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CASS

CENTRE for AEROSPACE & SECURITY STUDIES

FOREWORD

The Centre for Aerospace & Security Studies (CASS) was established in November 2018 to serve as a thought leader in the realm of Aerospace and Security. It was envisioned as a think tank to enhance its outreach worldwide and provide independent and comprehensive insight and evidence-based research to policymakers in these areas.

Since its inception the Centre has been conducting activities/ events, both at the national and international level. Apart from these activities, there is a very strong focus at CASS on original, analytical and policy-driven research. For this, we have several publication Series like Issue Papers, Working Papers, Policy Briefs, and Analysis Reports produced by the research team. These have been well received in Pakistan and around the globe.

However, it was felt that since the nexus between aerospace and security issues remains very new for Pakistan, a highly specialised journal should be initiated for those young and budding scholars who are moving towards these areas.

Publication of the flagship *Journal of Aerospace & Security Studies* (JASS) is, hence, a major milestone by the Centre. The first volume is in your hand. In line with the vision and scope of the journal, every paper in this issue underwent a rigorous desk review and then an exhaustive subject-expert peer review process. This process has not only ensured that every paper is well-researched and analytical but also brings forth original ideas and policy prescriptions.

In this regard, Shaza Arif explores the military applications and potential risks of AI as well as Pakistan's progress in this field while Abdullah Rehman Butt, in his paper, looks at UAVs and their role in both the civil and military domains. Maheen Shafeeq moves towards the United States and analyses its defence modernisation

plans and strategies towards AWSs, JADC2, space militarisation, hypersonic vehicles and digital engineering and data architecture.

Apart from emerging technologies, the journal's Board also chose 'International Relations' and 'Political Economy' as secondary themes of focus. I was pleased to read Hassan Mujtaba's paper which offers a very original employment policy for the unemployed youth of Pakistan inspired by Spanish and Italian models. His proposal to create and promote community-based entrepreneurial firms or 'Worker Cooperatives, should be given serious consideration by relevant policymakers. When it comes to our region, one cannot ignore discussing Pakistan and India's conflictual relationship. However, Dr Zia Ul Haque Shamsi's paper proposes an interesting way of looking at this relationship from the lens of deterrence, which he has coined as 'Ready Deterrence'.

Without having a strong interest in reading books, no scholar/ researcher or academic can hope to progress far in his/her field. The latest books reviewed in this first volume of the *Journal of Aerospace & Security Studies*, written by stalwarts like Daniel Yergin, Alex Lubin, Ryan Hass, Craig Whitlock and Bernd Carsten Stahl, should be on everyone interested in AeroSec issues' reading list for the year.

I, commend the Editorial Board and Scholars for their endeavours and contributions to make the publication of the inaugural issue possible. I hope that the *Journal of Aerospace & Security Studies* finds significant readership and research contributions in the days and years ahead, both from Pakistan and abroad.

Air Marshal Farhat Hussain Khan, SI(M), SBt (Retd)

President CASS, Islamabad

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Military Applications of Artificial Intelligence: Impact on Warfare

Shaza Arif

Abstract

Artificial Intelligence (AI) has surfaced as a potent enabler that has penetrated all areas of human life. Given its profound efficiency and inspired by the postulates of realism, this dual-use enabler is now being integrated into the military sector at a fast pace by policymakers worldwide. The increasing autonomy and speed of decision-making associated with AI is bound to impact future warfare in novel ways. This paper examines the use of AI across various military domains, including Intelligence, Surveillance Reconnaissance (ISR), Command and Control (C2), Autonomous Weapon Systems (AWS) / Lethal Autonomous Weapon Systems (LAWS), cyber defence / offence, military planning, training, and logistics. It also explores the numerous opportunities and potential risks that AI can steer vis-a-vis warfare. Noting the dynamic nature of AI, the paper also discusses Pakistan's status in this field.

Keywords: Military, AI, Algorithms, Warfare.

Introduction

New technologies are swiftly making their way into the battlefield and have the potential to impact future warfare. Artificial Intelligence (AI) is one such emerging enabler which has extended its scope in diverse areas. Defining AI is quite difficult, and experts have not reached a consensus on any particular definition. An elementary way to explain it would be to programme machines in a way that their cognitive ability simulates human intelligence, enabling them to perform a variety of tasks. AI-enabled systems are capable of learning and predicting future scenarios through processing large amounts of data. The algorithms which process the given data act as analytical models to programme the systems in the most optimal way and learn from their experiences over time. This continuous learning allows better utilisation of the available information and execution of the most rationale decision/action according to the given context.[1] Hence, it is a technology which is forward-looking and increases efficiency in terms of performance of various tasks and decision-making as well.

The research on AI commenced in 1940[2] yet a notable burgeoning effect was witnessed after 2010 given the availability of more data, better machine learning and faster computer processing power. This technology has especially attracted military policymakers around the world. Russia's President Putin declared that 'Whoever leads in AI will rule the world'[3] akin to Alfred Thayer Mahan's assertion that whoever controls the waves will rule the world.

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1 Ziyad Muhammed, "Artificial Intelligence Definition, Ethics and Standards," (paper, The British University in Egypt, Cairo, 2019).

2 Keith D. Foote, "A Brief History of Artificial Intelligence," *Dataversity*, April 5, 2016, https://www.dataversity.net/brief-history-artificial-intelligence/.

3 David Meyer, "Vladimir Putin says Whoever Leads in Artificial Intelligence Will Rule the World," *Fortune*, September 4, 2017.

AI is being termed as the third revolution in military affairs followed by nuclear weapons and gun powder, respectively.[4] The blinding efficiency of this technology has now pushed major powers to employ it in the military sector. Currently, the United States of America (USA) and China are leading this race and are engaged in serious competition in this technology. Experts such as Elon Musk have repeatedly termed AI more dangerous than nuclear weapons and argued that states should avoid applying this unpredictable technology in weapons, stressing serious concerns over its lethal nature. However, defence forces are inclined to augment their strength with the aid of this technology.

The militarisation of AI is not entirely new yet with the passage of time, the level of human involvement in the latest weaponry is decreasing rapidly with machines becoming more autonomous and less reliant on humans.[5] AI is applicable in almost every military technology and experts are bent on gaining better funding in order to chalk out avenues and potential applications where it can strengthen the military domain.

As of now, around 20 countries have developed AI policies with prospects of more joining the race. AI is becoming a central element of modern warfare with the emergence of new applications and increasing level of sophistication.

Military Applications of AI

AI has emerged as a dual-use technology - applicable both in the civil and military sector. Militarisation of AI has widely been associated with Lethal Autonomous Weapon Systems (LAWS) -

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4 Samuel Gibbs, "Elon Musk leads 116 Experts calling for Outright ban of Killer Robots," *Guardian*, August 20, 2017, https://www.theguardian.com/technology/2017/aug/20/elon-musk-killer-robots-experts-outright-ban-lethal-autonomous-weapons-war.

5 Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York : W.W Norton, 2018), 11.

more often referred to as 'Killer Robots.' However, AI is applicable across a wide spectrum whereas LAWS constitute only one aspect of the applications of AI in armed forces.

AI is rapidly bringing changes to the battlefield at both the micro and macro levels. Not only can it aid soldiers in the battlefield, but it can also streamline war planning and logistics. It is important to understand that AI is not a technology in itself rather it is an enabler which will add to the capabilities of existing technologies to make them more efficient. Hence, its application can be three-fold: It can bring autonomy to various systems, generate new and advanced techniques involved in warfare, and interpret/ process available information for further action. [6] Some of the areas where AI can be employed in the armed forces are discussed in the following sections.

Intelligence, Surveillance and Reconnaissance (ISR)

ISR is one of the most important areas where AI can effectively and efficiently help the armed forces. The ability to collect data through drones and sensors can provide large amounts of important information to support a wide range of military activities. Moreover, militaries have to process large volumes of data for surveillance which requires considerable time and effort. Between 2001 and 2011, data gathered by drones increased by 1600 percent.[7] Machine processing algorithms integrated with computer vision can process large volumes of data in unexpectedly small time thereby discerning important threats and targets making surveillance tasks easier for defence forces. Due to bandwidth limitations, some of the data can be analysed on ISR platforms

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[6] Michael C. Horowitz, "Artificial Intelligence, International Competition and Balance of Power," *The Scholar* 1, no. 3 (2018): 41, https://repositories.lib.utexas.edu/bitstream/handle/2152/65638/TNSR-Vol-1-Iss-3_Horowitz.pdf?sequence=2&isAllowed=y.

[7] Thom Shanker, "In New Military, Data Overload Can Be Deadly", *New York Times*, January 16, 2011, https://www.nytimes.com/2011/01/17/technology/17brain.html.

deployed in the battlefield, while more sensitive data can be analysed at intelligence processing centres.

The data, which is now available in the form of information, is then used to derive the picture of what is happening on the battleground. It is then further used for decision-making at the military commander's end. Once the potential response is ready to be executed, the role of ISR once again comes into play. The AI-enabled sensors provide the commander with the location and other necessary details of their targets. In addition, the data regarding the presence of any threat is also relayed back to the commander to ensure operational success.[8] This way AI tremendously aids ISR in outmanoeuvring an adversary.

At present, differing data processing mechanisms and data synchronisation obstructs ideal communication between air and ground forces. Alternatively, AI-enabled software can process large amounts of data and categorise it according to the requirement of the recipient which would enable different units of military to receive the information without any delays.[9]

Machine learning systems can create normalcy patterns based on data which is trained overtime. These normalcy patterns take into consideration various factors, such as speed, direction, and movement of different weaponry stationed in sea, land, and air. Whenever a deviation is observed from the standard pattern, the behaviour can be detected and relayed for further action. Automatic Identification System (AIS), Fuzzy Adaptive Resonance Theory

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[8] Nishawn S. Smagh, *Intelligence Surveillance and Reconnaissance Design for Great Power Competition*, report (Washington, D.C.: Congressional Research Service, 2020), 15.

[9] Eaton Joshua, "An Emerging Capability: Military Applications of Artificial Intelligence and Machine Learning," *Small Wars Journal* (2019): 12, https://smallwarsjournal.com/jrnl/art/emerging-capability-military-applications-artificial-intelligence-and-machine-learning.

(ARTMAP) neural network, Gaussian Mixture Model (GMM), Kernel Density[10] are some of the systems which are autonomous and being used for surveillance in order to detect any suspicious activity. Hence, AI will expedite the process of sifting available data which allows it to get hold of information which is critical.[11]

Command and Control (C2)

Militaries around the world rely on C2 structures to operate smoothly. These refer to the exercise of authority and direction for the accomplishment of a given operation. By taking help of AI-enabled systems, these structures can meet their intermediate, mid-term and far-term needs.[12] Intermediate needs refer to data which is provided for a respective operation. Mid-term needs refer to the dynamic planning and coordination which is done by the AI systems. AI could also help C2 in meeting its far-term needs, i.e., centralised control with a decentralised execution.

Armed forces can employ AI in C2 to have better defence organisation. A Multi-Domain Command and Control (MDC2) is already being planned by the US forces.[13] Such systems aim to chalk out an integrated network where sea, land, air and space-

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[10] Peter Svenmarck, "Possibilities and Challenges for Artificial Intelligence in Military Applications," *Swedish Defence Research Agency* (2018): 3.

[11] Jack Corrigan, "Three-Star General Wants AI in Every New Weapon System," *Defence One*, November 3, 2017, https://www.defenseone.com/technology/2017/11/three-star-general-wants-artificial-intelligence-every-new-weapon-system/142239/.

[12] Matthew Walsh, Lance Menthe, Edward Geist, Eric Hastings, Joshua Kerrigan, Jasmin Leveille, Joshua Margolis, Nicholas Martin, and Brian P. Donnelly, *Exploring the Feasibility and Utility of Machine Learning-Assisted Command and Control: Volume 1, Findings and Recommendations*, report (Santa Monica: RAND Corporation, 2021), https://www.rand.org/pubs/research_reports/RRA263-1.

[13] Kelly M. Saylor, *Artificial Intelligence and National Security*, report (Washington, D.C.: Congressional Research Service, 2021).

based operations are centrally planned and well-integrated together. Currently, there are diverse platforms which provide the military leadership with the information which is critically assessed by the decision-makers for possible action.[14] For the future battlefield, a 'Common Operating Picture' is being envisioned which will act as single source of information providing a comprehensive picture of the events of the battlefield based on the information collected through different sensors, thereby enabling seamless integration. Although MDC2 is still in infancy yet the US Air Force is collaborating with a number of companies, including Lockheed Martin, in order to have this capacity for the purpose of which a series of war games were held in 2018 to further plan requirements in this regard.[15]

In the future, communication patterns will also benefit from AI-enabled programmes. AI can introduce alternate modes of sending information in scenarios where communication networks have been disrupted by the adversaries. Apart from sifting incoming information, AI algorithms are also capable of providing military commanders on the battlefield, several possible options for execution, taking into account real-time analysis of any given scenario. All these measures will streamline C2 for military commanders.

[14] Theresa Hitchens, "Air Force Expands 5G as it Transforms to Multi-Domain Ops: Donovan," *Breaking Defence*, September 4, 2019, https://breakingdefense.com/2019/09/air-force-expands-5g-as-it-transforms-to-multi-domain-opsdonovan/.

[15] Mark Pomerlau, "How Industry's Helping the US Air Force with Multi-Domain Command and Control," *Defence News,* September 25, 2017, https://www.defensenews.com/c2-comms/2017/09/25/industry-pitches-in-to-help-air-forcewith-multi-domain-command-and-control.

Autonomous Weapon Systems (AWS) / Lethal Autonomous Weapon Systems (LAWS)

Armed forces can incorporate AI in a wide range of their existing weapons such as aircraft, naval vessels, air-defence systems, tanks, and other military equipment. It can also be integrated into systems and software, such as radars in order to make them more efficient. Likewise, AI can also be employed in weaponry which can be used for supporting missions such as the 'Loyal Wingman' which is used for aircraft combat support missions.

On the other hand, AI is also a critical element in the development of LAWS, which are systems equipped with the capability to independently discern and engage their targets without any command from human beings.[16] There is a clear shift in warfare which is marked by its transition from automated weapons to autonomous weapons.[17]

It is important to differentiate between the concept of 'automation' and 'autonomy' to understand the applications and implication of AI. When military leaders assign a specific command to a machine, they delegate a certain amount of authority to that machine. If the level of authority is high, the system is autonomous.[18] AWS execute their decision based on reasoning, perception, and rationale, thereby, chalking out an optimal output. On the other hand, decision-making abilities of automated systems depend on pre-defined sets of inputs which do not have any cognitive capability, they execute what they are programmed to do which suggests that they have less authority in each mission/programme. The

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16 Ronald Arkin, "Lethal Autonomous Systems and the Plight of the Non-combatant," *AISB Quarterly* (2013): 1.

17 Ibid.

18 Forrest E. Morgan, Benjamin Boudreaux, Andrew J. Lohn, Mark Ashby, et al., *Military Applications of Artificial Intelligence: Ethical Concerns in an Uncertain World*, report (Santa Monica: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RR3139-1.html.

development of LAWS will gradually replace 'automation' with 'autonomy'.

Militaries aim to enhance their precision strikes through LAWS which can be deployed in various land, air , sea, and space-based platforms.The decision-making aspect of a LAW is highly debated. Technology experts have repeatedly emphasised that these 'killer robots' should not be given the autonomy of initiating an attack as they can precipitate undesirable results. However, major powers particularly, the US and China are all set to bring such systems into the battlefield.

Cyber Defence and Offence

The threat from cyber warfare is a persistent one and is likely to grow in the future. Protecting data from the malicious activities is crucial to protect the integrity and confidentiality of important information from potential attacks. Due to this, the vulnerability of computers and software is increasing since traditional methods of detecting cyber-attacks is not adequate to detect their evolving forms.

Militaries around the world are prone and subjected to attacks from their adversaries. Apart from the systems/data damage done through such attacks, the armed forces are also encountered with major attribution challenges. In order to deal with this issue, military policymakers are looking towards AI as it can be a major tool to avert such attacks noting that data, software and programmes protected with AI are relatively less prone to cyber-attacks. AI can record the pattern of cyber-attacks and through machine learning, it can find ways in order to develop measures to execute counter-strikes against those attacks in order to avert the exposure of important data. An Intrusion-Detection System (IDS) can effectively distinguish between normal data and intrusive data to avert the disruption of crucial data.

The most popular technique to detect intrusive data is the signature-based technique. This method employs AI to recognise

malware and cyber-attacks. Systems are fed with malware signatures (byte sequence of a code) of different known malwares.[19] This database uses the available signatures to identify a potential malware and prevent it from penetrating further into the system. While it is true that such methods are less effective against malwares which are new, there is considerable effort being done in this regard to train the systems in a manner that enables them to record patterns and use machine learning to identify new forms of malwares on their own.

Likewise, for some states, this might function as a robust tool to carry out offensive attacks in the cyber domain against their adversary noting that cyber is one of the avenues which is quite vulnerable. The success of the attack will depend on the defensive systems. It is likely that this might lead to a contest between AI-enabled offensive cyber-attacks versus AI-enabled defensive cyber-attacks. The side which will employ the 'enable' more smartly will prevail in such scenarios. Hence, both offensive and defensive capabilities of AI, in the cyber domain, are likely to be used by states.

Planning and Training

AI will be instrumental in providing military leadership, from an infantry soldier to the top general, the required planning and training. It can provide a better overview of how to plan missions effectively that improve accuracy, reduce manpower, expenditure, and most importantly, save the time that is invested when everything relies on human beings. Machine learning can play a paramount role in offering armed forces with more secure networks, making them less vulnerable. Likewise, militaries can also benefit from AI by forecasting component failure at an early stage. Cross-referencing and automatic co-relational analysis can

[19] Kirti Raj Bhatele, Harsh Shrivastava and Neha Kumari, "The Role of Artificial Intelligence in Cyber Security," in *Countering Cyber Attacks and Preserving the Integrity and Availability of Critical Systems* (Pennsylvania: IGI Global, 2019), 181.

assist in the detection of any faults and anomalies. Furthermore, threats can be detected via sensor data. Analysing all this data, decision-makers can come up with more pragmatic conclusions. Even though absolute delegation of planning will not be regulated by AI-enabled systems, they will provide soldiers the larger picture of the battlefield.

AI systems can also be utilised in the training of armed forces. Individual capabilities and learning styles can be considered, making the learning more personalised. They will also enable commanders to choose the best people for a given operation in a potential conflict. Machine learning systems can take into account various factors fed into the data sets and provide analytical models to military commanders to make decisions that will be beneficial for combat. Factors such as soldier's performance over time, his/her skills, personality traits, ability to work under pressure, strength and weaknesses can be drawn up against specific requirements of a mission.[20] Simultaneous analysis of all these factors could enable selection of the best officers for a given operation.

Moreover, AI, based on its cognitive capability, could also decide postings and promotions of officers using programmes which analyse an officer's capabilities, learning experiences and performance in order to come up with the most suitable posting. In this way, the capabilities of the armed forces will be best utilised with optimal stationing of the combatants.[21] In addition, it will also prevent the practice of bias in any of the above stated activities.

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[20] Matthijs Maas and Tim Swejs, "Artificial Intelligence and Future of Defense: Strategic Implications for Small and Medium-Sized Force Providers," (paper, The Hague Centre for Strategic Studies, Hague, 2017).

[21] Fabien Merz, "AI in Military Enabling Applications," *CSS Analysis* (2019): 2.

Inventory, such as simulators, is also being used to train military personnel during peace time. War-gaming techniques can be refined using AI as they can provide a wide range of options in a potential encounter with the adversary.[22] This will increase the effectiveness of such technology by providing soldiers with a better field experience in order to comprehend the best ways to utilise latest technologies in a potential conflict with an adversary. Virtual Reality (VR), coupled with AI and sophisticated algorithm, is envisioned to enhance the training of armed forces by a great magnitude.[23]

Logistics

Logistics is another area where AI has the potential to strengthen the capacities of the armed forces, e.g., air forces can benefit from AI-enabled systems by employing predictive aircraft maintenance tasks. This technology would enable regular maintenance of aircraft though predetermined schedules which would save waiting for making repairs after the aircraft has been impaired. The US has already established a 'predictive logistics' cell which has been assigned the task of coming up with intelligent calculations for maintenance of aircraft. AI will help to predict when a certain component may break.[24] This method is currently being employed by F-35's Autonomic Logistics Information System which takes real-time data from different components and directs it to a predictive algorithm and analyses when the operator needs to visit and replace any components of the aircraft.

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22 Elsa Kania, "Learning Without Fighting: New Developments in PLA Artificial Intelligence War-Gaming", *The Jamestown Foundation* 19, no. 9 (2019), https://jamestown.org/program/learning-without-fighting-new-developments-in-pla-artificial-intelligence-war-gaming/.

23 Ibid.

24 Marcus Weisgerber, "Defence Firms to Air Force: Want Your Planes' Data? Pay Up," *Defence One*, September 19, 2017, http://www.defenseone.com/technology/2017/09/military-planes-predictive-maintenance-technology/141133/.

In addition, AI-enabled systems can assist the armed forces to tackle big data. Big data comprises of information which is either too large to be stored on one computer's memory, is generated too quickly to be processed by one computer or is present in different formats making it difficult for human beings to process. Conversely, AI-enabled systems can store big data more efficiently.

Machine learning algorithms can also make use of available data to formulate smart budgeting solutions for the optimal allocation of resources and cost for nearly all military activities. Likewise, it can also help in military transportation making it easier to transport troops, armaments, and ammunition in military operations. Not only can it reduce the cost required in transportation but also lower the human operational efforts.[25]

Implications for the Battlefield

Despite the fact that militarisation of AI is still in its initial stages; its increasing efficiency and fast-evolving nature, which is subject to surprise and uncertainty, can have a number of implications for future warfare. The following section of the paper will focus on the potential benefits and risks which AI will steer along on the battlefield.

Benefits

Given the unprecedented efficiency of this technology, AI will offer a number of benefits in the military domain.

Time is a major one. Autonomous systems perform tasks much more quickly than human beings, and hence, enable operating systems to increase their pace manifold, thereby accelerating the speed of combat. They particularly assist the military in tasks that

[25] Kristofer J. Carlson, "The Military Application of Artificial Intelligence," *ResearchGate* (2019), https://www.researchgate.net/publication/335310524_THE_MILITARY_APPLICATION_OF_ARTIFICIAL_INTELLIGENCE.

require long duration and are beyond human endurance.[26] Also, their autonomous capability of identifying flaws in military equipment can save militaries from unexpected breakdown delays that might pose hurdles in a potential mission.

