. China, the European Union, Russia, and the United States are all actively pursuing the development of sophisticated AI technologies, with an assortment of economic, socio-political and military-security consequences. From automated production lines to networked drone swarms to automated mass surveillance, the combination of ever-more-sophisticated sensory arrays, immense computing power, and coding know-how is driving paradigm shifts in the creation of wealth, the governance of polities, and the functioning of societies. The threats and opportunities stemming from these developments present a host of challenges to liberal democratic societies. AI technologies' potential impact on national security, economic prosperity, and fundamental democratic values is profound, and renders it highly relevant to contemporary interstate competition in the economic, sociopolitical, and military-security domains. This is due to the technology's tendency to manifest winner-takes-all dynamics. States which succeed in strategically harnessing AI today, can reasonably expect to derive relative benefits from doing so perpetually, resulting in what can be understood as a 'first-past-the-post' race, the impacts of which require active policymaker engagement to mitigate.

We offer five recommendations to inform the design and content of AI policies across the economic, sociopolitical, and military-security domains specifically targeted at European policymakers in Brussels and in individual capitals, with the goal of safeguarding the bloc's ability to compete internationally going forward:

1. **Support small and medium e-tech companies**. When it comes to the development of AI-related applications, size is everything. This is because specific AI applications require the availability of use-case-specific big data, and because the innovation level of private-sector R&D efforts grows with entity and market size. The EU currently lacks an established e-tech market. This hamstrings the EU's ability to develop AI applications: not only is data not generated at a scale which is conducive to its development, the lack of entity scale also inhibits the development of sophisticated use cases. *To realize AI's potential benefits, the EU and its member states will need to facilitate and/or incentivize the growth of e-tech companies that benefit from economies of scale. This can be partially implemented by promoting investment in start-ups as well as in scale-ups. Investing in scale-ups ensures the long-term sustainability of funding initiatives and facilitates firms in consolidating themselves in their respective markets, thus allowing them to have access to larger pools of users, and to invest more heavily in AI-related R&D activities*.

2. **Formulate balanced privacy standards**. This study clearly outlines the trade-offs between the unfettered generation of big data, individual-level privacy, and AI ecosystem competitiveness. This trade-off is particularly evident in the US and China, where the datafication of individuals' private lives is routinely incentivized with an eye towards facilitating the development of ever-more sophisticated AI solutions. While the EU is a leader in the use of industrial and technical data for algorithm development, it has found itself unable to compete with American companies in the harvesting and use of consumer data. With the implementation of the GDPR, the EU has taken a strong stance on this issue and has effectively signaled its belief that user privacy should come before all else. While this approach is beneficial from the perspective of avoiding the manifestation of negative externalities within the sociopolitical domain, the GDPR fails to strike a healthy balance between individual privacy and AI ecosystem competitiveness. Among other things, the regulations' insistence that companies explain how user data is utilized in AI applications has led companies to forego use of the technology altogether,[3] thus effectively exacerbating the negative dynamics outlined in the previous suggestion. *Aspects of the recent EU-wide privacy regulations should be reformulated and/or reconsidered. While the EU is justified in pursuing policy which safeguards user privacy, provisions which serve to disincentivize commercial use of AI-related technologies altogether should be amended. Provisions such as the EU-US Privacy Shield also erode the bloc's economic security by rendering large (US-based) tech firms relatively more able to compete than their smaller (EU-based) rivals. Provisions relating to the anonymization of user data should be maintained.*

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3 Eline Chivot, "One Year on, GDPR Needs a Reality Check | Financial Times," Financial Times, 2019, https://www.ft.com/content/26ee4f7c-982d-11e9-98b9-e38c177b152f.

3. **Facilitate academic sector R&D**. One of the foremost issues preventing the EU from playing a central role in international innovation vis-à-vis AI is in the relative underperformance of the bloc's academic sector in transferring knowledge to applications. Though EU-based researchers can generally be considered as being cutting edge, their productivity is oftentimes hamstrung by lack of long-term funding. Long-term funding allows for longer term development trajectories. Within the context of AI-related technologies, this means that long-term funding facilitates the development of more sophisticated algorithms and/or data harvesting initiatives, thus boosting the EU's capacity to implement **applied** research. *EU procurement should pivot towards longer-term project funding. To improve the long-term impact of the technologies developed through such programs, the procurement process should feature project sustainability more centrally by requiring contractors to formulate viable business models and/or long-term sustainability strategies prior to receiving funding.*

4. **Ensure shared understanding of AI among Member States**. In order to meaningfully shape forthcoming international regulations on AI related applications, EU Member States need a unified understanding of the continent's position on issues related to the technology, including, among others, individual privacy & data collection, and acceptable use cases on a domain-by-domain basis. *In order to ensure Member State unity, the EU should push forward existing efforts falling within the purview of the Digital Single Market's Artificial Intelligence Policy, with the overarching goal of publishing a Member State-sponsored document which outlines a shared understanding of key AI-related policy issues. The existing High Level Expert Group on Artificial Intelligence (AI HLEG) constitutes a helpful starting point for such an effort. Publications such as the Ethics Guidelines for Trustworthy Artificial Intelligence serve as helpful examples of the type of documentation that should be developed and integrated into the European Commission's Coordinated Plan on Artificial Intelligence.*

5. **Leverage the EU's economic weight in international norm-setting**. The EU's combined economic weight affords it considerable normative power internationally. This allows EU-based policymakers to 'diffuse' norms internationally through issue linkage. A prominent example of this presents itself in the GDPR, which links normative values vis-à-vis individual online privacy to economic incentives, thus forcing companies to enact wide-ranging reforms in order to access the EU market. While large companies such as Facebook or Google can realistically calculate that the financial gains of deploying region-specific services (i.e. US users are offered different data options than EU users) outweigh the costs of developing such a system, the majority of service providers cannot realistically sustain such an arrangement. This forces these companies to

choose between changing their international *modus operandi* to align with EU standards, or to be excluded from the EU market entirely – a prospect that, due to the EU's economic weight, is extremely unfavorable. *The EU should more actively encode normative values in regulations which are tied to private-sector access to EU-based consumers. The GDPR constitutes a positive first step in this direction, but – provided a shared definition of AI is adopted at the EU level – such regulations could be employed much more strategically.*

Introduction

The threats and opportunities associated with Artificial Intelligence (AI) technologies force liberal societies to grapple with a range of fundamental issues, many of which directly affect the existing economic, social, political, and even security fabrics that underpin the domestic and global orders. Both the commercial use of Machine Learning (ML) algorithms to cluster user profiles and optimize adverts targeting,[4] as well as political applications of the technologies – such as the introduction and export of AI-powered social surveillance systems – constitute early harbingers of this new reality.

The complexity and potential impacts associated with AI-related technologies has resulted in their rapid evolution from a science fiction potentiality to a real-world actuality that is very visibly manifesting itself within the public interest sphere.[5] AI as a multipurpose technology is associated with far-reaching ramifications within the economic, sociopolitical, and military-security domains that has emerged as a driving force in the interstate competition that characterizes contemporary geopolitics. As the nature of geopolitics has shifted from competition over the control of territory to support material power capabilities to the process of attempting to "*gain advantage, often relative to others believed to pose a challenge or threat, through the self-interested pursuit of contested goods such as power, security, wealth, influence, and status*,"[6] the technology is set to play an increasingly central role within interstate competition.

Influential states such as China go as far as identifying the technology as one which will "become a new focus of international competition" articulating a clear ambition to "lead the future",[7] while the US designates it as being of "paramount importance to maintaining the economic and national security of the United States".[8] Others have written about the role of AI in strategic competition between states and the

4 This introduces sociopolitically-relevant considerations by opening the door to the exacerbation of political polarization through foreign influence campaigns.

5 The McKinsey Global Institute (MGI) records a several-fold increase in policymaker interest (as measured by number of public mentions) in AI between 1995 and 2018. See "AI Index 2018," December 2018, 44, http://cdn.aiindex.org/2018/AI%20Index%202018%20Annual%20Report.pdf.

6 See Michael J. Mazarr et al., "Understanding the Emerging Era of International Competition," Research Report (Washington, D.C.: RAND Corporation, 2018), 5.

7 See China's "A Next Generation Artificial Intelligence Plan", as translated by Graham Webster, Paul Triolo, Elsa Kania, and Rogier Creemers (2017).

8 Donald J. Trump, "Executive Order on Maintaining American Leadership in Artificial Intelligence," Executive Order (Washington, D.C.: The White House, February 11, 2019), https://www.whitehouse.gov/presidential-actions/executive-order-maintaining-american-leadership-artificial-intelligence/.

potentially dramatic impact it may have on the future international balance of power. This is particularly evident in light of 'the breadth of AI, with its ability to influence defense, diplomacy, intelligence, economic competitiveness, social stability, and the information environment.'[9] One observer discusses the rise of AI superpowers and the profound impact the ongoing AI revolution will have on the international order.[10] The versatility of AI technologies' use cases within the economic, sociopolitical and security domains opens up a ream of geopolitical threats and opportunities. These range from the exacerbation of various types of inequality (at both the domestic and international levels) to an increased risk of interstate military conflict – and many other risks in between.[11] For liberal democracies, it means that they proactively confront the variety of issues that this all-purpose technology brings to the fore lest they be unable to protect security, prosperity and the liberal democratic make up of their societies.

This report identifies the challenges and frames a policy agenda for liberal democracies based on an in-depth examination of threats and opportunities associated with AI. The degree to which such threats and opportunities identified manifest in the coming 5-10 years is dependent on a wide range of variables, including state uses of AI applications, the initiatives undertaken by corporate, private, & societal actors, the nature of future regulatory frameworks as well as the overall rate of technological progress. To gauge future trajectories within this period, this study analyzes the AI ecosystems of four globally influential entities;[12] the United States, China, the Russian Federation, and the European Union (EU),[13] and presents findings based upon hundreds of documents, as well as a wide range of datasets. In concrete terms, this entails assessing a range of baseline indicators in order to provide a high-level overview of these respective actors' AI-programs and profiles. In doing so, it provides insights into the size and quality of their AI infrastructures, measured through the **digitization**, **data processing capacity**, **innovation infrastructure**, the relative competitiveness of these entities' domestic AI industries, as well as the **strategic coherence** through which they coordinate AI-related activities within their ecosystems. This, in turn, allows for an assessment of these actors' current and future trajectories, as well as for the identification of AI-related threats and opportunities which policymakers would be well-served in enacting measures against and/or capitalizing on.

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9 Michael Horowitz et al., "Strategic Competition in an Era of Artificial Intelligence" (Washington, D.C.: Center for a New American Security, 2018), https://www.cnas.org/publications/reports/strategic-competition-in-an-era-of-artificial-intelligence.

10 Kai-Fu Lee, *AI Superpowers: China, Silicon Valley, and the New World Order*, 1 edition (Houghton Mifflin Harcourt, 2018).

11 S. Ahmed et al., "AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives" (NSI, December 2018), https://nsiteam.com/social/wp-content/uploads/2019/01/AI-China-Russia-Global-WP_FINAL_forcopying_Edited-EDITED.pdf.

12 These entities are identified as internationally influential on the basis of the previously published FBIC index. See Jonathan D. Moyer et al., "Power and Influence in a Globalized World" (Washington, DC: Atlantic Council and HCSS, January 2018), https://www.atlanticcouncil.org/images/Power_and_Influence_.pdf.

13 For a rationalization of the EU's inclusion as a single entity – and an overview of the challenges associated with doing so – see Stephan De Spiegeleire et al., *Volatility and Friction in the Age of Disintermediation* (The Hague: The Hague Centre for Strategic Studies, 2017), 47–48, http://hcss.nl/report/volatility-and-friction-age-disintermediation.

The report proceeds as follows: the next chapter offers an explanation of the research methods, concepts and definitions employed in this study, followed by summaries of the case studies containing the most important findings. It proceeds with a comparative analysis and synthesis of the high-level findings of the case-studies and an analysis of the domain specific implications of AI technologies. It concludes with an assessment of the most pressing policy challenges and formulates a policy agenda for policymakers on how to either prevent or mitigate the threats and leverage the opportunities associated with AI.

THE KIND OF AI ADDRESSED HERE

Given the fluidity of the 'definition' of AI, it helps to shortly outline background on the subject and to solidify the 'type' of AI covered within this paper.

In general, we can distinguish between three types of AI.[14] These are:

- **Artificial Narrow Intelligence.** ANI (commonly referred to as "weak AI") describes machines that are equal or exceed humans in intelligence at **narrow**/specific/ tasks. AlphaGo developed by Google DeepMind provides a good example for narrow AI, whereby a computer algorithm taught itself to play the game Go using neural networks and training from past human and computer gameplays.[15]
- **Artificial General Intelligence**. AGI (commonly referred to as "strong AI") is considered more powerful as it meets "the full range of human performance across any task."[16] This type of AI is not yet fully established, but examples of what it would look like are observable in some sci-fi movies, such as *Her*, where machines will be able to exhibit human-like intelligence and behavior. However, in order for AGI to be able to exert behavior such as decision-making or problem-solving, arguably a certain level of consciousness needs to be achieved.
- **Artificial Super-intelligence**. ASI portrays a form of machine intelligence that would surpass human capabilities across any task – this generation of AI is yet to be achieved in the medium to long run.

In this paper, only narrow AI and its employment across the socio-political, economic and military domains is discussed. ANI is good at solving small problems with a high degree of accuracy, through fetching information from certain datasets or preset algorithm. ANI offers benefits that relieve humans from mundane, routine or hazardous tasks, such as analyzing through an abundance of data or detecting landmines.[17] Unlike AGI or ASI, narrow AI has only the ability to perform one single task.[18] In order to do so, it is necessary to train the AI algorithm beforehand. This is done through **machine learning** (ML), which can primarily be used for **classification** or **regression**-based tasks.

14 De Spiegeleire, Maas, and Sweijs, "Artificial Intelligence and the Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers."
15 Kumar, "Artificial Intelligence."
16 De Spiegeleire, Maas, and Sweijs, "Artificial Intelligence and the Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers."
17 Achkar and Owayjan, "Implementation Of A Vision System For A Landmine Detecting Robot Using Artificial Neural Network."
18 Jajal, "Distinguishing between Narrow AI, General AI and Super AI."

In **classification**, the algorithm is used to sort data points into categories based on shared features. As an example, a researcher might present an algorithm with pictures of apples and pears and ask it to sort them into categories. The AI might then recognize features such as color, shape, etc. to differentiate between them and to sort the pictures. In **regression**, the algorithm is looking for trends in the data that allow it to infer information about unknown variables. In complex datasets, this is often a process that results in complex mathematical models for understanding how a change in one variable affects another. A simple example of regression is the use of AI to 'guess' how expensive a house will be depending on its size. If a researcher tells an AI that a large house is worth EUR 1200 and a small house is worth EUR 900, the AI could then infer that a medium house would be somewhere in-between (EUR 1050) by drawing a line of best fit between the two existing data points. This process can be either **supervised** or **unsupervised**. In supervised learning, human operators 'correct' the algorithm when it reaches conclusions, thus prompting it to change its behavior. In unsupervised learning, this process is automated – the algorithm determines how close the outcome it has determined is to a predefined target, and then optimizes its behavior in a way that narrows the gap between X and Y.

1. Actor: AI Programs and Profiles

1.1 Introduction

Despite the fact that technological landscapes are subject to unpredictable disruption,[19] this study aims to assess future trajectories and likely impact of the use of AI technologies 5-10 years into the future. It does so by looking at the likely manifestation of AI-related threats and opportunities on the basis of case studies covering four actors; namely: the United States, China, Russia, and the EU-28.[20] These actors' perspectives and preferences on the utility of these technologies are informing their national AI programs and their positions on standards and norms regulating AI applications.[21] An analysis of these trend setters' profiles and programs within the field is consequently conducive not only to understanding which threats and opportunities are likely to contribute to in the coming 5-10 years, but also to understanding which threats and opportunities are likely to be mitigated by forthcoming (international) regulatory frameworks.

This chapter first provides a brief explanation of the method used in the comparative benchmark of the country profiles and programs. For the readers solely interested in the research findings, these are presented on page 20 and onwards. The chapter follows with the analysis of the four case studies, offers a comparative assessment of the four profiles and a high-level overview of the threats and opportunities identified in the case studies.

1.2 Method

In general terms, the relative competitiveness of a state's AI ecosystem can be understood as deriving from a combination of the scale of its existing (AI-relevant)

19 Julie Rennecker and Lindsey Godwin, "Delays and Interruptions: A Self-Perpetuating Paradox of Communication Technology Use," *Information and Organization* 15, no. 3 (2005): 247–266, https://doi.org/10/dwc3gz.

20 The authors acknowledge the relevance that private-sector actors' use of AI-related technologies has on geopolitics, but stipulate that measures taken towards the mitigation (or utilization of) the threats and/or opportunities these corporations' activities present can be conceptualized as comprising a part of nation states' strategies to realize (or prevent) geopolitical outcomes. As such, the **strategic coherence** section of the country profiling rubric incorporates questions relating to state regulation and/or cooperation with (read utilization of) private-sector actors.

21 John McCarthy and Patrick J. Hayes, "Some Philosophical Problems from the Standpoint of Artificial Intelligence," in *Readings in Artificial Intelligence* (Elsevier, 1981), 431–450.

infrastructure[22] and from the **policy and/or organizational framework** which has been put in place to utilize it. Within the context of this study, **infrastructure** is constituting 'inert' (AI-relevant) resources which can be stitched together into a robust AI ecosystem through the introduction of coherent legislation. Within the context of this study, the **infrastructure** component of the country's scoring exercise is conceptualized as being contingent on the existence of resources which facilitate:

a) the harvesting and/or generation of large reams of data**,** referred to as **digitization**;
b) the speedy processing and/or analysis thereof, referred to as **data processing potential**;
c) the development of innovative and/or utile algorithms, referred to as **innovation infrastructure**.

The absence of any of these three factors negatively impacts a nation's ability to develop cutting-edge AI and to apply it towards geopolitically-relevant outcomes.[23] The development of sophisticated and/or widely applicable AI algorithms is entirely contingent on AI developers' access to a.) the human resources[24] necessary to code them, and b.) a large volume of data upon which to train the resulting algorithms.[25] In concrete terms, this means that sophisticated AI cannot emerge in the absence of large-scale R&D activities and data availability.[26] Simultaneously, the presence of infrastructure which facilitates data processing is of relevance within the context of geopolitically-impactful AI not only because it constitutes a prerequisite for data harvesting but because it is key to unlocking some of the technology's more cutting-edge use cases.[27] Even if a large volume of data is harvested, its use within the context of training algorithms will be limited in the absence of the computing power necessary to analyze it. As an example, the use of AI to analyze data in real-time - an application which facilitates the development of sophisticated forecasting models, and which can drastically improve state agencies' reactive capabilities - constitutes a computationally intensive process in which data needs not only to be 'cleaned' and processed in real time, but also to be analyzed.[28]

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22 Read: supercomputers, data centers, education programs, universities offering AI-relevant studies, etc.
23 Darrell M. West and John R. Allen, "How Artificial Intelligence Is Transforming the World," *Brookings* (blog), April 24, 2018, https://www.brookings.edu/research/how-artificial-intelligence-is-transforming-the-world/.
24 Duncan R. Dickson and Khaldoon Nusair, "An HR Perspective: The Global Hunt for Talent in the Digital Age," *Worldwide Hospitality and Tourism Themes* 2, no. 1 (2010): 86–93, https://doi.org/10/c9n4gg.
25 Quora, "Is Data More Important Than Algorithms In AI?," Forbes, accessed April 19, 2019, https://www.forbes.com/sites/quora/2017/01/26/is-data-more-important-than-algorithms-in-ai/.
26 See Stuart J. Russell and Peter Norvig, *Artificial Intelligence: A Modern Approach* (Malaysia; Pearson Education Limited, 2016).
27 Max Tegmark, "Benefits & Risks of Artificial Intelligence," Future of Life Institute, accessed April 19, 2019, https://futureoflife.org/background/benefits-risks-of-artificial-intelligence/.
28 Gwen Shapira, "The Seven Key Steps of Data Analysis," Oracle, accessed April 19, 2019, http://www.oracle.com/us/corporate/profit/big-ideas/052313-gshapira-1951392.html.

As previously alluded to, the mere presence of infrastructure conducive to the building of a robust AI ecosystem does not guarantee its productivity.[29] Within the context of the country scoring exercise, which is incorporated in this research, this notion is operationalized by means of the **strategic coherence** variable, which assesses to what degree the four actors, facilitate, and/or guide AI-related activities internally. National governments play an important role not only in ensuring effective utilization of the infrastructure and/or resources which are present but also in ensuring favorable conditions continue to exist.[30] This is true not only within the context of achieving geopolitical outcomes through the application of AI-related technologies, but also within the context of circumventing the manifestation of negative externalities.[31] As an example, the European Union's GDPR regulation[32] - which limits what data private sector entities can collect (and how they can use it) - constitutes a clear instance of a government intervention which is geared towards mitigating the impact of a negative externality (in this case, the sociopolitical issue of political and/or societal polarization) brought on by private-sector use of AI.[33] Government policy, however may also negatively impact the competitiveness of a state's AI ecosystem.[34] For example, constraints on private-sector data collection or on the employment of international workers may hamstring the productivity and range of possible applications developed by a state's AI ecosystem.[35] The frameworks for analyzing infrastructure and strategic coherency are outlined in the paragraphs below.

1.2.1 Digitization

The digitization component of the country scoring framework is geared towards operationalizing a state's potential for generating and harvesting big data.[36] At the highest possible level, 'big data' sources can thus be conceptualized as operationalizing either the **activities of individuals** (as is the case with social media data & government data, as well as some types of IoT-and-commercially-sourced data), or dynamics within the **physical environment** (as is the case with some types of IoT, commercial, and social media-sourced data). As such, the adhered-to methodology for gauging included states' digitization incorporates indicator categories geared towards measuring data

29 George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving* (Pearson education, 2005).
30 Tim Dutton, "Building an AI World: Report on National and Regional AI Strategies," CIFAR, December 6, 2018, https://www.cifar.ca/cifarnews/2018/12/06/building-an-ai-world-report-on-national-and-regional-ai-strategies.
31 "AI Problems and Promises | McKinsey," accessed March 6, 2019, https://www.mckinsey.com/featured-insights/artificial-intelligence/the-promise-and-challenge-of-the-age-of-artificial-intelligence.
32 "EUGDPR – Information Portal," accessed April 19, 2019, https://eugdpr.org/.
33 James Vincent, "The Problem with AI Ethics," The Verge, April 3, 2019, https://www.theverge.com/2019/4/3/18293410/ai-artificial-intelligence-ethics-boards-charters-problem-big-tech.
34 "Should Artificial Intelligence Be Regulated?," Forbes, accessed April 19, 2019, https://www.forbes.com/sites/quora/2017/08/31/should-artificial-intelligence-be-regulated/.
35 "What Is the General Data Protection Regulation? Understanding & Complying with GDPR Requirements in 2019," Text, Digital Guardian, January 23, 2017, https://digitalguardian.com/blog/what-gdpr-general-data-protection-regulation-understanding-and-complying-gdpr-data-protection.
36 As previously outlined, the training of AI algorithms is contingent on researcher access to large reams of data, with larger datasets generally facilitating the development of more sophisticated and/or precise algorithms.

generation through **government**, **social media**, **IoT**, and **commercially-sourced** data. The digitization component of the country scoring framework is geared towards mapping the scale of potential data sources present within a country rather than the factual degree to which the aforementioned data sources are being actively harvested. The following indicators are utilized as proxy measurements:

'Big data' source	Measurement proxy (indicator)
Government	E-governance participation
Social media	Smartphone possession (saturation rate)
	Broadband speed
Internet of things & sensors	Smart city initiatives
Commercial sources	Number of medium-large companies

1.2.2 Data processing potential

The 'data processing potential' component of the country scoring framework is geared towards operationalizing a state's potential for processing and analyzing big data. This research conceptualizes the data processing component as deriving from **processing power** and **industry engagement**. The processing power is geared towards operationalizing the scale of a country's data processing infrastructure and industry engagement is geared towards operationalizing a country's capacity to source additional capacity from domestic suppliers. As is also the case with the 'data generating potential' component of the country profiling exercise, the 'data processing potential' component aims to provide insights into the scale of the state's existing infrastructure rather than into the degree to which the aforementioned infrastructure is factually utilized.[37] The following variables are used as proxy measurements within the context of the data processing component of the country profiling exercise:

Indicator	Subsumed variable(s)
Processing power	Number of supercomputers
	Capacity (petaflops)
	Number of data-centers (colocation & hyperscale)
Industry	Size of semiconductor industry
	Sophistication of domestic semiconductor industry

37 As outlined in a preceding section, this approach is derives from the conceptual framework applied in this study, which subscribes to the notion that the robustness of a state's AI ecosystem derives from its ability to maximize the utility of available infrastructure (read: resources) through the implementation of a coherent (strategically-considered) policy framework.

1.2.3 Innovation infrastructure

The innovation infrastructure component of the country profiling exercise is geared towards operationalizing the scale of the innovation network present in each of the reviewed entities. As previously outlined, this component is geared towards gauging to what degree the countries included within this research preside over the infrastructure necessary to operationalize the previous two components into utile AI applications. This research differentiates between innovation network-related resources whose existence and/or development can be associated with **public-sector** initiatives,[38] and innovation network-related resources whose existence and/or development can be associated with **private-sector** initiatives.[39] The following variables are utilized as proxy measurements within the context of the 'innovation infrastructure' component of the country profiling exercise:

Indicator	Indicator subcategory	Subsumed variable(s)
Public sector	Workforce & education	Number of AI-related studies offered
		Number of graduates from AI-related studies
		Net student flow
		Number of AI-related publications
	Funding	Total public-sector funding commitments to AI-related R&D
Private sector	Organizational & human capital	Total patents granted to private-sector companies
		Number of registered AI-related startups
		Statistics relating to scientific and technical employment
	Funding	Total private-sector funding commitments to AI-related R&D

1.2.4 Strategic coherence

Insights gleaned through the 'digitization', 'data processing potential', and 'innovation infrastructure' components of the country profiling exercise are contextualized by means of the strategic coherence component. The strategic coherence component is geared towards analyzing to what degree the policy framework present within the countries featured in this research succeeds in a.) capitalizing on existing infrastructure, and b.) plugging holes and/or addressing shortcomings in existing infrastructure. Differences in the context surrounding AI strategies necessitate a methodological approach, which facilitates the process of conducting contextually

38 "AI in Public Sector | McKinsey," accessed April 19, 2019, https://www.mckinsey.com/industries/public-sector/our-insights/when-governments-turn-to-ai-algorithms-trade-offs-and-trust.

39 Cüneyt Dirican, "The Impacts of Robotics, Artificial Intelligence on Business and Economics," *Procedia-Social and Behavioral Sciences* 195 (2015): 564–573, https://doi.org/10/gfz53p.

focused analyses. Towards this end, this study's research gauges the effectiveness of a country's policies through the application of an open question-based rubric, which is geared towards facilitating an analysis of policies relating to **public-private cooperation**, **government understanding**, **workforce development**, **level-playing field / ecosystem**, and **civil-military cooperation**. The questions incorporated within the aforementioned rubric, as well as the policy areas they are conceptualized as relating to, are further outlined below:

Indicator	Rubric applied
Public-private cooperation	Are there policies geared towards giving private sector actors access to data collected by the public sector (and vice-versa)?
	Does the existing legal framework allow for public (or private)-sector data harvesting?
	Are there policies geared towards making private-sector firms more successful internationally?
	Does the government offer private-sector firms advise and/or support in the adoption (and use of) AI technologies?
Government understanding	Is the government well informed on the impact AI is likely to have within industry?
	Has the government evaluated which sectors or agencies are lagging behind in their data collection and/or taken steps to address these shortcomings?
	Does the government have a coherent overview of how it can integrate AI within its own processes?
	Has the country identified shortcomings within its data generation & data collection infrastructure(s), and taken steps to address these?
Workforce development	Does the government have a coherent policy for allowing (or not) skilled individuals from outside the country to work in the domestic AI sector?
	Has the government put in place education programs and/or other contingency measures to ensure that future (and current) are equipped to work with AI technologies?
Level playing field	Is there any policy in place which aims to make sure datasets (and AI algorithms themselves) are 'diverse' and ethically grounded?
	How is basic and applied research incentivized?
	Has the government opted to introduce any standards on acceptable use cases and/or requirements for AI development?
Civilian-military cooperation	How is the landscape for civilian-military cooperation in AI?

1.2.5 Scoring framework

Variations between the included case studies' national AI strategies makes drawing a meaningful comparison between them complex. Given this limitation, we adhere to a 5-point scoring scheme (1 being the lowest, 5 being the highest) to operationalize these countries' relative performance within the **digitization**, **data processing** potential, **innovation infrastructure**, and **strategic coherence** components. The case studies

universally fall within the 95th percentile of these respective components at the international level, simply by virtue of their demographic and/or economic weight. The adhered-to scoring scheme aims to relativize the case studies included within this study with one-another rather than the world at-large. Even within the context of the cases covered, a 5-point scale offers limited scope for nuanced differentiation between case studies. It is included nonetheless, as it provides an understanding of how these actors compare against one-another in the pursuit of AI technologies. The numeric element allows for smoothing of major structural differences between the case studies, that otherwise cannot be weighed against one another. Digitization, data processing, and innovation infrastructure scores reflect (inert) potential, with strategic coherence reflecting the degree to which the country's AI strategy succeeds in leveraging the aforementioned potential in practice.

As per this study's geopolitical focus, the results presented within the standardized scoring framework are accompanied by observations regarding the entities' activities within the **economic** ($), **sociopolitical** (), and **military-security** () domains. The goal of these domains' inclusion within the study is to allow for the systematic categorization of AI activities and/or developments according to their geopolitically-relevant use cases, and to facilitate the drawing of conclusions. AI cases are generally categorized as relevant to and/or impacting the sociopolitical domain when they are associated with use cases which undermine democratic processes or infringe on individuals' fundamental rights. Because the development of socio-politically relevant AI use cases is commonly motivated by economic and/or financial considerations, this parameter is also applied to distinguish between AI applications within the sociopolitical and economic domains.[40] The military-security domain is populated by AI applications which are developed with specific military use cases (i.e.: target acquisition, missile guidance, etc.) in mind, as well as by applications that are developed (*sans*-government contract) by actors within the private-sector, but which may nonetheless have military applications.[41]

40 In concrete terms, this mean that applications are considered as falling within the economic dimension whenever they *don't* fit within the sociopolitical dimension (i.e.: they *don't* have the potential of undermining democratic processes or of infringing on individuals' fundamental rights.

41 This is because AI is a quintessentially dual-use technology. An example presents in the application of Google's image recognition – and labelling – algorithms (which are traditionally used to optimize image processing in its line of Pixel phones and to streamline e-commerce) in the US DoD's Project Maven drone program. See Lee Fang, "Google Hedges on Promise to End Controversial Involvement in Military Drone Contract," *The Intercept* (blog), March 1, 2019, https://theintercept.com/2019/03/01/google-project-maven-contract/.

1.3 Case Studies

1.3.1 China

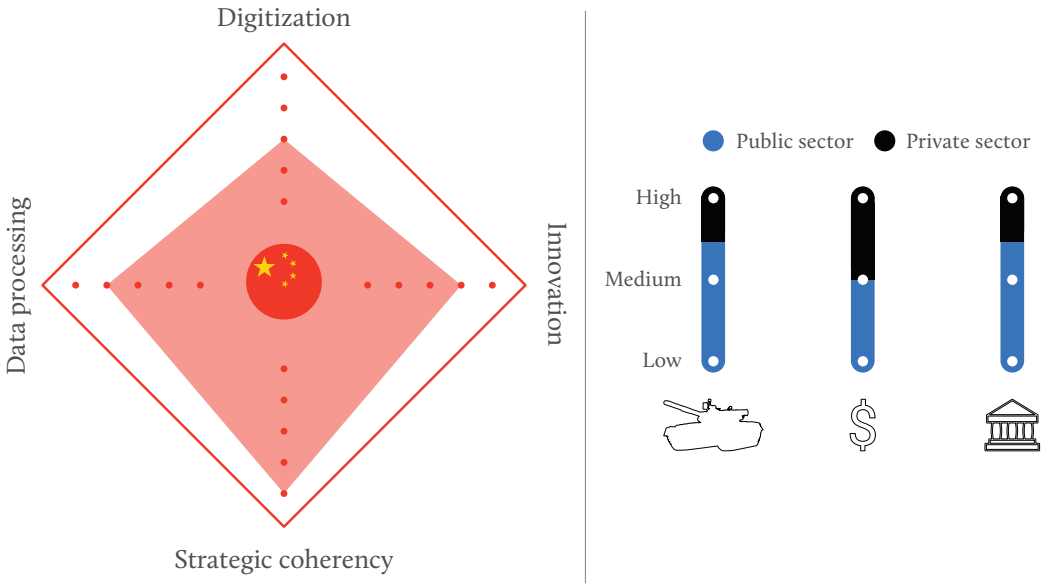

Figure 3: China AI Profile.

China presides over a high-potential AI ecosystem, the global competitiveness of which is actively and effectively furthered by government policy and initiatives (see Figure 3). Although China leads the consumer-driven digital economy, it lags far behind advanced economies in terms of its digitization, with the country's most digitized cities – Hong Kong, Beijing, and Shanghai – respectively scoring world 68th, 81st, and 85th on EasyPark's Smart Cities Index.[42] These shortcomings are partially offset by the enormous amount of data generated by the country's 1.386 billion inhabitants and estimated 730 million internet users.[43] While China is relatively avant-garde in terms of its innovation infrastructure, its processing capacity does not yet match the processing capacity of its western competitors.[44] This shortcoming materializes in the ability to develop core semiconductor-based technologies.[45] The country remains the world's top consumer of semiconductors, accounting for approx. 45% of the global demand for chips but produces only 33% of global

42 When assessing the level of digitization, particular focus was set on the governance and digitalization indicators, as those are considered to be the determinantal components of a government's ability to collect and use data.

43 Olaf J. Groth, Mark Nitzberg, and Dan Zehr, "Vergleich Nationaler Strategien zur Förderung von Künstlicher Intelligenz." (Sankt Augustin Berlin: Konrad-Adenauer-Stiftung e. V, 2018), https://www.kas.de/c/document_library/get_file?uuid=46c08ac2-8a19-9029-6e6e-c5a43e751556&groupId=252038.

44 Chris C. Demchak, "Four Horsemen of AI Conflict: Scale, Speed, Foreknowledge, and Strategic Coherence," *Cyber and Innovation Policy Institute*, AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives, December 2018, 100–106.

45 Jeffrey Ding and Paul Triolo, "Translation: Excerpts from China's 'White Paper on Artificial Intelligence Standardization'" (New America, June 20, 2018), https://www.newamerica.org/cybersecurity-initiative/digichina/blog/translation-excerpts-chinas-white-paper-artificial-intelligence-standardization/.

supply.[46] Chinese processing power – largely as a result of its relatively antiquated and unsophisticated semiconductor industry – thus constitutes the weakest component of its national AI approach. Underperformance within the digitization and data processing components is largely compensated for within the strategic coherence component, which serves to ensure the presence of a competitive innovation infrastructure.[47] Beijing's strategic coherence further mitigates shortcoming within its digitization and data processing infrastructures by channeling resources into the development of China's semiconductor industry, as well as through its 'no ethics' approach to data collection, which allows for the widespread collection of ground-level data. The productivity of China's AI R&D sector can be clearly observed in its private and academic sectors' activities. Chinese applicants filed 1,381,594 patents in 2017, equaling 43,6% of the global patent share and China surpassed the US in the quantity of published academic papers on AI from as early as 2006.[48] It is also evident within its universities' performance, which amounts to 800 doctoral students per year.[49] With 1000+ AI companies,[50] China harbors 11% of the global AI enterprises,[51] the existence of which is largely contingent on state-sponsored venture capitalism.[52]

The Chinese case stands out vis-à-vis the other actors in terms of the degree to which government policy aims to capitalize on the country's vast data gathering and innovation potential. Policy documents made publicly available by Chinese authorities regarding the country's approach to fostering a globally competitive AI ecosystem attest to a high degree of coherence as well as considerable subject knowledge expertise at the national level. This is enshrined in, among others, the *New Generation Artificial Intelligence Report Plan* (AIDP), as well as in the technology's continued importance within the country's 'Two Sessions' national congress.[53] This presents Beijing's (international) support for private-sector corporations, its aggressive investment into increasing the level of sophistication of domestic semiconductor production processes.[54] It is further manifested in its evaluation and incentivization of increased cross-sectoral use of AI technologies, and in the government's funding

46 Gordon Orr and Christopher Thomas, "Semiconductors in China: Brave New World or Same Old Story?" (McKinsey Global Institute, August 2014), https://www.mckinsey.com/industries/semiconductors/our-insights/semiconductors-in-china-brave-new-world-or-same-old-story.

47 Largely as a result of state support for (inter)national private-sector initiatives.

48 Data regarding the exact number of publications is unavailable.

49 Groth, Nitzberg, and Zehr, "Vergleich nationaler Strategien zur Förderung von künstlicher Intelligenz."

50 See Fabian, "The Global Artificial Intelligence Landscape," *Asgard* (blog), May 14, 2018, https://asgard.vc/global-ai/; China Institute for Science and Technology Policy, "China AI Development Report 2018" (China Institute for Science and Technology Policy at Tsinghua University, July 2018), http://www.sppm.tsinghua.edu.cn/eWebEditor/UploadFile/China_AI_development_report_2018.pdf.

51 China Institute for Science and Technology Policy, "China AI Development Report 2018."

52 This makes the country's innovation infrastructure susceptible to a 'burst', as the 'unicorn' nature of many of its AI startups means the country's AI ecosystem bears resemblance to a 'tech bubble'.

53 Dingding Chen and Hangyi Yang, "China's 2019 'Two Sessions' and the Statement of Artificial Intelligence Ambitions," The Diplomat, 2019, https://thediplomat.com/2019/03/chinas-2019-two-sessions-and-the-statement-of-artificial-intelligence-ambitions/.

54 China still faces major hurdles in this regard, with the country's technical workforce – though highly competent – generally lacking the 'niche' expertise needed to innovate and/or push the needle forward at the national level. Beijing has taken several measures – including loosening restrictions on work permits – to address the issue.

mechanisms, one of which is projected to crest the $15 billion mark by 2020.[55] Notable about the Chinese approach is not only policymakers' explicit identification of innovative capability as an Achilles' heel, but the degree to which the resulting policy framework is geared towards addressing this shortcoming. It is facilitating the acquisition of talent by encouraging domestic enterprises to obtain international experts, establishing research and scientific centers in countries which engage in Chinese projects, and offering incentive measures - such as permitting easier access to local residential or work permits - to would-be expats.[56] In terms of the geopolitically-relevant domains incorporated into this study's research framework, China's AI strategy stands out as exceptionally well rounded, with concrete initiatives being made to support not only **military-security** and **socio-political** AI developments, but also to ensure Chinese global **economic** competitiveness.

The Chinese case study also serves to outline ethical dilemmas relating to the development and maintenance of AI ecosystems. China's policy framework incentivizes a relatively more far-reaching datafication initiative than in other case studies explored within this research. Chinese authorities are also relatively more enthusiastic in applying the aforementioned data – much of which consists of 'ground level' personal information – towards the development of personally invasive AI applications, allowing Beijing to actively, rather than accidentally utilize the technology towards **socio-politically** relevant goals.[57]

While the Chinese AI ecosystem can be surmised as generally matching that of the United States within the **data generation**, **data processing**, and **innovation infrastructure** components, the likely nature – and scale – of its geopolitical impact differs significantly. This is because Beijing's approach to fostering, maintaining, growing, and purposefully harnessing the potential of China's AI ecosystem means that its propagation of geopolitically relevant AI impacts generally constitutes the culmination of a calculated, strategic process. In the Chinese case, the most topical example of this phenomenon presents within the **sociopolitical** domain, in which the active development – and export – of technologies underlying China's AI-powered social control systems facilitates not only Chinese autocracy, but illiberal governance models in general. Drawn into the future, the trend lines associated with Chinese export of this so-called 'digital authoritarianism' are likely to culminate not only in Chinese developers' access to reams of internationally-sourced data, but in the normalization of autocratic governance models.

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55 Yue Wang, "Will The Future Of Artificial Intelligence Look Chinese?," *Forbes*, November 6, 2017, https://www.forbes.com/sites/ywang/2017/11/06/will-the-future-of-artificial-intelligence-look-chinese/.

56 Ariel Lu, Jessie Chen, and Frank Fu, "China's Venture Capital (VC): Bigger than Silicon Valley's?," *INSEAD*, 4-20-2018, April 20, 2018, 39.

57 China's social credit and/or control systems – the underlying technologies of which are increasingly 'exported' to 3rd countries, constitute a clear example of this, and can be interpreted as feeding into an overarching strategy (on Beijing's part) to safeguard authoritarianism internationally.

Chinese activities within the **military-security** domain are likely to impact the development of future regulatory frameworks.[58] Chinese officials retain substantive knowledge regarding the security risks that can be associated with AI, such as an elongated risk of war stimulated by an absence of casualty risk. Chinese technologists and policymakers alike perceive AI-related technologies as posing a threat to international security, and place high stock in cooperation as a tool for preventing the manifestation of negative externalities,[59] and have proven keen to foster international cooperation in a bid to preempt an AI arms race.[60] This notwithstanding, China presides over a variety of overt military AI projects, including the *China Aerospace Science and Industry Corporation's* AI-endowed intelligent cruise missile and various autonomous military vehicle development programs. The products of the latter have previously been supplied to Middle Eastern countries such as Saudi Arabia and the UAE.[61] The size of Chinese **military-security**-related AI investments is unclear, in no small part due to the (likely) dual nature of many government investment initiatives, which allows for the 'shrouding' of military-relevant R&D activities behind the guise of economically-motivated projects. Beijing has even gone so far as to set up a military-civil fusion committee in order to facilitate military uptake of civilian R&D. The Chinese approach to the military-security domain can generally be characterized as far-reaching and features a heavy focus on not only developing unmanned and autonomous systems, but on empowering algorithms to partake in decision making.[62]

The key takeaways to be derived from the Chinese case study are as follows:

- Chinese policymakers preside over a high degree of strategic coherence when it comes to building a national AI ecosystem. This presents in the country's widescale datafication efforts, its recognition of the need for and implementation of far-reaching education reforms, and the government's cross-sectoral provision of incentives to adopt AI technologies. Chinese strategic coherence allows the country to partially overcome structural shortcomings relating to its innovation potential and data processing potential.
- China's centralized governance system facilitates the development of its AI ecosystem, with public-and-private sector entities enjoying an unprecedented

58 De Spiegeleire, Maas, and Sweijs, "Artificial Intelligence and the Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers."

59 Gregory C. Allen, "Understanding China's AI Strategy," February 6, 2019, https://www.cnas.org/publications/reports/understanding-chinas-ai-strategy.

60 Nonetheless, while the AIDP stresses the importance of 'deepening international collaboration', it fails to directly address the matter of arms race. Per contra, the state-backed think tank, China Academy of Information and Communications technology, fills this gap as it urges the Chinese government in their recently published paper to "avoid Artificial Intelligence arms races among countries. See Gregory C. Allen.

61 China also plans to soon export its next generation stealth drones to the UAE and Saudi Arabia, once they are developed. See Ludovic Ehret, "China Steps up Drone Race with Stealth Aircraft," *Phys.Org* (blog), November 9, 2018, https://phys.org/news/2018-11-china-drone-stealth-aircraft.html.

62 See Adrian Pecotic, "Whoever Predicts the Future Will Win the AI Arms Race," *Foreign Policy* (blog), accessed May 4, 2019, https://foreignpolicy.com/2019/03/05/whoever-predicts-the-future-correctly-will-win-the-ai-arms-race-russia-china-united-states-artificial-intelligence-defense/.

degree of cooperation and coordination. This extends beyond domestic constraints, where the aforementioned relationship facilitates intensive data sharing and into the international realm, with Beijing often playing point-guard when it comes to Chinese corporations' efforts to cooperate with international firms. Beijing's high degree of cooperation with the Chinese private sector is further endemic of the country's recognition of the dual-use nature of AI-related technologies.

- China's AI ecosystem bears resemblance to a 'tech bubble', boasting a large number of 'unicorn' startups. Over $62 billion was invested in 1441 venture deals in 2017 alone. This has the potential of hamstringing the productivity of the country's AI ecosystem over time, depending on the degree to which the Chinese state is able to keep such companies afloat going forwards.
- Boasting not only the highest number of AI-related publications, but also a leading share of the world's most-cited AI-related publications, the Chinese academic sector excels at **fundamental** research within the field. The country also presides over robust **industrial** and **applied** research capacity, with both public-and-private-sector entities allocating significant sums towards these technologies' integration into everyday processes.

1.3.2 The European Union

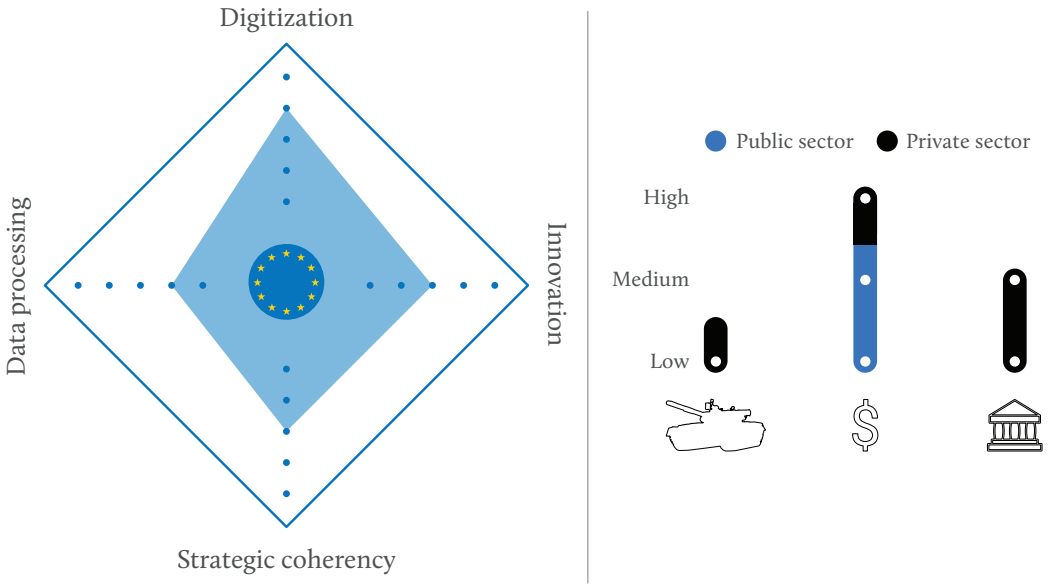

Figure 4: European Union AI Profile.

The EU presides over a medium-potential AI ecosystem, the global competitiveness of which is limited by a.) structural shortcomings, and b.) fragmentation of Member State initiatives and standards (see Figure 4). The EU's AI ecosystem derives strength from its digitization – which, as a result of a high degree of smartphone saturation

(±86%),[63] high broadband speeds, and high degree of IoT-device integration (with 54 cities being listed within the top-100 of EasyPark's Smart Cities Index), is relatively robust. The bloc scores less admirably within the data processing potential and innovation infrastructure components of the country profiling exercise. This is largely due to the EU's relative lack of globally competitive tech firms.[64] European universities remain exceptionally competitive and produced 58,941 PhD candidates in STEM-fields in 2017.[65] The research and commercial sectors are relatively productive, with 19,051 (30.7%) papers being published by institutes located in the EU,[66] and a total of 234,796 high-tech patents being granted in 2017. All these figures notwithstanding, it pays to note that – while expansive – the EU's innovation infrastructure generally pales in comparison with those present within the US and China, which cumulatively host 18 out of the world's 20 top tech companies.[67]

Shortcomings in EU data processing potential and innovation infrastructure are exacerbated by the incoherent implementation of AI strategies on the parts of EU Member States. This contributes to inconsistencies in data formats, thus hampering **digitization** and results in the undertaking of redundant activities within the bloc's R&D sector. The Commission has published a ream of documents, most notably the *Coordinated Plan on Artificial Intelligence*[68], which, taken together, amount to an AI strategy that addresses many of the trading bloc's shortcomings. Through its Horizon 2020 program, it has pledged over $1.67 Billion in R&D funding between 2018-2020[69]. Structural challenges, including differences between Member State data reporting standards and differences in Member State focus areas effectively serve to hamstring the EU's AI ecosystem. France and Germany have respectively allocated EUR 1.5 billion,[70] and EUR 3 billion towards growing their AI ecosystems.[71] The UK presides over the most competitive AI ecosystem among EU member states, owing largely to the government's attention to detail when it comes to implementing relevant data standards and fostering a climate which is conducive to private-sector growth and innovation. Countries such as France and Germany (which are explored as part of

63 See "Broadband Access - Mobile Broadband Subscriptions - OECD Data," the OECD, accessed March 16, 2019, http://data.oecd.org/broadband/mobile-broadband-subscriptions.htm.
64 European Commission, *Annual Report on European SMEs 2017/2018* (Brussels: European Commission, n.d.), https://publications.europa.eu/en/publication-detail/-/publication/a435b6ed-e888-11e8-b690-01aa75ed71a1.
65 Atomico, "The State of European Tech 2017" (Atomico, 2018), 29, https://2017.stateofeuropeantech.com.
66 Daniel Fiott and Gustav Lindstrom, "Artificial Intelligence – What Implications for EU Security and Defence? | European Union Institute for Security Studies," Institute for Security Studies, 2018, https://www.iss.europa.eu/content/artificial-intelligence-%E2%80%93-what-implications-eu-security-and-defence.
67 François Candelon, Martin Reeves, and Daniel Wu, "18 of the Top 20 Tech Companies Are in the Western U.S. and Eastern China. Can Anywhere Else Catch Up?," *Harvard Business Review*, May 3, 2018, https://hbr.org/2018/05/18-of-the-top-20-tech-companies-are-in-the-western-u-s-and-eastern-china-can-anywhere-else-catch-up.
68 European Commission, "Communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Commute of the Regions Coordinated Plan on Artificial Intelligence" (2018).
69 European Commission.
70 See "Artificial Intelligence: 'Making France a Leader,'" Gouvernement.fr, accessed May 5, 2019, https://www.gouvernement.fr/en/artificial-intelligence-making-france-a-leader.
71 Janosch Delcker, "Germany's €3B Plan to Become an AI Powerhouse," POLITICO, November 14, 2018, https://www.politico.eu/article/germanys-plan-to-become-an-ai-powerhouse/.

this research's EU case study) also perform well, through the degree of public-private cooperation – as well as the degree of government support for efforts regarding data availability – but efforts in these countries lag behind those of the UK.