Military analysts have to spend considerable amount of time sifting huge amounts of data. AI can play a critical part in analysing this data with speed and relaying the most important elements back to military commanders for further evaluation. Data processed by AI can give a more detailed and accurate overview to commanders who are analysing complex environments. The Central Intelligence Agency (CIA) has more than 140 projects in which AI systems will be used to collect data for analysis and decision-making. Resultantly, AI's ability to attain, process and analyse data from different sources has the potential to have a notable impact on the quantity, quality and accuracy of the data which is available to military decision-makers.

The significant improvement in deep neural networks have led to notable efficiency in image recognition. Resultantly, AI can increase the accuracy of target recognition in combat as machine learning is able to learn, detect and identify targets based on the given information and battlefield situation. Improved image analysis can save valuable time and prioritise potential threats. This data can be relayed back to response teams for further action.

Despite the fact that the legal aspect of LAWS is widely debated on many forums, yet they have the potential to replace soldiers in dangerous combat and mitigate the loss of human lives. Moreover, with MDC2, commanders can execute decisions effectively while being considerably away from the battlefield. There is also the possibility of utilising AI for providing robotic assistance on the battlefield which will strengthen war-fighting capabilities of the armed forces without increasing manpower.

[26] Saylor, *Artificial Intelligence and National Security.*

Not only can AI enhance situational awareness, it also provides the best possible options regarding a given context to the military commander taking into consideration various factors such as environmental conditions, weather, probability-based assessment of enemy behaviour and existing capabilities. As an ICT, AI can communicate the intentions and motivations of adversaries making it effective as a peacekeeping tool between hostile adversaries. Moreover, AI can aid critical processes such as self-regulation, self-control and self-actuation of combat systems due to its unprecedented competency in autonomous decision-making and processing capabilities.[27] Consequently, its predictive and analysis capability can help military leaders make much more informed decisions. Likewise, it will have a notable impact on the dynamics of combat preparedness. In short, it will bring in more solutions with new approaches for militaries to cater diverse challenges.

Risks

As discussed in the previous sections, the promises of AI are convincing. It presents several opportunities for militaries to improve their defence and security functions. On the other hand, armed forces must also face the dilemma of integration of AI during various phases of development, deployment, and usage. In all the stages, potential challenges with regards to safety and escalation (contesting with the potential benefits) may be overlooked. The incentives of more efficiency, rapid processing rate and lesser human involvement might overwhelm the risks posed as security forces would want to avert lagging behind in this race and prevent their militaries from becoming more vulnerable to others. This pursuit for AI could trigger an arms race and disruptive proliferation

[27] Amit Gulhane, "Military Applications of Artificial Intelligence in 2018," *Market Research Blog,* October 3, 2018, https://blog.marketresearch.com/8-key-military-applications-for-artificial-intelligence-in-2018.

of this technology.[28] Future warfare will also be rendered more uncertain and ambiguous with LAWS making their way into battlefields.

Since the level of autonomy in warfare is increasing, it is likely that in the future, a major portion of decision-making may be done by machines themselves. In such scenarios, there are ethical concerns. For example, in a potential conflict scenario, systems may start exercising absolute control in choosing their targets, deciding the mode of action and the lethality of force. Stronger AI, with no human oversight, may lead to significant collateral damage. What happens if a system or a machine fails to interpret data correctly?[29] This is major moral dilemma for military as well as political leaders as it can inflict considerable harm.

There can also be circumstances that force human beings to make all-out efforts in order to opt for de-escalation in conflict. However, machines do not adhere to safety norms. Once a machine has made itself familiar with a particular goal, it will do everything deemed necessary to achieve it. This may lead to a situation where the goals of AI may not remain compatible with those of human beings resulting in unwanted escalation. Such escalation can precipitate a major conflict which is likely to have irreversible repercussions considering the disastrous nature of LAWS, thereby, making human efforts towards de-escalation and peace, futile.

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[28] Michael C. Horowitz, "The Promise and Peril of Military Applications of Artificial Intelligence," *Bulletin of the Atomic Scientists*, April 23, 2018, https://thebulletin.org/2018/04/the-promise-and-peril-of-military-applications-of-artificial-intelligence/#.

[29] Ross W. Bellaby, "Can AI Make Ethical Decisions?" *Criminal Justice Ethics* 40, no.2 (2021), https://www.tandfonline.com/doi/full/10.1080/0731129X.2021.1951459?scroll=top&needAccess=true.

Though experts have not been able to reach consensus on a definition of AI, yet they have been able to agree that it can be (and in most cases, is), lethal.

Nick Bostrom, a well-known technology expert has expressed grave concerns about the militarisation of AI by stating that integrating technologies such as AI into weapons is similar to children playing with bombs.[30] In 2018, Apple CEO Tim Cook and SpaceX CEO Elon Musk hosted a conference in which they asserted that there is a certain limit in which human beings can control AI. Once this threshold is crossed, humans will involuntarily lose power over it, followed by a situation in which they would not be controlling AI, rather it would be the other way around with AI making decisions on its own.[31] Hence, human beings would be unable to interpret the decision-making and executing process which would enhance the spectrum of uncertainty.

For countries like China and Russia, AI has surfaced as an opportunity where they can challenge the US' hegemony and military might which has remained uncontested for a very long period. Such inclination can force states to let go of moral and ethical considerations and grant more autonomy to AI-equipped weapons.[32] Grave concerns about integrating this technology in the armed forces can be well understood by evaluating the Cuban Missile Crisis (CMC), where one false alarm could have led to a nuclear catastrophe. Likewise, similar scenarios can spiral out into situation that can bring states to a potential war-time scenario. Similarly, a setting which involves multiple AI systems would further complicate an already tense situation as different AI systems

[30] Tim Adams, "Artificial Intelligence: 'We're Like Children Playing with a Bomb'", *Guardian*, June 12, 2016, https://www.theguardian.com/technology/2016/jun/12/nick-bostrom-artificial-intelligence-machine.

[31] Nick Bostrom, *Superintelligence: Paths, Dangers, Strategies* (London: University of Oxford, 2017).

[32] Ibid.

would be trained differently, and therefore, may arrive at different, conflicting conclusions and result in uncertain decision-making.

Furthermore, AI depends upon gathering data from different sensors which then interprets it. In the event that one or multiple sensors fail, the future trajectory of AI would remain highly ambiguous. The system could either crash completely, thereby tarnishing the credibility of AI or lead to fatal crisis which would roll out in a manner not taken account into by policymakers. Likewise, data can be deliberately tempered in order to force an adversary to take actions which can derail conflict management process.

The assertion that in the future, civilian casualties will be less as compared to now is not very convincing as there are chances that autonomous machines may do great damage. In a scenario where such systems are used in a conflict-stricken area or an area where the threshold of conflict is very low, damage can be significant.

Credence is a requirement of strategic stability whereas AI can also bring uncertainty and unpredictability to the battlefield. Resultantly, the sense of heightened efficiency can make the latter more prone to escalation. While it is true that high accuracy coupled with astounding precision is apt for the military purposes, yet AI-enabled systems may not be able to take into consideration contextual variation. Hence, increase in reliance on their directions means that more (rather than less) unpredictability would prevail.

Pakistan and Artificial Intelligence

Given the importance of AI, it is pertinent to discuss it in Pakistan's security context. It is evident that AI will become an integral part of future warfare. Already, numerous states are on their way to employing it in their militaries at a fast pace. The US, Russia and China have already made visible progress in this domain.

In South Asia, the Hindutva-inspired regime in India has always been keen to find opportunities to target Pakistan. This regime is also looking towards AI as a tool to revamp its aggressive designs.

In its Land Warfare Doctrine (2018), the importance of integrating AI in the armed forces was particularly emphasised. Developed by the Defence Research and Development Organisation (DRDO), the Centre for Artificial Intelligence and Computing (CAIR) is working on developing AWS for the Indian Armed Forces. Autonomous drones, autonomous tanks, and a Multi-Agent Robotic Framework (MARF)[33] are some of the initiatives which have already been completed or are near completion in India. Hence, these developments should be considered by Pakistan as well. The efficiency that is provided by AI can significantly improve the potential and capabilities of Pakistan's tri-services. But, to do so, the government needs to significantly invest in this technology. In this regard, both international cooperation and indigenous Research and Development (R&D) should be promoted in the country.

There are several universities which are offering degrees / courses related to AI in Pakistan. Air University, National University of Science and Technology (NUST) and National University of Computer and Emerging Sciences are some of the notable examples in this regard. Similarly, the Centre of Artificial Intelligence and Computing (CENTAIC) was inaugurated in August 2020 to promote R&D in both civil and military spheres. However, Pakistan still has a long way to go, and more attention is needed.

The government needs to work with friendly countries, particularly China, to make advancements in AI. Secondly, the curriculum taught in the institutions mentioned earlier needs to be compatible with international standards. Furthermore, universities should pay considerable attention to the practical applications of this technology.

[33] Shaza Arif "Militarization of Artificial Intelligence: Progress and Implications," in *Towards an International Political Economy of Artificial Intelligence* (London: Palgrave Macmillan, 2021), 230.

Conclusion

Artificial Intelligence (AI) is an enabler which has succeeded in making its way into the military domain. Over time, more states will resort to employing it for defence purposes. While its impacts on future battlefields are likely to be significant, states need to be wary of its potential risks as well, including rapid and catastrophic conflict escalation instead of de-escalation. Ultimately, the future of AI in the battlefield will primarily depend on how much autonomy, decision-makers are willing to grant such technologies.

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Evolving Role of UAVs: A Case of Pakistan

Abdullah Rehman Butt

Abstract

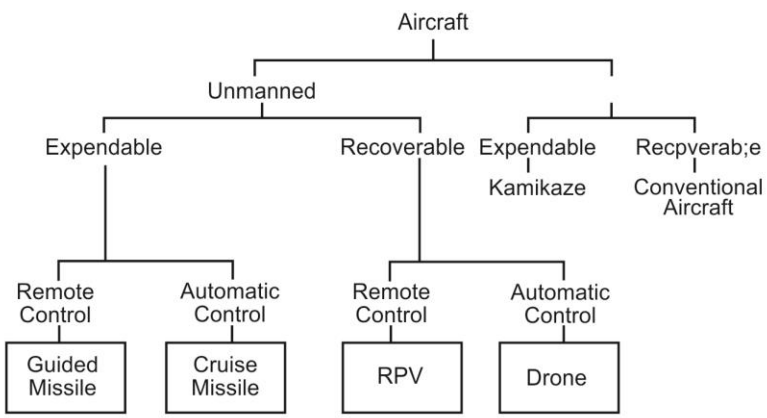
The use of Unmanned Aerial Vehicles (UAVs) has grown significantly in recent years. Because of their efficiency, precision, low cost, and lower risk, UAVs have seen rapid adoption in civil, commercial, and military sectors. The vast array of their applications, spanning from entertainment to national security, has prompted global technology giants and governments to invest in this field. Their role will continue to develop as technology advances and they are likely to become more effective, safer, and dependable in the future. In Pakistan, UAVs are being used in the civil and military domains. This paper aims to shed light on the evolving role of UAVs in both these domains, shed light on Pakistan's existing UAV capabilities and their applications, and suggest a way forward for the country to get maximum gains out of this technology in the future.

Keywords: Unmanned Aerial Vehicles, UAVs, Drones, Military, National Security.

Introduction

Unmanned Aerial Vehicles (UAVs) have evolved and impacted every facet of human life over the last few years. The revolution in this technology domain is not only changing the human perception of traditional real-time data collection, transportation, and logistics but also about how future wars will be fought. Owing to their evolving role and versatile applications, there exists no universally accepted definition of UAVs. Likewise, it is arduous to distinguish between various types because of their overlapping characteristics. However, the US Army Doctrine Reference Publication (ADRP) defines UAV as 'an aircraft that does not carry a human operator and is capable of flight with or without human remote control.'[1] However, UAVs are only one element of a large group of aerial platforms and vehicles. These are further divided into two categories as shown in Figure 1:

Figure 1: Manned and Unmanned Aircraft Family Tree



Source: Michael Armitage, *Unmanned Aircraft* (London: Brasseys, 1988).

[1] *ADP 1-02 Terms and Military Symbols*, report (Washington, D.C.: Headquarters Department of the Army, August 14, 2018), fas.org/irp/doddir/army/adp1_02.pdf.

Expendable unmanned aircraft include aerial vehicles that cannot be redeemed after their usage, e.g., cruise missiles. While others are recoverable, UAVs, that are further classified into two categories, i.e., drones and Remotely Piloted Vehicles (RPVs), cannot be. A drone can be best defined as 'an autonomous and automatic pilotless aircraft that carries at least a mechanism to sustain stable flight or its course will be programmed some way.' While an RPV can be described as 'a pilotless aircraft that transmits mission-related data to a remote controller and reacts to his command and inputs.'[2] The boundaries between the different types of UAVs are still ill-defined, because some have features of both the aforementioned categories and degree of autonomy sometimes also varies. In this paper, the term 'UAVs' will be used for recoverable Unmanned Aerial Vehicles.

Over the past few years, there has been a significant increase in the applications of UAVs. Because of their efficiency, accuracy, low cost, and lesser risk, their adoption rate has seen momentous growth in civil, commercial, and military domains. A report published by the Ohio University estimated in 2018 that there would be around 7 million UAVs active in the airspace system by 2020.[3] As per statistics released by the United States Federal Administration of Aviation (USFAA), 873,144 UAVs were registered (382,404 for commercial use and 490,740 for personal use) in the US alone for civil uses till January 2021.[4] The size of the global UAV

[2] Michael Armitage, *Unmanned Aircraft* (London: Brasseys, 1988).

[3] Ohio University, "The Benefits and Challenges of UAVs," Blog, February 3, 2020, https://onlinemasters.ohio.edu/blog/the-benefits-and-challenges-of-uavs/.

[4] Federal Aviation Administration, "Drones by the Numbers," United States Department of Transportation, Accessed June 11, 2021, https://www.faa.gov/uas/resources/by_the_numbers/.

market reached USD 25.9 billion in 2019 and is anticipated to cross USD 133.5 billion by 2026.[5]

The acquisition of UAVs by the armed forces for defence-related purposes, commercial usage including mapping, surveying, tracking, precision farming, product distribution, and industrial uses in aerospace, mining, telecommunication, and logistics are key drivers fuelling the growth of the global UAV market. Owing to this growth in the UAV market, many leading aerospace technology enterprises, including Boeing, Saab AB, Lockheed Martin, Elbit Systems, AeroVironment, and Textron, among others, have invested in the development and manufacturing of a diverse range of UAVs.

However, UAV manufacturing companies have been facing serious setbacks since the outbreak of COVID-19. The major portion of global supplies of the batteries, sensors, cameras, and other plastic parts of UAVs come from China. Because of the pandemic, the disruption in global supply chains has halted the exports of these essential parts, therefore, the production rate of UAVs has been adversely affected worldwide.[6]

Pakistan started its indigenous UAVs development programme back in the late '90s. Though the country has achieved significant milestones in the indigenous development of UAVs for military purposes, it has not been able to reap the benefits of this technology as other developing countries are reaping, especially on the commercial side. The aim of this paper is to shed light on the evolving role of UAVs in both civil and military domains, to review Pakistan's existing UAV capabilities and their applications, and to

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5 "Unmanned Aerial Vehicle (UAV) Market Size is Projected to Reach USD 133.5 Million by 2026 - Valuates Reports," *CISION Newswire*, July 20, 2020, https://www.prnewswire.com/in/news-releases/unmanned-aerial-vehicle-uav-market-size-is-projected-to-reach-usd-133-5-million-by-2026-valuates-reports-879169104.html.

6 "Unmanned Aerial Vehicle (UAV) Market Size is Projected to Reach USD 133.5 Million by 2026 - Valuates Reports," *CISION Newswire*.

suggest a way forward for the country to get maximum gains out of this technology in the future.

Evolving Role of UAVs

The history of UAVs is as old as the history of aviation itself. Due to technological advancements, availability, and low cost, the role and applications of UAVs have witnessed a significant expansion in both civil and military domains over the past few decades. Artificial Intelligence (AI), advance network connectivity and datalinks, next generation sensors, satellite-based GPS, increased compatibility of weapon systems with UAVs, and continuously improving airspace management systems are the key factors contributing to this evolution.[7] Experts, such as United States Air Force General James Michael Holmes (former head of Air Combat Command), are of the opinion that UAVs might take over all the roles traditionally performed by manned aircraft, in the future: 'UAVs could start replacing manned fighters in mid-2020.'[8] Although this foresight has a higher probability of becoming a reality in the future as today's technology allows UAVs to carry out the entire mission with no or little human interference, still UAV/unmanned aircraft technology would need a lot of time, human-like superior information processing speed, improved response algorithms, increased situational adaptability, and enhanced memory capacity

[7] Charles L. Barry and Elihu Zimet, "UCAVs-Technological, Policy, and Operational Challenges," *Defense Horizons 3* (National Defense University Press, October 1, 2001), https://ndupress.ndu.edu/Media/News/News-Article-View/Article/1215552/ucavs-technological-policy-and-operational-challenges/.

[8] Garrett Reim, "UAVs could Start Replacing Manned Fighters in Mid-2020s: USAF," *Flight Global*, February 28, 2020, https://www.flightglobal.com/military-uavs/uavs-could-start-replacing-manned-fighters-in-mid-2020s-usaf/136978.article.

to finally replace manned aircraft.[9] Following are some factors in support of UAVs in comparison with manned aircraft:

Low Production Cost

UAVs are much cheaper than manned aircraft in terms of their per-unit production cost. With the sophistication of technology, the per-unit cost of manned aerial platforms increases from one generation to the next. For instance, the cost of the F-4 Phantom in 1962 was around USD 6 million, while the cost of the F-15 was USD25 million in 1974.[10] On the other hand, UAVs provide much cheaper options to modern militaries.

Operational and In-Service Cost

Operational and maintenance costs of traditional manned aircraft are much higher than that of UAVs. These costs are not only growing with time but have also reached twice the per unit production cost. For instance, according to data by the US Department of Defense, per hour operational cost of the F-35A is USD 28,455.[11] Likewise, data by the USAF Tactical Air Command found that the cost of replenishment of spare parts of F-15A aircraft during its in-service life was USD 10.7 million, while the depot maintenance cost was USD 5.8 million, respectively.[12] On the other hand, the operational cost of MQ9 Reaper (Predator B) was USD

9 Office of the Secretary of Defense, *Unmanned Aircraft Systems (UAS) Roadmap, 2005-2030*, report (Virginia: Pentagon, August 4, 2005), https://fas.org/irp/program/collect/uav_roadmap2005.pdf.

10 Armitage, *Unmanned Aircraft*.

11 Niall McCarthy, "The Hourly Cost of Operating the U.S. Military's Fighter Fleet," *Forbes*, August 16, 2016, https://www.forbes.com/sites/niallmccarthy/2016/08/16/the-hourly-cost-of-operating-the-u-s-militarys-fighter-fleet-infographic/.

12 Armitage, *Unmanned Aircraft*, pp. 99-100.

3,234 per hour.[13] Moreover, the cost of the air crew of manned aircraft and the cost of their training are also important aspects in comparing the cost effectiveness of both systems.[14]

Deployability

With relatively lower cost, a greater range of movement, ability to fly on lower altitudes and in different directions, and with less risk involved in flying in adverse environments, UAVs are more readily and effectively deployable than traditional manned aircraft.[15]

Reconnaissance and Imaging

UAVs are better at taking high quality aerial images and real-time data in both peace and war times.[16]

Precision

Due to their size, speed, manoeuvrability, and application-oriented programming, UAVs equipped with modern navigation capabilities provide more precision in both civil and military applications.[17]

Civil Applications of UAVs

Civil applications of UAVs are categorised into personal, commercial, and government applications. For personal use, UAVs, specifically quadcopters (or quadrotors), are used for photography, videography, gaming, and other recreational purposes. A report by

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[13] Association for Unmanned Vehicle Systems International, "Are UAS More Cost Effective than Manned Flights?," October 24, 2013, https://www.auvsi.org/are-uas-more-cost-effective-manned-flights.

[14] Armitage, *Unmanned Aircraft*, p.100.

[15] Ohio University, "7 Pros & Cons of Drones and Unmanned Aerial Vehicles," Blog, May 11, 2021, https://onlinemasters.ohio.edu/blog/the-pros-and-cons-of-unmanned-aerial-vehicles-uavs/.

[16] Ibid.

[17] Ibid.

Philly by Air estimated that there were 1.32 million personal UAVs and 990,000 operators registered in the US alone at the end of 2019. *Insider Intelligence* had predicted that sales of personal drones would exceed USD 12 billion by the end of 2021,[18] and 'total global shipments to reach 2.4 million in 2023 – increasing at a 66.8 percent compound annual growth rate (CAGR).' This growth is expected in the agriculture, construction and mining, insurance, media and telecommunications, and law enforcement sectors.[19]

In the commercial domain, UAVs have become an essential part of the daily business functions of various industries. These include telecommunication, journalism and news coverage, aerospace, food delivery, inventory management, advertising, live entertainment, sports coverage, courier and shipments, film industry, and tourism. The drone services market size is expected to grow from USD 4.4 billion in 2018 to USD 63.6 billion by 2025.[20]

UAVs are also playing an important role in improving governance systems and sustainable development of nations around the world. Government agencies are using UAVs for urban planning, infrastructure development, mining, inspecting the energy sector, waste management, monitoring of maritime activities, weather forecasting, precision agriculture, disease control, pandemic

[18] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future," *Business Insider*, January 12, 2021, https://www.businessinsider.com/drone-technology-uses-applications.

[19] "Drone Market Outlook in 2022: Industry Growth Trends, Market Stats and Forecast," *Insider Intelligence*, April 15, 2022, https://www.insiderintelligence.com/insights/drone-industry-analysis-market-trends-growth-forecasts/.