Though the geopolitical focus of EU Member States' AI strategies varies, the EU generally displays a trend towards pursuing (or regulating the use of) AI technologies towards the realization of **economic** and **sociopolitical** goals. Arguably the EU's most relevant (from a geopolitical perspective) exports present in the form of norms which – due to the EU's economic stopping power – have international impact. This is particularly clear in human-centric regulations such as the General Data Protection Regulation (GDPR), which – in introducing large penalties as enforcement mechanisms – has resulted in the 'diffusion' of the EU's norms regarding data privacy. This explicitly aim to balance individuals' human rights against factors which contribute to economic & technological progress.

Though the EU presides over a relatively robust degree of potential vis-à-vis the **data generation**, **data processing**, and **innovation infrastructure** components, the bloc's foremost impact within the field is likely to be in the form of the formulation and export of norms and rules. This is because – though fragmentation between EU Member States means that much of the trading bloc's infrastructure cannot live up to its full potential in practice,[72] Member States' combined economic 'weight' allows institutors such as the European Commission to formulate regulations with a far-reaching international impact. The EU arguably constitutes the only entity to be included within this research which actively engages in the formulation of policies geared towards curtailing AI technologies' negative impacts on the privacy and fundamental rights of individuals. As a result, it is set to continue to exert influence over various **socio-politically** relevant AI applications.

The bloc's valuation attention to detail vis-à-vis the ethical implications of AI is also likely to result in its impacting of regulations within the **military-security domain**, though a relative lack of Member State unity may limit collective action within this area. German (publicly available) initiatives are largely geared towards improving the Bundeswehr's ability – in conjunction with the Ministry of Foreign Affairs – to formulate predictive policy strategies on the basis of databases such as the Armed Conflict Location & Event Data (ACLED), the Global Database of Events, Language, and Tone (GDELT), and the Global Terrorism Database (GTD).[73] France places a heavier weight on the development of 'human-in-the-loop' systems,

72 Though individual Member States have succeeded in fostering extremely productive and/or coherent AI ecosystems (see, among others, the UK and Finland), these countries' individual potential falls far short of the potential commanded by rival great powers.

73 See Roland Freist, "Die Bundeswehr will KI-gestützte Lageprognosen - Trade & Invest," accessed May 5, 2019, https://www.hannovermesse.de/de/news/die-bundeswehr-will-ki-gestuetzte-lageprognosen-93248.xhtml.

and has launched a EUR 1.5 Billion investment plan for the Direction Générale de l'Armement (Directorate General of Armaments, DGA) to develop future weapon technology, with an annual budget of EUR 100 Million specifically intended for AI R&D.[74] The government has additionally pledged to recruit 50 AI specialists until 2022 to the DGA, and provide an annual funding of EUR 10 Million to test and integrate existing AI technology,[75] and will place a particular focus on integrating AI into combat aircraft as part of the Man-Machine Teaming (MMT) initiative. The UK has prioritized "Spearhead" innovation programs. These include combat sub-surface threat analysis of submarines, networked sensors, improved command and control, AI-enabled decision-making processes, as well as combining hard- and software to enhance data analysis capabilities for intelligence, surveillance and reconnaissance systems.[76] Funding for these programs is to the tune of GBP 160 Million (under the Modernizing Defense Program), with the Secretary of State for Defense of the United Kingdom having pledged to allocate an additional GBP 340 Million under next year's spending review. [77]

The key takeaways to be derived from the EU case study are as follows:

- Despite the relative comprehensiveness of the European Commission's AI strategy, inconsistencies between Member States' implementation thereof is likely to hamstring the bloc's ability to compete on AI with other powers.
- The international stopping power of EU legislation affords the bloc a highly utile tool for mitigating the sociopolitical impacts of AI. Because the sociopolitical impacts associated with AI require governments to formulate coherent mitigation strategies, this provides the EU with a relatively unique toolkit. Alternatively, the EU's introduction of legislation such as the GDPR – especially when coupled with the introduction of increased internet censorship in China, etc. – can be viewed as being reflective of a wider trend of 'internet governance fragmentation', which may render the EU's toolkit impotent internationally.
- The EU is best positioned to propagate **economically**-relevant developments in AI. As previously mentioned, the bloc's **sociopolitical**, AI-relevant exports present in the form of regulations. Depending on interpretation, the EU's general adherence to ethical and privacy-oriented AI can be viewed as an artificial 'weight' on the bloc's innovation potential.

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74 See Pierre Tran, "French Procurement Office to Undergo Transformation," Defense News, accessed April 30, 2019, https://www.defensenews.com/global/europe/2018/07/06/french-procurement-office-to-undergo-transformation/.

75 See Tran.

76 See "Mobilising, Modernising & Transforming Defence" (London: Ministry of Defence, 2018), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/765879/ModernisingDefenceProgramme_report_2018_FINAL.pdf.

77 Kim Sengupta, "UK Must Prepare to Fight Wars with Artificial Intelligence and in Space, Defence Secretary Says | The Independent," December 17, 2018, https://www.independent.co.uk/news/uk/home-news/wars-space-online-uk-future-funding-armed-forces-modernising-defence-programme-gavin-williamson-a8687946.html.

- The EU is particularly strong when it comes to developing and exploring **fundamental** and **industrial** AI-related research applications.[78] The bloc's academic sector publish a high number of cutting edge research papers relating to the technology, while large manufacturers – especially those in France and Germany (which respectively focus on general-use and automotive applications) – invest large sums of money into developing AI for industrial use cases.
- The EU's foremost shortcomings presents in the bloc's lack of a robust semiconductor industry and in its relative non-utilization of its expansive academically-based innovation infrastructure, which respectively serve to limit its **processing capacity** and **innovation infrastructure**. The EU's lack of large e-tech firms further limits its potential to generate corporate data and to harness public-sector AI R&D, thus degrading its **data generation** potential.

1.3.3 The Russian Federation

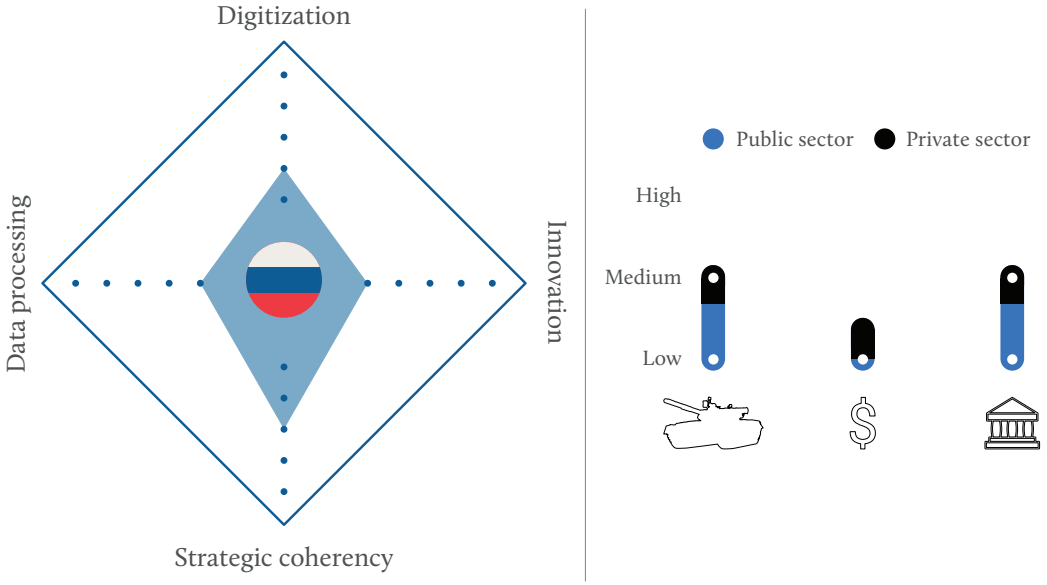

Figure 5: Russian Federation AI Profile.

The Russian Federation presides over a relatively low-potential AI ecosystem (see Figure 5), the global competitiveness of which is limited by negative trends in the country's economy and demographics, the restrictive nature of the country's innovation ecosystem, and the absence of a robust domestic semiconductor industry (Russia produces less than 1% of the world's semiconductors).[79] The Russian government has taken some preliminary steps to address the structural weaknesses

78 The EU's potential for conducting **fundamental** research is further supported and/or propagated by expansive public-sector funding efforts. Please refer to the *innovation infrastructure* section of the EU case study for further information and/or statistics.

79 Natalia Kulikova, "Современное Состояние и Тенденции Развития Электронной Промышленности в России (Modern State and Development Trends of Electronic Industry in Russia)," *Теория и Практика Общественного Развития* 12 (2017): 87–92, https://doi.org/10/gfw9xw.

hampering the country's growth potential. A notable example presents in the "Data Economy Russia 2024" strategy, which outlines concrete goals for expanding the country's domestic data storage and processing capabilities.[80] Russia performs poorly on EasyPark's Smart Cities Index (with only two cities appearing in the top 100), presides over a limited number of medium (14,035) and large (8,894) companies,[81] and boasts – with 330 AI startups,[82] - a relatively noncompetitive private sector.[83] In response, the government has taken steps to address the country's brain drain problem, which serves to offset the potential it derives from its access to top-tier universities and limits its innovation potential. Funding for AI-related activities remains relatively low within the Russian Federation, with public-and-private sector entities respectively allocating $360 million (between 2007-2017),[84] and $40 million.[85]

Russia's AI ambitions are predominantly geared towards furthering the country's security, both internally and externally. In concrete terms, this means that Russian policymakers place a heavy emphasis on pursuing AI-related technologies whose application areas fall within the **military-security** and **sociopolitical** domains. Though Russian policymakers have previously acknowledged **economic** potential of AI-related technologies, few concrete steps have been undertaken to further public and private-sector use of these technologies within this domain. The government's prioritization of the **military** and **sociopolitical** domains is clearly reflected in the degrees of strategic coherence and/or technical know-how which characterize programs that fall within them. Within the **sociopolitical** domain, a ream of laws – enforced through technological means such as the System of Operative Search Measures 3 (SORM-3),[86] and implemented in cooperation with government agencies such as the FSB and private-sector companies (including telecom companies and the Russia-based Yandex) – govern free speech on the internet. Authorities reported the processing of more than 530,000 telephone conversations and emails per year as early

80 While the "Data Economy Russia 2024" is geared mainly towards data gathering and/or processing, the country has acknowledged the need for a Russia's first comprehensive AI strategy is due to be published in the summer of 2019.

81 "Количество Средних Предприятий (Включая Территориально-Обособленные Подразделения) с 2017 г." (Russian Federation Federal State Statistics Service, 2018), https://www.fedstat.ru/indicator/57717#; Victor Barkhatov, Irina Belova, and Daria Bents, *"Предприятия Крупного Бизнеса России: Анализ в Разрезе Федеральных Округов," Вестник Челябинского Государственного Университета* 5, no. 401 (2017), https://cyberleninka.ru/article/n/predpriyatiya-krupnogo-biznesa-rossii-analiz-v-razreze-federalnyh-okrugov.

82 "Map of Artificial Intelligence in Russia," Карта искусственного интеллекта России, 2019, http://airussia.online/.

83 Russia's research sector ranks world 6th in terms of AI-related publications, and ±world 15th in terms of AI-related patents. See China Institute for Science and Technology Policy, "China AI Development Report 2018"; "Мировые и Российские Технологические Тренды в Области Цифровых, Интеллектуальных Производственных Технологий, Роботизированных Систем и Искусственного Интеллекта (Worldwide and Russian Technological Trends in the Space of Digital, Artificial Production Technologies, Robotics Systems and Artificial Intelligence" (РИЭПП (RIEP), 2017), http://inecprom.spbstu.ru/files/ecoprom-2017/ilina.pdf.

84 "Исследование SAP: в разработки искусственного интеллекта за 10 лет в России вложено около 23 млрд рублей," SAP CIS Press Centre, May 23, 2017.

85 "Исследование SAP."

86 Though SORM-3 does not feature AI-related technologies, the metadata generated through the system's application is processed and/or analyzed through automated (AI-powered) processes.

as 2012,[87] and entities affiliated with the FSB have fitted over 5000 cameras within the Moscow transport system with facial recognition technologies.[88] Russian activities within the **sociopolitical** domain equally attest to the likely (future) prevalence of 'digital authoritarian' governance systems, as well as – indirectly – to the cost-effective nature of utilizing AI technologies to wage hybrid influence campaigns.[89]

Military-security initiatives are spearheaded by the Russian DARPA equivalent Foundation for Advanced Research Projects, and – as is the case in the sociopolitical domain – are characterized by not only robust funding opportunities, but by the adoption (and implementation) of supporting policies. The Ministry of Defence funding for AI-related R&D is not discernible through openly available data, but the private sector allocated approximately $400 million towards R&D in 1386 AI-related projects which cumulatively employed between 6,000-10,000 researchers in 2017.[90] Considering technological, financial and capacity constraints, Moscow has narrowed down the focus of its military efforts to several key applications. These include developing next generation electronic warfare (EW) technologies, implementing AI to support troops and, predominantly, expanding the use of autonomous weapon systems (AWS).[91] Such developments are facilitated through innovation hubs in the Russian military-industrial complex and higher education institutions. Alongside AI supported systems, the Russian military has begun testing and rolling out AWS. This has, in part, taken place under the 2014 framework titled *Creation of Prospective Military Robotics through 2025*. Examples of autonomous systems have been demonstrated for air, land and naval applications. On land, for example, the Russian army has introduced the *Uran 9* unmanned combat ground vehicle (UCGV), a robotic system designed to provide troops with remote reconnaissance and fire support.[92] As also identified in the US and Chinese case studies, Russia's engagement with the military-security domain increases the likelihood that the country will be involved in the formulation and adoption of international agreements relating to these systems' use,[93] as exhibited by its (along with the US) blocking of a ban on 'killer robots' in 2018.[94]

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87 Andrei Soldatov and Irina Borogan, "Russia's Surveillance State" (World Policy, September 12, 2013), https://worldpolicy.org/2013/09/12/russias-surveillance-state/.

88 Alina Polyakova, "Weapons of the Weak: Russia and AI-Driven Asymmetric Warfare," A Blueprint for the Future of AI (Brookings, November 15, 2018), https://www.brookings.edu/research/weapons-of-the-weak-russia-and-ai-driven-asymmetric-warfare/.

89 This is exhibited in, among others, the spread of fake news.

90 "Исследование SAP."

91 S. Bendett, "In AI, Russia Is Hustling to Catch Up," *Defense One*, April 4, 2018, https://www.defenseone.com/ideas/2018/04/russia-races-forward-ai-development/147178/.

92 "Uran-9 UGV UGCV Unmanned Ground Combat Vehicle," Army Recognition, February 1, 2019, https://www.armyrecognition.com/russia_russian_unmanned_aerial_ground_systems_uk/uran-9_ugcv_unmanned_ground_combat_vehicle_technical_data_10910163.html.

93 The Russian 'low ethics' approach to developing AI and/or LAWS-related technologies in general means that the country's involvement is likely to contribute to the emergence of lax and/or 'open-to-interpretation' agreements.

94 Mattha Busby and Anthony Cuthbertson, "'Killer Robots' Ban Blocked by US and Russia at UN Meeting," The Independent, September 2, 2018, https://www.independent.co.uk/life-style/gadgets-and-tech/news/killer-robots-un-meeting-autonomous-weapons-systems-campaigners-dismayed-a8519511.html.

The key takeaways to be derived from the Russian case study are as follows:

- Russian AI aspirations are decidedly concentrated on the development of applications with have **military** and **sociopolitical** utility, with initiatives within both of these domains generally receiving generous funding and policy support. The development of **economically**-relevant AI applications within the Russian Federation is limited, in no small-part due to the brain drain brought about by the country's limited private-sector employment opportunities and lack of future prospects. This notwithstanding, several large-scale private-sector actors and state-owned enterprises (i.e. Gazprom) have developed niche AI applications to support and streamline the execution of critical business processes. The Russian government also frequently utilizes SOEs as testbeds for several AI applications, thus further benefitting from the high degree to centralization which is characteristic of its governance model.
- As is also the case in with the Chinese case study, Russia's approach to implementing AI technologies is characterized by a high degree of state centralization, with many of the companies upon which the successful execution of the country's AI strategy relies on being closely aligned with the state.
- Though the quality of Russian universities facilitates a limited volume of **fundamental** AI research, AI-research is largely **industrial** in nature, with companies such state-owned Gazprom investing (relatively) meager sums into the development of case-specific applications compared to international competitors. State-sponsored research for **applied** research is limited, and manifests largely within the military and sociopolitical domains.

1.3.4 The United States

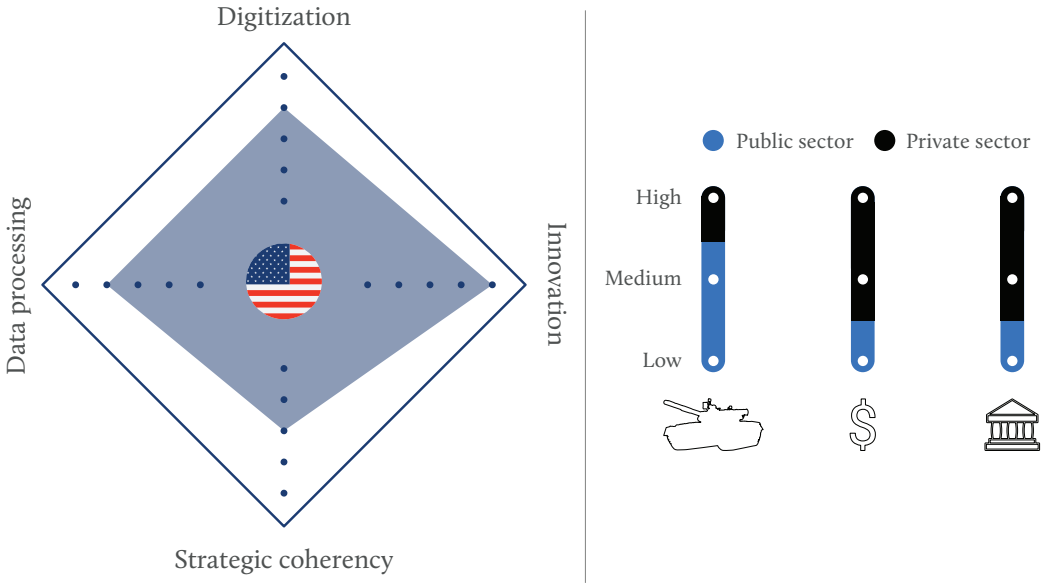

Figure 6: The United States AI Profile.

The United States presides over a high-potential AI ecosystem, the global competitiveness of which is partially furthered by government policies and initiatives (see Figure 6). The country is highly digitized as a result of expansive efforts on the parts of its private sector. However, data generation remains limited by shortcomings within the **government** (the US ranks 10th in the world for E-governance participation, lagging far behind countries such as South Korea and Denmark), **internet of things & sensors** (only 3 US cities are featured on EasyPark's Smart Cities Index,[95] and **social media** domains (high smartphone saturation is offset by low – and unequally distributed – broadband speeds). The country excels at **data processing**, owing to its large-scale – and extremely sophisticated – semiconductor industry,[96] as well as to the global competitiveness of US-affiliated tech corporations, such as Facebook and Google. It is also world-leading when it comes to **innovation infrastructure**, with venture capital (VC) investment into AI having increased with a compound annual growth rate of 36%, culminating in investments totaling $9.33 billion in 2018.[97] Moreover, it hosts many of the world's leading universities, allowing it to attract students, and thus, highly skilled labor, from all over the globe.

95 EPSCI examines the factors which define a smart city, those being: Digitalization (4G, plentiful Wi-Fi hotspots, high smartphone usage), Transport (smart parking, traffic sensors and car sharing apps. A smart city is sustainable, with a focus on clean energy and environmental projection. In addition, there is excellent online access to governmental services and a high level of citizen participation.

96 US-based firms such as Nvidia, AMD, Apple, and Google push the envelope on processor sophistication, boasting the large-scale production of various 7nm (or smaller) models.

97 Jean Baptiste Su, "Venture Capital Funding For Artificial Intelligence Startups Hit Record High In 2018," Forbes, accessed March 14, 2019, https://www.forbes.com/sites/jeanbaptiste/2019/02/12/venture-capital-funding-for-artificial-intelligence-startups-hit-record-high-in-2018/.

The United States presides over considerable potential to gather, process, and apply data towards the development of AI-related technologies. Nonetheless, the degree to which the US government is likely to find itself in a position to actively transpose this technology into intended, geopolitically-relevant outcomes in the next 5-10 years, is comparatively far from assured. The government has implemented multiple initiatives in order to capitalize on the strengths, which are present within its digitization, data processing, and innovation infrastructures. The government's active and concrete engagement with the development of AI-related technologies remains predominantly focused on pushing forward advancements within the **military-security domain**. The Defense Advanced Research Projects Agency (DARPA) alone has pledged to invest $2 billion towards the development of AI related programs over the next five years.[98] Most developments within the **economic** and **sociopolitical** domains are driven by private-sector initiatives, with the government assuming at best a coordinating role. Though the US Department of Defense has previously sought to include companies such Google (see Project Maven) in its efforts to develop AI for military use cases, the government's overall engagement with AI-related issues can generally be surmised as being relatively non-comprehensive certainly when compared to China. In minimizing private-sector regulation and in supporting American business interests overseas, the US national approach – as Enshrined in Donald Trump's *Executive Order on Maintaining American Leadership in Artificial Intelligence*[99] – nonetheless succeeds in bolstering the country's overall AI ecosystem. The most promising step towards expanding the government's involvement presents in the four-pillared Federal Data Strategy.[100] The strategy is geared towards a.) establishing priorities for using data as a strategic asset, b.) drafting policies that allow stakeholders to quickly and efficiently access public data, c.) improving government accountability and decision-making, and d.) allowing private enterprises and public institutions to access public data in order to encourage innovative and technological practices.[101]

The United States' approach is also unique in that its political system's lack of substantial private-sector oversight is associated with a ream of negative, geopolitically relevant sociopolitical impacts, including societal polarization through social media. This lack of oversight is not just a matter of principle but stems, at least partially, from

98 Drew Hardwell, "Defense Department Pledges Billions toward Artificial Intelligence Research," Washington Post, September 2018, https://www.washingtonpost.com/technology/2018/09/07/defense-department-pledges-billions-toward-artificial-intelligence-research/.

99 Trump, "American AI Initiative."D.C.","genre":"Executive Order","event-place":"Washington, D.C.","abstract":"Artificial Intelligence (AI

100 These are Enterprise Data Governance, Access, Use, and Augmentation, Decision Making & Accountability, and Commercialization, Innovation, and Public Use. See "Federal Data Strategy," United States Government, accessed April 8, 2019, https://strategy.data.gov/.

101 "Federal Data Strategy."

a limited understanding vis-à-vis the technologies underlying modern AI applications.[102] It is also a facilitator of the US private sector's development (and application) of AI tools within the **economic** domain, and undoubtedly constitutes to the country's exceptionally competitive tech sector.[103] As is evident within the **sociopolitical** sector, the governments approach effectively trades oversight for productivity, resulting in a highly dynamic – yet virtually untamed – innovation infrastructure.

Given the United States' high potential within the **data generation**, **data processing**, and **innovation infrastructure** components, US AI exports are set to continue being geopolitically impactful in the future, particularly within the **military** and **sociopolitical** domains.[104] These – and the country's ability to compete with its Chinese competitor within this area – will depend on the degree to which the government chooses to play an active role in improving the long-term prospects of US-based developers in the next 5-10 years. The US DoD takes a comparatively hands-on approach to fostering the active development of AI technologies, and released a five-pillared AI Artificial Intelligence Strategy in 2019.[105] This strategy is geared towards a.) accelerating the delivery of AI technologies, b.) scaling AI's impact across the DoD, c.) maintaining a leading AI workforce, d.) engaging with private industry, academia, and international partners, and e.) ensuring the US DoD remains at the forefront of military ethics. In order to complement the DoD's AI efforts and address some of its research challenges, in September 2018, DARPA announced $2 billion of funding towards *AI Next* - a campaign aimed at updating existing and building new AI systems capable of human-like communication and logical reasoning that outperform even the most advanced tech systems invented to date.[106] Outside of these frameworks, the US military has also benefited greatly from cooperation between its private defense industry and academia, which has resulted in *ALPHA*, an AI system used for UAV combat operation purposes that has consistently outperformed the *Air Force Research Lab* programs used by human experts.[107] The US takes an exceptionally 'catch all' approach to the development of military AI, and has programs in place

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102 Margaret Sullivan, "Perspective | Members of Congress Can't Possibly Regulate Facebook. They Don't Understand It.," *Washington Post*, April 10, 2018, sec. Style Perspective Perspective Discussion of news topics with a point of view, including narratives by individuals regarding their own experiences, https://www.washingtonpost.com/lifestyle/style/members-of-congress-cant-possibly-regulate-facebook-they-dont-understand-it/2018/04/10/27fa163e-3cd1-11e8-8d53-eba0ed2371cc_story.html.

103 Candelon, Reeves, and Wu, "18 of the Top 20 Tech Companies Are in the Western U.S. and Eastern China. Can Anywhere Else Catch Up?," 20.

104 US-based efforts are also impactful within the **economic** domain, though – owing largely to the wide range of applications – these do not take the form of concrete threats or opportunities, and largely feed into high-level AI-related impacts (i.e.: exacerbation of inequality, etc.)

105 "Summary of the 2018 Department of Defense Artificial Intelligence Strategy: Harnessing AI to Advance Our Security and Prosperity" (U.S. Department of Defense, February 12, 2019), https://media.defense.gov/2019/Feb/12/2002088963/-1/-1/1/SUMMARY-OF-DOD-AI-STRATEGY.PDF.

106 Jack Corrigan, "Inside DARPA's Ambitious AI NextProgram," RealClearDefense, March 11, 2019, https://www.realcleardefense.com/2019/03/11/inside_darparsquos_ambitious_lsquoai_nextrsquo_program_306997.html.

107 "University of Cincinnati Artificial Intelligence ALPHA Beats Veteran Pilot - Business Insider," accessed March 26, 2019, https://www.businessinsider.com/university-of-cincinnati-artificial-intelligence-alpha-beats-veteran-pilot-2016-6?international=true&r=US&IR=T.

dealing with autonomous deep learning machine systems, human-machine teaming, assisted human operations, advanced human-machine combat teaming, and network-enabled semi-autonomous weapons. The country generally aims to cede less control to machines than its Chinese competitor, particularly when it comes to strategic decision-making.

Given US clout within international institutions, Washington's positions vis-à-vis the development of and acceptable use cases for AI within the **military context** is likely to define any future international framework which aims to regulate the area.[108] This may exacerbate the 'race to the bottom' dynamics such as the one which directs state R&D into Lethal Autonomous Weapons Systems (LAWS) today. The nature of Washington's engagement with AI applications within the **sociopolitical** domain is of equal relevance. US policymakers' position vis-à-vis social media platforms' freedom to operate and grow will significantly shape the internet by changing these corporations' *modus operandi* internationally, and – if not in-line with allies' value systems – will contribute to the further fragmentation thereof. Any US-backed efforts to further curtail the export of Chinese authoritarianism through technology has opened up a new (digital) front in these nations' ideological competition.[109]

The key takeaways to be derived from the US case study are as follows:

- The US AI ecosystem – which is decidedly well-funded and cutting-edge – is globally competitive simply because it benefits from structural factors such as its world-renowned universities, high level of investment and leading e-tech companies.
- As exhibited by the productivity of the country's universities, the United States boasts a world-class **fundamental** research infrastructure. US-based companies excel at the development of **industrially**-oriented applications, though the degree to which these algorithms development is actively supported by the US public sector remains extremely limited. Applied, government-supported research is particularly prominent within the military field.
- US-based (nonmilitary) private-sector entities arguably lead the world in AI research, though the focus – as exhibited by Google and Facebook – is predominantly economic in nature. These companies can also be associated with a ream of negative (international) socio-politically relevant AI-related impacts, the threat of which the US government has thus far largely neglected to mitigate through regulatory instruments.

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108 This is not only because the US will develop a position of its own, but also because its efforts to explore such technologies – owing in no small part to the strategic advantages they provide – is certain to impact the activities and/or voting patterns of rival great powers such as China and Russia.

109 See as an example the US' campaign against Huawei: Julian E. Barnes and Adam Satariano, "U.S. Campaign to Ban Huawei Overseas Stumbles as Allies Resist," *The New York Times*, March 18, 2019, sec. U.S., https://www.nytimes.com/2019/03/17/us/politics/huawei-ban.html.

- Though the US is well positioned to pioneer military advancements in AI in the coming 5-10 years, the government's constrained ability to interact and retain non-traditional contractors from Silicon Valley is likely to limit it in terms of the types of applications it can reasonably expect to develop. This shortcoming is partially mitigated by the scale of US defense funding, as well as the high degree of technical sophistication of US defense contractors.

1.4 Findings

An in-depth overview of the included case studies' relative performance within this research's ecosystem components (**digitization**, **data processing potential**, **innovation infrastructure**, **strategic coherence**) is available in Table 1 on pp. 42-44. The results of the case studies relative performance yields eight main findings:

1. The Chinese government's high degree of **strategic coherence** – as well as its ability and willingness to forego ethical constraints and the sheer size of the country's population – facilitate robust performance within the **digitization** and **data processing** components. However, the latter remains hamstrung by a lack of innovation and production capacity when it comes to semiconductors. China's main shortcoming lies in its **innovation infrastructure**, which – though actively state-supported and exceptionally competitive with that of the US – is limited by several factors. Most prominently, Chinese companies largely relied on state-sponsored and supported corporate espionage in order to keep up with leapfrogging advances made with their American competitors. Though some companies have shown promise (i.e.: Huawei, Xiaomi) within this area, notably when it comes to synthesizing and/or pioneering AI-ready processor modules, structural factors continue to hamstring the Chinese public sector's ability to attract international talent, and even result in brain drain.[110]

2. Chinese **strategic coherence** empowers its participation across all domains, with the government placing an emphasis on the **military-security** and **sociopolitical** domains. Developments within the **economic** domain are actively supported through funding, but no overarching strategy appears to exist for ensuring specific outcomes. Chinese efforts within the **military-security** and **sociopolitical** domains respectively transpose into initiatives such as the country's social control system and into efforts to a.) develop autonomous weapons systems, and b.) cede (military) strategic decision making to algorithms. Chinese AI exports are jointly propagated by its public and private sectors; a high degree of integration between these sectors is characteristic of the Chinese approach to growing the country's AI ecosystem.

110 These dynamics – combined with the state's support of large-scale (indiscriminate) VC funding – is also likely to contribute to the bursting of the Chinese 'tech bubble', with the likely result being the exacerbation of Chinese brain drain and/or the emergence of increasingly oligopolistic market structures.

3. The European Union presides over an AI ecosystem which performs well within theoretical and advanced research, but which generally fails to apply this research in practice. This is partially due to the bloc's general lack of an established digital sector, meaning its exceptionally productive universities are essentially educating individuals to work in the American private sector. It is also partially due to a lack of EU and Member State-sponsored initiatives to incentivize the bloc's private sector to engage in such activities. Shortcomings in the EU **innovation infrastructure** are partially exacerbated by the bloc's lack of a world-competitive domestic semiconductor industry (which limits **data processing**). The EU performs exceptionally strongly within the **digitization** component, due to its exceptionally high smartphone saturation rate, high bandwidth speeds, and high utilization of IoT technologies. Member States' performance vis-a-vis **strategic coherence** varies, with the result being that there exist barriers such as data format incompatibilities which hamper the development of EU-specific algorithms. Though the European Commission has published and allocated funds towards a relatively coherent EU-wide strategy for improving the EU's AI ecosystem, the bloc's future competitiveness is likely to depend entirely on Member State engagement therewith.

4. The European Union's foremost AI-related export and impact presents in the form of regulations such as the GDPR, which – in limiting the range of AI applications by regulating private entities' data harvesting rights – serve to positively impact the **sociopolitical** domain. EU efforts at impacting the **economic** and **military-security** through the introduction of AI-related technologies remain limited, with (small-scale, niche) initiatives being propagated largely by individual Member States. Due to its economic importance, as well as its established role as an international norm and trend-setter, the EU is nonetheless well-placed to impact the international regulation of these domains in the near future.

5. The Russian Federation presides over a relatively unproductive AI ecosystem, the application – and development – of which remains largely contingent on state-sponsored initiatives. Russia's AI ecosystem does not closely compete (or supersede) China, the EU, or the US within any of the country profile components. The country's most concrete strengths present within the **digitization** and **innovation infrastructure** components, which are respectively bolstered by state-sponsored efforts at the introduction of an expansive IoT (surveillance) infrastructure and by Russian universities' continued ability to produce well-educated graduates. While Russian **strategic coherence** is clearly exhibited in the country's **digitization** component, it is absent within the **innovation infrastructure** and **data processing potential** components. This manifests in the country's challenge addressing brain drain and in its virtually nonexistent semiconductor industry.

6. The Russian Federation's AI ecosystem is utilized prominently towards the manifestation of impacts within the **sociopolitical** and **military-security** domains. Russian sociopolitically-oriented AI use-cases are predominantly geared (as is also the case with China) towards maintaining a degree of societal control. Though these systems are far removed from the sophistication of their Chinese counterparts, they nonetheless fit within a larger trend of state-sponsored initiatives towards realizing digital totalitarianism. Russian military-security initiatives are generally more advanced than the country's efforts within the sociopolitical domain, and center around the development of autonomous weapons systems. Russian private entities have engaged in niche use of AI elements within their day-to-day activities, meaning there is some activity within the **economic** domain, but these algorithms' narrow use cases do not rise to the level society-impacting use cases which are under development in the US and China.

7. The United States presides over a remarkably advanced AI ecosystem, which – as a result of exceptionally competitive universities, an aggressive and competitively funded private sector, and a world-leading semiconductor industry – derives a lead over its Chinese competitor within the **data processing** and **innovation infrastructure** components. The country's shortcomings present within the **digitization** and **strategic coherence** components, in which it suffers from a high degree of asymmetry vis-á-vis rural-metropolitan data availability and underutilization of IoT technologies (**digitization**) and from a general lack of government 'vision' when it comes to addressing this (**strategic coherence**).

8. The robustness of the US AI ecosystem – coupled with the government's hands-off attitude when it comes to exercising private-sector oversight – means that its AI exports are set to continue being geopolitically impactful in the future, particularly within the **military-security** and **sociopolitical** domains. The US' relative lack of **strategic coherence** means that – from both a long-and-short-term perspective – the country is less ideally positioned than its Chinese competitor to shape geopolitical outcomes through the active leveraging of these technologies. Government support for free-market practices means that – while US-based companies are exceptionally active within the **economic** dimension – the negative externalities associated with their work are rarely contained. A concrete example presents within the **sociopolitical** domain, there the activities of companies such as Facebook and Google have contributed to societal polarization, as well as to the success of foreign influence campaigns.

A comprehensive summary of the included countries' relative performance within the AI profiling exercise is provided in Table 1 below.

China

Digitization	Data processing potential
3	4
Largest population, but least connected in per-capita terms and weaker e-government participation as well as smart phone possessions contrary to the studied counterparts. However, state centralization and mass data collection by state and SOEs enables the Chinese government to amass immense amounts of data on its population. This is reinforced by the widely interconnected surveillance infrastructure in parts of the country. From a commercial perspective, China boasts more medium and large enterprises than other case studies, with the exception of the US, providing it with an advantage in commercial and industrial data generation.	China currently matches the processing capacity of the US, as it has been expanding its potential at rapid rates. Although the US possess the most powerful supercomputer, China heads with the total number of supercomputers. The storage and infrastructure, however, require further development. The number of colocation and hyperscale data centers is a fraction of the US's. The semiconductor industry is flourishing, but China's demand for hardware outstrips its production capabilities, in regard to quantity as well as semiconductor sophistication. As a result, China's reliance on the import of foreign innovative technology, and in particular its demand for chips smaller than its mass produced 28nm, creates a strategic vulnerability in supplementing its domestic supply gap.

Innovation infrastructure	Strategic coherence
4	5
Counter to the US private-market dominance, advanced technology is often derived from Chinese state-owned enterprises. The country's innovation ecosystem has been growing at a fast rate, albeit from a lower starting point. The number of academic papers on AI outpaces the US, while the number of filed patents is almost half of all filed worldwide, demonstrating immense knowledge generation. However, the majority of said patents are deemed as of low innovative quality. This, along with the substantially low number of net student flow, constitutes a notable drawback for Chinese innovative capabilities. Another impediment exists in China's IT industry, which has faced increasing labor costs combined with relatively low labor productivity and exuberant amounts of capital directed at China's AI industry. In turn, risks of an AI 'tech bubble' prevail and that can undermine the current innovation landscape.[111]	China is undoubtedly the leader in strategic thinking in implementing AI technologies. It is the only actor, out of the included countries, that has taken a 'rounded' approach to introducing AI, meaning it has sought for its uses across sociopolitical, economic and military-security domains. This is at least in part a result of the country's centralized governance structure and hierarchical nature, whereby SOEs frequently serve not only commercial interests, but also strategic objectives of national and regional governments. China's lack of concern for ethics or privacy, along with the absence of lengthy control processes, positions it strategically ahead of the US and the EU, which often become embroiled in legal and ethical disputes over the collection and processing of data. The country has clearly identified the potential of AI, as well as its strengths and weaknesses (in fully integrating the technology). China ensures that the People's Liberation Army benefits from these advancements, by compelling businesses to share know-how and technologies with the country's military sector.

111 It is worth noting that in the long run, China's predatory practices against foreign multinational companies are likely to stifle its innovation ecosystem. While China strives to achieve independence in the high-tech sector, it is still dependent on technology transfers from more advanced economies and the exclusion of these entities would harm its domestic development.

EU

Digitization	Data processing potential
4	2
Very well-connected population with vast e-participation, high rate of smartphone possessions as well as rapid internet bandwidth speed that comes merely second following the US. The EU possesses relatively large amount of enterprises and startups collecting data, with the number of medium and large enterprises surpassing China's. European cities are some of the most digitized worldwide and the continent's smart cities surmount those of other case studies, thus presenting theoretical potential for data collection.	The EU possesses a limited number of supercomputers, which are predominantly located in western Europe. This pattern is evident for much of other infrastructure, suggesting that regional inequality will result in uneven use of AI technologies in the bloc. The number of data centers positions the EU ahead of China, but much further behind the US. The EU semiconductor industry is moderately sized, providing key hardware to the global semiconductor value chain. However, it remains unevenly technologically advanced, with countries such as Germany producing chips at 90nm, while the Netherlands has the capability of producing 7nm chips.

Innovation infrastructure	Strategic coherence
3	3
The EU has a fairly sized AI market, but the number of startups per capita is a quarter of that of the US. However, the EU boasts an established higher education sector that generates some of the most impactful papers on AI and attracts top talent from around the world. As a result, European enterprises benefit from a highly skilled talent pool. Funding options are extensive, from national funds, EU programs such as Horizon 2020 and private means of financing including venture capital and angel investors. Academic papers and patent requests further demonstrate high level of knowledge generation, but while European companies constitute critical links in the global high-tech industries, the potential of EU companies remains in the shadow of the US and Chinese tech sectors.	The bloc has demonstrated a relatively high degree of coherence on application of AI, but is victim to significant regional inequalities, whereby several countries, namely the UK, Germany and France far outperform fellow EU members. In 2018, the EU has presented a collective AI strategy, demonstrating a scramble toward achieving coherence despite the difference of technological development within the bloc. Lack of private-sector engagement has been identified as one of the shortcomings and is being addressed by attempts to streamline capital to the industry via EU-wide funds. The EU is presented with a unique human-centric approach to AI as well as privacy regulations such as the GDPR, in addition to regulations on ethical use. While this strengthens consumer protection, it limits the scope of data that can be harvested and thus the digitization capacity. Further drawbacks are identifiable in the limited progress within existing frameworks, lengthily bureaucratic processes and the reluctance of EU entities to adjust to the rate of global competition.

Russia

Digitization	Data processing potential
2	1
Connected population combined with rapid growth of digital services among consumers and initial business-to-business (B2B) application. However, the constrained domestic market leaves few local actors to collect consumer data. The government is expanding its reach into the Russian internet infrastructure, but the costs of compliance with government regulations have slowed down the implementation of harvesting technology. In socio-economic terms, Russia faces a declining population and a stagnant economy, meaning future digitization will remain limited.	The country has almost no leading non-military supercomputers, limited colocation data storage facilities, no hyperlocation sites and no established domestic semiconductor industry. The latter is estimated to make up less than 1% of the global market and to be 10-15 years behind frontrunning competitors in terms of hardware sophistication. Relative to discussed counterparts, Russia is the least able in terms of data processing. The silver lining is the recent expansion of colocation data centers and the potential to harvest China's storage demand.

Innovation infrastructure	Strategic coherence
1	3
AI market is the smallest out of the presented case studies but is moderate relative to the population of the country. It remains constrained by market dominance of state-owned enterprises and a lack of private capital. The country produces a high number of academic papers, but this is not translated into actual applications and output by the industries. A major advantage is highly skilled and cheap labor, resulting from a traditionally strong academic sector. Though this is threatened by outward migration and over reliance of businesses on cheap labor. The country's political and economic volatility reduces the attraction of the country to foreign expertise and investments.	Despite the Russian government frequently acknowledging the importance of pursuing AI technologies, Russia currently lags behind its counterparts. The country has yet to establish a comprehensive AI strategy and for now relies on sector specific frameworks as part of various, often uncoordinated, strategies. However, Russia has evidently recognized its capacity limitations and has narrowed down its focus in AI implementation to national security and the military domain. The campaigns in Ukraine and Syria have acted as test-beds for next generation military technology. At the same time, the country has not been as successful in capitalizing on comparative advantages, such as engaging its leading STEM human capital pool. Gauging the government's financial commitment is difficult, as R&D for military purposes is classified, but among non-military applications, federal grants and state owned or co-owned enterprises are leading sources of funding. Therefore, bearing in mind Russia's defense-centric approach to AI, its strategies appear to steer toward the actualization of its goals.

US

Digitization	Data processing potential
4	4
The US has a well-connected population with the highest e-participation amongst the other studied cases. It also fosters a great deal of smart phone possession, on par with the EU, combined with many startups and private companies to collect data. The US enjoys a higher internet speed in contrast to its counterparts, yet there appear to be major differences between its states. The well-established tech sector provides ample opportunity to generate and collect consumer data, and the high level of digitization in the industry presents cases for process data generation.	Most data centers combined with a strong domestic semiconductor industry makes the US more able and independent to produce innovative results to equally lead in data processing with China over the other competing powers. The position is reinforced by the private sector's access and ability to process the acquired data. However, the US trails in the number of supercomputers it possesses, which is almost half of China's. Another advantage is the transnational reach of US enterprises and hence their ability to collect data beyond the US. Unlike the EU, a bloc of similar socio-economic level of development, the US is more willing to provide its citizens data for use by businesses.

Innovation infrastructure	Strategic coherence
5	3
The US boasts the most vibrant private sector and has the highest number of AI companies relative to its size. High levels of patenting demonstrate continuing innovation leadership and support the application of AI technologies. Moreover, the US has extensive funding opportunities, both public and private, as well as a world-leading higher education sector that is closely connected to the labor market. One limitation of the US is the concentration of innovation in select fields such as financial and IT services, with industries such as healthcare and retail lagging far behind.	The US currently does not have a comprehensive AI strategy, but the government is informed on the potential of AI and has outlined several key objectives, such as increased investment for R&D. The US has harvested its competitive advantage by providing the private sector with limited regulation, thus enabling it to innovate freely. However, it does not provide guidelines or practical assistance for businesses to successfully deploy AI and integrate it into their operations. Another shortcoming is identifiable in the US' visa restrictions for STEM students and lack of adequate strategy to integrate AI into public services. In addition to this, the government does not adequately address the issue of potential job losses as a result of automation, nor are there programs in place to re-educate the existing workforce to adjust to an AI transformed business model. Instead, the government has directed its focus on the military-security domain. In this instance, the private sector in the form of contractors continues to perform an important role. However, the free-market approach delegates much of the power to shape outcomes to the private sector, in turn reducing the control exercised by the government and as a consequence, limiting the strategic coherence of the US.

Table 1: AI Profiles and Programs: China, EU, Russia and the EU.

2. Domain impacts

The included case studies' initiatives facilitate their active engagement with and development of AI-related technologies whose emergence impacts the **economic**, **sociopolitical**, and **military-security** domains. AI's application within these domains can be associated with a ream of 'generic' impacts which are shortly outlined in the sections below, which include both threats and opportunities. Within the context of this study, 'generic' impacts are derived from a 'horizon scan'-style literature review of ±50 documents published by research institutes, think tanks, NGOs & consultancies, and academia, while more concrete (domain-specific) implications are derived from observations made from the case studies themselves. More specifically, we identify concrete negative externalities which are associated with initiatives undertaken by actors within the study. This approach is underpinned by several overarching assumptions; namely:

a) that current activities are indicative of future activities,
b) that more productive ecosystems are better equipped to push the envelope than those which are not, and
c) that a higher degree of strategic coherence amplifies ecosystem productivity and output.

This means that – in general – the concrete negative externalities outlined in the sections below constitute extrapolations based on past and present initiatives.

2.1 Economic

The economic impacts of AI-related technologies are acutely evident in society as a result of the private sector role in the development and use of AI for commercial applications. Prospect of gains have prompted companies to seek applications of AI to outperform competitors, both nationally and internationally.[112] While the processing of Big Data has provided ample opportunities - namely: **supply-side efficiencies**, **personalization of goods and services** and **stimulation of the economy** - the benefits

112 Directorate-General for Research and Innovation, "2018 Industrial R&D Scoreboard: EU Companies Increase Research Investment amidst a Global Technological Race" (European Commission, December 17, 2018), https://ec.europa.eu/info/news/2018-industrial-rd-scoreboard-eu-companies-increase-research-investment-amidst-global-technological-race-2018-dec-17_en.

of these are being distributed unevenly. AI's effectiveness depends heavily on the quantity and quality of data, elements often reserved to the leading corporations in the digital sector.[113] Data generation and its use is creating path dependencies, as companies with the greatest data accumulation continuously reinforce their leadership position and stifle market competition.[114] The adverse effects of these trends are evident in modern markets' tendency towards **developing oligopolistic markets** with **winner-takes-all-dynamics**, **the rise in inequality**, **economic insecurity** and a protectionist response with the **creation of rival regulatory frameworks**. Moreover, these threats are becoming evident at the individual, market and state levels. A high-level overview of the threats and opportunities associated with AI's application within the economic domain is provided in Figure 7 below.

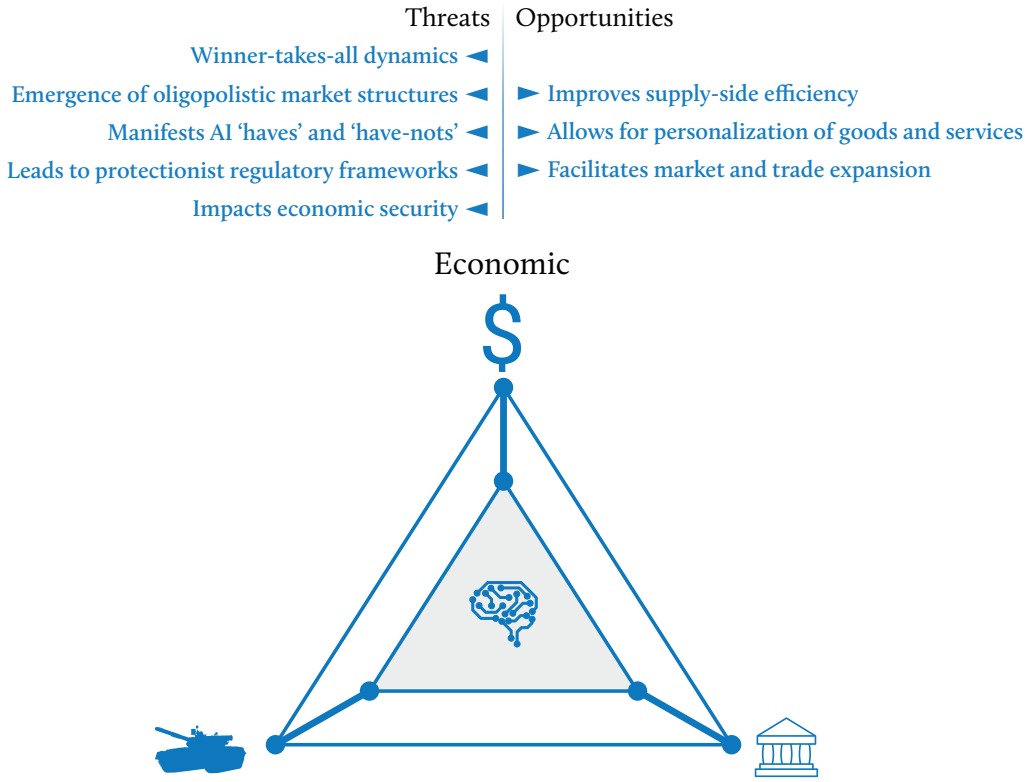

Figure 7: Economic Threats and Opportunities of AI.

2.1.1 Threats

Digitization of processes across many sectors in the economy, namely finance, healthcare, manufacturing, logistics, and consumer goods and services, has given rise to a new dimension of competition. Companies that harvest mass amounts of data

113 Willem Sundblad, "Data Is The Foundation For Artificial Intelligence And Machine Learning," Forbes, October 18, 2018, https://www.forbes.com/sites/willemsundbladeurope/2018/10/18/data-is-the-foundation-for-artificial-intelligence-and-machine-learning/.

114 Daniel Faggella, "The AI Advantage of the Tech Giants: Amazon, Facebook, and Google," Emerj, February 26, 2019, https://emerj.com/ai-executive-guides/ai-advantage-tech-giants-amazon-facebook-google/.

- oftentimes generated by their processes or customers - leverage it to improve their competitive position.[115] By utilizing the accumulated Big Data, companies accelerate the development of AI technologies. This dynamic positions companies with the largest data generation potential to benefit disproportionately from AI. As a result, integration of AI is contributing to the development of **winner-takes-all-dynamics** in (inter)national markets. This effect is particularly evident in the technology sector, where network effects continue to generate disproportionately large returns for the leading firms such as Google and Facebook, with the result being the development of oligopolistic market structures and inequality.[116]

The winner-takes-all-dynamics demonstrates how AI is reinforcing the **tendency towards oligopolistic market structures**. This occurs, in part, from the cost of developing and integrating AI-related technologies into industrial workflows and the uneven implementation of such technologies within industrial sectors.[117] Furthermore, due to implementation costs, industrialized economies are likely to realize the efficiencies associated with the technology before developing ones.[118] As an outcome, the winner-takes-all-dynamics reinforce oligopolistic market structures, within which an increasingly small number of corporations dominate (inter)national markets.[119] This dynamic is particularly likely to propagate geopolitically negative externalities within sectors such as agriculture and manufacturing, where efficiency gains of Western and/or Chinese firms are likely to render them relatively more competitive to their counterparts in developing nations. These changes are set to reduce the prosperity of producers in developing countries, which will be less able to compete with their Western counterparts on price and quality, thus reducing a significant share of these states' income potential. This dynamic also plays out at the domestic level, where often already marginalized population groups will experience the negative externalities associated with these technologies' implementation. Across the developed nations, blue-collar workers will be affected disproportionately more than their white-collar counterparts.