[20] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future."

monitoring, healthcare, law enforcement, emergency response, humanitarian aid, and disaster relief.[21]

Military Applications of UAVs

In the military domain, early development of the concept of pilotless aircraft for military purposes is associated with the idea of the 'Flying Bomb' during World War I. However, unmanned aircraft were employed by the US Armed Forces during the Vietnam War to perform the traditional roles previously held by manned aerial platforms.[22] During that period, the US defence forces were reluctant to recognise and publicise the significance of unmanned aerial platforms because of cultural resistance within its Armed Forces. However, after successful demonstration of the utility and effectiveness of these platforms in the Yom Kippur War and Operation Desert Storm, the US started to invest in the development of UAVs openly and other modern militaries followed suit.[23] The use of Unmanned Combat Aerial Vehicles (UCAVs) and RPVs in military operations in Syria, Afghanistan, and in the Nagorno-Karabakh conflict has elucidated the significance of this technology in contemporary warfare. According to the Center for the Study of the Drone at Bard College, at least 95 states around the globe are operating military UAVs.[24] Another report predicted that the market

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[21] "How Drones Will Impact Society: From Fighting War to Forecasting Weather, UAVs Change Everything," *CB Insights Research*, January 9, 2020, https://www.cbinsights.com/research/drone-impact-society-uav/.

[22] Isaac Keister, "Technology and Strategy: The War in Vietnam," (Senior Thesis, Western Oregon University, Oregon, 2016), p. 33.

[23] Committee on Armed Services, *Intelligence Successes and Failures in Operations Desert Shield/Storm: Report of the Oversight and Investigations Subcommittee of the Committee on Armed Services, House of Representatives, One Hundred Third Congress, First Session*, report (Washington, D.C.: Senate CAS, 1993).

[24] "38 Ways Drones Will Impact Society: From Fighting War to Forecasting Weather, UAVs Change Everything," *CB Insights Research,*

size of military UAVs is estimated to reach USD 23.78 billion by the end of 2027.[25]

In contemporary times, both remotely piloted and autonomous UAVs (also called UCAVs) are being used for three kinds of broader roles in the military domain:

1. **Intelligence, Surveillance, and Reconnaissance (ISR):** In ISR role, UCAVs are employed in operational missions to collect and disseminate real-time data for target identification and battlefield awareness at both tactical as well as strategic levels by using high-resolution sensors, e.g., theatre ISR, portable ISR systems, and small unit ISR.
2. **Attack:** In the attack role, UCAVs engage a target with the payload they carry. Attack missions may include air-to-air and air-to-ground attacks, reactive or preemptive attacks, Suppression or Destruction of Enemy Air Defence (SEAD/DEAD), etc.
3. **Combat Support:** In combat support missions, UCAVs are used for jamming, electronic attacks, communication relay, delay, early warning, logistics, fire support to ground troops, and training purposes. [26]

Apart from above mentioned military roles, modern defence forces are developing networked, autonomous, all-weather, multirole, smaller but lethal Unmanned Aerial Systems (UAS) that will not only shape the future battlefield but will also change warfare. The

January 9, 2020, https://www.cbinsights.com/research/drone-impact-society-uav/.

[25] "Drone Technology Uses and Applications for Commercial, Industrial and Military Drones in 2021 and the Future."

[26] National Research Council, *Autonomous Vehicles in Support of Naval Operations* (Washington, D.C.: National Academies Press, 2005).

concepts of drone swarming, manned-unmanned mix, and 'Loyal Wingman' are the pertinent examples in this regard.[27]

Case of Pakistan

Pakistan has not been able to reap the full potential of UAV technology because of its cultural and economic predispositions, and lack of awareness and capacity. Civil applications of UAVs in Pakistan have been limited to journalism, surveying, and recreational use only. However, recently, this technology was effectively used by government institutions to fight against locust attacks in Punjab and Sindh provinces,[28] as well as by Law Enforcement Agencies (LEAs) for surveillance.[29] In the future, Pakistan can gain maximum benefits from this technology by its effective utilisation in agriculture, forestry, urban planning, mining, disaster management, border management, infrastructure development and monitoring, resource monitoring, and research and development sectors.

On the other hand, Pakistan has made adequate progress in indigenous development of UAVs and their application for military purposes. The efforts of the Pakistan Aeronautical Complex (PAC), Air Weapons Complex (AWC), National Engineering & Scientific Commission (NESCOM), Surveillance & Target Unmanned Aircrafts (SATUMA), and Global Industrial & Defence Solutions (GIDS) are

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27 Thomas McMullan, "How Swarming Drones Will Change Warfare," *BBC News*, March 16, 2019, https://www.bbc.com/news/technology-47555588.

28 Tasneem Ahmad, "Combating Desert Locust Plague: Drone Technology," *Frontier Post*, June 25, 2020.

29 Haroon Hayder, "Punjab Police to Use Drones to Crackdown Against Kite Flyers," *ProPakistani*, April 21, 2020, https://propakistani.pk/2020/04/21/punjab-police-to-use-drones-to-crackdown-against-kite-flyers/.

commendable in this regard.[30]The details of indigenously developed military UAVs in Pakistan are given in Table 1:

Table 1: Pakistan's Indigenously Developed Military UAVs

Name	Developer	Role	Year	Range
Burraq[31]	NESCOM, PAF	Reconnaissance, Strike	2014	1000 km
Jasoos II[32]	SATUMA	Reconnaissance, Training	2010	100 km
Shahpar[33]	GIDS	Surveillance	2020	250 km
Ababeel[34]	PAC	Strike	2014	140 km
Uqab[35]	GIDS, NESCOM	Reconnaissance	2011	150 km
Mukhbar[36]	SATUMA	Reconnaissance, Surveillance	2012	180 km

Source: Author's own.

[30] Syed Aseem Ul Islam, "Pakistan's UAV Development, Deployment, and Future," *Quwa*, July 5, 2020, https://quwa.org/2020/07/05/pakistans-uav-development-deployment-and-future-2/.

[31] Farhan Bokhari, "Pakistan to Deploy Its Own UAVs over FATA," *IHS Jane's Defence Weekly*, April 2, 2015, https://web.archive.org/web/20150402153944/http://www.pakviewz.com/pakistan-deploy-uavs-fata/.

[32] "Bravo+," SATUMA, Accessed February 9, 2021, http://satuma.com.pk/?portfolio=bravo.

[33] Aseem Ul Islam, "Pakistan's UAV Development, Deployment, and Future."

[34] "Ababeel. Specifications. A Photo," Avia.Pro, September 1, 2016, https://avia-pro.net/blog/ababeel-tehnicheskie-harakteristiki-foto.

[35] "Uqab-UAV System," Global Industrial & Defence Solutions, Accessed June 28, 2021, http://gids.com.pk/uqab-uav.

[36] "Mukhbar," SATUMA, Accessed June 28, 2021, http://satuma.com.pk/?portfolio=mukhbar.

Along with these indigenous military UAV capabilities, Pakistan has also been purchasing advanced UCAVs from China to meet its national security needs. Recently, China exported five multirole CH-4 UCAVs to Pakistan.[37] Moreover, Chinese aerospace company Chengdu Aircraft Industry and PAC Kamra are also collaborating to jointly produce 48 Wing Long UCAVs for the Pakistan Air Force.[38]

Way Forward for Pakistan

The evolving role of UAVs and a significant increase in their applications have posed some legal, regulatory, ethical, and airspace control challenges for Pakistan. The government has taken some important initiatives to promote as well as regulate the applications of UAVs. In December 2020, the Ministry of Science and Technology was directed to establish a committee to formulate a 'Drone Regulatory Act' to promote and regulate the manufacturing and applications of UAVs. A 'Drone Regulatory Authority'[39] will also be established to deal with registration, licensing, authorisation, and regulatory issues related to civil and commercial uses of UAVs. The government needs to expedite this legislation process to develop and boost Pakistan's UAV manufacturing services industry.[40]

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[37] Gabriel Dominguez, "Pakistan Receives Five CH-4 UAVs from China," *Janes.com*, January 27, 2021, https://www.janes.com/defence-news/news-detail/pakistan-receives-five-ch-4-uavs-from-china.

[38] Vidi Nene, "China and Pakistan to Jointly Produce 48 Wing Loong II Drones," Drone Below, October 11, 2018, https://dronebelow.com/2018/10/11/china-and-pakistan-to-jointly-produce-48-wing-loong-ii-drones/.

[39] Associated Press of Pakistan, "Pakistan to Set up Drone Regulatory Authority," *News International*, December 23, 2020, https://www.thenews.com.pk/print/762933-pakistan-to-set-up-drone-regulatory-authority.

[40] Sana Jamal, "Pakistan to Launch Drone Policy to Boost Local Manufacturing Industry," *Gulf News*, December 22, 2020,

In this regard, provincial and federal government agencies are making efforts to promote and regulate the use of UAVs in their respective domains. For instance, Punjab's Agriculture Department has issued the 'SOP for Agricultural Use of Drones/UAVs.'[41] While this is a positive initiative, there should be a central coordination mechanism to synergise efforts of all government agencies under the Civil Aviation Authority (CAA) which is currently responsible for regulating the uses of UAVs under the Civil Aviation Rules, 1994.[42]

There are several private companies that have been manufacturing UAVs independently or in collaboration with public sector organisations over the last two decades. In order to promote the local UAV industry, the Government of Pakistan needs to facilitate such private companies by introducing regulations, controlling smuggling, and providing tax incentives/subsidies.

Comprehensive guidelines about operational standards, safety, and security of UAVs as well as other aerial objects should be formulated by the government to enable accelerated integration of unmanned vehicles into the national airspace. Likewise, areas of jurisdiction of various national institutions must be clearly demarcated to avoid any confusion, especially, in defence-related applications.

Keeping in view its national security needs and the growing capabilities of its adversary, Pakistan needs to enhance its unmanned aircraft capabilities. Moreover, it should also cater for vulnerabilities (such as jamming, hacking, cyber-attacks etc.) in the Command and Control (C2) of UAVs operations. After India's

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https://gulfnews.com/world/asia/pakistan/pakistan-to-launch-drone-policy-to-boost-local-manufacturing-industry-1.76066172.

41 Punjab Agriculture Department, "SOP for Agricultural Use of Drones/UAVs," press release, Accessed February 9, 2021, http://www.agripunjab.gov.pk/system/files/UAV.pdf.

42 Pakistan Civil Aviation Authority, "Civil Aviation Rules, 1994, " https://www.caapakistan.com.pk/upload/SF/pdf/CARs%201994.pdf.

demonstration of drone swarming capability in January 2021,[43] Pakistan must also develop kinetic and non-kinetic anti-drone capability to maintain deterrence. International cooperation and technology sharing could play a crucial role in this regard.

Conclusion

Unmanned Aerial Vehicles (UAVs) have become pivotal for the daily businesses of various private as well as public sector entities. The broad spectrum of their applications ranging from recreational activities to national security has persuaded global technology giants and governments to invest in this domain. With persistent technological advancements, the role of UAVs will continue to evolve. They are likely to become safer, more effective, and more reliable in the future. The Government of Pakistan needs to take appropriate measures - including legislation and policy formulation - to facilitate the mass adoption of this technology and accrue maximum benefits in the civil, commercial, and national security domains.

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[43] David Hambling, "Indian Army Shows Off Drone Swarm of Mass Destruction," *Forbes*, January 19, 2021.

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Future Warfare and Emerging Military Technologies: An Analysis of US Defence Modernisation

Maheen Shafeeq

Abstract

Analysing United States' defence modernisation plans and strategies about Autonomous Weapon Systems (AWS), Joint All-Domain Command and Control (JADC2), space militarisation, hypersonic vehicles and digital engineering and data architecture, the paper discusses what impact such Emerging Military Technologies (EMTs) will have on variables such as speed, lethality, decision-making and nuclear Command and Control (C2) structures in future warfare. The paper emphasises that technological advancements have made war very swift. This, in turn, has increased its lethality leaving decision-makers with compressed response time. The study finds that of the various EMTs under study, digital engineering and data architecture are likely to have the gravest impact on the character and conduct of future wars.

Keywords: AI, Hypersonics, AWS, Speed, Lethality, Warfare.

Introduction

In International Relations, security is discussed as a vital component of foreign affairs. In the present multipolar world, friction between states has also intensified strategic competition. This strategic competition is characterised by influence on economic and political domains but also by having an upper hand on military-technology as it determines the global security environment.[1] Most academics and policy experts have given considerable importance to emerging military-technologies for enhancing military strength and balancing strategic rivalries.[2]

Emerging technologies hold the potential to alter the rules of the game,[3] whether in terms of strategic competition or in warfare. They also act as a factor that drives the most change in the character of warfare as compared to other elements.[4] It is a massive peacetime investment to impact the character of warfare that determines strategic competition as well as strategic reforms.[5] Whichever state holds the authority to impact strategic reforms is then able to demonstrate its military superiority.

More specifically, Emerging Military Technologies (EMTs) provide solutions to strategic and tactical problems such as reducing

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1 Michael Raska, "Strategic Competition for Emerging Military Technologies Comparative Paths and Patterns," *Prism* 8, no. 3 (2020): 61-81, https://ndupress.ndu.edu/Portals/68/Documents/prism/prism_8-3/prism_8-3_Raska_64-81.pdf.

2 Andrew D. James, "Emerging Technologies and Military Capability," in *Emerging Critical Technologies and Security in the Asia-Pacific* ed. R.A. Bitzinger (London: Palgrave Macmillan, 2016), https://doi.org/10.1057/9781137461285_2.

3 Ibid.

4 Alex Roland, "War and Technology," Foreign Policy Research Institute, February 27, 2009, https://www.fpri.org/article/2009/02/war-and-technology/.

5 Warren Chin, "Technology, War and the State: Past, Present and Future," *International Affairs* 95, no. 4 (2019): 765–783, https://doi.org/10.1093/ia/iiz106.

casualties, limiting collateral damage and even responding to quantitative superiority of the adversary.[6] Ultimately, they allow states to continue employing warfare as a policy instrument where political decisions fail to create consensus.[7]

Besides impacting strategic competition, EMTs have continued to make warfare complex. The interplay of man and machine in warfare has assumed unprecedented importance. As Hables Gray explained: 'In postmodern war, the central role of human bodies in war is being eclipsed rhetorically by the growing importance of machines.'[8] There is also the debate about who is superior - humans or machines[9] or who can make decisions faster.[10]

Of various military technologies, future warfare is most likely to be impacted by Autonomous Weapon Systems (AWS), Joint All-Domain Command and Control (JADC2), space militarisation, hypersonic vehicles and digital engineering and data architecture. This paper looks at these military advancements from the lens of United States' defence modernisation plans and strategies and how they will impact the speed, lethality, decision-making and nuclear Command and Control (C2) complexities of future warfare.

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6 Daniel R. Lake, "Technology, Qualitative Superiority, and the Overstretched American Military," *Strategic Studies Quarterly* 6, no. 4 (2012): 71-99, http://www.jstor.org/stable/26270567.

7 Chin, "Technology, War and the State: Past, Present and Future."

8 Ibid.

9 M. L. Cummings, "Artificial Intelligence and the Future of Warfare," Chatham House International Affairs, January 2017, https://www.chathamhouse.org/2017/01/artificial-intelligence-and-future-warfare.

10 James Vincent, "The Future of War Will Be Fought by Machines, But Will Humans Still Be In Charge?," *Verge*, April 24, 2018, https://www.theverge.com/2018/4/24/17274372/ai-warfare-autonomous-weapons-paul-scharre-interview-army-of-none.

Autonomous Weapon Systems (AWS)

Devices capable of operating without human interference fall under the category of Autonomous Weapon Systems (AWS) such as unmanned vehicles or robotics. A machine can become autonomous if three things are mounted on it: first, sensors to monitor external influence; second, Artificial Intelligence (AI) or a processor to decide how to respond to the external environment, and lastly, some set of tools to respond to the external influence.[11]

An AWS can be categorised as semi-autonomous weapons that are pre-programmed only to perform a set of specific tasks and actions without external commands and fully autonomous weapons that can perform tasks independently by choosing an optimal solution based on the information sensed from the external environment. Fully autonomous weapons are not pre-programmed to respond or even have pre-programmed goals, rather they depend on AI to respond to unforeseen circumstances. So far, such weapons have not been brought into the battlefield as there remain serious ethical and moral questions linked to their use.

Impact on Future Warfare

Speed

Military planners in the United States believe that AWS, less dependent on human decision-making and control, will be able to operate at a far faster speed. This will make war operations speedy. The current remotely operated autonomous systems are slower because they rely on distant C2 systems for communication that is often hampered by delays, jamming, or denial. The speed at which AWS will be capable of operating may create incentives to remove

[11] Peter W. Singer, *Wired for War: The Robotics Revolution and Conflict in the 21st Century* (London: Penguin Books, 2009).

humans from the decision-making loop.[12] Referring to speed and intensity of operations conducted by AWS, John Allen and Amir Husain have termed such a war as 'hyper war',[13] while Paul Scharre calls it a 'flash war'.[14]

Lethality

The lethality of an AWS is expected to increase as it will be operated in large swarms of hundreds or even thousands of relatively small and low-cost drones. Even if an AWS operates in smaller number, it can be carrying small explosives that detonate precisely on the target increasing the lethal impact. The future AWS will return mass fighting on the battlefield as such autonomous systems will be able to inflict massive damage on the enemy through autonomous tactical movement in retaliation.[15] Moreover, AWS are capable of tethering to one another providing them the capability of synchronised attack or defence. This will ultimately increase the footprint of impact on the adversary.

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[12] Matthew Rosenberg and John Markoff, "The Pentagon's 'Terminator Conundrum': Robots That Could Kill on Their Own," *New York Times,* October 25, 2016, https://www.nytimes.com/2016/10/26/us/pentagon-artificial-intelligence-terminator.html.

[13] John R. Allen and Amir Husain, "On Hyperwar," *Proceedings* 143, no. 7, U.S. Naval Institute (2017), https://www.usni.org/magazines/proceedings/2017/july/hyperwar; Jules Hurst, "Robotic Swarms in Offensive Maneuver," *Joint Force Quarterly* 87, no. 4 (2017): 105-111, https://www.hsdl.org/?view&did=804820; Graham Warwick, "Powerful Pairing," *Aviation Week and Space Technology,* (November 27-December 10, 2017): 35-36, https://archive.aviationweek.com/issue/20171127; and Graham Warwick, "Swarm Enabler," *Aviation Week and Space Technology*, (April 3-16, 2017): 31-32, https://archive.aviationweek.com/issue/20170403.

[14] Paul Scharre, *Army of None: Autonomous Weapons and the Future of War* (New York: WW Norton & Company, 2018).

[15] Ibid.

Decision-making

With greater speed and increased lethality coming at the adversary, the latter's decision-making time and efficiency may decrease. In an attack by an AWS, the competition will be between machine and man. Given that man is making decisions on the other end, his/her decision-making would need to be at a faster or similar pace as that of the machine to effectively respond to the attack. Moreover, if the attack or threat of attack by an AWS is sudden, it significantly compresses strategic decision-making time. In the future, AWS will surpass the speed of political decision-making which may reduce the ability of leaders to manage an escalating crisis.

Nuclear C2

The impact of AWS on nuclear systems remains an understudied subject. However, the present studies suggest that AWS can make nuclear C2 complex as states might deploy risky AWS if their second-strike capability is threatened. AWS would also introduce considerable changes to force posturing and first-strike capability.[16]

Joint All-Domain Command and Control (JADC2)

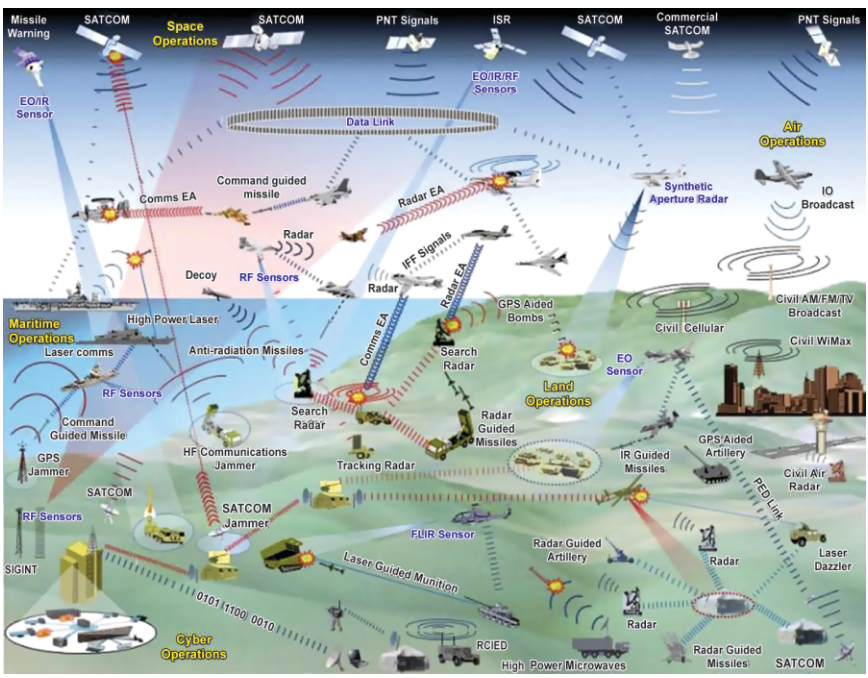
Joint All-Domain Command and Control (JADC2) is a concept introduced by the US Department of Defense (DoD) (Figure 1).[17] The purpose behind this concept is to connect sensors from all military services - Air Force, Army, Navy, Marine Corps and Space Force - into a single network. Such a network will allow interoperability as compared to traditional military services that deploy their own

[16] Michael C. Horowitz, Paul Scharre, and Alexander Velez-Green, "A Stable Nuclear Future? The Impact of Autonomous Systems and Artificial Intelligence," Cornell University, December 13, 2019, https://arxiv.org/pdf/1912.05291.pdf.

[17] Congressional Research Service, *Joint All-Domain Command and Control (JADC2),* report (Washington, D.C.: CRS, 2020), https://fas.org/sgp/crs/natsec/IF11493.pdf.

tactical networks which may not be compatible with other services. JADC2 is envisioned as synergy of complementary services such that each capability increases effectiveness and compensates for the vulnerabilities of other services.[18]

Figure 1: Joint All-Domain Command and Control (JADC2)



Source: Congressional Research Service, *Joint All-Domain Command and Control (JADC2)*.

[18] U.S. Department of Defense, *Capstone Concept for Joint Operations: Joint Force 2020,* report (Washington, D.C.: U.S. DoD, 2012), https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/cross_domain_planning_guide.pdf?ver=2017-12-28-161956-230.

Impact on Future Warfare

Speed

Presently, USAF's air-tasking cycle stretches over 72 hours according to the Air Force Operation Center (AOC).[19] Such a slow process would be incompatible with future requirements as the speed of operations would be greater. JADC2 will reduce this time frame while replacing emphasis from deliberate and thoughtful planning to dynamic and proactive planning to support the speed of operations in a contested and congested environment. It will centralise control of planning, directing, and coordinating a military operation while having decentralised execution to generate required operational speed in order to cope with disorder, uncertainty, and fluidity of combat in air operations.

Lethality

As JADC2 will thread information coming from sensors of US Air Force, Army, Navy, Marine Corps and Space Force into one system, it will increase the lethality of response operations. For instance, a Navy missile fired from offshore could be the most effective and quick response to a threat detected by an Air Force Unmanned Aerial Vehicle (UAV). Similarly, lethality of JADC2 operations would increase when either a rocket artillery, air-to-surface missile or naval gunfire would be able to respond to a call of fire from an infantry battalion.[20] Such a scenario would engage multiple

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19 Sherrill Lingel, Jeff Hagen, Eric Hastings, Mary Lee, et al., *Joint All-Domain Command and Control for Modern Warfare: An Analytic Framework for Identifying and Developing Artificial Intelligence Applications*, report (Santa Monica: RAND Corporation, 2020), https://www.rand.org/pubs/research_reports/RR4408z1.html.

20 Jim Garamone, "Joint All-Domain Command, Control Framework Belongs to Warfighters," U.S. Department of Defense, November 30, 2020, https://www.defense.gov/Explore/News/Article/Article/2427998/joint-all-domain-command-control-framework-belongs-to-warfighters/.

asymmetric instruments to respond along a vertical and horizontal axis with varying degrees of impact.[21]

Decision-making

USAF believes that JADC2 would ease the decision-making process for commanders as it would allow them to quickly analyse the information coming from all sensors using their Advanced Battle Management System (ABMS) to understand the battlespace.[22] It would also allow decision-makers to direct forces faster than the adversary while delivering synchronised combat across all domains. The primary challenge under JADC2 would be to institutionalise decision-making, authorities and command relationships as multiple warfighting domains would be involved.[23]

Nuclear C2

JADC2 would increase second-strike capability in case a state's first-strike capability is destroyed. It will focus on cross-domain nuclear deterrence which would broaden the spectrum of strategies to respond to the adversary.[24]

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21 Patrick J. Cullen and Erik Reichborn-Kjennerud, *MCDC Countering Hybrid Warfare Project: Understanding Hybrid Warfare,* report (London: Assets Publishing Service, 2017), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/647776/dar_mcdc_hybrid_warfare.pdf.

22 Congressional Research Service*, Joint All-Domain Command and Control (JADC2)*.

23 Paul E. Bauman, *Cross-Domain Synergy in Joint Operations*, *Planners Guide*, report (Washington, D.C.: Future Joint Force Development, 2016), https://www.jcs.mil/Portals/36/Documents/Doctrine/concepts/cross_domain_planning_guide.pdf?ver=2017-12-28-161956-230.

24 King Mallory, *New Challenges in Cross-Domain Deterrence,* report (Santa Monica: RAND Corporation, 2018), https://www.rand.org/pubs/perspectives/PE259.html.

Space Militarisation

Many states are now exploiting space for military purposes.[25] Although Russia and China established their space forces in 2015,[26] it was not until 2018 when the US released its first 'National Space Strategy'[27] which signalled other states to view 'space' as a potential warfighting domain. Now, most emerging technologies such as network-centric warfare, early warning systems and autonomous systems are dependent on space satellites for communication, navigation, meteorology, imagery, sensing as well as offensive and defensive capabilities. States are now more inclined towards developing their own space forces, military space systems and space doctrines seen as a force multiplier capable of providing real-time global coverage and secure in-theatre communication across all domains namely air, ground, cyber, and naval fleet operations.[28]

Impact on Future Warfare

Speed

With the incorporation of space into warfighting domains, handling information on the battlefield has become proficient and quick. Space Network Management Systems (SNMS) have assisted in

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[25] Jun Nagashima, "The Militarization of Space and its Transformation into a Warfighting Domain," The Sasakawan Peace Foundation, July 17, 2020, https://www.spf.org/iina/en/articles/nagashima_02.html.

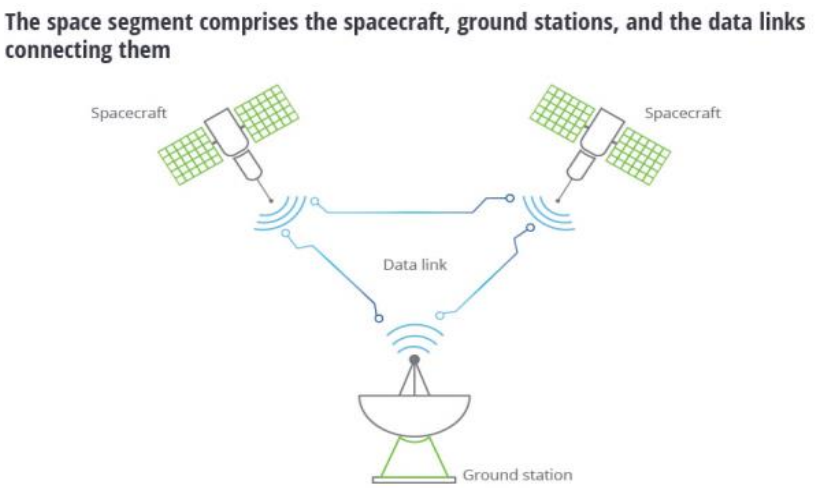
[26] Jen DiMascio, "How Will Russia and China Respond to U.S. Space Force?" *Aviation Weekly Network,* December 15, 2020, https://aviationweek.com/defense-space/budget-policy-operations/how-will-russia-china-respond-us-space-force.

[27] Marcia Smith, "White House Releases Fact Sheet on New National Space Strategy- Updated," *Space Policy Online*, March 24, 2018, https://spacepolicyonline.com/news/white-house-releases-fact-sheet-on-new-national-space-strategy/.

[28] "United States Space Capabilities," United States Space Force, Accessed January 21, 2020, https://www.spaceforce.mil/About-Us/About-Space-Force/Space-Capabilities/.

speeding up standardising and directing highly complex data, users, and nodes.[29] For instance, a satellite might combine various radio frequencies or even re-route data through Inter-Satellite Optical Wireless Communication (IsOWC) to find clear paths of communication to quickly deliver information where required on the battlefield. The use of satellites for gathering and dissemination of intelligence information has made military operations faster. It has been reported that space is now utilised for 90 percent of US intelligence operations.[30]

Figure 2: Present Space Intelligence Network

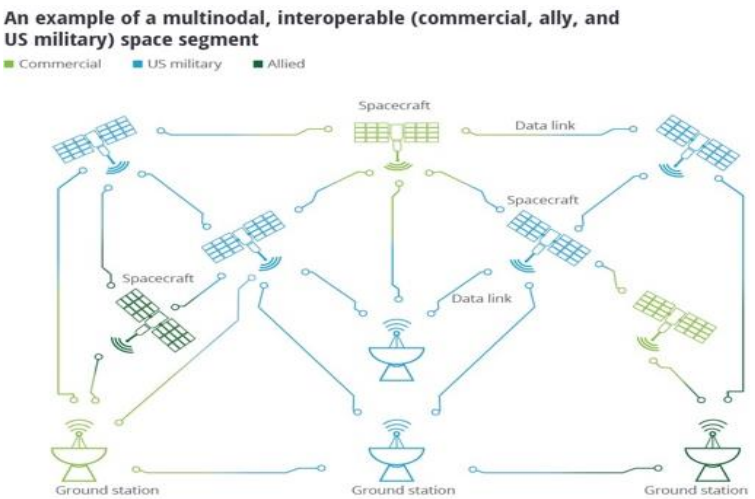


Source: Reed, Routh and Mariani, "Information at The Edge: A Space Architecture for a Future Battle Network."

[29] Justin Reed, Adam Routh and Joe Mariani, "Information at The Edge: A Space Architecture for a Future Battle Network," *Deloitte Insights*, November 16, 2020, https://www2.deloitte.com/us/en/insights/industry/public-sector/future-space-weapons-space-architecture.html.

[30] Niall Firth, "How to Fight a War in Space (And Get Away with It)," *MIT Technology Review*, June 26, 2019, https://www.technologyreview.com/2019/06/26/725/satellite-space-wars/.

Figure 3: Future Space Intelligence Network



Source: Reed, Routh and Mariani, "Information at The Edge: A Space Architecture for a Future Battle Network."

Lethality

Space has also increased the lethality of the battlefield by allowing commanders to understand the battlespace swifter and designating the desired and most effective response rapidly and forcefully. Space has also amplified the lethality of warfare with the development of space-based weapons such as Directed-Energy Weapons (DEWs), kinetic energy weapons against surface and missile targets and space-based conventional weapons against surface targets. The lethality of space-based weapons can be gauged by how they can make in-motion and stationary ground targets sitting ducks. For instance, a laser constellation in space can target fighter jets or cruise missiles or even above-ground terrestrial targets such as fuel tanks or fuel trucks, launchpads of missiles or even missiles and other relatively thin-skinned or flammable targets.[31] Nonetheless, satellites in space are also

[31] Bob Preston, Dana J. Johnson, Sean J.A. Edwards, Michael Miller et al., *Space Weapons-Earth Wars*, report (Santa Monica: RAND Corporation,

vulnerable to Anti-Satellite Weapons (ASAT). The satellites targeted in space or objects targeted by space-based weapons do not need explosive devices rather kinetic energy is destructive enough to eliminate the target. Space, therefore, has opened a new domain to inflict lethal destruction on an adversary.

Decision-making

According to a RAND Project Air Force report, decision-making time, against space-based weapons, is reducing drastically as response time is squeezed. For example, the response time to space-based DEWs, laser or electromagnetic spectrum, is calculated to be in seconds. Similarly, the response time to space-based kinetic energy against missile targets is a few minutes while against surface targets is a few hours. Whereas response time for space-based conventional weapons is said to be about ten minutes.[32]

Nuclear C2

The increasing number of space actors have reduced nuclear deterrence. Although not well planned, the threat of nuclear war or nuclear accident in space exists. [33] However, nations would pivot towards restraint of use of space as a battleground for nuclear war due to exponential risks attached to the outcome of such a war or accident.[34] Nonetheless, this does not eliminate space from being an area where deterrence can be ignored.

2002), https://www.rand.org/content/dam/rand/pubs/monograph_reports/2011/RAND_MR1209.pdf.

32 Ibid.

33 Jeremy Grunert, "John J. Klein, Understanding Space Strategy: The Art of War in Space," *Journal of Space Law* 44 (2020): 332, https://heinonline.org/HOL/LandingPage?handle=hein.journals/jrlsl44&div=14&id=&page=.

34 Thomas Graham, "Space Weapons and the Risk of Accidental Nuclear War," Arms Control Association, 2005,

Hypersonic Vehicles

Hypersonic vehicles include hypersonic missiles and jets that are capable of attaining speeds up to Mach 6 to Mach 27.[35] The reason hypersonic missiles are seen to be advantageous to militaries is that they combine hypersonic speeds with low altitude and great manoeuvring capabilities to evade missile defence systems. Prototypes of hypersonic aircraft are being developed with the combination of a conventional turbine engine having dual-mode ramjet/scramjet propulsion. The ramjet would be used in early flight, while the scramjet would assist the vehicle reach hypersonic speed of Mach 6. Hypersonic jets could be made faster if pilots are left out of the cockpit.[36]

Hypersonic vehicle technology has advanced across three broad spectrums that include propulsion systems, airframe material, and embedded electronics. First, the propulsion system is designed so that the flight pattern of hypersonic weapons is unpredictable. They do not adopt a ballistic trajectory like ballistic missiles, rather they follow an unpredicted zigzag pattern as they dodge the missile defence radars. Second, the airframe materials, circuit board and the electronic components they incorporate ensure that they can survive temperatures, vibration, and extreme pressure of the hypersonic flight. Third, hypersonic missiles have secure

https://www.armscontrol.org/act/2005-12/features/space-weapons-risk-accidental-nuclear-war.

35 Richard H. Speier, George Nacouzi, Carrie Lee, and Richard M. Moore, *Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons* (Santa Monica: RAND Corporation, 2017), https://www.rand.org/pubs/research_reports/RR2137.html.

36 Guy Norris, "Hypersonic Skunk," *Aviation Week and Space Technology*, 2017, quoted in Michael E. O'Hanlon, *Forecasting Change in Military Technology, 2020-2040*, report (Washington, D.C.: Brookings Institution, 2020), https://www.brookings.edu/wp-content/uploads/2018/09/FP_20181218_defense_advances_pt2.pdf.

communications with C2 networks that help them evade detection and interception.[37]

Impact on Future Warfare

Speed

Hypersonic missiles are known for their speed. A hypersonic vehicle can fly as fast as Mach 6 to Mach 27 which is about 5000 to 25000 miles per hour. In other words, a hypersonic missile covers one to five miles in a second.[38] This makes warfare complex as such fast missiles and jets introduce a new dimension of threats, defence against which requires equally fast responding technologies.

Lethality

The kinetic energy that comes with the speed of a hypersonic missile can unleash catastrophic impact. However, the precision of hypersonic missiles was once considered to be highly accurate, more recently though, a union of concerned scientists warned that hypersonic missiles still face serious technical challenges to be precise.[39] Nonetheless, their heat and temperature can leave a lethal impact on the targeted area.

Decision-making

A hypersonic missile attack can occur with a warning time of only a few minutes. Additionally, manoeuvrability in hypersonic missiles leaves room for greater unpredictability of its intended target,

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[37] JR Wilson, "The Electronics Design Challenges of Hypersonic Flight," *Military & Aerospace Electronics*, May 22, 2020, https://www.militaryaerospace.com/sensors/article/14176531/the-electronics-design-challenges-of-hypersonic-flight.

[38] Speier, Nacouzi, Lee, and Moore, *Hypersonic Missile Nonproliferation*.

[39] Cameron Tracy, "The Accuracy of Hypersonic Weapons: Media Claims Miss the Mark," Union of Concerned Scientists, March 9, 2020, https://allthingsnuclear.org/ctracy/the-accuracy-of-hypersonic-weapons-media-claims-miss-the-mark.

therefore planning the desired response can be difficult. This may leave leadership of the targeted state puzzled and with less time to respond.[40]

Nuclear C2

Hypersonic missiles are capable of carrying out disarming/ decapacitating first strike.[41] Their use as a pre-emptive strategy will entangle states in a 'use or lose' scenario.[42] Such threats are magnified if nuclear warheads are part of a hypersonic missile's payload. Moreover, nuclear and conventionally equipped hypersonic weapons could trigger an arms race and competition that may initiate a cycle for stability-instability and action-reaction syndrome.[43] China and Russia have developed low yield stockpile of nuclear-armed hypersonic missiles.[44] In case, nuclear deterrence is unstable, contesting states may feel the urge to employ nuclear-armed hypersonic weapons.

Digital Engineering and Data Architecture

According to the US' DoD 'Digital Engineering Strategy', the emerging technologies incorporated in their digital engineering and

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40 O'Hanlon, *Forecasting Change in Military Technology, 2020-2040*.

41 Matteo Frigoli, "The Implications of the Advent of Hypersonic Weapon Systems for Strategic Stability," *Pugwash Conferences on Science and World Affairs,* December 17, 2019, https://britishpugwash.org/wp-content/uploads/2019/12/M.Frigoli-Hypersonics-Stability-and-arms-control-PDF-2.pdf.

42 Sander Ruben Aarten, "The Impact of Hypersonic Missiles on Strategic Stability Russia, China, and the US," *Militaire Spectator,* April 21, 2020, https://www.militairespectator.nl/thema/strategie/artikel/impact-hypersonic-missiles-strategic-stability.

43 Adil Sultan and Itfa Khurshid Mirza, "Hypersonic Weapons in South Asia: Implications for Strategic Stability," *IPRI Journal* XXI, no. 1(2021): 61-81.

44 Alan Cummings, "Hypersonic Weapons: Tactical Uses and Strategic Goals," *War on the Rocks*, November 19, 2019, https://warontherocks.com/2019/11/hypersonic-weapons-tactical-uses-and-strategic-goals/.

data architecture would be cyber, advanced computing, AI and big data analytics.[45] These technologies are highly dependent on digital and data architecture which will give war planners unique methods of combat.

Impact on Future Warfare

Speed

Digital engineering has increased computational speed, processing capabilities and storage capacity of warfighting management systems.[46] In the field of data architecture, AI has upgraded every level of warfare from quick hunt of enemy with sensors to gathering quick intelligence and sorting through complex data with exceptional speed.[47] Stanford University's 'AI Index 2019 Annual Report' found that computational speed of AI doubles every three months and it is outpacing Moore's Law.[48] The speed of machine learning is also said to be reaching the speed of light.[49] This shows that exponential increase in speed of digital and data will directly impact the speed of engagement. It is also believed that this

[45] Office of the Deputy Assistant Secretary of Defense for Systems Engineering, *Digital Engineering Strategy*, report (Washington, D.C.: U.S. Department of Defense, 2018), https://fas.org/man/eprint/digeng-2018.pdf.

[46] Ibid.

[47] Rudy Guyonneau and Arnaud Le Dez, "Artificial Intelligence in Digital Warfare: Introducing the Concept of the Cyber Teammate," *The Cyber Defense Review* 4, no. 2 (2019): 103-116, https://www.jstor.org/stable/pdf/26843895.pdf?refreqid=excelsior%3A4065c0be4120f94a5e5480e3e782133a.

[48] Cliff Saran, "Stanford University finds that AI is outpacing Moore's Law," *Computer Weekly,* December 12, 2019, https://www.computerweekly.com/news/252475371/Stanford-University-finds-that-AI-is-outpacing-Moores-Law.

[49] Anthony Cuthbertson, "Machines Can Learn Unsupervised 'At the Speed of Light' After AI Breakthrough," *Independent*, July 21, 2020, https://www.independent.co.uk/life-style/gadgets-and-tech/news/ai-machine-learning-light-speed-artificial-intelligence-a9629976.html.

increased speed, in an autonomous systems face-off or in a cyber-attack, may push humans out of the decision-making loop.[50]

Lethality

Digital engineering and data architecture may also increase the lethality of future warfare. For instance, AI will be able to give power to machines to decide to kill, such systems are known as Lethal Autonomous Weapons Systems (LAWS). At some point in the future, man might have to give the decision to kill to machines. However, this comes with its consequences. Giving authority/autonomy to a machine to make decisions might not be dangerous but the machine getting out of control due to algorithmic failure or error might be highly lethal.[51] In case of failure or loss of control over a fully autonomous weapon, a machine could cause unintended casualties and conflict escalation.[52] Similarly, cyberweapons could inflict massive damage to critical military systems, nuclear included. Cyber is considered lethal as it is difficult to track and target a hacker. Moreover, damage assessment is difficult in a cyber-attack, as more viruses/malware may be hidden within the data. Likewise, damage repair is also challenging. For these reasons, cyber-attacks should also be prosecutable or at least designated as a 'war crime.' This demonstrates that digital and data attacks can inflict as lethal damage as kinetic war.[53]

Decision-making

With digital engineering and data architecture, the processing of information can be done in early stages of the combat. Efficient AI,

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50 Konaev, "With AI, We'll See Faster Fights, But Longer Wars."

51 Scharre, *Army of None.*

52 Stephanie Mae Pedron and Jose da Arimateia da Cruz, "The Future of Wars: Artificial Intelligence (AI) and Lethal Autonomous Weapon Systems (LAWS)," *International Journal of Security Studies* 2, no. 1 (2020).

53 Neil C. Rowe, "Ethics of Cyberwar Attacks," in *Cyber War and Cyber Terrorism,* ed. A. Colarik and L. Janczewski (Hershey: The Idea Group, 2007), https://faculty.nps.edu/ncrowe/attackethics.htm.

for instance, can provide real-time actionable intelligence that can help make the right decisions and reduce the risk of collateral damage and casualties.[54]

Nuclear C2

Digital engineering and data architecture have raised new concerns about the security of nuclear C2, e.g., if the latter is automated with the help of AI, a cyber-attack could disable the system. If nuclear weapons become dependent on AI, it may reduce strategic stability.[55] With growing dependence on digital engineering, cyber, coding and software, all aspects of nuclear weapons such as early warning, protection of data, authorisation of use and firing could become more vulnerable because of hackers. This vulnerability can reduce nuclear deterrence and increase the chances of error and miscalculation. [56]

Analysis

From the discussion above, it can be concluded that in terms of the gravity of impact, **digital engineering and data architecture** is likely to have the '*gravest*' impact on warfare given greater acceptability and flexibility of integration (Table 1). The two also need immediate investment to deliver modest outcomes for future warfare. This is the one technology that could affect all other technologies. For instance, if there are advances in AI, such as machine learning holding the capability to mimic the human brain, it would increase

[54] Konaev, "With AI, We'll See Faster Flights, But Longer Wars."

[55] Mark Fitzpatrick, "Artificial Intelligence and Nuclear Command and Control," *Global Politics and Strategy* 61, no. 3 (2019): 81-92, https://www.tandfonline.com/doi/full/10.1080/00396338.2019.1614782?scroll=top&needAccess=true.

[56] Andrew Futter, *Cyber Threats and Nuclear Weapons: New Questions for Command and Control, Security and Strategy,* report (London: Royal United Services Institute, 2016), https://rusi.org/sites/default/files/cyber_threats_and_nuclear_combined.1.pdf.

the scope of other technologies like robotics to manufacture advanced humanoids, also referred to as a soldier's wingman on the battlefield. Similarly, deeper understanding of algorithms would be able to defend nuclear C2 against cyber espionage and attacks. Furthermore, with emerging technologies crowding the battlefield, there would be an explosion of data which would make manual analysis impractical and ineffective. This is where digital and data would play a critical role in providing the most effective method to analyse data. Moreover, lethal threats would grow at a high rate which would require cyber and AI efficiency to reduce lethality by employing various techniques. Example of lethal threats could be cyber-attacks on C2 to misguide missiles or an adversary taking charge of drones and robots and reversing the offense. Additionally, cyber and AI would be the most cost-effective defensive and offensive weapon as they can not only be launched quickly but also spread and corrupt the adversary's system with low chances of detection and prediction.