AI's impact on inequality is widespread, with **AI haves and have-nots** forming at individual, market and state levels. Aside from the effect on traditional sectors,

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115 Faggella.

116 "AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives" (Washington, D.C.: Department of Defense, 2018), 38, https://nsiteam.com/social/wp-content/uploads/2018/12/AI-China-Russia-Global-WP_FINAL.pdf.

117 Jacques Bughin et al., "Notes from the AI Frontier: Modeling the Global Economic Impact of AI" (McKinsey), accessed April 13, 2019, https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Artificial%20Intelligence/Notes%20from%20the%20frontier%20Modeling%20the%20impact%20of%20AI%20on%20the%20world%20economy/MGI-Notes-from-the-AI-frontier-Modeling-the-impact-of-AI-on-the-world-economy-September-2018.ashx.

118 PricewaterhouseCoopers, "PwC's Global Artificial Intelligence Study: Sizing the Prize," PwC, accessed June 28, 2019, https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html.

119 Arif Khan, "Disrupt the Disruption: The Tech Oligopoly Part 2," SingularityNET, October 7, 2018, https://blog.singularitynet.io/disrupt-the-disruption-the-tech-oligopoly-part-2-bb8747b7e16d.

tech clusters and the accompanying high-paying salaries are concentrated in a number of developed countries, indicating a tech talent flow to these clusters and resulting in a harder hit on developing nations' economies.[120] Within nation states, the rural-urban divide has been highlighted in recent years by the rise in populism, where the disenfranchised rural areas continue to stagnate while the largest cities flourish.[121] While AI is not responsible for this trend, it is acting as a stress factor on the current socio-economic trends. Within industries, AI is acutely impacting low-skilled professions, where increases in automation are resulting in human tasks being replaced or even becoming obsolete. Within the technology sector, technical jobs are male-dominated, particularly in countries leading the AI development race. This sectoral gender-divide highlights the risks that gender inequality will be ingrained in AI due to bias in the development process.[122] This is further leading to the unequal distribution of benefits, with few policy suggestions currently in place to offset this.

AI is perceived to further establish 'AI haves and have-nots' among nation states. It threatens to eliminate comparative advantages of developing economies that rely heavily on cheap, labor-intensive manufacturing, such as textile production.[123] While countries such as China and the US are predicted to be the top beneficiaries by taking 70% of AI's economic benefits, developing countries across Asia, Africa and Latin America are expected to gain less than 6% of the prospected global GDP increase.[124] The overall result is anticipated wider income, gender, geographic, and international inequalities.[125] It is notable, that the extent of these technologies' overall impact on the labor market is currently inconclusive, with evidence of both positive and negative trends, whereby while some jobs are displaced, new opportunities are created. Past waves of technological progress have often resulted in worker displacement, while at the same time generated net positive gains in employment. However, estimates for the current technological revolution estimate the impact to take effect at ten times the pace of the previous ones.[126] As a result, it is evident that to harness the benefit of AI, policies have to be adopted to accommodate transition of displaced workers to other professions.

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120 "AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives."

121 Gideon Rachman, "Urban-Rural Splits Have Become the Great Global Divider," Financial Times, July 30, 2018, https://www.ft.com/content/e05cde76-93d6-11e8-b747-fb1e803ee64e.

122 Hannah Devlin and Alex Hern, "Why Are There so Few Women in Tech? The Truth behind the Google Memo," *The Guardian*, August 8, 2017, sec. Life and style, https://www.theguardian.com/lifeandstyle/2017/aug/08/why-are-there-so-few-women-in-tech-the-truth-behind-the-google-memo; John Villasenor, "Artificial Intelligence and Bias: Four Key Challenges," *Brookings* (blog), January 3, 2019, https://www.brookings.edu/blog/techtank/2019/01/03/artificial-intelligence-and-bias-four-key-challenges/.

123 "AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives."

124 PricewaterhouseCoopers, "PwC's Global Artificial Intelligence Study."

125 Though AI is likely to result in job loss in the short term, the technology's implementation will also create jobs and/or greatly increase demand for several existing professions. See McKinsey & Company, Inc., "Smartening up with Artificial Intelligence (AI) - What's in It for Germany and Its Industrial Sector?," April 2017, https://www.mckinsey.com/~/media/McKinsey/Industries/Semiconductors/Our%20Insights/Smartening%20up%20with%20artificial%20intelligence/Smartening-up-with-artificial-intelligence.ashx.

126 Klaus Schwab, "Globalization 4.0," January 22, 2019, 0, https://www.foreignaffairs.com/articles/world/2019-01-16/globalization-40.

Exacerbation of inequalities vis-à-vis the rate of harvesting the benefits of AI may result in laggards initiating **protectionist regulatory frameworks** to resist the adoption of rules which they view as 'adding an extra burden on them, with vague benefits' within international institutions.[127] An intensification of protectionism is likely to follow as some states are incentivized to introduce measures geared towards protecting domestic industries from international competition. This fear of 'losing out' incentivizes countries to hamper the development of international standards and introduce barriers to international trade. The resistance is reinforced by the states perception that conceding to these rules risks the inception of an international framework which consolidates existing (digital) power asymmetries.[128] This may hamper the timely adoption of internationally binding norms and rules, thus potentially exacerbating the severity of existing digital divides. Besides domestic protectionist measures such as the US' assault on the Chinese technology giant Huawei, barriers are being erected at multilateral institutions. In light of the rising trade tensions between the US and China, the US has actively slowed down the functioning of the dispute-settling Appellate Body at the World Trade Organization (WTO) by failing to reappoint judges and thus reducing their ability to handle cases in a timely manner.[129]

Introduction of AI is further presenting challenges of **economic insecurity**, both at domestic and international levels. At the domestic level, the prominence of the private sector in the development and implementation of AI increases the vulnerability of governments and alters their strategic options. This is a result of control over crucial technologies, often supporting critical infrastructure, being handed over to a third-party. This has national security connotations, as highlighted by, among others, the US presidential order blocking the acquisition of the American chip manufacturer Qualcomm by Singaporean Broadcom.[130] At the international level, recent challenges have been safeguarding companies from corporate espionage and predatory business practices abroad, particularly in China. Companies from Western market-based economies find themselves competing against (Chinese) companies or state-owned enterprises with substantial state financial backing, which results in market distortions and hampers the innovation and growth of Western companies. The arising deadlock in the global regulatory environment and the slowdown of dispute settlement at the WTO negatively affects economic security as it limits the

127 Christopher Foster and Shamel Azmeh, "Trade Wars Are Growing over the Digital Economy – and Developing Countries Are Shaping the Agenda," The Conversation, 2019, http://theconversation.com/trade-wars-are-growing-over-the-digital-economy-and-developing-countries-are-shaping-the-agenda-113000.

128 This view is further exacerbated by the fact that many developing countries preside over neither the technical know-how nor the foreknowledge to predict how their domestic industries will develop and are therefore unable to comprehensively evaluate these rules' likely impact.

129 "U.S. Blocks WTO Judge Reappointment as Dispute Settlement Crisis Looms," *Reuters*, August 27, 2018, https://www.reuters.com/article/us-usa-trade-wto-idUSKCN1LC19O.

130 Jacob Kastrenakes, "Trump Issues Order Blocking Broadcom Takeover of Qualcomm, Citing National Security," The Verge, March 12, 2018, https://www.theverge.com/2018/3/12/17111766/broadcom-qualcomm-acquisition-blocked-trump-national-security.

international potential of companies. A further issue is corporate espionage, which has become more prolific in the age of digitization. Leading Western technology companies are consistently under attack from groups seeking to acquire commercial technology.[131] Reinforced by predatory business practices, market players are challenged further through unfair intellectual property (IP) transfers, whether legal or illegal. In the case of China, most companies simply handed over their IP as a prerequisite to gain access to the Chinese market.[132] The impact is significant, as in numerous instances, technology produced by Western companies is being used to reinforce digital totalitarianism in authoritarian states.[133] Due to the aforementioned dependence on the private sector in digitization, corporate espionage threatens to undermine not only economic, but also national security.

Overall, the economic threats arising from AI are ample and will have wide-reaching implications. Within markets, introduction of AI risks to reinforce the position of the leading firms in a winner-takes-all-dynamic, stifle competition and thus limit innovation. The uneven distribution of AI and automation within the economy will likely result in increases in inequality across numerous boundaries, between, among others, the digitally literate vs illiterate, blue-collar vs white-collar workers and rural vs urban residents. The resulting adverse effects are prompting governments to establish protectionist measures to safeguard domestic industries and limit the negative externalities of the exponentially growing impact of AI technologies. Finally, the economic risks involving the companies behind AI development have implications on national security by limiting the strategic position of states, as well as exposing critical industries to foreign predatory practices and corporate espionage.

2.1.2 Opportunities

AI-related technologies are projected to have substantial ramifications on domestic, regional and global economies, with figures estimating a global contribution in GDP of as much as $13 trillion by 2030, equal to 1.2 percent of additional GDP growth per year.[134] AI's added value within the economic domain currently derives almost entirely from the technology's ability to automate processes. Applications span manufacturing tasks, particularly those in unsafe environments, quality testing, logistics, fraud detection, and routine business processes. It can be universally associated with

131 "China Broke Hacking Pact before New Tariff Fight," Axios, accessed June 28, 2019, https://www.axios.com/china-broke-hacking-pact-before-new-tariff-tiff-d19f5604-f9ce-458a-a50a-2f906c8f12ab.html.
132 United States International Trade Commission, "China: Effects of Intellectual Property Infringement and Indigenous Innovation Policies on the U.S. Economy" (US Government, 2011), https://www.usitc.gov/publications/332/pub4226.pdf.
133 Sui-Lee Wee, "China Uses DNA to Track Its People, With the Help of American Expertise," *The New York Times*, February 21, 2019, sec. Business, https://www.nytimes.com/2019/02/21/business/china-xinjiang-uighur-dna-thermo-fisher.html.
134 Bughin et al., "Notes from the AI Frontier: Modeling the Global Economic Impact of AI."

increased safety, cost efficiency, productivity, empowerment of workers and advanced understanding of market demand.

AI allows for unprecedented gains in **supply-side efficiency**, driven by improved worker productivity, cost-efficiency and process optimization. AI is reducing the necessity for humans to operate in dangerous environments such as offshore oil rigs and coal mines, ensuring the quality of products through image recognition, and reducing oversupply and loss of sales through automating stock monitoring and replenishment. Furthermore, it is automating routine business processes in data management, provision of IT services, and semantic analysis. Particular aspects of supply chains that will benefit from AI are repetitive tasks, processes generating large amounts of data and work requiring pattern or anomaly detection from text or imagery.[135] While in many cases technologies are still undergoing testing, industry use-cases are numerous. Large distributors such as Amazon and Ocado have introduced robotized and almost fully automated warehouse operations systems, where robots stack shelves and autonomously prepare delivery orders.[136] Amazon has progressed a step further, whereby it has begun publicly testing unmanned aerial vehicles to deliver products to customers in the US and the UK.[137] The technologies have widespread applications within the financial sector, where it is playing an increasingly prominent role in identifying and executing trades and granting loan agreements. In tackling financial crime, AI is being deployed to prevent fraud, tax evasion and money laundering through the detection of anomalies, such as suspicious purchases and uncharacteristic transactions.[138]

On the demand-side, AI is being used to deliver **personalization of goods and services**. Analysis and understanding of Big Data is enabling companies to better understand their customers' preferences and allocate their products to market segments accordingly. Through the combination of social media, mobile applications and e-commerce, consumer goods companies are better able to develop and distribute their products.[139] The use and purchase data from the services of these companies is being used to reinforce the companies' understanding of their customers and as a result, improve the targeting of their goods and services to the respective market segments. As a result, consumers are receiving more relevant products and services.

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135 Andrew Scott et al., "Modeling Artificial Intelligence and Exploring Its Impact" (Frederick S. Pardee Center for International Futures Josef Korbel School of International Studies University of Denver, May 2017), https://pardee.du.edu/sites/default/files/ArtificialIntelligenceIntegratedPaper_V6_clean.pdf.

136 James Vincent, "Welcome to the Automated Warehouse of the Future," The Verge, May 8, 2018, https://www.theverge.com/2018/5/8/17331250/automated-warehouses-jobs-ocado-andover-amazon.

137 April Glaser, "Why Amazon Is Testing Drone Delivery in the U.K. — and Not in the U.S.," Vox, December 14, 2016, https://www.vox.com/2016/12/14/13955818/amazon-drone-delivery-uk-us-faa-testing.

138 E. Geist and A. J. Lohn, *How Might Artificial Intelligence Affect the Risk of Nuclear War?* (rand.org, 2018), https://www.rand.org/pubs/perspectives/PE296.html.

139 Bernard Marr, "27 Incredible Examples Of AI And Machine Learning In Practice," Forbes, accessed July 15, 2019, https://www.forbes.com/sites/bernardmarr/2018/04/30/27-incredible-examples-of-ai-and-machine-learning-in-practice/.

As a result of the improvements in supply chains and better market understanding, AI has the potential to be a crucial economic stimulant. The overall impact of automation and AI-related activities is not evident, but the benefits of AI are already visible in the energy, transport, finance, manufacturing and retail sectors. On the supply side, implementation of AI is leading to the automation of processes and augmentation of worker experience, in turn generating efficiency gains in production. On the consumer side, targeted advertising is processing mass amounts of customer data and applying algorithms to improve the classification of its audience for targeted advertising campaigns. Resulting gains stimulate innovation and drive international trade due to increased competition both in hardware, software, services and consumer goods. AI technologies should further accelerate the transition to services economies and boost output of products such as robots, microchips, sensors and other machine equipment.[140] Furthermore, economic growth will result from required upgrades in current (telecommunications) infrastructure, as well as the addition of internet fiber-optic cables and the roll out of 5G network equipment around the world.[141]

The dual-use nature of AI naturally presents economic opportunities, which are however, evidently outweighed by the geopolitical implications of the economic risks presented by this range of technologies. Many current projections are hypothetical estimates as the technology is evolving exponentially, thus immediate conclusions and the extent of the impact cannot be determined with certainty.[142] As a result, the threats of AI seem more apparent than the opportunities. While the benefits currently appear as narrow process-augmenting functions, they have the potential to have immense overall impact on the economy.

2.2 Sociopolitical

As AI technology reaches into every aspect of daily routines, it is set to augment the basic principles of societal functions. Commercial interests have generated a path dependence in technological progress, as companies seek to understand the most intricate details about their customers. As a result of their dominance in the development of AI, intricate algorithms and data generating tools are now being applied en-masse, in use cases which span far beyond targeted advertising. AI is enabling governments to understand their citizens better, in some cases for the **improvement of the quality of life**, while in others, for stemming individual

140 Joshua P. Meltzer, "The Impact of Artificial Intelligence on International Trade," *Brookings* (blog), December 13, 2018, https://www.brookings.edu/research/the-impact-of-artificial-intelligence-on-international-trade/.

141 "Do We Understand the Impact of Artificial Intelligence on Employment? | Bruegel," accessed July 15, 2019, https://bruegel.org/2017/04/do-we-understand-the-impact-of-artificial-intelligence-on-employment/.

142 Steve Lohr, "A.I. Will Transform the Economy. But How Much, and How Soon?," *The New York Times*, November 30, 2017, sec. Technology, https://www.nytimes.com/2017/11/30/technology/ai-will-transform-the-economy-but-how-much-and-how-soon.html.

freedoms. AI is enabling **enhancements of online experience** and **augmentation of social interactions**. In states with limited protection of human rights, AI is set to empower ruling governments to strengthen their control over their population and project their influence abroad. This results in **AI-enforced governance models** at home, and **export of digital totalitarianism** and **diversified foreign influence campaigns** abroad, which r**einforce existing social polarization**. In these cases, AI is tilting the tug-of-war between citizens and states in favor of the latter. A high-level overview of the threats and opportunities associated with AI's application within the sociopolitical domain is provided in Figure 8 below.

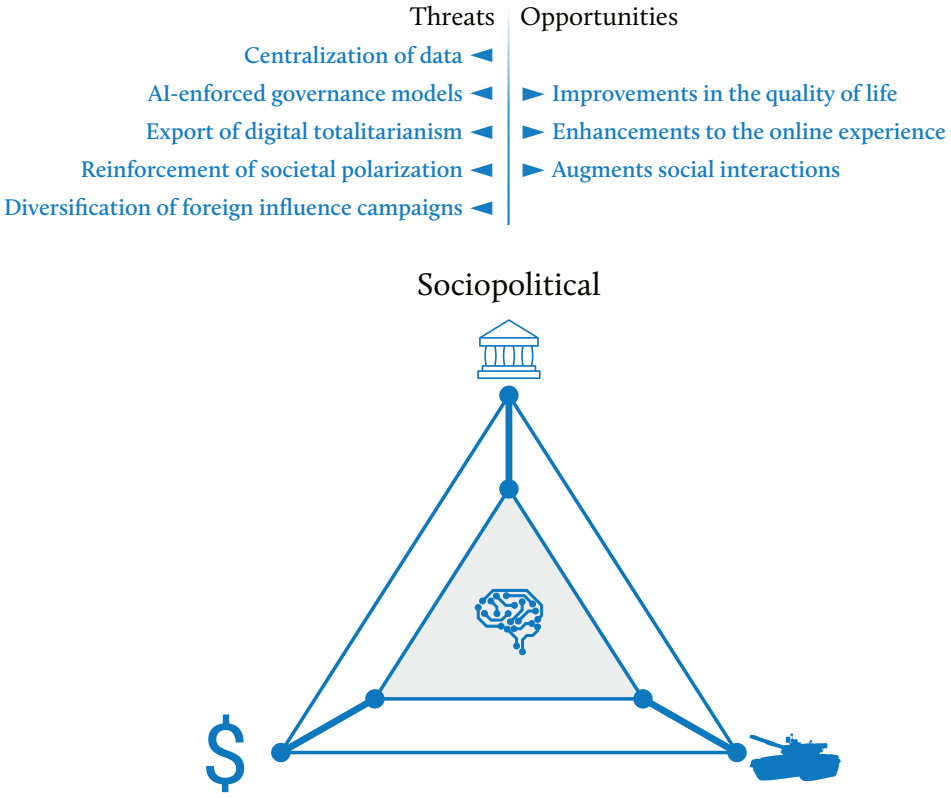

Figure 8: Sociopolitical Threats and Opportunities of AI.

2.2.1 Threats

As highlighted in the economic section, the use of AI by leading data-generating companies to reinforce their market position has socio-political connotations. **Centralization of data**, whether by companies or governments, is establishing the intricate understanding of customers or citizens behaviors' by select entities.[143] In a socio-political context, this acts as a foundation for AI-driven surveillance and control of citizens, as is becoming evident with China's experimentation with digital

143 Jathan Sadowski, "Companies Are Making Money from Our Personal Data – but at What Cost? | Technology | The Guardian," The Guardian, 2016, https://www.theguardian.com/technology/2016/aug/31/personal-data-corporate-use-google-amazon.

social credit systems.[144] Meanwhile, in Western democracies, the dependence of large swathes of the population on services provided by the FAANG corporations has stalled anti-competition legislation against these countries both in North America and Europe.[145] In both liberal and illiberal states, the growing dependence on platforms that centralize data collection increases the risk of infringement of human rights, by means depicted in the following paragraphs.

The **rise of AI-enforced governance models** and the **export of digital totalitarianism** are intimately linked, largely because the implementation of AI-enforced governance models requires the development of easily transferable technologies.[146] Within the context of this study, these phenomena have been predominantly observed in the Russian and Chinese case studies. In the Chinese case, the combination of AI-driven facial recognition, centralization of communication platforms (WeChat, etc.) and state utilization of 'ground level' (healthcare, etc.) data has allowed for the inception of an early social credit system in which citizens are awarded credit for 'good behavior', and penalized for 'bad behavior', including, among others, jaywalking and walking a dog without a leash.[147] Penalties reportedly range from citizens being precluded from using certain forms of public transport, denying their children enrollment into the best schools, and in the worst cases, to imprisonment.[148] Russia utilizes a similar, though far less-developed system to optimize its domestic information campaigns, and to identify and repress dissent domestically.[149] The technologies underlying these control systems are easily exportable, and – in serving to consolidate the regimes which implement them – have the potential of 'normalizing' illiberal governance internationally.[150] Armenia, Azerbaijan, Belarus, Ecuador, Kazakhstan, Kenya, Pakistan, Singapore, Sudan, Tunisia, Venezuela and Zimbabwe have all sought to implement Chinese surveillance technologies in bids to emulate Beijing's model of AI-led repressive governance.[151]

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144 Jack Karsen and Darrel M. West, "China's Social Credit System Spreads to More Daily Transactions," *Brookings* (blog), June 18, 2018, https://www.brookings.edu/blog/techtank/2018/06/18/chinas-social-credit-system-spreads-to-more-daily-transactions/.

145 John Naughton, "Tech Giants Face No Contest When It Comes to Competition Law," Then Guardian, 2017, https://www.theguardian.com/commentisfree/2017/jun/25/tech-giants-no-contest-on-competition-law-amazon-whole-foods.

146 Amy Hawkins, "Beijing's Big Brother Tech Needs African Faces," *Foreign Policy* (blog), accessed June 28, 2019, https://foreignpolicy.com/2018/07/24/beijings-big-brother-tech-needs-african-faces/.

147 Alexandra Ma, "China has started ranking citizens with a creepy 'social credit' system — here's what you can do wrong, and the embarrassing, demeaning ways they can punish you," Business Insider Nederland, October 30, 2018, https://www.businessinsider.com/china-social-credit-system-punishments-and-rewards-explained-2018-4.

148 Vicky Xiuzhong Xu and Bang Xiao, "'Punishing the Disobedient': China's Social Credit System Could Engineer Social Behaviour by 2020," Text, ABC News, March 31, 2018, https://www.abc.net.au/news/2018-03-31/chinas-social-credit-system-punishes-untrustworthy-citizens/9596204.

149 Soldatov and Borogan, "Russia's Surveillance State."

150 Wu'er Kaixi, "China's New World Media Order | by Wu'er Kaixi & Christophe Deloire," Project Syndicate, June 3, 2019, https://www.project-syndicate.org/commentary/china-press-freedom-attack-democracy-by-wu-er-kaixi-and-christophe-deloire-2019-06.

151 For the full list of countries, see Freedom House, "Freedom on the Net 2018: The Rise of Digital Authoritarianism" (Freedom House, October 31, 2018), https://freedomhouse.org/sites/default/files/FOTN_2018_Final%20Booklet_11_1_2018.pdf.

A linkage is also evident between the previously identified **societal polarization in liberal democracies** and increases in the impact of **diversified foreign influence campaigns**. Though autocrats take an active role in propagating 'threatening' AI-related applications, several of the liberal democracies included within this study, with the United States in particular, can be credited with facilitating the propagation of socio-politically-relevant AI technologies. These derive largely from big tech companies' use of clustering models to maximize advertising revenues, and can be universally associated with the exacerbation of political radicalization in liberal democracies.[152] This is because the clustering models are used not only to present users with relevant advertisements, but also to maximize their time spent on the platform by, among others, filtering the news articles they interact with, the 'groups' the platform recommends joining and the 'influencers' they are encouraged to follow. Big tech companies, such as Twitter and Facebook, increasingly create focal points within their users' content consumption habits.[153] These algorithms impact the health of the discourse in liberal democracies as they cluster significant cohorts of populations who are led to perceive the world in largely segregated media ecosystems.[154] The creation of these so-called echo chambers undermines social cohesion and breeds societal polarization by cementing identities.[155] The EU has played an active role in attempting to curtail the impact of this phenomenon, through, among others, the implementation of the GDPR.

Another issue gaining prominence in the **reinforcement of social polarization** is the rise in augmented video, image and audio content, known as deepfakes.[156] While liberal democracies have been identifying methods to counter written disinformation on social media, development of deepfakes has matured and is easily accessible to the average internet user. Deepfakes are developed using the generative adversarial networks (GAN) AI technology, where algorithms are trained to replicate patterns such as the face or voice of a political figure.[157] Recent breakthroughs have made the creation of deepfakes as simple as text editing, whereby an algorithm matches the text to create a video or audio based on past video or audio samples.[158] Deepfakes have in

152 Matt Kapko, "How Social Networks Are Changing Mobile Advertising," CIO, August 20, 2014, https://www.cio.com/article/2475406/how-social-networks-are-changing-mobile-advertising.html; Mostafa M. El-Bermawy, "Your Filter Bubble Is Destroying Democracy," *Wired*, November 18, 2016, https://www.wired.com/2016/11/filter-bubble-destroying-democracy/.
153 Kapko, "How Social Networks Are Changing Mobile Advertising."
154 "AI, China, Russia, and the Global Order: Technological, Political, Global, and Creative Perspectives."
155 Jeff Stibel, "Fake News and Social Media: Confirmation Bias Puts Us in Echo Chambers," UsaToday, May 15, 2018, http://www.usatoday.com/story/money/columnist/2018/05/15/fake-news-social-media-confirmation-bias-echo-chambers/533857002/.
156 Villasenor, "Artificial Intelligence and Bias."
157 Karen Hao, "Inside the World of AI That Forges Beautiful Art and Terrifying Deepfakes," MIT Technology Review, accessed June 28, 2019, https://www.technologyreview.com/s/612501/inside-the-world-of-ai-that-forges-beautiful-art-and-terrifying-deepfakes/.
158 Stanford University, "Edit Video by Editing Text," Stanford News, June 5, 2019, https://news.stanford.edu/2019/06/05/edit-video-editing-text/; Emerging Technology from the arXiv, "Facebook's AI System Can Speak with Bill Gates's Voice," MIT Technology Review, accessed June 28, 2019, https://www.technologyreview.com/s/613647/facebooks-ai-system-can-speak-with-bill-gatess-voice/.

recent years been used in political contexts, in one instance by the Flemish Socialist Party's video campaign of a faked Donald Trump speech on climate change.[159] Deep fakes are therefore yet another tool to reinforce societal polarization and enable disinformation campaigns to be more impactful, as visual content has a higher tendency to go 'viral' on social media platforms and as a result, capable of reaching wider audiences. Moreover, the ease of access of deepfakes on the internet and the offerings of deepfakes-as-a-service presents them as a powerful tool for non-state actors that are seeking to generate the greatest impact at the lowest possible cost. As such, deepfakes are an example of AI shifting the balance of power, particularly between state and non-state actors.