On the other hand, **autonomous weapons** would *'gravely'* impact the conduct of warfare. Due to cheap manufacturing and cost-benefit analysis, drones, Unmanned Aerial Vehicles (UAVs) and robots would be the preferred choice of militaries for future warfare. With continuous improvement in AI and machine learning, automation of weapons would be preferred as the speed of conflict would be outside or faster than the framework of human brain calculation. Moreover, future wars would not be blood battles rather machine battles under which AWS would play a key offensive and defensive role such as attack in swarms or performing ISR missions. However, there still remains a lot of scope for understanding the human-machine partnership/interaction on the battlefield and improvement in AWS to avoid errors and failures.[57]

[57] "Autonomous Weapon Systems: Technical, Military, Legal and Humanitarian Aspects," (Expert Meeting, Geneva, Switzerland, March 26-28, 2014), https://reliefweb.int/sites/reliefweb.int/files/resources/4221-002-autonomous-weapons-systems-full-report%20%281%29.pdf.

Space militarisation would have *'significant impact'* on warfare as this is a domain of warfare is not yet perfected by states other than major powers. Slow progress in space is also due to various treaties that prevent deployment, threat, or use of weapons in outer space and ban its weaponisation. The support of space-based communication, navigation and ISR capabilities would increase the effectiveness of military operations. It would also introduce warfare to new technologies such as space-based kinetic and laser attacks that yet do not have counter-attack strategy or technology available. However, space militarisation is an expensive and long-term task that would not only require huge budget for Research and Development but also demand investment in personnel, facilities, training and strategy. However, if space militarisation is invested in, it would increase warfighting capability manifold and ultimately dominate the battleground.

JADC2 would have '*marginal immediate impact*' but is likely to impact future warfare in the longer run. It would enable all forces to work together through data networks to process information quicker and give rapid response, however its processes still face unique challenges. First, JADC2 is dependent on other technologies such as autonomous systems, space-based communication, digital engineering and data architecture as well as integration of all these systems. Once these systems gain efficiency independently, only then, they could be incorporated together to give an effective response. Besides technology, another complex matter is bringing decision-makers and authorities who command JADC2 on the same page. Such a task would require synchronisation across multiple services, forces, brigades as well as synchronisation of monitoring and training. Therefore, a cost and benefit analysis and keeping in view the character of warfare in the future that will move from physical operations to information operations, JADC2 would likely have marginal impact. Nonetheless, if advanced battle management systems are made efficient and joint decision-making is synchronised, they hold the capability to wreak havoc on the battleground.

Hypersonic weapons would likely have '*marginal impact*' on future warfare due to diminishing use of kinetic weapons under greater threat of unintended escalations in highly contested environments. Nonetheless, their speed and maneuverability would offer effective response options. Given that the future warfare is about speed, it could be the ideal weapon for strikes against targets that are time critical. However, such weapons would not be among the initial ones deployed to win a war, rather they are likely to be employed to conclude a standoff as a last resort. Chances of their employment are also low as there would remain ambiguity in detection of whether the warhead used is nuclear or non-nuclear. Additionally, hypersonic weapons Research and Development is an expensive field and there still remain many engineering challenges in hypersonic missiles and jets. Nevertheless, this is certainly a potential future military technology (See Table 1).

Table 1: Impact of Emerging Military Technologies on Future Warfare

Emerging Technologies	Grave/Lethal	Significant	Marginal
Autonomous Weapon Systems	x		
Digital Engineering & Data Architecture	x		
Space Militarisation		x	
Joint All-Domain Command and Control			x
Hypersonic Vehicles			x

Source: Author's own.

Conclusion

Security requirements of states have increased due to growing rivalries between them which is pushing military strategists and policymakers to find creative ways to increase deterrence. This is where Emerging Military Technologies (EMTs) are giving states comparative advantage over each other not only in terms of security but also economically and politically. EMTs are a peacetime investment to alter and shape the rules of warfare in order to gain superiority over the adversary. While introducing new dimensions to warfare, EMTs have changed the relationship between man and machine.

This relationship would change as under the United States' defence modernisation plans and strategies, Autonomous Weapon Systems (AWS) and Joint All-Domain Command and Control (JADC2) would speed up war operations that would require proactive and thoughtful planning to cope with uncertainty and fluidity of combat. Space network management systems have assisted in making warfare rapid through quick delivery of information using satellites to places where more information is required on the battlefield to execute a task. Similarly, hypersonic missiles and jets have also impacted the rapidness of war and introduced new dimensions of threats. Likewise, digital engineering and data architecture have increased computation speed, processing capabilities and storage capacity of warfighting systems.

Speed has directly impacted the lethality of warfare. Autonomous weapons elevate the level of lethality as they bring synchronised mass fighting to the battlefield that can inflict maximum and accurate damage. Lethality would also increase when JADC2 would be able to respond to an attack using sensors that would engage multiple asymmetric instruments along vertical and horizontal axis. An enabling environment would be provided to JADC2 with space-based communication system as well as space-based weapons such as kinetic and Directed-Energy Weapons (DEWs). Kinetic impact would increase the lethality of war,

especially the kinetic energy released by hypersonic flight. Similarly, cyber warfare is also considered lethal as it is difficult to predict, track and target a cyber-attack.

The speed and lethality of warfare will reduce decision-making time. Therefore, for future warfare, leadership would need to make decisions at quicker or at the pace of a machine. Such decision-making would need new methods to institutionalise decision-making. The time to make decisions may be reduced from hours to minutes. However, due to technological developments, machines would be capable of providing real-time actionable intelligence to support decision-making that reduces casualties.

The speed and lethality of future warfare would also make decision-making complex, allowing states to deploy risky autonomous systems on nuclear C2 if their second-strike capability is undermined. Likewise, hypersonic vehicles add to nuclear complexity with the threat of hypersonic missile carrying a nuclear warhead. This is likely to push states to increase their second-strike capability in case of decapacitation of nuclear capability. Similarly, digital engineering and data architecture expose nuclear C2 systems such as early warning systems, protection of data, authorisation of use and firing of nuclear weapons to greater vulnerability under the threat of cyber-attack.

Admittedly, all EMTs hold relevant importance on the battlefield. If the level of impact was to be accessed, this study finds that digital engineering and data architecture would have the gravest impact on future warfare.

To conclude, it is important to highlight that future of warfare is only a prediction based on past and current developments in military science. One aspect is certain that EMTs would make warfare more complex, not simpler. It would require new systems of education, training, doctrines, strategies, and imaginative cognition. That is only possible if there is systemic transformation to set new standards and formats of operation. Since technological trends often also drive conflict instead of deterring it, militaries may need

to reverse the sequence from what were once (or traditionally) considered winning warfare strategies. In this regard, militaries must make noticeable alterations in their processes to adjust emerging technologies. This is only possible if war fighters are visionary and proactive. However, in the race to keep pace with EMTs, one must be careful of not driving the world towards an anarchic scale of lethality.

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COVID-19, Job Market Disruptions & Cooperatives Alternative: A Case Study of Pakistan

Hassan Mujtaba

Abstract

The objective conditions of Pakistan's economy - especially in its labour market - have not kept pace with broader demographic changes such as population growth. This has created wide-ranging socioeconomic inequities in the form of poverty, unemployment, falling living standards, and so on. The COVID-19 pandemic further exacerbated this situation. Research suggests that widespread poverty and unemployment - especially among the youth - can directly increase crime, terrorism, and militancy. In this context, the paper recommends a hitherto untested alternative employment policy that can benefit all segments of Pakistan's society, with a special focus on unemployed youth. This policy broadly revolves around the creation and promotion of community-based entrepreneurial firms, also called 'Worker Cooperatives.' The latter have a robust academic tradition, specifically in Marxian political economics, with Mondragon Cooperatives Corporation (MCC) and Marcora Law serving as its international best practices. If allowed to grow and mushroom untrammelled, a Worker Cooperatives Sector can become an engine of economic growth and employment generation in Pakistan.

Keywords: Worker Cooperatives, Unemployment, Youth, Pakistan, COVID-19, Security.

Introduction

The COVID-19 pandemic has altered the world in unprecedented ways. Besides creating a health emergency, the pandemic has fundamentally affected all facets of human life, which are unlikely to be overturned even after the pandemic is completely over. The pandemic has been especially hard for countries that work on reactive — rather than proactive — logic, especially Low-Income Developing Countries (LIDC). Pakistan is among those LIDCs which were ill-prepared and consequently hit-hard by the pandemic. Even before the spread of COVID-19, Pakistan was struggling on various fronts. For example, the country consistently underperformed all its regional rivals in key performance indicators such as the Human Development Index (HDI), governance, economic management, taxation, ease-of-doing-business, and so on. This dismal performance made Pakistan a nation at par with the least developed countries of Sub-Saharan Africa.

To compound its problems, Pakistan has a huge youth bulge with approximately two-thirds of its population under 30 years of age and around 1.4 million people entering its labour market every year.[1] To accommodate these aspiring young workers, Pakistan needs to sustain a GDP growth rate of at least 7 percent.[2] However, the recent economic performance of Pakistan is anything but promising. In the last two years, the country has had a growth rate of under 2 percent, with the COVID-19 shock plunging the economy

[1] "Over 1.4 Million People to Join Labour Force Every Year in Next Five Years," *Mettis Global News*, February 28, 2019, https://mettisglobal.news/over-1-4-million-people-to-join-labour-force-every-year-in-next-five-years.

[2] Shahid Sattar, "Is Pakistan Prematurely De-industrialising?," *PIDE Blog*, September 4, 2020, https://pide.org.pk/blog/is-pakistan-prematurely-deindustrialising/.

to a dismal -0.38 percent.[3] This has increased the unemployment level from 5.8 million in 2019-20 to a staggering 6.65 million in 2020-21. Young people bear the brunt of the unemployment scourge as the unemployment rate is highest among the educated — who are on average three times more likely to be out of the job market — and among the 20-24 age group.[4]The precarious condition of Pakistan's labour market, especially concerning youth employment, poses a serious security challenge for Pakistan. If the situation is not addressed urgently, then the anger and frustration of the youth can potentially vent in the form of delinquency, vandalism, street-crime, and even Islamist/separatist militancy. A plethora of studies[5] in labour economics also confirms the causal relationship between unemployment and crime/militancy. Perhaps the best-known example of unemployment fuelling social unrest

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3 Mishal E Noor, "Covid-19 and Pakistan's Economic Fallout," *Express Tribune*, October 22, 2020.

4 Bakhtawar Mian, "Number of Jobless People to Reach 6.65m in 2020-21," *Dawn*, June 17, 2020, https://www.dawn.com/news/1564053.

5 Holly Young, "'Youth Unemployment Is an International Security Issue," *Guardian*, August 20, 2014, https://www.theguardian.com/global-development-professionals-network/2014/aug/20/youth-unemployment-interactive-vicki-escarra; O. B. C Nwolise, "Implications of the Arab-Spring for National Security in the West African Sub-Region: The Role of the Nigerian Army," *Open WorldCat*, 2013, https://www.worldcat.org/title/implications-of-the-arab-spring-for-national-security-in-the-west-african-sub-region-the-role-of-the-nigerian-army/oclc/912512766; Polet François, *The State of Resistance: Popular Struggles in the Global South* (London/New York: Zed Books, 2007); Louise M. Fox and Melissa Sekkel Gaal, *Working out of Poverty*, report (Washington, D.C.: The World Bank, April 24, 2008), https://doi.org/10.1596/978-0-8213-7442-9; Sandra Alters, "World Poverty," (paper, Gale, Cengage Learning, Detroit, 2013); Lester Russell Brown, *Redefining National Security* (Washington, D.C.: Worldwatch Institute, 1977); Hyacinth N. Iwu, "Re-Contextualising Unemployment and National Security in Nigeria," *Journal of Sustainable Development* 8, no. 6 (July 2015), https://doi.org/10.5539/jsd.v8n6p231.

comes from Tunisia when an unemployed graduate working as a fruit vendor set himself on fire in a display of sheer agony and dejection.[6] This single event culminated in local unrest further cascading into a regional protest movement better known as the 'Arab Spring', in a remarkable illustration of the Butterfly Effect. Since then, the Arab Spring has degenerated into abominable conflicts resulting in regional instability in the form of the Syrian War, NATO invasion of Libya, and so on. Hence, in the case of Pakistan, the menace of unemployment should be seen as a high-risk security issue requiring a collaborative strategy of both the defence and economic policymakers.

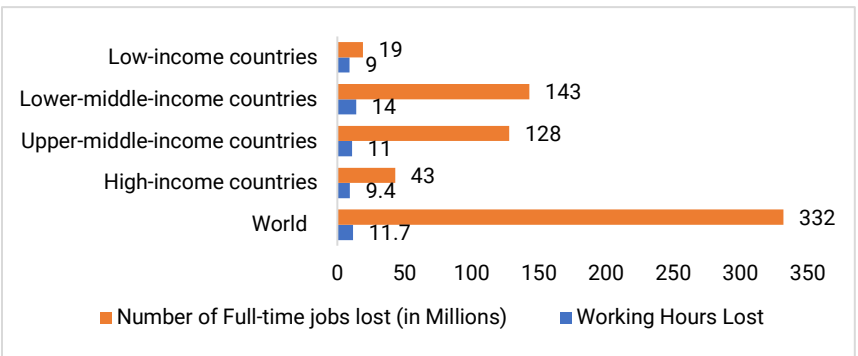
It is in this context that this paper proposes an alternative model of employment and entrepreneurship, which has the potential to benefit a wide segment of the Pakistani populace in all sectors of the economy. This model is known as 'Worker Cooperative' (WC) or Worker Self-Directed Enterprises (WSDE). A WSDE eliminates the dichotomy between workers and the owners. The model is unique owing to its creative way of organising work, which is fundamentally different from top-down hierarchical firms, whether in the private sector, public sector, not-for-profit, and so on. Little wonder then that the model is gaining traction and is the focus of discussion and theorisation in a plethora of heterodox economics journals. This study adds to the growing literature on WCs from around the world, especially in Latin America and parts of Western Europe, where the cooperatives have had much success in the form of Mondragon Cooperatives Corporation (MCC) in Northern Spain, and in the shape of a potent employment policy called 'Marcora Law' in Italy. In the context of Pakistan, this is a pioneering work that addresses a gap in academic research and employment policy and seeks to fill it by proposing a national level cooperatives policy.

[6] Tarek Amara, "Young Jobless Tunisian Sets Himself on Fire," *Reuters*, March 12, 2013, https://www.reuters.com/article/us-tunisia-politics-immolation-idUSBRE92B0GS20130312.

COVID-19 and Job Market Disruptions

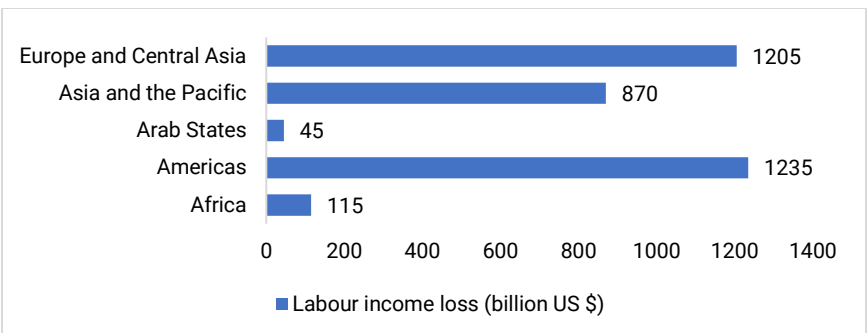
Since its outbreak, the COVID-19 pandemic indiscriminately affected all countries and societies across the globe. Besides creating an unprecedented public health crisis, the pandemic resulted in massive economic and labour market disruptions not seen since the Great Depression of the 1930s and World War II. Among all the economic variables, the labour market has taken the heaviest toll of the pandemic, which is conspicuous in the form of widespread job losses, layoffs, cuts in remuneration, loss of working hours, and so on. This is shown in Figures 1 and 2:

Figure 1: Number of Jobs Lost in Q1 (2020)



Source: ILO Monitor (Sixth Edition).

Figure 2: Loss of Labour Income in Q1-Q3



Source: ILO Monitor (Sixth Edition).

According to the data compiled by the International Labour Organization (ILO), 332 million people have lost their full-time jobs directly as a result of the COVID-19 pandemic (Figure 1). In addition, the aggregate labour income lost amounts to USD 3470 billion (Figure 2).

Although the virus has wreaked havoc across regions, the middle- and lower-income countries have borne the brunt of it, especially in terms of numbers of jobs lost and the fall in labour income. Prolonged lockdowns in many LIDC have further exacerbated the situation as a large majority of their population cannot work-from-home owing to their low education and weak skill set. Besides, structural issues such as weak institutions and economic constraints, like limited resources and tight fiscal space, further add to the problem. Small wonder then that IMF economists predicted that COVID-19 may undo the recent economic progress painstakingly achieved by many LIDCs.[7] In addition, COVID-19 has also created massive fiscal imbalances and debt sustainability problems for struggling LIDCs.[8]

In this context, it becomes clear that the virus is anything but a 'great equaliser' as it disproportionately affects poorer countries and the weaker segments of society. Pakistan, too, is among the LIDCs who have been unevenly impacted by the virus. Although the pandemic did not result in an egregious public health emergency, it nevertheless created great socioeconomic upheaval in the country. To begin with, 8 million people have lost

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7 Daniel Gurara, Stefania Fabrisio, and Johannes Wiegand, "COVID-19: Without Help, Low-Income Developing Countries Risk a Lost Decade," *IMF Blog*, August 27, 2020, https://blogs.imf.org/2020/08/27/covid-19-without-help-low-income-developing-countries-risk-a-lost-decade/.

8 Emmy Hawker, "COVID-19: The Impact on Developing Economies," *www.businessbecause.com*, June 25, 2020, https://www.businessbecause.com/news/insights/7052/covid-19-impact-on-developing-economies.

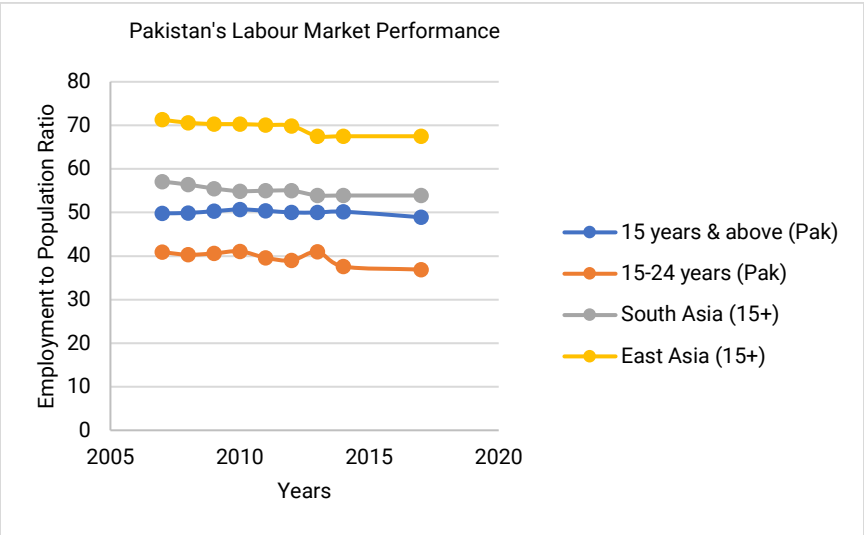
jobs directly due to COVID-19, and food inflation climbed to double digits when it struck.[9] This translates into more people — especially those already on the margins — slipping below the poverty line. Indeed, according to a study conducted by the Pakistan Institute of Development Economics (PIDE),[10] the poverty rate is projected to increase from 23.4 percent to 59 percent resulting in 75 million more impoverished people, thus bringing the total to 125 million people living below the poverty line. In addition, the labour market is expected to tighten and shrink further, with youth unemployment reaching record levels. For instance, a joint report[11] prepared by the Asian Development Bank (ADB) and ILO estimated that 1.5 million to 2.3 million Pakistani youth will lose jobs owing to the subsequent COVID-19 waves and the policy measures aimed at containment. Hence, the exogenous shock of COVID-19 has further strained an economy and a labour market that has historically underperformed even in comparison to other regional rivals. This is depicted in Figure 3:

[9] Bakhtawar Mian, "Number of Jobless People to Reach 6.65m in 2020-21," *Dawn*, June 17, 2020, https://www.dawn.com/news/1564053; "High Food Costs," Dawn, October 29, 2020, https://www.dawn.com/news/1587585.

[10] "COVID-19 in Pakistan: Caring for the Poor and Vulnerable," Pakistan Institute of Development Economics, 2020, https://www.pide.org.pk/index.php/covid-19.

[11] "Tackling the COVID-19 Youth Employment Crisis in Asia and the Pacific," International Labour Organization and Asian Development Bank, August 18, 2020, https://www.ilo.org/asia/publications/WCMS_753369/lang--en/index.htm.

Figure 3: Employment to Population Ratios (2007-17)



Source: Pakistan Bureau of Statistics.

This paper employs the employment-to-population ratio as a proxy to gauge the vibrancy of Pakistan's labour market when comparing it to other regional countries located in South and East Asia. The employment-to-population is a simple metric used by labour economists to measure the number of people employed as a percentage of the total population. When compared to other analogous measures — such as the unemployment rate — the employment-to-population ratio does a relatively better job in depicting the true picture of the labour market[12] As one can see in Figure 3, the employment-to-population ratio of Pakistan (for the age group 15 and above) averages to 0.5, which is lower than the South Asian average of 0.55 and far lower than the East Asian

[12] Eric Esteves, "What Is the Employment-To-Population Ratio?," *Investopedia*, November 30, 2020, https://www.investopedia.com/terms/e/employment_to_population_ratio.asp.

average of 0.7. In addition, youth unemployment in Pakistan is far higher even in comparison to the national average, as reflected by the average employment-to-population ratio of 0.4 for the age group 15-24.

The loss in employment as a result of COVID-19 is only going to worsen the population-to-employment ratio, especially for the youth. Besides raising the poverty level, the fall in incomes will also exacerbate existing economic and social inequities, and as this study has already established, income inequality and unemployment directly feed into crime and social unrest.[13] In other words, the shock of COVID-19 can potentially lead to a rise in crime and terrorism — hence, posing a grave security issue — until some proactive policy is adopted immediately and earnestly.

Workers Cooperatives (WCs): Theory and Practice

The literature in political economy and labour economics contains a rich history of ideas that many scholars deem as alternatives to the present-day, ubiquitous mode of work that involves a social relationship of employer-employee or a boss-subordinate and so on. WCs are one such example.

Although the idea itself is quite old, it was widely popularised in the 19th Century by radical intellectuals like Karl Marx (1818-1883), who viewed it as a potent alternative to replacing the capitalistic way of work. Marx saw merit in cooperatives since they eliminate the dichotomy between owners and workers by allowing the latter to assume full responsibilities of the former, besides performing work and controlling all aspects of the workplace. This way of organising work, according to Marx, helps eliminate capitalistic 'exploitation' as the workers fully appropriate the surplus value that they produce. These views of Marx are reflected thus: '(Through a cooperative)

[13] Muhammad Khalid Anser et al., "Dynamic Linkages between Poverty, Inequality, Crime, and Social Expenditures in a Panel of 16 Countries: Two-Step GMM Estimates," *Journal of Economic Structures* 9, no. 1 (June 5, 2020), https://doi.org/10.1186/s40008-020-00220-6.

the opposition between capital and labour is abolished here, even if at first only in the form that the workers in association become their own capitalist, i.e., they use the means of production to valorise their own labour.'[14]

Despite Marx's favourable assessment, the WCs have played a very limited role in socialist and communist economic policies of the 20th Century, especially of the former Soviet Union. This is partly attributable to post-revolution conditions — civil war, foreign invasion, and so on — and partly to the limited vision of revolutionaries. Although the leader of the Russian revolution, Vladimir Lenin (1870-1924), had a lucid understanding of cooperatives' significance for a socialist economy - as reflected in his pamphlet *On Cooperation* - his premature demise precluded any chance that Russia had of converging towards a full-fledged WC economy. What emerged instead was a complete dominance of the state on all aspects of society, including economy, industry, and agriculture. The state sphere of influence stretched to the workplace as well, where state bureaucrats replaced private capitalists, giving no respite to the workers, and keeping intact the old way of organising work. Similarly, the surplus-value, which was previously siphoned-off by the private capitalists, now came to be appropriated by the bureaucrats and a state apparatus that was controlled by the Communist Party. In other words, private (free market) capitalism had been replaced by state capitalism in the garb of communist planning.[15]

Despite the penchant of radical (political) philosophers towards WCs, it is surprising that the best practice of WCs come from apolitical enterprises rather than socialist countries. Consider the example of Mondragon Cooperatives Corporation (MCC).

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[14] Karl Marx, *Capital*, vol. 3 (1894; repr., New York: Vintage Book, 1981), 571.

[15] Stephen A Resnick and Richard D Wolff, *Class Theory and History: Capitalism and Communism in the U.S.S.R* (New York: Routledge, 2002).

In the 1940s, during the height of the Spanish Civil War, a Catholic priest named José María Arizmendiarrieta arrived in the town of Mondragon located in the Northern Basque region of Spain, which at that time was plagued by rampant poverty, rising unemployment, extreme inequality, and social unrest. To help the local community stand on its own feet, he started a technical college in 1956, which later become the first cooperative enterprise named 'Ulgor'. This is the humble background in which MCC was founded. Today, the MCC has more than 96 subsidiary cooperatives, 14 Research & Development (R&D) centres and employs 81,000 workers making it the largest employer in the Basque region and among the top 10 big businesses of Spain.[16]

The distinguishing feature of MCC — indeed of any WC — is the ability of its workers to collectively decide upon the fundamental economic premise, i.e., what to produce? How to produce? For whom to produce? and what to do with the profits? Moreover, every year, workers from all the cooperatives congregate in the Annual General Assembly (AGA) and democratically elect their Managing Director (MD) and other senior corporate officials. In addition, all the official decisions regarding the pay, perks, privileges, and hiring/firing of the senior management are also made collectively by the MCC workers. This is in sharp contrast to a capitalist firm, where the reverse is true. In other words, in MCC, as in any WC, the workers are the real owners and where the dialectical contradiction of bourgeoisie-proletariat has been negated.[17]

In recent years, MCC has seen unprecedented horizontal growth as well, as it has expanded its operations overseas into new markets. In addition, it has started its university with approximately 4,000

[16] Ricardo R. Fuentes Ramíres, "Three Essays on Economic Stages and Transition," (PhD diss., University of Massachusetts, Amherst, 2016).

[17] Richard Wolff, "Yes, There Is an Alternative to Capitalism: Mondragon Shows the Way," *Guardian*, June 24, 2012, https://www.theguardian.com/commentisfree/2012/jun/24/alternative-capitalism-mondragon.

enrolled students and is offering advanced degrees (Bachelors, Masters, and PhD) in a plethora of disciplines, including engineering, business, education, gastronomy, and cooperatives management. Besides, the MCC has opened a cooperative bank named 'Caja Laboral', which holds approximately €24 billion in deposits.

Despite these impressive achievements, the MCC has retained a spirit of camaraderie among its rank and file. In fact, almost all of its success is attributable to this sense of solidarity and worker autonomy. Consider, for example, the fact that all cooperative organisations look out for each other, especially in bad times, by allocating 10 percent of their profits to fellow cooperatives who are financially struggling. Small wonder then that only six firms have shut down in the network of MCC since its birth. In addition, during a financial downturn, the worker-owners preserve their employment by either taking a cut in compensation or transfer some of their fellow employees to other cooperatives, but no one is laid off. In a similar vein, the pay differential between the highest and lowest paid worker in MCC is in the ratio of 6.5 to 1 respectively, and this decision, like all others, is made democratically by worker-owners as well. Compare this to the pay differentials in the United States, where an average Chief Executive Officer (CEO) of a big corporation earns almost 400 times greater than the lowest-paid worker.[18]

While the highly publicised case study of Mondragon proves the competitive advantage of WCs in entrepreneurship and business management, the Italian government's 'Marcora Law' demonstrates the policy efficacy of cooperatives in the context of employment generation and production capacity optimisation.

The Marcora Law was passed in 1985 by the then-Minister for Trade and Industry Jiovani Marcora, who had grown concerned by the rising claims and costs of the unemployment benefits.

[18] Wolff, "Yes, There is an Alternative to Capitalism: Mondragon Shows the Way." and, Ramíres, "Three Essays."

Instead of sanctioning an expansion of social security, Marcora called for fostering self-reliance in communities by promoting entrepreneurship, which would also increase the productive capacities of the country. However, his scheme did not involve the advocacy and creation of propriety-based enterprises but rather community-based collective organisations, i.e., WCs. Thus, the Marcora Law was born.

Apart from creating viable communal enterprises, the Marcora Law is also an effective employment generation policy. As per its rules, the Italian government pays a lump-sum amount in start-up capital to a group of unemployed people provided that they agree to run it as a WC. Note that the amount in start-up capital is a substitute for the unemployment benefits, which the Italian government would otherwise have to pay to unemployed or laid-off workers.

As a public policy, the Marcora Law is widely successful, and in the three decades since its inception, it has directly created 257 businesses resulting in 9,300 jobs. Besides, these cooperative businesses are, on average, more successful than non-cooperative or capitalistic firms. For example, the survival rate of industrial cooperatives in Italy is 87.16 percent, while on the other hand, 48.3 percent of non-cooperative firms fail in the first three years of their business.[19] The 'Worker Cooperative Sector', created by the Marcora Law, has added to the resilience of the Italian economy and has been helpful, especially during times of financial crises.[20]

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[19] International Cooperative Alliance, "The Marcora Law Supporting Worker Buyouts for Thirty Years - ICA," www.ica.coop, September 11, 2015, https://www.ica.coop/en/media/news/marcora-law-supporting-worker-buyouts-thirty-years#:~:text=Thirty%20years%20ago%20the%20then.

[20] Marcelo Vieta, Sara Depedri, and Antonella Carrano, "The Italian Road to Creating Worker Cooperatives from Worker Buyouts: Italy's Worker-Recuperated Enterprises and the Legge Marcora Framework," *SSRN Electronic Journal* (2015), https://doi.org/10.2139/ssrn.2641057; Camillo De Berardinis, "The Marcora Law: An Effective Tool of Active

To conclude, the example of Mondragon Corporation in Spain and Marcora Law in Italy show that WCs can successfully function both as business organisations and as an employment generation public policy. While scholarly research on such initiatives is limited, available evidence suggests that cooperatives are more resilient than capitalist firms,[21] boost higher worker productivity,[22] preserve jobs better[23] and are counter-cyclical, i.e., they retain rather than fire employees in a business cycle downturn, as shown by the example of MCC.[24] In addition, the greater autonomy afforded to workers by the cooperative structure results in more job satisfaction and a

Employment Policy," *Co-Operative News*, September 22, 2015, https://www.thenews.coop/98000/sector/retail/marcora-law-effective-tool-active-employment-policy/.

21 Alberto Zevi, Antonio Zanotti, François Soulage and Adrian Zelaia, *Beyond the Crisis: Cooperatives, Work, Finance. Generating Wealth for the Long Term,* report (Brussels: CECOP Europe, 2011), https://www.cecop.coop/img/pdf/beyond_the_crisis_english-2.pdf; Chiara Bentivogli and Eliana Viviano, "Changes in the Italian Economy: The Cooperatives," *SSRN Electronic Journal*, February 16, 2012, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2023189.

22 Joseph R. Blasi, Richard B. Freeman, and Douglas L. Kruse, *The Citizen's Share: Putting Ownership Back into Democracy* (New Haven: Yale University Press, 2013) .

23 Virginie Pérotin, "Entry, Exit, and the Business Cycle: Are Cooperatives Different?," *Journal of Comparative Economics* 34, no. 2 (June 2006): 295–316, https://doi.org/10.1016/j.jce.2006.03.002; Virginie Pérotin, "Worker Cooperatives: Good, Sustainable Jobs in the Community," *Journal of Entrepreneurial and Organisational Diversity* 2, no. 2 (2013), https://doi.org/10.5947/jeod.2013.009.

24 Eddi Fontanari and Carlo Borsaga, *La funzione anticiclica delle cooperative italiane* [The Counter-Cyclical Function of Italian Cooperatives] report (Trento: Second Euricse Report, Euricse Edizioni, 2013).

sense of ownership, which is the secret behind cooperatives' competitive advantage. [25]

Cooperative Societies in South Asia: Historical Context

In the late 19th and earlier 20th Century, the province of Punjab in British ruled India was afflicted with the problems of low crop yield, low farmer productivity, and inadequate agricultural output due to various reasons. The chief amongst them was the issue of the high debt burden accrued by farmers and a lack of credit provision mechanism.

To overcome this issue, which was pervasive in Punjab and other agriculturalist states of India, the British government instituted various high-powered committees and gave them the mandate to assess the situation and come up with creative solutions. One such committee recommended that the British government form 'Cooperative Credit Societies' which can support farmers and other agriculturalists in meeting their credit needs. As a result, the first Cooperatives Act was passed in 1904, which was followed by another Act in 1912.[26] In the post-colonial India and Pakistan, these two acts still form the backbone of contemporary cooperatives movement, especially in the agriculture and housing sectors.

Agricultural Cooperatives

In Pakistan's rural Punjab, primary cooperative societies exist at the base or operational level, which solicit their funds from the Punjab Cooperatives Bank. The Punjab Cooperatives Bank, in turn, raises

[25] Virginie Pérotin, "What Do We Really Know about Worker Co-Operatives?", Co-Operatives UK, 2015, https://www.uk.coop/resources/what-do-we-really-know-about-worker-co-operatives.

[26] Khalid Mustafa and Zulfiqar Ahmad Gill, "Cooperatives and Development: Lessons from the Punjab Experience," *The Pakistan Development Review* 37, no. 4, Part II (December 1, 1998): 1017–30, https://doi.org/10.30541/v37i4iipp.1017-1030.

this sum of money from the Federal Bank of Cooperatives (FBC from now on), which was established in 1976 with a heavy mandate of supporting provincial cooperatives bank, conducting R&D on agricultural cooperatives, reviving the cooperative movement, resolving the credit issues of farmers and other agriculturalists, assisting the provincial cooperative banks in chalking out plans for seasonal lending, besides carrying out appraisals and feasibility studies for such programmes. However, the FBC has failed to deliver on most of its objectives and currently serves merely as a lender to provincial cooperative banks.[27]

With the establishment of the Agricultural Development Bank, alongside the entry of several commercial banks in the rural sector, the pool of potential credit supply to farmers increased. In fact, at the time of Pakistan's independence, the cooperative institutions were a major, if not the only source, of finance as they accounted for 98.33 percent of all loans provided. However, by 1997, this figure had fallen to 26.29 percent.[28]

The entry of private lenders was complemented by the government, which introduced a new scheme of loan provision at zero interest rates in the 1970s to support the cooperatives movement. On the surface, it appeared that there was sufficient credit in the system to meet the needs of every farmer, but unfortunately, many farmers

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[27] Government of Pakistan, *Report of the National Commission on Agriculture*, report (Islamabad: Ministry of Food and Agriculture, 1988); Federal Bank for Cooperatives Pakistan, "Federal Bank for Cooperatives Act 1977," Islamabad: FBC, 1977.

[28] PBS, "Agricultural Statistics of Pakistan," (Islamabad: Pakistan Bureau of Statistics, Government of Pakistan, 1975); PBS, "Punjab Development Statistics," (Lahore: Bureau of Statistics, Government of Punjab, 1986); and, PBS, "Punjab Development Statistics," (Lahore: Bureau of Statistics, Government of Punjab, 1998).

could not benefit due to corruption in cooperatives societies and political meddling.[29]

Despite government efforts over the years to promote and strengthen the institution of agricultural cooperatives, the overall participation rate of farming households in cooperatives remains relatively small. This is attributable to several factors. First, the supply of credit to agricultural cooperatives remains tight, even though the government introduced many schemes in the past to resolve this issue, as noted in a previous paragraph. Second, the government department dealing with cooperatives is remissive as it failed to mobilise rural households to join agricultural cooperatives. Third, large landowners and agriculturalists in Punjab have come to possess a disproportionate influence over primary cooperatives owing to their propitious terms and conditions that are in reality devised for small farmers. This observation is backed by evidence as well. Statistics show that only 1 percent of small farming households are registered with cooperatives, but this figure rises to 13 percent for households owning more than 148 acres of land.[30]

Housing Cooperatives

After the creation of Pakistan in 1947, millions of immigrants crossed the border to seek refuge in the newly created Muslim homeland. However, unfortunately, the state of Pakistan was not fully prepared to accommodate all of them and provide proper provisions in terms of food, clothing, and shelter. Left with no option other than to fend for themselves, many such refugees built their own mud houses in major urban centres, thus, creating squatter settlements or *katchi abadis* that were largely tolerated by the state. This vacuum, created by the impotency of the state, was filled by cooperatives that adopted a township approach of

[29] A Waheed, "The Role of Cooperatives in the Rural Development of the Punjab," (paper, National Institute of Public Administration, 1985).

[30] Government of Pakistan, "Rural Credit Survey," 1985.

developing land and building houses. The state, however, did provide large tracts of land (1200 acres according to one estimate) to cooperative societies for township development.[31]

Upon receiving a piece of land from the government, a cooperative society develops a housing scheme by carving out residential/ commercial plots and then leasing it to individual members. The provisions of basic amenities (like electricity, water, gas, etc.) are usually the responsibility of the city development authority, who are paid in full by the cooperative.[32]

The individual members of housing cooperatives are tenant-owners, similar to worker-owners in the WCs. The tenant-owners receive the registry of a plot contingent upon payment once the housing cooperative finishes developing the land. The tenant-owners are then authorised to construct a housing unit themselves but are required to follow the map and other construction regulations of the cooperative. The tenant-owners are also required to continue paying union dues as required by the Federal Government and stipulated in the land transfer agreement. Although the tenant-owners are rightful owners of their housing units, any transfer or sale/purchase is the purview of the housing cooperative.[33] The management of the cooperative is elected democratically on the principle of one tenant-owner one vote, and all the important decisions concerning the housing society are made collectively.

While the housing cooperatives in Pakistan are generally successful in developing land on a large-scale and filling in the vacuum created by the state's inability to provide houses; some cooperatives, in the past, have been guilty of corruption and mismanagement leading to their permanent ban by the state

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31 Coop, "Pakistan Archives," Cooperative Housing, Accessed July 7, 2021, https://www.housinginternational.coop/co-ops/pakistan/.

32 Ibid.

33 Coop, "Pakistan Archives."

authorities, hence, harming the reputation of other cooperatives as well, that were conducting their business with honesty and integrity. This shows that even cooperatives are not immune from misgovernance, ill-intentions, and greed, and therefore, prospective worker-owners or tenant-owners need to remain cautious. Table 1 shows the total number of cooperatives existing in Pakistan and their division in the agricultural and housing categories:

Table 1: Cooperatives in Pakistan

	Total Cooperatives	Housing Cooperatives	Agricultural Cooperatives
Punjab	2570	669	1,901
Sindh	3,605	1,275	2,330
Khyber Pakhtunkhwa	662	232	430
Balochistan	1,236	511	725
Total	8,073	2,687	5,386

Source: Cooperative Housing International.

WCs and Pakistan: A New Labour Policy

Having done a thorough review of cooperatives literature, this paper now returns to the research problem of this study, i.e., the ubiquitous unemployment issue in Pakistan - exacerbated by the COVID-19 shock - and its potential to create a security dilemma, and what to do about it.

After analysing in detail, the merits, effectiveness, and efficacy of WCs, especially in juxtaposition to capitalist firms, the paper now proposes a new 'National Worker Cooperative Labour Policy' for Pakistan, akin to the Italian Marcora Law. While referring to

Marcora Law, it is imperative to note that unlike Italy, Pakistan is not a welfare state that does not (and cannot) support its unemployed citizens via the mechanism of social security and unemployment benefits. It means that unlike unemployed Italians, unemployed Pakistanis cannot have access to the start-up capital needed to start a WC. However, inability to get equity capital from the state should not stop unemployed Pakistanis from setting up a WC, for there are other alternatives which are discussed in the subsequent section.

In the first step, the Federal Government can launch a national Cooperative Entrepreneurship Scheme titled *Khushhal Samaj* open to all Pakistani citizens but with preference given to unemployed youth, women, minorities, and people from periphery areas. Next, the government can provide training to enrolled people, educating them about all aspects of WCs. Note that this is a critical step as there is a considerable gap in information about cooperatives, and hence, is essential for any successful cooperative start-up. At the same time, this study recognises that Pakistan's government, at present, lacks the resources, technical expertise, and wherewithal to undertake the ambitious task of providing training and education for *Khushhal Samaj*. Fortunately, however, many bodies are active globally to provide support to budding WCs in the form of training, education, consultancy, and even sometimes venture capital. 'Working World', 'Democracy at Work', and 'International Co-operative Alliance' are examples of such organisations. So, as a next step, the Federal Government can partner with these organisations and develop an online interactive platform to dispense training and education. This can happen in the form of compulsory online courses (similar to Massive Online Open Courses [MOOC] format) and live training, which will also serve to connect enrolled students with their mentors.

Once the period of mandatory training and mentorship is over, the government can organise the participants into different groups based on their stated area(s) of business interest and region. This study's recommendation is a minimum of ten people in a group;

however, it can be adjusted based on the unique needs of a start-up and the conditions of the relevant industry or geographical region. The only important thing in this regard is to ensure the democratic structure of the proposed start-up, where all members work on the principle of 'One Worker, One Vote.'

The next step in this process will be securing funding for the start-up cooperative. This is where the participants of *Khushhal Samaj* will take a proactive role, with the government acting merely as the facilitator. Organised in groups, the participants of *Khushhal Samaj* will apply for business loans from various commercial banks of Pakistan. In doing so, the participants will follow all the rules, regulations, and procedures of Pakistan's banking system. For instance, they will still need to offer collateral and pay interest to the banks. However, the silver lining is that since they will be soliciting funds as a group, their burden will be shared, and risk will be significantly mitigated. This is the beauty of a WC as all aspects of the business - from risk to potential rewards - are equally shared and distributed. In addition, since the *Khushhal Samaj* is being proposed as a national level scheme of the Federal Government, the commercial banks can consider the loan application of participants on a preferential basis. The government can further incentivise banks by offering tax breaks to those banking companies which process the maximum number of loan applications of *Khushhal Samaj* participants.

This scheme still leaves out people from very low-income or marginalised backgrounds, i.e., those who cannot afford bank collateral, even in a partnership. In such cases, Catherine Mulder, a leading academic expert on WCs, recommends that the government itself should offer the banks (or other similar financial institutions) a guarantee on behalf of future worker-owners. In case they fail, the government can repay the bank or bail out the loss-making WC. This amount can easily be recovered by taxing other profit-making WCs, which will be up and running by that time, hence

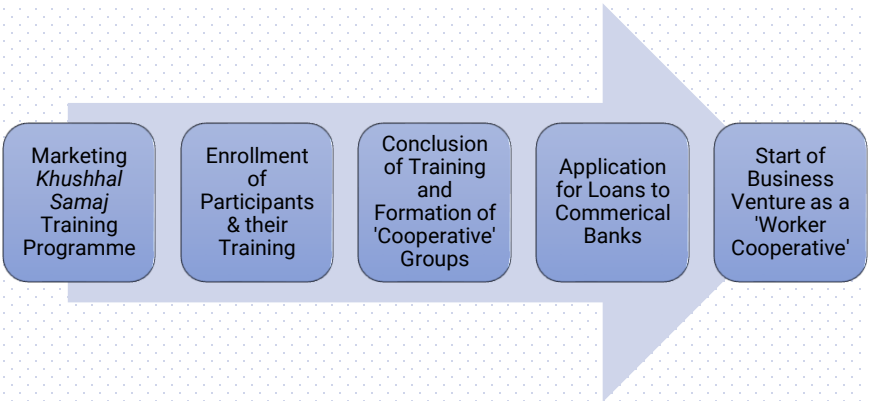
mitigating any loss to the national exchequer. Mulder[34] calls this 'reverse revenue stream' which is usually greater than the original amount lent in finance or as a bail-out.