Collectively, AI technologies are bolstering the socio-political projections by illiberal regimes, by propagating their rhetoric more effectively, both domestically and abroad. China and its western Xinjiang province in particular have been testing grounds for AI-enforced governance models. This has attracted interest from numerous countries seeking to establish population control methods in fear of increased social mobilization and popular revolutions. The likely result is the continued splintering of the internet along governance models and further isolation of authoritarian regimes, highlighted by China's online censorship and Russia's continued efforts to develop the ability to disconnect itself from the global internet.[160] Meanwhile, AI is increasingly leveraged to fortify digital echo chambers and provide disinformation campaigns with more tools to stifle debate on controversial issues in liberal democracies. The complacency of Western big tech firms in both selling technology to authoritarian regimes with limited due diligence and in removing disinformation content from social media platforms has aggravated the issue further.[161] Finally, as liberal democracies seek to resist and/or counter disinformation and challenge authoritarian narratives, they themselves risk weakening own principles in competition with less-morally oriented counterparts. The erosion of basic human rights is therefore a risk in liberal democracies too, where recent legislative action, such as the EU's GDPR has sought to constrain the capabilities of the big tech in collection of consumer data.

2.2.2 Opportunities

AI-driven functions are already contributing to various aspects of societal functions and **improvements in the quality of life**. Demographic trends and projections across

159 Hans von der Burchard, "Belgian Socialist Party Circulates 'Deep Fake' Donald Trump Video," POLITICO, May 21, 2018, https://www.politico.eu/article/spa-donald-trump-belgium-paris-climate-agreement-belgian-socialist-party-circulates-deep-fake-trump-video/.

160 Charlotte Jee, "Russia Wants to Cut Itself off from the Global Internet. Here's What That Really Means.," MIT Technology Review, accessed June 28, 2019, https://www.technologyreview.com/s/613138/russia-wants-to-cut-itself-off-from-the-global-internet-heres-what-that-really-means/.

161 Dan Sabbagh, "Mark Zuckerberg Has 'No Plans' to Go to UK to Give Evidence to MPs," *The Guardian*, May 15, 2018, sec. Technology, https://www.theguardian.com/technology/2018/may/15/mark-zuckerberg-facebook-plans-uk-evidence-mps-parliament.

the developed world are tending towards an increasing dependency ratio, where the number of dependents supported by working individuals will continue to rise, in part due to the rapidly ageing population in some states. Shortages of caretakers and insufficient tax revenues in the future have prompted a search for alternatives, with robotics being one of the pursuits.[162] Japan has begun experimenting with robots to replace human nurses, as well as wearable devices to support elderly in care. In medicine, algorithms, are being trained to identify skin cancers from imagery and have achieved detection rates comparable to dermatologists. Similarly, algorithms developed to detect prostate cancer have already superseded a majority of pathologists, with correct positive rates of 70% and 61%, respectively.[163] As a result, AI will increasingly be able to assist doctors in clinical decision support in complicated or uncertain cases.

Beyond nursing and medicine, applications have been identified in legal processes, law enforcement and education. Automation of legal tasks, such as the use of NLP to process legal evidence, has been estimated to reduce the number of working hours for lawyers by 2.5% annually over the next 5 years and as a result, expedite legal proceedings.[164] In law enforcement, adoption of computer vision has enabled the use of facial recognition for the identification of suspects or wanted criminals, as well as for improving border security.[165] Meanwhile in education, NLP and machine learning algorithms are being developed to personalize teaching in schools and expand class sizes in higher education institutions.[166] With the help of AI, schools have the ability to introduce concepts such as 'adaptive learning' that help stimulate students and boost their academic performance, producing, as a result, more agile future generations. These technological advancements are enabling efficiency gains in delivery, expanding provision and improving the quality of social services.

Beside opportunities for basic societal functions, AI plays a role in **enhancing people's online experiences** and **augmenting social interactions**, by, for instance, prioritizing advertisements based on their online behavior, preferences and social (inter-)actions. Consequently, this results in the appearance of more relevant products to the individual. Another advantage offered by this process of personalization

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162 Mizuho Aoki, "Nursing Care Workers Hard to Find but in Demand in Aging Japan," *The Japan Times Online*, June 27, 2016, https://www.japantimes.co.jp/news/2016/06/27/reference/nursing-care-workers-hard-to-find-but-in-demand-in-aging-japan/.

163 Yoav Shoham et al., "Artificial Intelligence Index: 2018 Annual Report" (Stanford, CA: AI Index Steering Committee, Human-Centred AI Initiative, Stanford University, December 2018).

164 Jason Tashea, "Courts Are Using AI to Sentence Criminals. That Must Stop Now," *Wired*, April 17, 2017, https://www.wired.com/2017/04/courts-using-ai-sentence-criminals-must-stop-now/; Steve Lohr, "A.I. Is Doing Legal Work. But It Won't Replace Lawyers, Yet.," *The New York Times*, March 19, 2017, sec. Technology, https://www.nytimes.com/2017/03/19/technology/lawyers-artificial-intelligence.html.

165 Standing Committee on the One Hundred Year Study of Artificial Intelligence, "Artificial Intelligence and Life in 2030" (Stanford, CA: Stanford University, 2016), https://ai100.stanford.edu/sites/g/files/sbiybj9861/f/ai100report10032016fnl_singles.pdf.

166 Standing Committee on the One Hundred Year Study of Artificial Intelligence.

is that it enables users to connect with various other individuals that share the same ideals, interests or lifestyles, and access topics relevant to their interests. The ability to discover like-minded individuals and organize into groups using social media platforms fosters more collective action that can appear in the form of social movements based on certain beliefs or issues, as illustrated in movements such as *Fridays For Future.* As in other contexts, however, AI is a dual-use technology, meaning that while some algorithms drive collective action on pressing challenges such as climate change, others are fortifying digital echo-chambers of extreme political groups by directing individuals to more extreme content.

AI technologies are poised to transform the most basic social processes, from legal proceedings and law enforcement to medical care and education. While most are currently undergoing testing, the demonstrated potential is extensive. Machines are increasingly outperforming human counterparts in linear, but complex tasks, allowing the outsourcing of highly-specialized activities to AI and resulting in the improvement of service delivery. Meanwhile, internet users are set to experience enhanced digital environments, as collected user information is fueling classification algorithms to provide content they are likely more interested in. In turn, this opens wider opportunities for association and supports social movements.

2.3 Military-security

The military domain is often the early-adopter of nascent technologies, fueled by extensive funding and the pursuit to outperform adversaries. As such, the use-cases of AI technologies in the military are clearly identified, as the deployment of such technology possesses the ability to **reduce military as well as civilian casualties** and alter warfare as a whole. Moreover, AI presents an opportunity in **reduction of operational costs** and **operational efficiency gains**. On the other hand, the risks it presents are reflected in both combat settings and at the geopolitical level, where an arms race between leading AI-developing countries is gaining steam. The increasing permeation of AI in the military domain is leading to **fewer constraints on going to war**, with **friction breeding escalation**. The asymmetric nature of AI application is leading to **upsets in the military balance of power**, resulting in the possibility of **hyper war with the 'human-out-of-the-loop'**. A high-level overview of the threats and opportunities associated with AI's application within the military-security domain is provided in Figure 9 below.

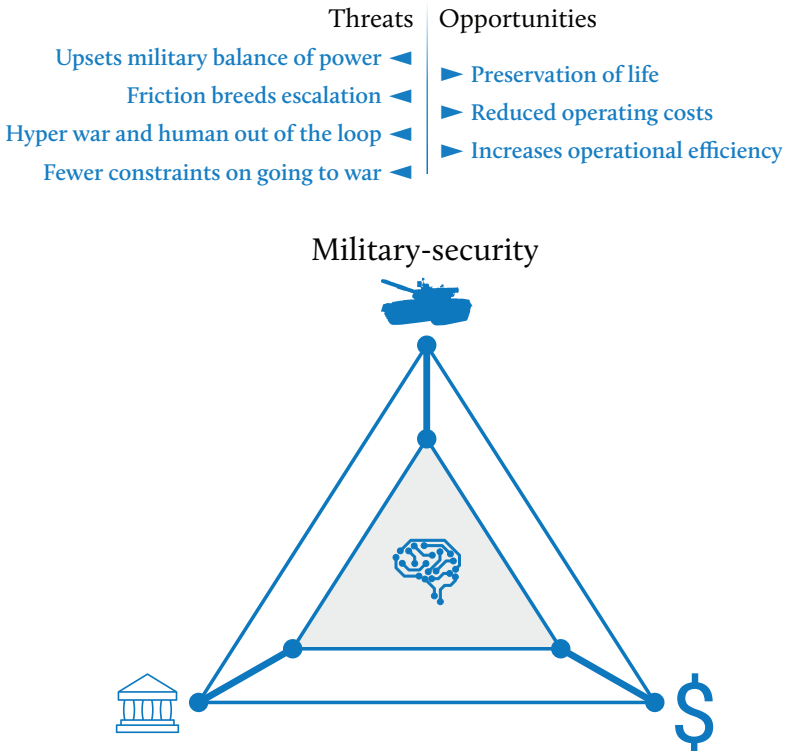

Figure 9: Military-security Threats and Opportunities of AI.

2.3.1 Threats

There are a number of threats associated with the inclusion of AI in existing military capability portfolios. The first is that new AI powered systems can **upset the existing military balance of power** by making traditional systems and doctrines obsolete. Development of AI has presented an alternative stream of competition, providing militarily stagnant countries with a new opportunity to re-enter the race. This has been the case with Russia and China, which, despite spending on military a fraction of what the US' does, have concentrated large proportions of the spending in AI research.[167] China's accelerated rate of AI development has positioned it to outpace the US, and considering the close proximity of Chinese enterprises with the Chinese state, the technological gains are highly likely to be transferred to the military. Moreover, there is a diffusion of power to non-state actors, that are able to utilize low-cost, widely available tools to sow discord. This can be carried out, among other

167 Christina LarsonFeb. 8, 2018, and 9:00 Am, "China's Massive Investment in Artificial Intelligence Has an Insidious Downside," Science | AAAS, February 7, 2018, https://www.sciencemag.org/news/2018/02/china-s-massive-investment-artificial-intelligence-has-insidious-downside; Gregory Allen Kania Elsa B., "China Is Using America's Own Plan to Dominate the Future of Artificial Intelligence," *Foreign Policy* (blog), accessed June 28, 2019, https://foreignpolicy.com/2017/09/08/china-is-using-americas-own-plan-to-dominate-the-future-of-artificial-intelligence/; Debby Wu, Henry Hoenig, and Hannah Dormido, "Who's Winning the Tech Cold War? A China vs. U.S. Scoreboard," accessed June 28, 2019, https://www.bloomberg.com/graphics/2019-us-china-who-is-winning-the-tech-war/.

ways, through the use of deepfakes in disinformation campaigns or the use of cheap unmanned drones to provoke or battle more sophisticated adversaries.[168]

Among the major contestants for AI-driven systems, **friction breeds escalation**. The US, Chinese and Russian governments' focus on exploiting AI-related technologies within the military highlights the security dilemma associated with not exploring these weapons.[169] The US and Chinese approaches differ markedly, with the Chinese military focusing more heavily on empowering algorithms to partake in strategic decision making, and the US military being geared almost solely to developing 'human-in-the-loop' systems. The asymmetry between these approaches incentivizes continued investment, as both strive to overcompensate for the activities of the other.[170] The upsetting of the military balance of power is associated with increased friction and escalation potential within the military-security domain, as countries like Russia and China attempt to challenge the status quo, while the US retrenches to maintain its military superiority.[171]

The large-scale advent of an AI arms race significantly increases the risk of a **hyperwar with the 'human-out-of-the-loop'**, as the pressures associated with 'winning' such an arms race may incentivize states to cut corners in pre-deployment testing and potentially declaring the technologies 'operational' prematurely. AI technology will expedite decision-making processes and make split decisions, resulting in narrower time frames for non-military crisis management in times of conflict escalation. Because autonomous ('human-out-of-the-loop') weaponry can operate independent of human oversight,[172] these systems can also escalate the pace of conflict operations to such a degree that human intelligence can no longer keep up, resulting in the advent of so-called 'hyperwars'.[173]

The role of AI in combat is profound, as the political costs of going to war decrease with the prospect of reduced human costs. Deployment of unmanned equipment reduces the loss of soldiers in combat, hence resulting in **fewer constraints on going to war**. The 2015 shootdown of a Russian fighter jet by the Turkish Air Force near the Turkey-Syria border resulted in a major diplomatic fall out between the two nations, including responses at the head-of-state level. Meanwhile, multiple takedowns of

168 "Human-Machine Teaming" (Ministry of Defence, United Kingdom, 2018), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/709359/20180517-concepts_uk_human_machine_teaming_jcn_1_18.pdf.

169 This is because AI weapons face states with a modern-day 'security dilemma'. See Matthijs M. Maas, "How Viable Is International Arms Control for Military Artificial Intelligence? Three Lessons from Nuclear Weapons," *Contemporary Security Policy*, February 6, 2019, 1–27, https://doi.org/10/gfz53m.

170 Pecotic, "Whoever Predicts the Future Will Win the AI Arms Race."

171 Larry Lewis and Anna Williams, "Impact Of Unmanned Systems To Escalation Dynamics" (CNA, n.d.), https://www.cna.org/CNA_files/PDF/Summary-Impact-of-Unmanned-Systems-to-Escalation-Dynamics.pdf.

172 Boulanin and Verbruggem, "Mapping the Development of Autonomy in Weapon Systems."

173 John Allen et al., "Future War NATO? From Hybrid War to Hyper War via Cyber War," GLOBSEC NATO Adaptation Initiative (GLOBSEC), accessed April 14, 2019, https://www.globsec.org/wp-content/uploads/2017/10/GNAI-Future-War-NATO-JLF-et-al.pdf.

Iranian drones in Syrian airspace by American forces since 2017 resulted in no more than a heated exchange between Russian and US military officials.[174] As a result, engagement against unmanned equipment reduces the threshold for adversaries to engage in combat. Moreover, in terms of upsetting the military balance of power, non-state actors are able to counter state actors more effectively. In 2017, the US army reported a US ally using a $3 million Patriot missile system to disable an enemy quadcopter, which happened to be an inexpensive commercially available drone.[175] This instance demonstrates the changing nature of combat with the introduction of AI-powered equipment, which empowers non-state actors and challenges traditional weapons systems and tactics. The issue is set to gain further prominence, as AI enables the development of 'swarm' combat tactics, whereby unmanned systems will be able to communicate with each other in combat.[176]

In summary, AI in the military domain, particularly when coupled with robotic systems, has the potential to unsettle the current military balance of power by enabling weaker state and non-state actors to challenge the status quo. The reducing role of humans 'in the loop' decreases the threshold of attack and breeds friction, as countries are more likely to test each other with no human cost involved. The expedited decision-making processes in instances of military friction risk further exacerbating the situation and leading to hyper wars. As a result, new or updated principles and arms control regimes will be necessary to constrain the military applications of the exponentially developing field of AI technologies.

2.3.2 Opportunities

Enhancing the safety of troops and the reduction of casualties in combat, both military and civilian, is considered to be one of the primary objectives for the adoption of AI in the military.[177] In fulfilling operational tasks, AI-related technologies also have the potential of directly contributing to reduced combatant attrition rates. This is presented by these technologies' ability to operate autonomously in hazardous and inaccessible areas, as well as carry out terrain analysis and automated target acquisition.[178] In high-risk environments, autonomous weapons systems can be deployed instead of soldiers, to reduce the risk of loss of life within own forces.

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174 Michael R. Gordon, "American Warplane Shoots Down Iranian-Made Drone Over Syria," *The New York Times*, June 20, 2017, sec. World, https://www.nytimes.com/2017/06/20/world/middleeast/american-warplane-shoots-down-iranian-made-drone-over-syria.html.

175 "Human-Machine Teaming."

176 "Human-Machine Teaming."

177 For an overview of many non-kinetic applications of AI, see De Spiegeleire, Maas, and Sweijs, "Artificial Intelligence and the Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers."

178 Michael C. Horowitz, "Artificial Intelligence, International Competition, and the Balance of Power," *Texas National Security Review* 1, no. 3 (May 15, 2018), https://doi.org/10.15781/T2639KP49; "Daksh Remotely Operated Vehicle (ROV)," *Army Technology* (blog), accessed July 15, 2019, https://www.army-technology.com/projects/remotely-operated-vehicle-rov-daksh/; U. S. Army Training and Doctrine Command and Army Capabilities Integration Center, *The U.S. Army Robotic and Autonomous Systems Strategy*, n.d.

The introduction of AI technologies, such as satellite image analysis, can be used to identify civilians and diminish accidental killing of non-combatants, particularly in air campaigns. Similarly, computer vision allows for the extraction and identification of 'objects of interest' from moving or still imagery. This is illustrated in the US Department of Defense's *Project Maven,* which has the ability to improve targeting of drone strikes, identify civilians and diminish accidental killing of innocent people.[179]

AI has the potential to be a transformative technology in generating **operational efficiency gains in the military**. AI applications are associated with a range of opportunities within tasks comprising intelligence, planning and mission support, as well as combat operations. AI can improve the quality and speed of military planning, analysis, forecasting and decision-making through the adoption of new technologies.[180] As a result, AI offers the prospect of the preservation of life as well as reduction in costs and increase in efficiency of operations. AI-enhanced functionality is especially useful in critical situations where human responses are cognitively insufficient, or when repetitive tasks – such as the monitoring of sensors – can be automated to allow humans to dedicate their time to higher level tasks.[181] Narrow application AI systems have the potential to oversee combat operations through the processing of large datasets to predict human action.[182] The speed at which AI systems can process information is particularly vital in the military-security domain as time-sensitive decisions present a critical challenge to successful military operations.[183] Furthermore, the deployment of AI technology in a military context can fundamentally change the character of warfare, resulting in a transformation from what the Chinese military has identified to be today's "informatized" ways of warfare to future "intelligized" warfare.[184] This will accelerate the cognitive speed in decision-making and thus improve situational awareness through means such as taking humans "out of the loop" in robotic and autonomous systems.

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179 Cheryl Pellerin, "Project Maven to Deploy Computer Algorithms to War Zone by Year's End," *U.S. Department of Defense*, July 21, 2017, sec. DoD News, Defense Media Activity, https://dod.defense.gov/News/Article/Article/1254719/project-maven-to-deploy-computer-algorithms-to-war-zone-by-years-end/.

180 Horowitz, "Artificial Intelligence, International Competition, and the Balance of Power."CEOs, and academics have suggested that a revolution in artificial intelligence is upon us. Are they right, and what will advances in artificial intelligence mean for international competition and the balance of power? This article evaluates how developments in artificial intelligence (AI

181 Such as a swarm attack of unmanned devices or an inbound hypersonic weapon. See Andrew Feickert et al., "U.S. Ground Forces Robotics and Autonomous Systems (RAS) and Artificial Intelligence (AI): Considerations for Congress," Informative report (Congressional Research Service, November 20, 2018), https://fas.org/sgp/crs/weapons/R45392.pdf.

182 Horowitz, "Artificial Intelligence, International Competition, and the Balance of Power."CEOs, and academics have suggested that a revolution in artificial intelligence is upon us. Are they right, and what will advances in artificial intelligence mean for international competition and the balance of power? This article evaluates how developments in artificial intelligence (AI

183 Feickert et al., "U.S. Ground Forces Robotics and Autonomous Systems (RAS) and Artificial Intelligence (AI): Considerations for Congress."

184 Elsa B. Kania, "数字化 – 网络化 – 智能化: China's Quest for an AI Revolution in Warfare," The Strategy Bridge, accessed June 28, 2019, https://thestrategybridge.org/the-bridge/2017/6/8/-chinas-quest-for-an-ai-revolution-in-warfare.

The use of AI in the military domain also proves to be economical, as it permits the **reduction of costs of defense and conducting military operations** as well as overall gains in the efficiency of combat tasks, such as equipment operation, target acquisition and electronic warfare. For instance, deployed defensive systems, similar to the Russian S-400 system and Israel's *Iron Dome*, are able to analyze data about the likely impact zone, use radar to track incoming short-range projectiles and fire interceptor missiles. In this fashion, the system stops incoming missiles or aircraft instantly, significantly faster than a human could react. Such systems not only contribute to more efficient military operations, but also reduce the costs thereof. An example is provided in swarms of autonomous, long-range, and low-cost kamikaze drones, which upon becoming available, are expected to reduce the relevance of aircraft carriers in conflicts of the future.[185] Moreover, cost reductions in air warfare will be driven by decreased cost of procurement of aircraft and piloting staff. In the US, the training of an aircraft pilot is estimated to cost $557,000, while training a drone pilot costs a mere $65,000.[186] The same applies to actual aircraft, although with unit costs varying depending on modification. The unit cost of a US MQ-9 Reaper unmanned aerial drone is $6.5 million, while the unit cost of the latest generation F-35 Strike Fighter is between $148-$337 million (depending on the modifications).[187] Given these elements and the changing nature of combat, since 2014, the US Air Force is training more drone pilots than fighter and bomber pilots combined.[188] Therefore, the cost saving opportunities presented by AI-driven systems are extensive, particularly when incorporating the cost of losing soldiers in battle or the cost of long term treatment for those injured in combat.

In conclusion, AI is transforming the dynamic of conflicts, by reducing both the political and material cost of combat, while enhancing operational abilities of military forces. This combination enables militaries to achieve their objectives at lower costs and in new formats, such as through human-machine teaming. As a result of this, AI is contributing to improvements the safety of soldiers and reducing civilian casualties in high-intensity situations.

185 Greg Allen and Taniel Chan, "Artificial Intelligence and National Security," *National Security*, 2017, 132.
186 "Dilbert at War," *The Economist*, June 23, 2014, https://www.economist.com/united-states/2014/06/23/dilbert-at-war.
187 Wayne McLean, "Drones Are Cheap, Soldiers Are Not: A Cost-Benefit Analysis of War," The Conversation, accessed June 28, 2019, http://theconversation.com/drones-are-cheap-soldiers-are-not-a-cost-benefit-analysis-of-war-27924; War Is Boring, "How Much Does an F-35 Actually Cost?," *War Is Boring* (blog), July 27, 2014, https://medium.com/war-is-boring/how-much-does-an-f-35-actually-cost-21f95d239398.
188 "Dilbert at War."

3. Policy Challenges

This section presents an overview of the policy challenges which are likely to derive from threats presented within the **economic**, **sociopolitical**, and **military** domains. The following (domain-specific) policy challenges are intended to facilitate policy debate regarding appropriate courses of action for mitigating the previously identified threats, and generally strive to identify potential toolkits for starting to do so within the next 5-10 years.

3.1 Economic

High-level threats identified within the economic domain are the **introduction of winner-takes-all dynamics**, the **rise of oligopolistic market structures**, the **emergence of AI 'haves' and 'have nots'**, **increases in the digital divide**, and **erosion of economic security**.

3.1.1 Introduction of winner-takes-all dynamics

1. ***How to provide sufficiently low barriers to entry for new AI-technology companies?***
   a) How to enable SMEs to gain access to data for AI-technology development?
   b) Should market leaders be compelled to open sections of the data they collect?
2. ***How to support other market players?***
   a) What is the role of government funding in supporting SMEs developing AI technology?
   b) Should governments prioritize sharing public data with SMEs over market leaders? (e.g. through government contracts)
   c) Should SMEs be supported in working with academic institutions cultivating AI research?

The mitigation of negative externalities associated with the **introduction of winner-takes-all dynamics** revolves around policies which are geared towards maintaining a healthy SME infrastructure and which, by extension, strive to circumvent the

emergence of oligopolies. In concrete terms, this can generally be achieved either by reducing the barriers of entry for these organizations, or by supporting their growth, with policy initiatives that combine elements of these two toolkits arguably constituting ideal approaches.

Within the context of the AI industry, the reduction of barriers to entry can predominantly be achieved through government facilitation of a.) technology transfer within the private sector, and b.) data transfer between private-sector actors. The transfer of AI technologies and data from market leaders to SMEs constitutes an aggressive approach towards 'normalizing' competition between private-sector actors and allows SMEs to develop and realize AI applications which they otherwise would not have been able to. It is important to note that depending on the nature of the implementation, such policy initiatives also have the potential of stifling innovation. One option would consist of an 'opt-in' knowledge transfer platform in which nonessential technologies and data are transferred, as opposed to the more draconian (state mandated) alternative. This is because technology transfers reduce the potential gains associated with investments into R&D activities,[189] meaning that such initiatives generally become less financially attractive (or even viable) from a private-sector perspective.