While cooperative societies in housing and agriculture already exist in Pakistan, this idea has never been applied to start-ups, Small & Medium Enterprises (SMEs), and the corporate sector. And as the international best practices covered in the literature review reveal, cooperatives have enormous potential for job creation, quality output production, and inclusive profit generation without creating any negative externalities for the community in which they operate. Thus, it will be a unique and novel experience in Pakistan's labour market to create and promote an organisation type that simultaneously balances the social mores of democracy, egalitarianism, and collectivism with economic considerations of profit-making and employment creation.

Lastly, it should be noted that even as of this writing, the Federal Government of Pakistan is running a youth entrepreneurship programme *Kamyab Jawan* aimed at inculcating entrepreneurial skills among the unemployed and disadvantaged youth. It works by first providing enrolled students online training and then referring them to commercial banks to solicit funds. The *Khushhal Samaj* programme will complement *Kamyab Jawan* in dealing with the menace of unemployment, which is increasingly posing an ominous threat to Pakistan's social fabric and internal security. While *Kamyab Jawan* embraces the principle of individual entrepreneurship, *Khushhal Samaj* will espouse community-based entrepreneurship, and together they can eliminate the scourge of unemployment from Pakistan.

[34] Catherine P. Mulder, *Transcending Capitalism through Cooperative Practices* (New York: Palgrave Macmillan, 2015).

Figure 4: *Khushhal Samaj* Summary Schema



Source: Author's own.

Conclusion

Pakistan is at a crossroads. On one hand, it has the highest birth rate in South Asia, and on the other hand, it has the lowest Human Development Index (HDI) in the region, making it poorly equipped to deal with economic challenges, in particular, poverty and unemployment. Besides, any exogenous shock, such as a natural disaster, epidemic, financial crash, and so on, further exacerbates the economic conditions making life more challenging for Pakistani people. This was evident recently when the COVID-19 pandemic broke out early in March 2020. As a result of this pandemic, close to 1 million Pakistanis lost their full-time jobs, and many more were threatened to slip into poverty. It further adds to the troubles of millions of Pakistanis - especially the youth - who were already struggling to get jobs even before the pandemic began. If this situation is not accounted for immediately, then it can lead to social unrest, as poverty and unemployment pose serious security challenges.

To address this challenge, this paper presents a hitherto untested labour policy of generating employment by promoting a community-based entrepreneurship programme. Known as

Khushhal Samaj, this plan aims to foster self-reliance in youth and other unemployed people by setting up Worker Self-Directed Enterprises (WSDEs), also known as 'Worker Cooperatives' (WCs).

WCs are well-represented both in theory and practice. For instance, available research on cooperatives suggests that they are more efficient, less unequal, counter-cyclical, and more resilient than the alternative capitalist styled firms. In addition, they also preserve jobs better in a business cycle downturn. The Mondragon Cooperatives Corporation (MCC) of Spain serves as the international best practice of a cooperative, while the Marcora Law of Italy shows the way forward for a successful public policy revolving around WCs. Thus, in this backdrop, it is hoped that the *Khushhal Samaj* workers cooperative or community entrepreneurship programme will become an engine of business growth and employment generation in Pakistan while simultaneously assuaging any security concerns that may otherwise arise owing to redundancy and lack of respectable employment.

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Impermanence of Deterrence Regime: A Cause of Tactical Instability in South Asia

Dr Zia Ul Haque Shamsi

Abstract

The overt nuclearisation of South Asia led to the notion that an all-out conventional war between India and Pakistan was a distant probability, whereas, limited wars on the periphery may not be avoidable between the arch-rivals. Perhaps, to further marginalise the probability of limited wars, which could have serious consequences for regional peace and stability, Pakistan developed sub-kiloton Tactical Nuclear Weapons (TNWs). However, India could not be deterred and Balakot happened. Pakistan's response was prompt and fearless despite India's military capabilities. The Pakistan Air Force's performance in the aerial engagement against the Indian Air Force (IAF) on 27 February 2019, deflated India's dream of punishing Pakistan for its alleged support of the freedom struggle in Jammu & Kashmir (J&K). This paper is aimed at investigating the failures of deterrence regime at the tactical level between India and Pakistan, and the consequences of tactical instability at the strategic level in South Asia.

Keywords: Nuclear Deterrence, Strategic Stability, Tactical Instability, Balakot.

Introduction

South Asian rivals: India and Pakistan view each other's nuclear capabilities through different lens. India assumes that Pakistan's nuclear capability is aimed against its conventional and nuclear capability only and considers that its capacity to wage hybrid war remains relatively unguarded. India's assessment in this regard proved efficacious, particularly in the last two decades, until the Pulwama incident happened on 14 February 2019, in which a Kashmiri youth carried out a suicide attack on India's paramilitary convoy killing more than 40 soldiers. Contrarily, Pakistan views India's conventional as well as nuclear capability workable against its own similar capabilities, but without any space for an all-out conventional or nuclear war, regardless of duration and intensity.

At the strategic level, both India and Pakistan seemingly respect each other's military capabilities, but at the operational and tactical level, the arch-rivals keep testing each other's resolve through limited military engagements. Perhaps, leadership of the two nuclear neighbours is willing to take risks without due regard to the consequences of a military conflict in a nuclearised environment. This paper is based on ground realities of South Asia's security environment, particularly since the overt nuclearisation of the region in May 1998.

Theoretical Principles on Deterrence

The theoretical writings on deterrence suggest that 'nuclear weapons make war unwinnable if both sides have second-strike capability, since either side could utterly destroy the other after absorbing an attack.'[1] Because, 'deterrence depended on the ability

[1] Herman Kahn and Thomas C. Schelling, quoted in John A. Vasquez "The India-Pakistan Conflict in light of General Theories of War, Rivalry, and Deterrence," in *The India-Pakistan Conflict: An Enduring Rivalry,* ed. T.V. Paul (New Delhi: Cambridge University Press, 2006), 73.

to convince aggressors that a military offensive….would be frustrated.'[2]

In fact, 'Deterrence can be a technique, a doctrine and a state of mind. In all cases it is about setting boundaries for actions and establishing the risks associated with the crossing of those boundaries.'[3] Also, '……deterrence is mental. For deterrence to work you have to get inside your adversary's head.'[4] This implies that 'Operational Preparedness' by a state under threat must be to its fullest capacity and its only purpose should be to deny the enemy its mischievous and unjust objectives. Therefore, it was natural for states to quickly gain access to nuclear weapons' capability, especially when they saw its highly destructive power that nearly erased the Japanese cities of Hiroshima and Nagasaki on 6 and 9 August 1945, respectively.

'Deterrence is persuading an adversary (usually by threat) not to take action.'[5] However, for deterrence to be effective, it is necessary that it is credible, and clearly communicated to the adversary of the consequences of its undesired actions. The primary objective revolves around preventing the adversary from using its kinetic means against the deterrent state through credible signalling, posturing, and preparation. The concept was adequately propagated and understood as, 'dissuading someone from an action by frightening that person with consequences of the action…. Deterrence depends on what one can do, not on what one will do.'[6]

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2 Lawrence Freedman, *Deterrence* (Cambridge: Polity Press, 2004), 38.

3 Ibid., 116.

4 Ward Wilson, "Deterrence in the 21st Century," (paper, UK Parliament, Written Evidence, Session 2013-14, November 20, 2013), https://publications.parliament.uk/pa/cm201314/cmselect/cmdfence/writev/deterrence/dic11.htm.

5 Ward Wilson, "The Myth of Nuclear Deterrence," *The Nonproliferation Review* 15, no.3 (November 2008): 421-439.

6 Kenneth N. Waltz, "Nuclear Myths and Political Realities," *American Political Science Review* 84, no.3 (September 1990): 732-745.

In fact, it is the impermanence of the deterrence regime that makes its application unique.

South Asia's Conundrum

India challenged Pakistan's nuclear opacity and carried out multiple tests in May 1998. Pakistan responded without any delay with more tests to join the de-facto nuclear club. India received the message and Prime Minister Vajpayee undertook the 'Bus Diplomacy' visit to Pakistan's second largest city of Lahore through Wagah land border where he was received by then-Prime Minister Nawaz Sharif. At the conclusion of talks on 21 February 1999, the landmark 'Lahore Declaration' was signed in which both sides agreed to intensify joint efforts on all issues, including Jammu and Kashmir.[7] However, before the 'Lahore Declaration' could be executed, the Kargil Conflict[8] took place, which certainly surprised India.

On 10 August 1999, India shot down Pakistan Navy's Atlantique reconnaissance aircraft in Sir Creek area.[9] The incident further raised the level of tension between India and Pakistan, however, it failed to catch the attention of the West, especially the United States (US) due to 9/11. This event had major impact on the regional security environment, which were exploited by India to hurt Jammu & Kashmir's struggle for self-determination by declaring the Kashmiri freedom movement as 'terrorism'.

As the US was preparing to launch 'Operation Enduring Freedom' in Afghanistan to punish the Taliban government for its alleged support to al-Qaeda in October 2001, a group of Kashmiri freedom fighters

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7 UN Nations Peacemaker, "Lahore Declaration," (February 21, 1999), https://peacemaker.un.org/indiapakistan-lahoredeclaration99.

8 The Kargil Conflict 1999 occurred when Pakistani troops occupied the vacant Kargil Heights during the winter months.

9 The Atlantique Incident was an event in which a Pakistan Navy Atlantique patrol plane, carrying 16 people on board, was shot down by the Indian Air Force for alleged violation of airspace. The episode took place in the Rann of Kutch area on 10 August 1999.

attacked the Indian Parliament on 13th December the same year. India blamed Pakistan for the attacks and demanded that Pakistan curtail the activities of Lashkar-e-Tayyaba (LeT) and Jaish-e-Mohammad (JeM).[10] Pakistan immediately condemned the terror attacks on the Indian Parliament, but India initiated huge military build-up on its borders with Pakistan to coerce the latter into taking serious punitive actions against the alleged terror outfits. The year-long standoff between Indian and Pakistani forces brought the nuclear neighbours to the brink of an all-out war.

The progress of India's nuclear doctrine was reviewed by the Cabinet Committee on Security (CCS) which met on 4 January 2003. India's nuclear doctrine revolves around the concept of 'No First Use' against Non-Nuclear Weapon States (NNWS). However, it promises massive nuclear retaliation against a nuclear strike on its territory or its forces anywhere.[11] Whereas, Pakistan's nuclear doctrine is based on credible nuclear deterrent with no commitment towards non-use of first use in the aftermath of a massive conventional attack (by India). It now rests on comprehensive deterrence and its development of TNWs is to ward off threats from India's larger military force.[12]

However, these prevalent concepts on deterrence regimes as a strand of strategy have, outlived their utility over the years and need

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[10] P.R. Chari, Pervaiz Iqbal Cheema, and Stephen P. Cohen, *Four Crises and a Peace Process: American Engagement in South Asia* (Washington, D.C.: Brookings Institution Press, 2007), 152.

[11] Prime Minister's Office, "Cabinet Committee on Security Reviews Progress in Operationalizing India's Nuclear Doctrine," (January 4, 2003), https://archive.pib.gov.in/archive/releases98/lyr2003/rjan2003/04012003/r040120033.html.

[12] "Pakistan needs Short-Range Nukes for Deterrence against India: Govt Advisor," *Dawn*, March 24, 2015, http://www.dawn.com/news/1171574/print/print.

to be studied for their practicality,[13] particularly in South Asia's context. Although, the respective nuclear doctrines of the Cold War rivals - the US and former USSR - maintained strategic stability and the two superpowers did not engage militarily directly, however, proxy wars continued around the globe.[14] It is argued that, 'New nuclear states such as India and Pakistan are, inevitably, drawn towards nuclear war by their need to undertake low-level aggressive actions to maintain the credibility of their nuclear forces.'[15]

Therefore, for deterrence to be effective, it is necessary that the deterrent can create doubt in the mind of the adversary, about the resolve to eliminate it, without which the adversary will not be deterred. This is for a situation where one is on the offensive. However, if one is on the defensive, even then, one must be able to create doubt in the mind of the adversary that one does not care about the life and property of its citizens, and therefore, will leave no stone unturned, should the situation so arise and eliminate the adversary after surviving a first strike or even attacking it pre-emptively.

While one is striving to create doubt in the enemy's mind, it is important that one has no doubt in one's own mind that one will act regardless of the consequences if vital national interests are threatened, no matter how strong the enemy is. For example, Pakistan's then-Prime Minister Imran Khan's warnings to India in the post-Pulwama environment that 'Pakistan will not think but act in the same way to India's misadventure,' were not taken seriously by India's Prime Minister Narendra Modi and Balakot happened. However, once Pakistan lived up to its leadership's resolve and

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[13] Zia Ul Haque Shamsi, "Nuclear Deterrence and its Nuances," *Daily Times*, February 13, 2021, https://dailytimes.com.pk/723318/nuclear-deterrence-and-its-nuances/.

[14] Korean war (1950-53), Vietnam War (1955-75), Arab-Israel War (1973), Soviet Afghan War (1979-89), to mention a few.

[15] James Lo, "Nuclear Deterrence in South Asia: Theory and Practice," *International Journal* 58, no. 3 (Summer 2008): 395-414.

Pakistan Air Force (PAF) shot down two Indian Air Force (IAF) fighter jets the very next day, Prime Minister Modi must have realised the importance of the warnings.[16]

The lack of clear understanding at the leadership level about the concept of deterrence is perhaps one reason for its failure as a strategy of war and conflict avoidance. Leadership, particularly in developing countries, fails to understand the concept, and therefore get engaged in violent conflicts with equal opponents as well as unequal adversaries.[17] It is necessary that academia takes the lead to drive home the concept of deterrence and its efficacy as a strategy of war and conflict avoidance, as was initially envisaged by Bernard Brodie.[18]

Therefore, there is a need to do things differently and introduce a new theory of '***Ready Deterrence***,' to create doubt in the adversary's mind. However, the theory of 'Ready Deterrence' by no means proffers deployment of nuclear weapons, not even Low Yield Weapons (LYWs). Its main purpose is to ensure that no nuclear state undertakes any misadventure against another nuclear state; no matter how limited it is in scope and intensity.

The idea of 'Recessed Deterrence' was coined by Indian strategist Jasjit Singh, who defined it as, 'credible nuclear weapons capability which a country is able to draw upon for political and diplomatic purposes, and is able to deploy a nuclear arsenal within a defined

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[16] "Pakistan PM Imran Khan promises Action if India shows Pulwama Proof, Warns against Any Rash Move," *Economic Times*, February 19, 2019.

[17] Iraq's President refused warnings of dire consequences for his invasion of Kuwait on 2 August 1991. Likewise, the Taliban government of Afghanistan failed to read the post 9/11 environment and suffered another invasion by a superpower, the United States.

[18] Bernard Brodie, ed. *The Absolute Weapon* (New York: Harcourt, Brace & Company, 1946), 69.

time-frame and effectively use it physically for military purposes.'[19] Whereas, the concept of 'Non-weaponised Deterrence' was proffered by George Perkovich with a view that, 'that the two parties could retain fissile materials and nuclear weapon components but would stop short of manufacturing warheads.'[20]

The primary purpose of the above theories was to keep the nuclear equation out of contention to avoid any miscalculation, accidental firing, and ensure the safety and security of these dangerous tools during any conventional military conflict. The theory of 'Ready Deterrence' aims to counter 'Recessed Deterrence' and Non-weaponised Deterrence.' These theories heavily favoured India, which is a five times larger conventional power than Pakistan. Therefore, the theory of 'Ready Deterrence' looks to ensure that no military engagements take place at all for the fear of escalation resulting in an unthinkable nuclear exchange. This theory is aimed at creating fear and terror of Pakistan's diverse nuclear weapons programme in the heart and mind of the adversary, and who can go to any length in creating a space for war to punish the adversary for its alleged involvement in cross-border interventions.

Table 1 further explains the basic difference between the three theories dealing with deterrence regimes in the South Asian context:

[19] Debalina Ghoshal, "India's Recessed Deterrence Posture: Prospects and Implications," *The Washington Quarterly* 39, no. 1 (January 2016): 158-170.

[20] George Perkovich, "Non-Weaponized Deterrence: The Case of Pakistan," *Strategic Studies* 17, Special Issue (Autumn & Winter, 1994): 138-169.

Table 1: Contemporary Deterrence Theories for South Asia

Authors	Theories	Core Concept
George Perkovich	Non-weaponised Deterrence	'… two parties could retain fissile materials and nuclear weapon components but would stop short of manufacturing warheads.'
Jasjit Singh	Recessed Deterrence	India must develop 'credible nuclear weapons capability which a country is able to draw upon for political and diplomatic purposes, and is able to deploy a nuclear arsenal within a defined time-frame and effectively use it physically for military purposes …'
Author	Ready Deterrence	Pakistan must be prepared for an early interface of its nuclear arsenals to ensure its territorial integrity and sovereignty against the five-times larger conventional Armed Forces of India.

Source: Author's own.

Perhaps, it is for this purpose that India is not interested in the resolution of long-standing disputes with Pakistan, including the doable Siachen and Sir Creek,[21] so that it has a reason to initiate hostilities at the time and place of its choosing. In order to counter the ongoing negative narrative, it is incumbent upon Pakistan to do things differently and only what is in its best national interest.

If Pakistan's leadership thinks that by adopting 'Ready Deterrence', it may be put it in the West's bad books, one needs to remember that the country has been there ever since it developed nuclear capability. Moreover, policymakers must understand that appeasement is failed strategy as it fails to hammer in its declared nuclear policy and fails to avert a war with India, no matter how limited, and then during military engagement, it opts for adopting a nuclear posture.

Therefore, the significance of PAF's successful action against IAF under 'Operation Swift Retort', which led to the re-establishment of the deterrence regime, cannot be over-emphasised. PAF's action was in line with the principles of deterrence, which lays greater emphasis on credibility than on capability. Perhaps, it is necessary to underscore that if the deterrence lacks credibility in its pronouncements or the intent of the leadership, it loses its effectiveness, because the adversary would not be deterred by mere rhetorical onslaught.

Pakistan's leadership was cognizant of the fact that failure to respond to Indian aggression would mean a sign of weakness, thus, paving the way for repeated aggression. In that situation, it would have become extremely difficult to re-establish deterrence against a five-times larger adversary which has offensive designs. Moreover, had the PAF not responded on 27th February - the next

[21] Zia Ul Haque Shamsi, *Nuclear Deterrence and Conflict Management between India and Pakistan* (New York: Peter Lang Publishing Inc., 2020), 41-63.

day of India's Balakot strike -there would have been numerous surgical strikes by Indian Armed Forces in different forms and at different times and places, because India's hard-line Modi government would have felt emboldened by the weakness shown by Pakistan. By doing so, India would have embarrassed Pakistan's Armed Forces as and when it wanted, and regularly tested Pakistan's resolve and capability to respond. In either case, Pakistan would have been forced to both succumb to India's pressure and give up its support to Kashmir's freedom movement, or retaliated irrationally to India's strikes, thus, leading to conflict escalation. However, Pakistan's decision to level the account immediately a day later is similar to its response against India's surprise nuclear tests of May 1998.

Application of 'Ready Deterrence' in South Asia

Both India and Pakistan have acted in accordance with the precepts of 'Ready Deterrence' at different occasions. Pakistan, in May 1998, responded to India's nuclear tests immediately, thereby proving its readiness to respond correspondingly to any evolving situation. India, during the Kargil conflict, retaliated to Pakistan's ingress across the Line of Control (LoC), and did not rest until Pakistani troops started to withdraw as per the understanding reached between then-US President Clinton and Prime Minister Nawaz Sharif after the 4 July 1999 Kargil Summit at the Blair House.

Again in 2019, Pakistan re-established deterrence by adopting the 'Ready Deterrence' approach when India crossed the international border on the night of 25-26 February. In fact, then-Prime Minister Khan had sent a clear message to Prime Minister Modi that Pakistan would not think rather act, if India undertook any misadventure.[22] However, Modi miscalculated Khan's resolve and

[22] "Pakistan PM Imran Khan promises Action if India shows Pulwama Proof, Warns against Any Rash Move," *Economic Times*.

initiated a deep thrust attack on mainland Pakistan in the middle of the night. Although, IAF's mission failed to inflict any damage to life and property in the general target area, Balakot, barring a few trees, Pakistan's response was in line with the precepts of 'Ready Deterrence.' Next morning, on 27 February 2019, PAF carried out multiple strikes in broad daylight and also shot down two IAF interceptors in the process.

Looking at the historical account of the Cuban Missile Crisis (CMC) of 1962, Modi's miscalculation of Khan's resolve is similar to that of Soviet leader Khrushchev's assessment about US President Kennedy. The Soviet leader assumed that Kennedy being young and inexperienced, would perhaps not take any extreme action against Soviet placements of Medium Range Ballistic Missiles (MRBMs) on Cuban soil. However, Khrushchev failed to realise that the US leadership does not operate in isolation. It has an organisational process for strategic decision-making. Kennedy, soon after getting reports of Soviet missiles on US shores set up an Executive Committee (ExComm), which dealt with the crisis in an organised manner.

Likewise, former PM Khan had not issued a warning of retaliation to India's impending aggression following the Pulwama[23] incident in isolation, rather did so after consultations with the National Security Committee after the incident happened.

Pakistan, on multiple occasions and multiple tracks, has tried to convince India that there is no space for war between the two nuclear neighbours, no matter how tense the relations are, and all disputes, including that of J&K, need to be resolved through dialogue.[24] For this, Pakistan remains open to dialogue, either

[23] A Kashmiri youth, Adil Ahmad Dar carried out a suicide attack on a convoy of Indian paramilitary police in Pulwama, on 14 February 2019, killing at least 40 soldiers.

[24] Imtiaz Alam, "In letter to PM Modi, Pakistan's Imran Khan makes Fresh Appeals," *Hindustan Times*, June 8, 2019.

bilaterally or through the active participation of international players, and organisations. India's doctrinal developments, aimed at pushing Pakistan against the wall, particularly in an environment of ever-increasing conventional asymmetry and economic disparity, somehow compelled Pakistan to develop Low Yield Weapons (LYWs), or non-strategic weapons, to plug the gap in respective capabilities.[25]

India aspires to play a leading role in the region for which it has developed strategic partnerships with the US. India may punish Pakistan for its support to Kashmiris' struggle for self-determination, to break the status quo. To counter India's designs, 'Pakistan may pre-empt India's strategy of attempting a kill through non-kinetic means, which could be supplemented by limited physical force at an opportune time, under the influence of Pro-active Operations (PAO).'[26]

Pakistan desires to move on and improve its relationship with India in the entire spectrum of international relations. However, India has threatened Pakistan of massive nuclear retaliation[27] if the state contemplates using LYWs against invading forces, in case its armed forces are unable to withstand the massive conventional force asymmetry.