Outside of reducing barriers to entry for SMEs, Dutch policymakers can also circumvent the **emergence of winner-takes-all dynamics** through efforts to support their activities. Potential tools for supporting these organizations' activities present in the form of (among others) funding, the provision of government-sourced data, an option which potentially necessitates an improvement in the Netherlands' **strategic coherence** and the cultivation of partnerships between SMEs and relevant academic institutions. These options universally provide SMEs with resources, whether technology-, data-based or otherwise. This in turn allows them to better compete with larger private-sector actors. In doing so, they serve the purpose of circumventing the emergence of an oligopolistic market structure in which a limited number of companies not only operate (and have consolidated themselves) at the expense of potentially innovative SMEs, but in which the productivity of the Netherlands' AI ecosystem hinges almost entirely on the activities of a handful of companies.[190]

189 See Adam Mazurkiewicz and Beata Poteralska, "Technology Transfer Barriers and Challenges Faced by R&D Organisations," *Procedia Engineering*, 7th International Conference on Engineering, Project, and Production Management, 182 (January 1, 2017): 457–65, https://doi.org/10.1016/j.proeng.2017.03.134.

190 See Wen Chen, "Do Stronger Intellectual Property Rights Lead to More R&D-Intensive Imports?," *The Journal of International Trade & Economic Development* 26, no. 7 (October 3, 2017): 865–83, https://doi.org/10.1080/09638199.2017.1312493.

3.1.2 Rise of oligopolistic market structures

1. ***How to ensure that market leaders don't stifle competition?***
   a) What reforms are required to merger and acquisition policy for technological companies to address market leaders buying up smaller competing firms?
   b) Should mergers and acquisitions be reversed?
   c) How can the punching weight of existing antitrust regulations be increased, and how can enforcement rates thereof be increased?

The mitigation of threats associated with the **emergence of oligopolistic market structures** revolves almost entirely around measures geared towards inhibiting market leaders from taking active steps to stifle competition.[191] Depending on the legal framework in which they operate, large corporations' toolkit for stifling competition typically derives from a combination of 'hard' and 'soft' practices. Within the context of this typology, 'hard' practices encapsulate these companies' use of their financial means to either a.) buyout the competition,[192] or b.) eliminate it through legal attrition. 'Soft' practices encapsulate 'legally grey' antitrust practices such as those propagated by Apple and Google, whose curation of what apps are available in their respective app stores – as well as the order in which they are displayed to users – has previously been identified as a noncompetitive practice.[193]

The mitigation of these behaviors within the AI context does not differ markedly from the mitigation of similar behaviors within big tech as a whole, and centers around a more strategic review of mergers and acquisitions policy. This, most preferably, should include a review of past mergers and acquisitions at the SME level and upwards. To deter 'soft' practices – particularly those propagated by large companies that can afford to view fines as a 'cost of doing business' – the Netherlands and the EU would also be well-served in implementing more stringent antitrust regulations, and in enforcing them more actively.[194]

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191 For the purposes of this 'policy challenges' section, challenges associated with the emergence of oligopolistic market structures are conceptualized as being geared entirely towards the mitigation of the negative post-emergence effects thereof. Policy challenges associated with the circumvention of such a market structure's emergence are outlined in the previous section, under introduction of winner-takes-all dynamics. This division within the policy challenges section derives from the notion that – within the economic domain – winner-takes-all dynamics constitute a prerequisite for the emergence of oligopolistic market structures.

192 Apple purchases a new company every two to three weeks on average. See Sean Hollister, "Apple Buys Companies at the Same Rate You Buy Groceries," The Verge, May 6, 2019, https://www.theverge.com/2019/5/6/18531570/apple-company-purchases-startups-tim-cook-buy-rate.

193 See Russell Brandom, "How to Break up Facebook, Google, and Other Tech Giants," The Verge, September 5, 2018, https://www.theverge.com/2018/9/5/17805162/monopoly-antitrust-regulation-google-amazon-uber-facebook.

194 For an oligopolist like google, even a EUR 4.3bn fine can be written off as a 'cost of doing business.' See "Google Is Fined €4.3bn in the Biggest-Ever Antitrust Penalty," *The Economist*, July 21, 2018, https://www.economist.com/business/2018/07/21/google-is-fined-eu43bn-in-the-biggest-ever-antitrust-penalty.

3.1.3 Results in AI 'haves' and 'have nots'

1. ***What can the Netherlands to do bridge the gaps between AI 'haves' and 'have nots' at the individual level?***
   a) How can economic/labor policy support re-training for displaced workers?
   b) What amendments to existing labor laws would tackling labor displacement require? (e.g. expansion of workers' contract severance rights)
   c) Can taxation of capital, in this case AI and robotics, cover the cost of labor displacement/re-training?
   d) What educational reform is required to prepare young people for the future labor market?
2. ***What can the Netherlands do to bridge the gaps between AI 'haves' and 'have nots' in the private sector?***
   a) What actors are most likely to be left behind and how can public policy support these actors in the adoption of AI?
   b) What (type of) companies face the highest risk of rapid technological change? Can these companies be supported by the public sector?
3. ***What can the Netherlands do to bridge the gap between AI 'haves' and 'have nots' at the state level?***
   a) In what ways can Dutch (or European) trade policy be adjusted to minimize the impact of asymmetrical AI adoption rates at the state level?

Policies geared towards mitigating negative externalities associated with the emergence of **AI 'haves' and 'have nots'** universally relate to the emergence of a 'digital divide' between these groups.[195] Policy challenges present at the individual, company (private sector), and state levels, and respectively take the form of addressing labor displacement & ensuring (future) employment opportunities, equipping companies to weather rapid technological change, and reviewing trade policies to mitigate the exacerbation of inequality at the state level.

Starting with policy challenges regarding AI-related technologies' impact at the individual level, these are conceptualized as centering largely around the AI's impact

195 For the purposes of this 'policy challenges' section, challenges associated with the creation of **AI 'haves' and 'have nots'** are conceptualized as touching on the negative externalities associated with the (lack of) adoption of AI-related technologies at the individual, company and state levels. This clearly differentiates this section from the preceding two sections, which dealt with negative externalities associated with market-level asymmetries in the development of AI-related technologies. The company-specific policy challenges identified within this section are not geared towards market leaders and/or SMEs which engage in the development of this technology (these policy challenges are explored in the preceding two sections).

on labor markets, which is likely to require policies geared towards a.) addressing large-scale labor displacement, and b.) ensuring the employability of future generations. AI's contribution to labor displacement derives from the workplace automation it facilitates.[196] Such labor displacement can be tackled through a combination of policies which strive to provide re-training for displaced workers and by the amendment of existing labor laws. Re-training for displaced workers should ideally strive to equip them to work with computer code, meaning that crash courses in programming languages such as Python, R, or Ruby constitute non-omissible components of any such initiative.[197] Because companies implementing automation are – by definition – the 'haves' in this scenario, one implementation pathway for such an initiative presents in the expansion of existing labor laws to include workers with nonpermanent contracts. Equipping future generations with the skills necessary to be employable in an AI-saturated market likewise requires exposing them to programming languages, ideally through the restructuring of the existing education system.[198]

Policy challenges relating to AI technologies' exacerbation of inequality within the private sector derive largely from companies' inability or unwillingness to integrate AI into their workflows. Because AI technologies can generally be conceptualized as rendering early adopters relatively more competitive than nonadopters – and because large tech companies are increasingly applying these technologies within 'non-tech' markets (see for example Uber's push into the food delivery market with Uber eats) – widespread non-adoption risks the emergence of oligopolistic market structures.[199] This phenomenon's likely contribution to the eventual closure of a large number of businesses further has the potential of resulting in significant job loss, the retraining costs of which cannot easily be shifted onto wealthy private-sector actors. Addressing these policy challenges requires a.) the identification of companies and/or sectors which find themselves at particular risk of technological disruption in the short-to-

196 A recent report published by the McKinsey Global Institute estimates that 50 percent of current work activities are technically automatable through the adoption of currently demonstrated technologies. See McKinsey Global Institute, "Jobs Lost, Jobs Gained: Workforce Transitions in a Time of Automation" (McKinsey & Company, 2017), https://www.mckinsey.com/~/media/McKinsey/Featured%20Insights/Future%20of%20Organizations/What%20the%20future%20of%20work%20will%20mean%20for%20jobs%20skills%20and%20wages/MGI-Jobs-Lost-Jobs-Gained-Report-December-6-2017.ashx. See also PwC, "Will Robots Really Steal Our Jobs? An International Analysis of the Potential Long Term Impact of Automation" (PwC, 2017), https://www.pwc.com/hu/hu/kiadvanyok/assets/pdf/impact_of_automation_on_jobs.pdf.

197 Python is commonly cited as a useful language for building simple AI (ML) algorithms, and thus constitutes a useful basis for any displaced worker needing to better understand coding languages in general. See Milo Spencer-Harper, "How to Build a Simple Neural Network in 9 Lines of Python Code," *Medium* (blog), July 21, 2015, https://medium.com/technology-invention-and-more/how-to-build-a-simple-neural-network-in-9-lines-of-python-code-cc8f23647ca1.

198 This is a commonly cited policy recommendations, which some countries (notably China) have already taken aggressive steps towards implementing. See Elizabeth Mann, "The Role of AI in Education and the Changing US Workforce," *Brookings* (blog), October 18, 2018, https://www.brookings.edu/research/the-role-of-ai-in-education-and-the-changing-u-s-workforce/.

199 See Vankat Alturi et al., "Tech-Enabled Disruption of Products and Services: The New Battleground for Industrial Companies | McKinsey," McKinsey Digital, 2018, https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/tech-enabled-disruption-of-products-and-services.

medium term, and b.) the formulation (and implementation) of policy initiatives which aim to aid at-risk actors in the adoption of relevant AI technologies. Such a policy initiative should ideally be implemented by means of an 'intermediary' agency. These can include the Netherlands Enterprise Agency (RVO) or a subsidized private-sector agency which specializes in connecting technology suppliers to potential adopters.

At the state level, AI technologies exacerbate inequality because (non)adoption will serve to consolidate existing competitiveness structures. These policy challenges can be addressed through the revision of existing barriers to trade on the one hand, and through the reconsideration of existing foreign aid initiatives on the other. A clear example is evident in the Netherlands' policy for 'stabilizing' the Sahel region,[200] which places a strong emphasis on developing the region's agricultural capacity in the hopes that doing so will help to create employment opportunities for disenfranchised youth. In this particular example, the adoption of AI technologies within industrialized nations' is set to result in increases in crop yields which – barring the implementation of policies aimed at artificially increasing these goods' prices – are likely to translate into a further erosion of the Sahel-based farmers' ability to profit from selling their goods internationally.[201] Combined with trade barriers which prohibit the cheap import of these goods into the EU consumer market,[202] this means that AI technologies are set to play a role in keeping the Sahel agricultural sector underdeveloped, as well as in effectively rendering several aspects of the Netherlands' existing foreign aid policy ineffective.

3.1.4 Impacts economic security

1. ***International: How to protect Dutch and/or European innovation?***
   a) Should the EU assist European companies in competing against enterprises with heavy government support, such as Chinese state-owned enterprises? If so, how?
   b) How should the EU ensure reciprocity in access to digital markets abroad?
2. ***Domestic: How to protect Dutch and/or European innovation?***
   a) Should universities conducting research into AI receive a critical infrastructure designation?

200 "Wereldwijd Voor Een Veilig Nederland: Geïntegreerde Buitenland- En Veiligheidsstrategie 2018-2022" (Den Haag: Ministerie van Buitenlandse Zaken, 2018), https://www.rijksoverheid.nl/binaries/rijksoverheid/documenten/rapporten/2018/03/19/notitie-geintegreerde-buitenland--en-veiligheidsstrategie-gbvs/Notitie+GBVS.PDF; "Investeren in Perspectief: Goed Voor de Wereld, Goed Voor Nederland" (Den Haag: Ministerie van Buitenlandse Zaken, 2018), https://www.rijksoverheid.nl/documenten/beleidsnota-s/2018/05/18/pdf-beleidsnota-investeren-in-perspectie.

201 See Alina Tugend, "How A.I. Can Help Handle Severe Weather," *The New York Times*, May 20, 2019, sec. Climate, https://www.nytimes.com/2019/05/12/climate/artificial-intelligence-climate-change.html.

202 Kristin Palitza, "EU Food Exports Hinder African Agricultural Development," dpa International, accessed June 6, 2019, http://www.dpa-international.com/article/urn:newsml:dpa.com:20090101:170503-99-298260.

b) Should some foreign students be barred from attending universities engaged in AI research?
c) How can the EU support the practical application of academic research conducted within European institutions?

Within the geopolitical context, AI-related activities within the **economic** domain – not least as a result of AI technologies' dual-use nature, and the private sector's role in these technologies' development – raise a series of strategic dilemmas. The policy challenges presented within this section are almost universally geared towards drawing policymakers' attention to a.) the prevention of economic espionage and b.) to protecting Dutch and EU-based companies from predatory business practices abroad. Taken together, these challenges can widely be interpreted as being geared towards safeguarding the Netherlands' and the EU's ability to stay ahead on innovation. HCSS conceptualizes policy challenges relating to **economic security** as presenting at both the national and international levels, largely because the process of safeguarding Dutch and/or EU-based innovation outputs necessitates the implementation of policy initiatives at both of these levels.

At the international level, the safeguarding of Dutch and EU-based innovation outputs requires policymakers to consider methods for ensuring domestic firms' ability to compete globally. A topical challenge presents in the market distortions which derive from government support – often as a byproduct of high degrees of **strategic coherency** – for private-sector enterprises. While this practice does not result in dynamics which mirror those associated with the Asian Tigers' postwar growth,[203] government support can nonetheless improve private-sector innovation potential by reducing barriers to R&D investment and increasing data availability.[204] Such practices effectively render state-supported firms more capable of conducting large-scale R&D activities than their non-state-supported counterparts, and thus warrant a targeted response at the Dutch and/or EU levels. At the international level, Dutch and EU-based firms' innovation potential can also be hampered by policies which serve to restrict market and/or user data access.[205] HCSS generally advocates for a reciprocity-based approach to incentivizing foreign governments to provide Dutch and EU-based firms with market and data access – a company such as Huawei

203 This is because AI within the economic domain is not exported as a 'product' which (as a result of state support) is subject to direct large-scale 'dumping'. See Sanjaya Lall, *Learning from the Asian Tigers: Studies in Technology and Industrial Policy* (Springer, 1996).
204 Jessica Twentyman, "State Plays Vital Role in R&D Funding | Financial Times," Financial Times, 2017, https://www.ft.com/content/4c99afa0-6279-11e7-8814-0ac7eb84e5f1.
205 The EU's GDPR constitutes a prime example of the tradeoff between regulation and innovation in AI. See Eline Chivot and Daniel Castro, "The EU Needs to Reform the GDPR To Remain Competitive in the Algorithmic Economy," *Center for Data Innovation* (blog), May 13, 2019, https://www.datainnovation.org/2019/05/the-eu-needs-to-reform-the-gdpr-to-remain-competitive-in-the-algorithmic-economy/.

should not be allowed to collect user data within the EU which EU-based firms are not permitted to collect on the Chinese mainland.

At the domestic level, policy challenges relating to economic security relate almost entirely to a.) safeguarding the integrity of Dutch and EU-based innovation outputs, and b.) improving these innovation outputs' practical implementation. With regards the safeguarding the integrity of Dutch and EU-based innovation outputs, policymakers have access to a wide range of policy tools through which to curb 3rd parties' ability to benefit from economic espionage. Given the EU's high degree of university-based innovation potential – as well as students' well-documented role in innovation espionage at universities – any such initiative should feature the implementation of more stringent university acceptance procedures. There is a further need for implementation of a more national-security-oriented ('*espionage-proof*') foreign investment screening regime. The potential for unintended technology transfer derives from either a.) foreign ownership of Dutch and EU-based innovation capacity, or b.) foreign firms' physical proximity to Dutch and EU-based innovation outputs in campuses. The EU's high degree of university-based innovation potential means that universities are also likely to constitute pivotal actors within the context of any initiative to improve Netherlands' and the EU's ability to transpose innovation into practical AI applications. Previous research conducted by the European Commission indicates that major hurdles to ensuring the post-funding sustainability of research projects generally derive from these project outputs' lack of commercial applicability, as well as from a lack of long-term funding. As a result, tweaks to Netherlands and EU-based tendering processes – which should mandate the exploration of commercial sustainability as part of project work packages – as well as more transparent planning vis-à-vis project and R&D funding, are proposed as beneficial first steps to improving practical R&D uptake within the Netherlands and the EU.[206]

3.2 Sociopolitical

High-level threats identified within the sociopolitical domain are the **rise of AI-enforced governance models**, the **export of digital totalitarianism**, **societal polarization in liberal societies**, and increases in the stopping power of **foreign influence campaigns**. As a general rule, policy challenges presented within the sociopolitical domain can be viewed as requiring policymakers to consider the trade-offs between economic throughput, innovation, and sociopolitical wellbeing.

206 See "Innovation: How to Convert Research into Commercial Success Story?" (Brussels: European Commission, 2013), https://ec.europa.eu/research/industrial_technologies/pdf/how-to-convert-research-into-commercial-story_en.pdf.

3.2.1 Rise of AI-enforced governance models

1. ***How can the EU and the Netherlands position itself as the leader in responsible innovation?***
   a) What are the target audiences/countries/industries for this approach?
   b) What use cases and/or 'enabling' technologies should be targeted by norm formulation (and how?)?
   c) What international organization can be best leveraged for norm setting in use of AI technologies?

The mitigation of AI technologies' contribution to the consolidation of autocratic governance models constitutes a complex policy challenge.[207] This is due to the fact that AI integrates relatively organically into dictators' toolkits, with these tools simply facilitating the automation of pretexting processes and practices. As a result, policies geared towards leveraging international norms within the context of the mitigation of AI-enforced governance models should ideally focus on disincentivizing what is new – namely: these governance models' use and reliance on modern technology – rather than these governance models themselves. This is because authoritarian governance models – as well as the normative frameworks which rail against various aspects of their existence – are well established, while the algorithmic automation of these processes constitutes a development which has not previously been normatively scrutinized in a concrete fashion.

Because normative pressures can be exercised not only on states, but also on corporations and individuals, it pays to consider that – within the context of AI-related technologies, which are typically developed by private-sector actors – normative frameworks which target companies are likely to be more impactful than those targeting states. This phenomenon is exhibited partially in the EU's GDPR regulation, the implementation of which has modified corporate practices both within and without Europe.[208] The previously outlined case of the EU's GDPR – a European regulation which has succeeded in propagating the bloc's norms internationally – also raises questions relating to the optimal venue through which to impose norms at the international level. The reason is that it effectively makes an argument for – if only in the short-term – the circumvention of 'traditional' venues such as the U.N.

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207 The inhibition of dynamics relating to the **rise of AI-enforced governance models** centers almost entirely around norm-setting. Within the concept hierarchy adhered to in this report, policy challenges associated with the regulation of contributing technologies (though relevant to the rise of AI-enforced governance models) are addressed within the **export of digital totalitarianism** section. This is because this research team views the rise of AI-enforced governance models as a process which requires mitigation through preemption and/or deterrence, while the export of such governance models – an active process which only occurs once deterrence has failed – is viewed as constituting a process whose mitigation requires active measures.

208 Sarah Jeong, "Zuckerberg Says Facebook Will Extend European Data Protections Worldwide — Kind Of," The Verge, April 11, 2018, https://www.theverge.com/2018/4/11/17224492/zuckerberg-facebook-congress-gdpr-data-protection.

3.2.2 Export of digital totalitarianism

1. ***How to limit international corporations from complicity in supporting digital totalitarianism?***
   a) How can AI technologies, especially those developed by European companies, be restricted from reinforcing digital totalitarianism regimes?
   b) Can limitations on the use of AI technology be implemented?
2. ***How can governments be discouraged from pursuing and importing digital totalitarianism?***
   a) What measures can be taken to build resilience of governance structures to avoid susceptibility to totalitarian technologies?
   b) From the European perspective, what countries constitute 'strategically important' actors in which the implementation of such systems should be actively circumvented?
   c) What are some of the attraction mechanisms for pivot states to discourage the pursuit and acquisition of digital governance models?
   d) What technologies, advice, and/or incentives can the EU offer towards the goal of 'neutralizing' these technologies' sociopolitical impacts?

The mitigation of state engagement in the export of digital totalitarianism is conceptualized as requiring a two-pronged approach which a.) provides private sector actors with incentives to limit the export of contributing technologies, and b.) provides importing states with incentives not to engage in the import of the aforementioned technologies with the goal of realizing use cases relating to civil control mechanisms.

With regards to initiatives aiming to curb the export of digital totalitarianism by means of measures which target private-sector actors, these are almost universally geared towards limiting importing states' access to key 'enabling' technologies. Within the context of this study, 'enabling' technologies can generally be conceptualized as 'low tech' data collection and processing technologies (security cameras, processor chips, etc.) which are not inherently totalitarianism oriented, but which must be regarded as facilitators thereof within the current geopolitical context.[209] Policymakers at the Dutch and EU levels have several tools at their disposal through which to limit domestic industry's complicity in the spread of digital totalitarianism, the most important of which presents in the implementation of targeted export controls. Such an export control regime should ideally be based on a thorough review of EU

209 See Jennifer Kite-Powell, "Making Facial Recognition Smarter With Artificial Intelligence," Forbes, 2018, https://www.forbes.com/sites/jenniferhicks/2018/09/30/making-facial-recognition-smarter-with-artificial-intelligence/.

manufacturers' contributions (both current and past) to supply chains which are of relevance to the export of said technologies for 'digital totalitarianism'-related purposes. The Netherlands and the EU can also reduce domestic industry's incentives for developing such technologies by banning specific use cases on the home front.[210]

At the state level, Dutch and EU policymakers preside over a relatively less straightforward toolkit for curbing the export of digital authoritarianism. The most realistic options are either a.) the active provision of technologies, advice, and incentives aimed at combatting the attractiveness of digital totalitarian practices to national governments and/or local CSOs; or b.) the proactive engagement in resilience-building intended to ween governments off engaging in such activities at the state level. While proactive measures largely mirror those currently propagated through projects within the framework of the European Neighborhood policy, the pursuit of measures leveraging technologies, advice, or incentive provision can generally be conceptualized as constituting a policy option which is 'unique' to the circumvention of digital totalitarianism. This is because proactive measures are geared largely towards addressing state tendencies to engage in nondemocratic behaviors, while active measures – such as those previously outlined – can be geared specifically towards addressing the case-specific symptoms which derive therefrom. Unique to this policy toolkit is these options' ability to be implemented by means of intensive interaction with locally based CSOs, meaning that these can be manifested in the form of bottom-up initiatives. HCSS submits that any policy should be applied on the basis of a well-reasoned analysis of the Netherlands' / the EU's strategic interest in potential countries, with the previously identified **pivot states** – or countries within the European Neighborhood – constituting potential framework guidelines.

3.2.3 Societal polarization in liberal societies

1. ***How can society be better positioned to cope with the influence of digital technologies on social polarization?***
   a) What type of awareness-raising campaigns can contribute to the mitigation of societal polarization?
   b) What information can governments collect (demographics, viewership, etc.) can governments collect to help them zero-in on contributing factors?
   c) How can political processes (ad financing restrictions, etc.) be adjusted to mitigate the impacts of sensationalist rhetoric?

210 Such a policy would also serve to communicate a strong normative preference to industry actors, and thus ties in partially with points presented under the **rise of AI-enforced governance models** section.

2. ***What restrictions can be applied to social media and/or big tech companies that have the potential of promoting AI's contribution to societal polarization?***
   a) Should big tech companies be treated as media organizations?
   b) What does a targeted approach to adding disclaimers to sensationalist content look like?
   c) Should social media companies be forced to adapt different algorithmic decision-making processes based on user demographics?

AI's contribution to societal polarization derives from changes in the media landscape. The emergence of several forms of 'new media' facilitate the proliferation of sensationalist content and social media companies' exploitation of sophisticated user profiling results in the emergence of 'echo chambers.'[211] HCSS conceptualizes challenges vis-à-vis the successful mitigation of these phenomena is being contingent of a two-pronged approach which addresses societal interactions with AI-related technologies on the one hand, and private-sector use thereof on the other.[212]

Policy options aiming to mitigate AI technologies' impact on societal polarization through interaction with societal pathways are geared towards raising awareness vis-à-vis these technologies' effects. Policy options falling within this category present in a.) the implementation of education initiatives which are geared to either exposing subjects to alternate views, or to providing subjects with the knowledge necessary to spot sensationalist content, and b.) the introduction of restrictions vis-à-vis the nature, rhetoric, and placement venues of political ads. Because the polarization which characterizes AI technologies' impact within the sociopolitical domain can generally be understood as contributing to the formation of mentalities which are not susceptible to counternarratives, the validity of the notion that the dissemination of such content constitutes a sufficient measure merits reconsideration.[213] HCSS submits that the expansion of government efforts at identifying at-risk demographic groups represents a positive first step towards the development and implementation of tailored (targeted) education initiatives. At the societal level, AI's impact on societal

211 See Matthew A. Baum and Tim Groeling, "New Media and the Polarization of American Political Discourse," *Political Communication* 25, no. 4 (November 18, 2008): 345–65, https://doi.org/10.1080/10584600802426965.

212 The concept hierarchy separating this section from the following section – which concerns itself with foreign influence campaigns – derives from the fact that foreign influence campaigns (as was the case with, among others, Facebook's role in the 2016 U.S. election) often take advantage of the AI technologies that – even in the absence of foreign intervention – contribute to societal polarization. In keeping with this reality, this section presents policy challenges associated with AI's contribution to societal polarization 'as a whole,' while the following section outlines policy challenges which pertain to foreign influence campaigns specifically.

213 See Alessandro Bessi et al., "Science vs Conspiracy: Collective Narratives in the Age of Misinformation," *PloS One* 10, no. 2 (2015): e0118093, https://doi.org/10.1371/journal.pone.0118093. See also P. W. Singer and Emerson T. Brooking, *LikeWar: The Weaponization of Social Media* (Boston: Eamon Dolan/Houghton Mifflin Harcourt, 2018).

polarization can also be mitigated through the tightening of limitations on political ad placement on social media platforms.[214]

Policy challenges associated with initiatives to mitigate AI technologies' negative impact vis-à-vis societal polarization by means of interaction with private-sector actors are generally geared towards providing large tech companies with incentives to better govern their platforms. A previously discussed policy option presents in the designation of social media providers as media outlets.[215] This approach mirrors the EU's recently adopted Directive on Copyright in the Digital Single Market in terms of its incentive structure, and would – in making social media providers responsible for the content posted on their platforms – constitute an incentive structure for more aggressive self-curation on the part of large tech companies. Such an approach also addresses one of the most commonly cited concerns raised by tech companies – namely the removal of content risks imparting the impression of political bias and engagement in censorship – by 'outsourcing' responsibility to state regulators. Outside of a 'blanket' ban on sensationalist content on social media, policymakers can also explore a range of 'halfway' measures. These include mandating the implementation of a system which identifies and labels sensationalist and fake content, and – where relevant – the implementation of algorithms which reduce the intensity of the previously identified 'echo chamber' effect depending on the user's demographics.

3.2.4 Foreign influence campaigns

1. ***How does the EU/Netherlands prepare for the possibility of AI-driven disinformation content, such as altered video content (deep-fakes)?***
   a) How to limit the circulation of false content, both in regulatory and in practical terms?
   b) How to identify foreign influence campaigns more effectively?
   c) Can AI technologies aid in this pursuit (e.g. tracking and identifying malicious content)?

Policy challenges associated with mitigating AI technologies' role in foreign influence campaigns are conceptualized as centered around addressing problems relating to foreign influencers' use of these technologies to generate sensationalist and

214 For an overview of the concept of 'new media,' see Lev Manovich, *The Language of New Media* (MIT Press, 2001).
215 For an introduction to the discussion surrounding the question of whether social media company should be regulated like media outlets, see Catherine Buni, "Media, Company, Behemoth: What, Exactly, Is Facebook?," The Verge, November 16, 2016, https://www.theverge.com/2016/11/16/13655102/facebook-journalism-ethics-media-company-algorithm-tax.

oftentimes misleading content.[216] The most pressing policy challenge in this regard presents in the identification of methods in which AI technologies can be leveraged to counteract the dissemination of falsified content. The technology for identifying misleading content remains in its infancy. Although the identification of doctored photos and videos is relatively commonplace practice,[217] the identification of false 'narrative' content remains exceedingly challenging. This is only because narrative truth is challenging to falsify, but also because limiting user access to it falls within the ethically grey area between censorship and freedom of expression. Companies such as Facebook have previously sought to address this issue by implementing user interface elements which provide users with information regarding their news feed.[218]

The active mitigation of AI technologies' contribution to the effectiveness of foreign influence campaigns thus requires a.) the inception of a regulatory framework which limits the circulation of disinformation and b.) the inception of a technical and operational framework for identifying and flagging disinformation and politically motivated sensationalism. As previously outlined, the implementation of such a framework requires policymakers to thread a thin line between censorship and freedom of speech, and risks contributing to the formation of splinternets. Within this context, HCSS advocates for the implementation of legislation which a.) aims to increase media transparency by mandating the declaration of foreign finance streams, and b.) mandates social media platforms to flag sensationalist content for further analysis in instances where IP data suggests it originates from outside the national borders. This combination of policy initiatives represents an important first step – systematizing the automated identification of externally-generated content – in separating content generated by foreign influence campaigns from content generated as part of domestic discourses. In doing so, it reduces policymaker exposure to the politically toxic debate by generating a framework which provides clear grounds for content removal. Subsequent enforcement options (how should social media providers apply such a framework? etc.) constitute judgement calls which requires further reflection.

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216 AI-related technologies' contribution to the effectiveness of foreign influence campaigns derives from its contribution to societal polarization. As a result, many of the policy challenges outlined within the preceding section contribute to the mitigation of these technologies' contribution(s) to foreign influence campaigns. Foreign influence campaigns are included as an individual policy challenge specifically because of this study's geopolitical scope.

217 This can be observed in practice in (among others) Facebook's informing users they are about to share fake content, as has most recently been showcased in its conduct surrounding a deepfake video depicting an inebriated Nancy Pelosi. See Makena Kelly, "Facebook Begins Telling Users Who Try to Share Distorted Nancy Pelosi Video That It's Fake," The Verge, May 25, 2019, https://www.theverge.com/2019/5/25/18639754/facebook-nancy-pelosi-video-fake-clip-distorted-deepfake.

218 Jon Porter, "Facebook's News Feed Is Starting to Explain Itself," The Verge, April 1, 2019, https://www.theverge.com/2019/4/1/18290195/facebooks-news-feed-why-am-i-seeing-this-post-ad-context-interaction.

3.3 Military-security

High-level threats identified within the military domain are present in these technologies' contribution to propagating **upsets in the military balance of power**, contributing to **friction which breeds escalation**, increasing the risk of **hyperwar as a result of human-out-of-the-loop** use cases, and the phenomenon of **fewer restraints on escalation**.

Unlike as is the case within the **economic** and **sociopolitical** domains, potential solutions to tackling the challenges associated with AI's impacts within the **military** domain have barely been formulated, let alone tested. As a result, there are significantly fewer 'best practices' to build upon. In concrete terms, this means that the policy challenges for the **military** domain differs slightly from those for the **economic** and **sociopolitical** domains in that the writeup for the **military** domain is more geared towards outlining key questions than it is to presenting potential (previously applied) solutions.

3.3.1 Upsets military balance of power

1. ***How to ensure military capability portfolio of NL armed forces remains competitive?***
   a) How to experiment and adopt AI in evolving force structure?
   b) How to deter adversaries with more advanced AI-supported capabilities?
   c) How to deal with leveling of the military playing field and low-tech AI applications exploited by non-state actors?

From the Netherlands' perspective there are several policy challenges associated with AI's potential contributions to consolidating or upsetting existing military power structures warrant attention. The first of these presents in the question of how to adopt AI into the Netherlands' evolving force structure. As Dutch allies are set to integrate AI-based technologies within their operational force structures in the near future, a Netherlands-based push to do so constates nothing more or less than an initiative to ensure the country's continued compatibility with and utility to these alliance structures. These technologies may also have deterrent value, though establishing an appropriate strategy for combining these two elements constitutes a policy challenge in-and-of itself. HCSS submits that the Netherlands', NATO's or the EU's formulation and adoption of a doctrine which clearly stipulates a.) the parameters under which an AI-enabled attack will be labelled as such, and b.) in concrete terms, the retaliatory measures with which it will be met, constitutes a key component of any such strategy.[219]

219 Such an approach constitutes a stark departure from the policies of 'deliberate ambiguity' employed by (among others) the Russian Federation. See "From Russia with Menace," *The Times*, April 2, 2015, https://www.thetimes.co.uk/article/from-russia-with-menace-ctz29fb08sj.

Given the fact that AI-related technologies are also set to become an increasingly utile tool for nonstate actors operating within the military domain, the Netherlands is also faced with the policy challenge of mitigating upsets in the military balance of power between state and nonstate actors. While nonstate actors are unlikely to succeed in the deployment of the complex, systems-of-systems-based weaponry and infrastructure which characterize state use of AI technologies within the **military** domain, they are likely to gain access to a range of low-tech solutions.[220] As these systems have the potential of significantly bolstering these actors' capacity to wage asymmetrical warfare, the successful mitigation of this policy challenge hinges on a two-pronged approach. Such an approach should ideally a.) deter and prevent nonstate actors from acquiring key technologies (by means of, as an example, limited export controls on consumer drones, smartphones, 3D printers, etc.), and b.) equipping military outposts in areas which commonly deal with asymmetrical warfare to successfully react to their eventual use.

3.3.2 Friction breeds escalation

1. ***How to prevent friction from leading to (inadvertent) escalation?***
   a) How to regulate the (immature) roll out of AI platforms on the battlefield?
   b) What is the role of AI in (nuclear) command and control systems?
2. ***How to create barriers to escalation?***
   a) How to keep the costs of going to war high (in moral, financial, political, etc. terms)?

Policy challenges associated with AI technologies' contribution to conflict escalation center around a.) preventing these technologies from leading to inadvertent escalation, and b.) bolstering existing barriers to escalation. With regards to policy challenges relating to instances of inadvertent escalation, the questions of how to regulate the rollout of (immature) AI platforms and of how to integrate these technologies within command and control systems.

The rollout of immature AI platforms increases the chance of inadvertent escalation largely because these systems may make decisions autonomously, which invites miscalculation. As with many policy challenges presented within this report, the ideal scenario for the mitigation of this phenomenon presents in a combination of

220 The destructive potential of these technologies derives from their combination with 'existing' technologies, such as small warheads and/or advanced manufacturing, which allow for the at-scale production of tools that facilitate asymmetric warfare. See Thomas X. Hammes, "Technology Converges; Non-State Actors Benefit," *Governance in an Emerging World* Winter Series, no. 319 (2019), https://www.hoover.org/research/technology-converges-non-state-actors-benefit.

preventative and reactive measures, the implementation of which is likely to feature an international component. Given the fact that state incentives to deploy immature systems derive almost entirely from the perceived need to compete in the (ongoing) AI arms race, preventative policy options present in some form of regulation thereof. While the phenomenon of an AI arms race is unlikely to subside, several of the root causes underlying the deployment of immature systems lend themselves well to international regulation. First among these presents in the adoption of a 'shared' definition and taxonomy of military AI applications, as such a framework constitutes a prerequisite for any meaningful regulation at the international level.[221] Once such a framework is in place, several policy options can serve to deter the premature deployment of AI-enabled military hardware. The concept of AI 'explainability' plays a central role in initiatives which aim to reactively mitigate negative externalities associated with the premature deployment of AI-enabled systems.[222] This is because – unlike in instances where the actions of human operators result in unintended consequences – the genesis of 'miscalculations' on the part of AI-enabled systems can be clearly tracked and explained. As a result, the implementation of internationally shared 'explainability' standards within military AI has the potential of reducing the onset frequency of interstate miscommunications. A similar principle applies within the context of the discussion surrounding how to integrate AI technologies within command and control systems, where human oversight are likely to play a central role in averting scenarios in which the automation of command and control systems results in the manifestation of unintended outcomes.

Policy challenges associated with the need to bolster barriers to escalation derive from AI-related technologies' ability to 'replace' humans in the battlespace, which reduces troop attrition rates. The costs of escalating conflicts through the use of AI-enabled systems is further reduced by these systems' relative lack of explainability. This is because a lack of explainability facilitates the 'masking' of purposeful escalations behind the guise of 'systems malfunctions.' In this scenario, barriers to escalation are reduced by the fact that states may calculate – as a result of the dynamics surrounding inadvertent escalation – that they may be able to achieve strategic objectives by explaining escalations away as deriving from automated or faulty decision-making processes. While little can realistically be done to reduce the barriers to escalation from a political perspective, the deterrent value of many of today's existing tools can be expanded by means of their clearer linkage to conflict escalation involving AI-enabled systems. Simultaneously, the reductions in barriers to escalation which derive from a lack of system explainability can be mitigated by the introduction of the previously outlined 'explainability' standards in military AI.

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221 Sono Motoyama, "Inside the United Nations' Effort to Regulate Autonomous Killer Robots," The Verge, August 27, 2018, https://www.theverge.com/2018/8/27/17786080/united-nations-un-autonomous-killer-robots-regulation-conference.

222 AI explainability also plays a central role in DARPA's development initiatives. See David Gunning, "Explainable Artificial Intelligence," DARPA, 2018, https://www.darpa.mil/program/explainable-artificial-intelligence.

3.3.3 Hyperwar and human-out-of-the-loop

1. ***What processes need to be developed to ensure accountable AI-supported decision making?***
   a) How to design differentiated meaningful human control in a battlefield context, also vis-à-vis actors that take the human out of the loop?
   b) How to design the architecture of the next generation arms control regimes to regulate the production, deployment, and use of (semi-) autonomous weapon systems?
   c) How to 'AI-proof' existing arms control regimes?
   d) How to build coalitions of likeminded actors including partner countries, defense industry contractors and NGOs to develop norms and standards?

In addition to the previously explored challenges options, HCSS associates a variety of distinct policy challenges with the phenomenon of hyperwar and human-out-of-the-loop systems. These policy challenges gravitate away from these systems' potential to contribute to conflict escalation in the operational sense, and towards strategic and ethically-oriented questions relating to a.) how to integrate human control over these systems in meaningful (and strategically-minded) way, and b.) what arms control in an age of AI-enabled battlefield systems should look like.

With regards to the optimal format for the implementation of human control over AI-enabled systems, the formulation of a clear solution to these is complicated by the fact that it requires policymakers to weigh ethical concerns against strategic considerations. Because – assuming these systems 'behave' as intended in a battlefield setting – operational efficiency can generally be conceptualized as increasing as human control decreases,[223] states have a strong incentive to engage in 'races to the bottom' in which ethics are ceded for strategic considerations. Simultaneously, states which opt to fully cede human control over AI-enabled battlefield systems are likely to lose the legitimacy to contribute to the formulation of meaningful norms in this area. Given the EU's previously demonstrated 'niche' in acting as an AI norm-setter, HCSS advocates for the implementation of battlefield AI cases which either a.) are characterized by 'meaningful' human-in-the-loop decision-making processes, or b.) are characterized by human-out-of-the-loop decision-making processes, but for which the deployment parameters are clearly outlined in a national military doctrine. With regards to 'meaningful' human-in-the-loop decision-making processes, the

223 This is because a lower degree of human control allows systems to take decisions more quickly, the strategic benefit of which is that they can overwhelm opponents' ability to mount an organized defense. See Technology for Global Security, "AI and the Military: Forever Altering Strategic Stability," *Medium* (blog), February 14, 2019, https://medium.com/@Tech4GS/ai-and-the-military-forever-altering-strategic-stability-7471363bf9de.

middle ground between ethics and strategic robustness can be viewed in systems which incorporate explainability mechanisms, and which require human operators to 'greenlight' the use of kinetic force prior to its utilization. In this scenario, a wide range of AI's military opportunities – including the automation of logistics-related communication, asset positioning, etc. – can be realized, but situations in which states empower machines to pull the trigger on their own initiative are avoided. The implementation of an ethically-robust human-out-of-the-loop system constitutes a more complex task, and hinges almost entirely on the posturing which surrounds the implementation of such a capability. Within the context of this policy challenge, this requires the formulation and adoption of a doctrine which clearly stipulates a.) the parameters under which an AI-enabled attack will be labelled as such, and b.) in concrete terms, the retaliatory measures with which it will be met, constitutes a key component of any such strategy.

Policy challenges relating to arms control in an age of AI-related battlefield systems center around the questions of a.) how best to regulate the production, deployment, and use of these systems, and b.) how to maintain the integrity of existing AI regimes. The question of how to regulate the production, deployment, and use of AI-enabled battlefield systems is one which is subject to discussion, with the main constraints on the adoption of a comprehensive framework presenting in nation states' persistent refusal to agree on a 'definition' of what constitutes an AWS, as well as active vetoing of potentially utile measures by several member of the UN Security Council. As a result, any policy initiative aiming to tackle the aforementioned challenge is likely to be contingent on the Netherlands' and the EU's ability to build a coalition of likeminded partners through which to pressure reluctant nation states to opt into measures designed to slow down the 'race to the bottom' which is currently unfolding. China – owing in no small part to its recognition of the fact that such a race to the bottom could lead to accidental war – should be actively considered as such a partner.[224] Keeping this in mind, any future Dutch and EU-published 'China strategy' documents should identify the regulation of AI military applications as areas of potential cooperation. The principle of successful coalition building also applies to the policy challenge of 'AI-proofing' existing arms control regimes. Within this policy challenge, treaties governing aspects of (nuclear) missile technology – such as the INF Treaty and the Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty) – are the most immediately in-need of attention, as these threaten to be nullified by the introduction of missiles which are able to autonomously avoid missile defense systems.

224 See James Vincent, "China Is Worried an AI Arms Race Could Lead to Accidental War," The Verge, February 6, 2019, https://www.theverge.com/2019/2/6/18213476/china-us-ai-arms-race-artificial-intelligence-automated-warfare-military-conflict.

4. Conclusions and Recommendations

As evidenced by the efforts undertaken by the countries included within this analysis, the race for AI is on. China, the European Union, Russia, and the United States are all actively pursuing the development of sophisticated AI-related technologies, with an assortment of economic, socio-political and military-security consequences. From automated production lines to networked drone swarms on to automated mass surveillance, the combination of ever-more-sophisticated sensory arrays, never-before-seen computing power, and coding know-how is driving paradigm shifts in the creation of wealth, the governance of polities, and the functioning of societies. The threats and opportunities stemming from these developments present a host of challenges to liberal democratic societies. AI related technologies' potential impact on national security, economic prosperity, and fundamental democratic values is profound, and renders it highly relevant to contemporary interstate competition in the economic, sociopolitical, and military-security domains. This is due to the technology's tendency to manifest winner-takes-all dynamics. Because states which succeed in strategically harnessing AI today can reasonably expect to derive relative benefits from doing so perpetually, state efforts at developing it can be understood as a 'first-past-the-post' race, the impacts of which active policymaker engagement.

Challenges identified within the economic domain are the introduction of **winner-takes-all dynamics**, the rise of **oligopolistic market structures**, the emergence of **AI 'haves' and 'have nots'**, and the **erosion of economic security**. The mitigation of negative externalities associated with the introduction of winner-takes-all dynamics revolves around policies which are geared towards maintaining a healthy SME infrastructure, which is facilitated by reducing these organizations' barriers to entry and by policies which actively support their ongoing activities. The mitigation of challenges associated with the emergence of oligopolistic market structures revolves almost entirely around measures geared towards inhibiting market leaders from taking active steps to stifle competition, the implementation of which is reliant on robust antitrust policies and by the active review of previews mergers and acquisitions. Policies geared towards mitigating negative externalities associated with the emergence of AI 'haves' and 'have nots' universally relate to the emergence of a 'digital divide' between groups at the individual, company, and state levels. These take the form of policies which address large-scale labor displacement (individual), government support of AI-laggards (company), and revision of foreign aid and trade policies (state). Challenges relating to economic security present at both the national (domestic) and

international levels, and can be mitigated through the introduction of policies which safeguard Dutch and European innovation outputs.

Challenges identified within the sociopolitical domain are the **rise of AI-enforced governance models**, the **export of digital totalitarianism**, **societal polarization in liberal societies**, and **increases in the stopping power of foreign influence campaigns**. AI-specific policy options for addressing the **rise of AI-enforced governance models** present in the adoption of regulations with normative international stopping power, such as the GDPR. Meanwhile, the circumvention of state efforts to export **digital totalitarianism** relies partially on the regulation of Dutch and EU export of key 'enabling' technologies, and partially on outreach efforts geared towards outlining alternative governance models. AI's contribution to **societal polarization** derives from changes in the media landscape, with the emergence of several forms of 'new media' facilitating the proliferation of sensationalist content. This phenomenon can be mitigated through the combination of policies which aim build understanding within vulnerable groups on the one hand, and to incentivize media providers to adequately filter and label content online on the other. Finally, mitigation strategies pertaining to the phenomenon of **foreign influence campaigns** revolve almost entirely around the adoption of policies which increase media transparency, and which facilitate the development of tools which automate the identification of doctored photos and disproportionately sensationalist text.

Challenges identified within the military-security domain present in these technologies' contribution to propagating **upsets in the military balance of power**, contributing to **friction which breeds escalation**, increasing the **risk of hyperwar** as a result of human-out-of-the-loop use cases, and the phenomenon of **fewer restraints on escalation**. Mitigating AI-related technologies' contribution to upsetting the military balance of power requires the Netherlands to integrate AI into its force structure on the one hand, and to be better equipped against asymmetric warfare. AI technologies' contribution to **conflict escalatio**n can be understood as a being a byproduct of state engagement in a 'race to the bottom,' and presents in the rollout of immature technologies. This phenomenon can be addressed by increasing **barriers to escalation** - an area in which international regulations governing systems explainability are of particular interest. AI's contribution to hyperwars presents in the erosion of existing arms control regimes and in an over-reliance on human-out-of-the-loop systems. Outside of reviewing existing arms control regimes, addressing this challenge requires the development of a differentiated (shared) understanding of autonomous systems at the international level on the one hand, and the adoption of standards vis-a-vis systems explainability on the other.

We offer five recommendations to inform the design and content of AI policies across the economic, sociopolitical, and military-security domains specifically targeted

at European policymakers in Brussels and in individual capitals, with the goal of safeguarding the bloc's ability to compete internationally going forward:

1. **Support small and medium e-tech companies**. When it comes to the development of AI-related applications, size is everything. This is because specific AI applications require the availability of use-case-specific big data, and because the innovation level of private-sector R&D efforts grows with entity and market size. The EU currently lacks an established e-tech market. This hamstrings the EU's ability to develop AI applications: not only is data not generated at a scale which is conducive to its development, the lack of entity scale also inhibits the development of sophisticated use cases. To realize AI's potential benefits, the EU and its member states will need to facilitate and/or incentivize the growth of e-tech companies that benefit from economies of scale. This can be partially implemented by promoting investment in start-ups as well as in scale-ups. Investing in scale-ups ensures the long-term sustainability of funding initiatives, and facilitates firms in consolidating themselves in their respective markets, thus allowing them to have access to larger pools of users, and to invest more heavily in AI-related R&D activities.

2. **Formulate balanced privacy standards**. This study clearly outlines the trade-offs between the unfettered generation of big data, individual-level privacy, and AI ecosystem competitiveness. This trade-off is particularly evident in the US and China, where the datafication of individuals' private lives is routinely incentivized with an eye towards facilitating the development of ever-more sophisticated AI solutions. While the EU is a leader in the use of industrial and technical data for algorithm development, it has found itself unable to compete with American companies in the harvesting and use of consumer data. With the implementation of the GDPR, the EU has taken a strong stance on this issue and has effectively signaled its belief that user privacy should come before all else. While this approach is beneficial from the perspective of avoiding the manifestation of negative externalities within the sociopolitical domain, the GDPR fails to strike a healthy balance between individual privacy and AI ecosystem competitiveness. Among others, the Regulation's insistence that companies explain how user data is utilized in AI applications has led companies to forego use of the technology altogether,[225] thus effectively exacerbating the negative dynamics outlined in the previous suggestion. Aspects of the recent EU-wide privacy regulations should be reformulated and/or reconsidered. While the EU is justified in pursuing policy which safeguards user privacy, provisions which serve to disincentivize commercial use of AI-related technologies altogether should be amended. Provisions such as the EU-US Privacy Shield also erode the bloc's economic security by rendering large

225 Eline Chivot, "One Year on, GDPR Needs a Reality Check | Financial Times," Financial Times, 2019, https://www.ft.com/content/26ee4f7c-982d-11e9-98b9-e38c177b152f.

(US-based) tech firms relatively more able to compete than their smaller (EU-based) rivals. Provisions relating to the anonymization of user data should be maintained.

3. **Facilitate academic sector R&D**. One of the foremost issues preventing the EU from playing a central role in international innovation vis-à-vis AI is in the relative underperformance of the bloc's academic sector in transferring knowledge to applications. Though EU-based researchers can generally be considered as being cutting edge, their productivity is oftentimes hamstrung by lack of long-term funding. Long-term funding allows for longer term development trajectories. Within the context of AI-related technologies, this means that long-term funding facilitates the development of more sophisticated algorithms and/or data harvesting initiatives, thus boosting the EU's capacity to implement **applied** research. EU procurement should pivot towards longer-term project funding. To improve the long-term impact of the technologies developed through such programs, the procurement process should feature project sustainability more centrally by requiring contractors to formulate viable business models and/or long-term sustainability strategies prior to receiving funding.

4. **Ensure shared understanding of AI among Member States**. In order to meaningfully shape forthcoming international regulations on AI related applications, EU Member States need a unified understanding of the continent's position on issues related to the technology, including, among others, individual privacy & data collection, and acceptable use cases on a domain-by-domain basis. In order to ensure Member State unity, the EU should push forward existing efforts falling within the purview of the Digital Single Market's Artificial Intelligence Policy, with the overarching goal of publishing a Member State-sponsored document which outlines a shared understanding of key AI-related policy issues. The existing High Level Expert Group on Artificial Intelligence (AI HLEG) constitutes a helpful starting point for such an effort. Publications such as the Ethics Guidelines for Trustworthy Artificial Intelligence serve as helpful examples of the type of documentation that should be developed and integrated into the European Commission's Coordinated Plan on Artificial Intelligence.

5. **Leverage the EU's economic weight in international norm-setting**. The EU's combined economic weight affords it considerable normative power internationally. This allows EU-based policymakers to 'diffuse' norms internationally through issue linkage. A prominent example of this presents in the GDPR, which links normative values vis-à-vis individual online privacy to economic incentives, thus forcing companies to enact wide-ranging reforms in order to access the EU market. While large companies such as Facebook or Google can realistically calculate that the financial gains of deploying region-specific

services (i.e. US users are offered different data options than EU users) outweigh the costs of developing such a system, the majority of service providers cannot realistically sustain such an arrangement. This forces these companies to choose between changing their international modus operandi to align with EU standards, or to be excluded from the EU market entirely – a prospect that, due to the EU's economic weight, is extremely unfavorable. The EU should more actively encode normative values in regulations which are tied to private-sector access to EU-based consumers. The GDPR constitutes a positive first step in this direction, but – provided a shared definition of AI is adopted at the EU level – such regulations could be employed much more strategically.

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