Conclusion

Deterrence of any kind, type, and substance has a shelf life. Perhaps, this is one reason that deterring states as well as the deterred state keep on doing things differently to maintain or dilute the effects of deterrence, respectively. South Asia's situation is no

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[25] "Pakistan needs Short-Range Nukes for Deterrence against India: Govt Advisor."

[26] Shamsi, *Nuclear Deterrence*, 126.

[27] Ali Ahmed, "The Direction of India's Deterrent," Institute of Peace and Conflict Studies, September 30, 2011, http://www.ipcs.org/focusthemsel.php?articleNo=3471.

different. From No First Use (NFU) to massive retaliation for India,[28] and minimum nuclear deterrence to all-spectrum nuclear deterrence for Pakistan,[29] South Asian arch-rivals have been changing the goalpost to draw the maximum benefit of their nuclear capability. Rightly so because a war of any nature and character between the two nuclear neighbours would not remain localised, and therefore, may expand beyond borders.

Perhaps India and Pakistan understand the consequences of a nuclear conflict between them,[30] but what they do not understand is the seriousness of a limited war on the periphery, which may expand horizontally as well as vertically. The probability of an all-out military confrontation between the two nuclear neighbours may be limited but would have far-reaching consequences if started.

It is argued that 'states with nuclear weapons do not go to war with each other.'[31] The border skirmishes between the erstwhile Soviet troops and China's border security forces alongside Ussuri River[32] in 1969 was not considered serious enough to be declared as a war between the two nuclear states.

Likewise, the Kargil conflict of 1999 between India and Pakistan remained localised and did not expand horizontally or vertically, to cause alarm for the theorists proposing that nuclear powers do not

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28 Ibid., quotes Chairman Joint Chief of Staff Committee General Padmanabhan.

29 "Pakistan needs Short-Range Nukes for Deterrence against India: Govt Advisor."

30 Wilson, "The Myth of Nuclear Deterrence."

31 Baya Harrison, "Fallout at Kargil: The Nuclear War that Never Was," *Monsoon-Asian Journal of Brandeis University* III, no. 2 (2005), https://people.brandeis.edu/~monsoon/articles/harrison_kargil.htm.

32 The Sino-Soviet border conflict was a seven-month military conflict between the Soviet Union and China at the height of the Sino-Soviet split in 1969.

fight wars directly. However, the enduring rivalry between India and Pakistan causing limited military engagements at regular intervals amply prove that while nuclear weapons may act as deterrents at the strategic level, they cannot guarantee tactical stability in the presence of unresolved disputes. Lodhi argues that 'deterrence is not always a factor for stability as claimed by some.'[33]

Nuclear deterrence regimes failed to avert limited military engagements on the periphery,[34] and hence, raises the probabilities of Pakistan's nuclear posturing through LYWs for the purpose of re-establishing intra-war deterrence. The same may be construed by India as a possible first-use of these weapons by Pakistan. This may lead to India's nuclear posturing to deny Pakistan's first-use of these weapons, thereby initiating an unthinkable nuclear exchange by both, either concurrently in anticipation or one after another in retaliation.

Most analysts believe that 'nuclear crises are repetitive in South Asia because their outcomes are not decisive. Until a process of reconciliation is underway, the next crisis always waits in the wings.'[35] In fact, peripheral disputes, Sir Creek, and Siachen, are perhaps an outcome of one core dispute of J&K, which 'remains one of the most enduring and unresolved conflicts of our times.'[36]

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[33] Maleeha Lodhi, "The Kargil Crisis: Anatomy of a Debacle," *Newsline* (July 1999): 1-6.

[34] Kargil Conflict (1999), military standoff between India and Pakistan (2001-02), Balakot strikes (2019), to mention a few.

[35] Michael Krepon, Rodney W. Jones, and Ziad Haider, ed. *Escalation Control and the Nuclear Option in South Asia,* (Washington, D.C.: Henry L. Stimson Center, 2004).

[36] T.V. Paul, "Causes of India-Pakistan Enduring Rivalry," in *India-Pakistan Conflict: An Enduring Rivalry,* ed. T.V. Paul (New Delhi: Cambridge University Press, 2006), 3.

The situation in South Asia remains uncertain. The two nuclear neighbours do not have full diplomatic presence in each other's countries, and do not miss an opportunity to target the opponent on world fora. The dialogue process to look for a negotiated settlement of any of the protracted conflicts has been discontinued since India unilaterally annexed the state of J&K on 5 August 2019, hence, raising the probability of a repeat of Kargil, Pulwama, and Balakot.

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BOOK REVIEWS

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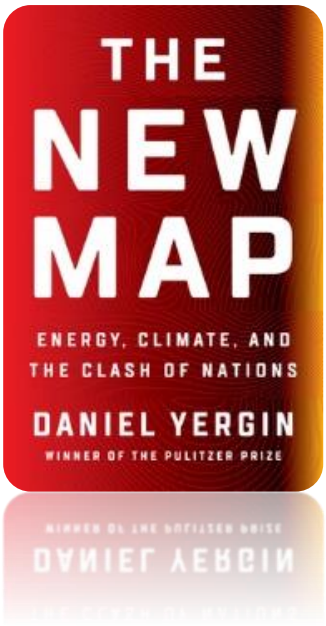

Daniel Yergin, *The New Map: Energy, Climate, and the Clash of Nations* (New York: Penguin Press, 2020).

Reviewed by Ali Haider Saleem
Former Researcher, Centre for Aerospace & Security Studies, Islamabad, Pakistan

Rapid expansion of the global economy since the Industrial Revolution has stretched natural resources and altered the nature of conflicts. Fossil fuels have been the main contributor to environmental degradation, but they are also the key enablers of economic activity. In an increasingly multipolar world, many countries are trying to extend their sphere of influence, thus, enhancing the impulse to ensure steady supplies for the future. The need to secure natural resources is creating new alliances and triggering disorder. Moreover, regions with proven energy reserves continue to be embroiled in power struggles. In this book, Daniel Yergin, a Pulitzer award winner for his previous work on oil industry, attempts to explain how the recent developments related to energy markets and climate change will shape the new global order.

A book like this covering various dynamics of modern-day conflicts was essential as the nature of conflict has evolved and encompasses a wide range of factors. It is a rare contribution that has given climate change its due consideration in terms of understanding future clashes. Moreover, many of his assertions have turned out to be true since the publication of this book. The

tussle between the Organization of the Petroleum Exporting Countries (OPEC) members over production quotas, growing militarisation of South China Sea and the fallout of United States' withdrawal from Afghanistan indeed indicate that instability will persist as both state and non-state actors engage in military confrontations.

The oil embargo imposed on the US after the Middle East war brought economic misery to the States. The severity of the crisis led US officials to introduce new speed limits on highways to bring down fuel consumption in the country. Yergin understandably begins this book by covering the shale oil revolution in the US which has made it an oil independent country. Even before the shale revolution, the US' dependence on Middle Eastern oil had considerably fallen after discovery of oil in Alberta, Canada. The author also explains that the reasons behind Washington's continued engagement in the Middle East are not primarily due to securing oil supplies but for maintaining its influence on the countries that supply the commodity to its rivals.

Yergin discusses a number of scenarios impacting the geopolitical landscape. China's Belt and Road Initiative (BRI), Washington's 'Indo-Pacific Strategy', Russia's growing interest in the East and changing energy market dynamics in light of climate change impacts are some of the key topics he refers to. The book covers the hostility between the West and Moscow and how President Putin aims to restore Russia as a great power globally. It explains how the Russian annexation of Crimea was part of the Kremlin's strategy to counter Western influence in the region and bring together countries of the former Soviet Union inside a common economic space under its leadership.

According to Yergin, BRI was launched to counter Washington's 'pivot' to Asia and a key part of the strategy was to march towards the West and expand its economic clout (p.182). In order to contain China, the US is aiming to strengthen economic ties with its traditional partners and the launch of Build Back Better World (B3W) further backs up Yergin's argument. The contentious nature

of the South China Sea was one of the factors behind Chinese investments in Pakistan. The development of Gwadar Port and road networks to connect Xinjiang will provide safer and shorter route for trade between China and majority of its partners. More importantly, Chinese access to Middle Eastern oil will not be hampered by the growing US presence in South East Asia.

Given the intertwined nature of modern conflicts, CPEC's route became controversial as India objected that it passed through disputed territory. CPEC related developments have partially contributed towards increasing clashes in the Jammu & Kashmir region and has forced China to be more assertive against India. The book also highlights how India is strengthening ties with countries like US, Japan and Australia to counter China's rise but he argues that for many countries 'there is advantage to attaching themselves to a rising China' (p.190).

India's territorial disputes with China and Pakistan have a long history and they continue to shape New Delhi's relations with its neighbours. Such disputes are also prevalent in the Middle East. The book gives a historical account of various conflicts in the region and how the discovery of oil elevated its position on the world map. Oil was also a source of conflict within the Middle East. Saddam Hussein was determined to redraw the region's map and seize oil resources of his neighboring countries (p. 214). His ambitions led to the formation of a 34-nation strong coalition to counter Iraq and the resulting conflict has had a lasting impact on Middle East's security dynamics. Further, the book describes how the quest for energy resources turned Middle East into a battleground and adds that recent discoveries have raised the significance of South China Sea. It explains how the region will become more contentious with growing possibilities of a direct conflict between the US and China.

The concluding chapter is titled 'The Disrupted Future' where the author discusses the fragmented global order and a new Cold War. According to him, the world order depends on China and the US who are increasingly at odds. China is challenging US dominance in

every sphere and the Thucydides' Trap is a fitting description for the current state of global affairs. Moreover, Yergin adds that fast paced innovations, the global pandemic and climate change are having considerable influence on international relations. To maintain their dominance, major powers have to adapt to changing trends as new technologies will shape the future map of energy and politics (p. 429).

This book is a useful resource for those interested in understanding the origins of some of the major global conflicts and how the future of our planet will shape up. To limit further deterioration of global peace and order, it is advisable to learn from history while taking scientific evidence and climate change realities into consideration.

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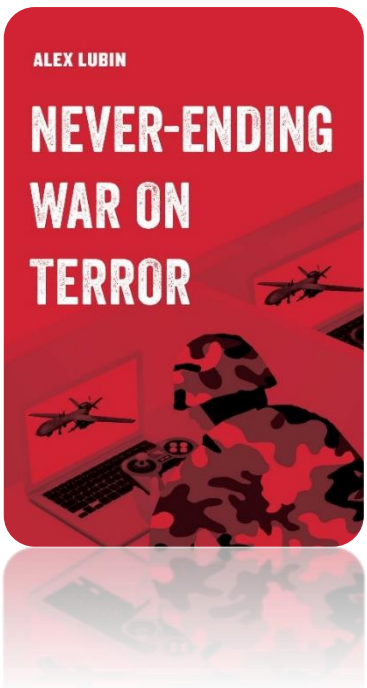

Alex Lubin, *Never-Ending War on Terror* (Oakland: University of California Press, 2021).

Reviewed by Abdullah Rehman Butt
Former Researcher, Centre for Aerospace & Security Studies, Islamabad, Pakistan

The roots of the War on Terror (WoT) can be traced back to the September 2001 terrorist attacks on the United States (US). The aftermath the counterterrorism policy of the US administration fails to provide a legal framework of conducting military operations and fails to outline a timeline about when such a war would end. Alex Lubin, Professor of African American Studies at Penn State University, in his book, 'Never-Ending War on Terror', has tried to deconstruct the US strategy and objectives behind the WoT. Lubin believes that the WoT has been nothing more than an attempt at continuity of American exceptionalism and its policy of legalising extrajudicial incarceration and assassination of so-called terrorists. Moreover, it is argued in the book that WoT was not only a kinetic conflict but launched with the purpose of cultural transformation and expansion of US national security. In short, the author has tried to unveil historical myths about American national and imperial identity and how American political elite have manipulated the term to form narratives to renew the country's imperialist designs, especially after the end of the Cold War.

The book can be divided into five primary themes. First, it identifies how 9/11 was used to infuse hatred against the perpetrators of the attacks. Second, it focuses on explaining the concept of homeland security, redefining norms of the privacy of US citizens, and the misuse of executive power within the US under section 15 of the 'US Patriot Act' (p. 57). Third, it discusses the human rights violations during the WoT in the light of the Geneva Convention and condemns the legitimisation of torture by the US administration. Fourth, it discusses the role of media in promotion of American nationalism. Fifth, the book also highlights the use of drones for extrajudicial killings as another change in liberal values under the Obama Administration. Lubin criticises the alteration of 'American political culture' by the last three administrations and notes that 'The United States has the right to kill without legal restraint whomever it chooses in the name of fighting terrorism' (p. 108).

In short, the main argument put forth in the book is that the US counterterrorism policy has proved contrary to its normative and liberal framework as the 9/11 attacks have provided American political elite the opportunity to justify and hide their illegitimate actions under the cover of the WoT. In this regard, the media played a complementary role by promoting American nationalism as well as the righteousness of a military response.

Lubin believes that the WoT is couched in several mistruths that have justified its continuation. Some of these mistruths include targeting Iraq as the home for Weapons of Mass Destruction, (WMDs) as well as connections that were alleged between the Saddam Hussein regime and the 9/11 attacks, as well as the mistruths that were used to justify continued conflict in Afghanistan (pp. 3-4). In short, throughout his book, the author has focused on the contradictions in the American norms and notions that were and are forced upon other nation-states to wage war.

One of the main strengths of this book is that it provides an unbiased and critical overview of how the US perpetuated opaque practices through coercion or persuasion and in so doing has caused irreparable damage to values like liberty and freedom of

expression which are touted as the foundation of the country's democracy. On the other hand, despite critiquing the narrative of WoT, the author is unable to fully dissect this apparent US agenda of 'never-ending wars' and the legality of such wars from an international humanitarian point of view. Moreover, the book only discusses the timeline of events after 9/11 referring to it as the basic cause behind the global WoT. What is missing is how this 9/11 narrative, promoted by the US, has also provided other countries with the option to achieve their objectives while playing within its realm. The ambiguity in explaining the narrative of this war has created complex challenges from a security perspective since there is now no universally accepted definition of 'terrorism.' Moreover, promotion of such a narrative itself has been harmful not just for American society as it has further strengthened radicalisation, polarisation, and used to justify acts of state violence (p. 29), but also countries in every part of the world.

This book is an insightful read for undergraduates and professionals who want to understand the foundations of the WoT. It can be a good addition in think tanks and university libraries to help students and academics deconstruct the implicit motives behind this war. This book is also recommended for media personnel to understand the power of media in promoting (hyper)nationalism and constructing/manipulating peoples' belief system.

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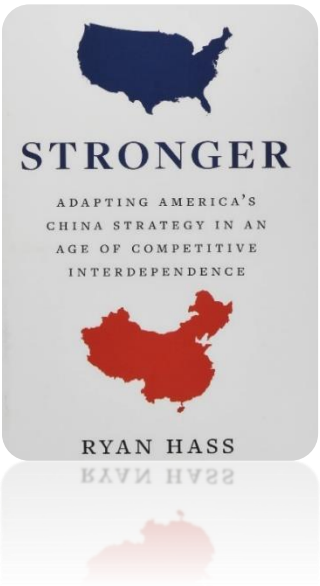

Ryan Hass, *Stronger: Adapting America's China Strategy in an Age of Competitive Interdependence* (London: Yale University Press, 2021).

Reviewed by Shaza Arif
Researcher, Centre for Aerospace & Security Studies, Islamabad, Pakistan

The shifting balance of power has once again marked the onset of great-power rivalry which has ignited the debate around reorienting United States' foreign policy. The book *Stronger: Adapting America's China Strategy in an Age of Competitive Interdependence* is a recent take on American foreign policy vis-à-vis China. The book is authored by Ryan Hass who has served as Director for China at the National Security Council as well as Foreign Service Officer in US Embassy, Beijing.

In 240 pages, the author analyses the US-China relationship and proposes a framework regarding how Washington should recalibrate its foreign policy when it comes to Beijing. In the initial part of the book, Hass argues that in recent years, American leadership has been successful in selling the rhetoric that China is responsible for all US sufferings. This factor is also reflected in its foreign policy which has become increasingly hostile towards China. However, despite China's rapid rise, the US still maintains supremacy over the former in various domains and holds considerable influence throughout the world. In fact, after discussing US-China competition in the military, economic and technological domains, the author comes to the conclusion that Washington's actions to contain Beijing are harming its own

interests. Hass is of the opinion that the adversarial aspects of US-China dealings should not define the bilateral relationship. He is convinced that the US needs to explore new avenues where both countries should cooperate rather than compete with each other. He stresses that China will be better dealt with if efforts employed to manage or contain China are used by the US to strengthen itself from within. He recommends that foreign policy should be formulated while taking into account American strengths and Chinese weaknesses.

The book is an interesting read and looks at the US-China competition from a new angle. Rather than focusing on the traditional narrative that a rising China is a prime threat to nearly every US interest, it emphasises that the US is still strong and can be made even stronger by calculated and rational decision-making.

Its core strength is that it is an apt and objective articulation of where US foreign policy is going wrong and how the country's leadership should deal with another rising power. In fact, it is a very honest self-reflection that US needs to review its role of being the sole indispensable global power; that it needs to let China assume the role of another global power and confidently deal with it rather than making it an even bigger adversary by provocative actions. Hass makes it fairly easy to understand that being the two strongest players in global politics, US and China are bound by a strong interdependence. The nature of this interdependence can be competitive, but it must not become hostile. The interests of both powers will be better served if they chose to cooperate with each other on larger issues rather than focusing on weakening each other. The book helps to understand that cooperation is imperative to tackle global challenges in the form of climate change, global economy, and health crises, such as the COVID-19 pandemic. The author deliberates that this competitive interdependence can also help circumvent a major conflict between the two major powers.

Stronger is also an open critique on the concept of US being the global policeman since the end of the Cold War. According to Hass, the policy can no longer remain applicable with another rising power as it tends

to divert US attention towards areas of lesser importance. He emphasises that it is imperative for US leadership to devise a forward-looking foreign policy with regards to China and lays out various policy options while taking into account the new power blocs. While some might find Hass' style rather patronising, this reader felt that he offers a balanced approach that can enable his country's policymakers to understand that China's gains do not imply US' loss. It also warns that repercussions of US-China rivalry will be catastrophic for the world at large.

With the increasing discourse on the implications of US-China rivalry, the book is a timely contribution. It is concise yet comprehensive. It uses simple vocabulary and is free of unnecessary details. It is very well-structured and written in a very engaging manner. The book provides insightful and diverse viewpoints since the author has also mentioned approaches of other political scholars as well. However, an area where the book leaves the reader a bit confused is the lack of specific guidelines/ recommendations as they are not backed by concrete steps as to how they can be implemented.

Overall, the book is an excellent take on the contours of great power competition and evolving world order. It is recommended to those who have an interest in the future of US-China relations. Reading Hass will also be helpful to those who want to understand the gradual transition which has taken place in China with regards to its military, politics, and economy. The work is equally important for his fellow Americans in order to have a broader, more objective view about a country ballyhooed as a major rival, and one, which has significant impact on their lives.

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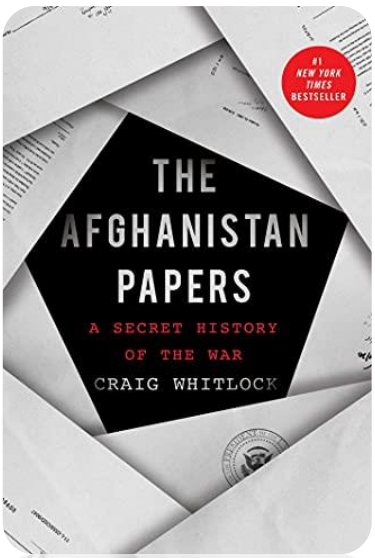

Craig Whitlock, *The Afghanistan Papers: A Secret History of the War* (New York: Simon and Schuster, 2021).

Reviewed by Khansa Qureshi
Researcher, Centre for Aerospace & Security Studies, Islamabad, Pakistan

The Afghanistan Papers: A Secret History of the War is based on interviews of over a thousand individuals who played a direct role in the United States' Afghan War. The book primarily uses the 'Special Inspector General for Afghanistan Reconstruction (SIGAR) Lessons Learned' project as its source material whose aim was to reflect on what went wrong in Afghanistan and how it could be avoided in the future. The individuals who SIGAR interviewed included high-ranking officials as well as soldiers on the battlefield, aid workers and Afghan nationals. Three times Pulitzer finalist journalist Craig Whitlock and *The Washington Post* could only obtain these documents after suing SIGAR twice under the Freedom of Information Act, as SIGAR had only published a redacted version. The US Army's 'Leadership Experience Project', Miller Centre's 'George Bush Oral History' project as well as the memos of then-Defence Secretary Donald Rumsfeld are also part of the book.

Craig Whitlock does not attempt to present an account of war history rather attempts to reveal what went wrong in US' Afghan war strategy. It shows how the three concerned US Presidents knew little about what benchmarks would drive the decision to withdraw troops once the actual goal of containing the al-Qaeda threat was achieved. One of the participants in the 'Lessons Learned' interview series, Lieutenant General Dan McNeil who was commander of US forces in Afghanistan twice, said he was shocked to realise that nobody in the military establishment could define the winning objectives upon his inquiry before his deployment (p. 10). Former US representative to NATO Nicholas Burns revealed that from 2003-05, the US lost track of what was going on in Afghanistan. These remarkable admissions by a top diplomat and commander demonstrate that from the very early years, the Afghan war started suffering from mission creep.

The book also shows how US war policies were flawed and led to failure. One interviewee said that in its eagerness to avenge 9/11, the US violated the Afghan way of war, as historically, after defeat, Afghan factions tend to shift their allegiances towards the winning side. However, the US refused to reconcile with the Taliban and decided to hunt them down to the very last member which provoked intense insurgency (p. 38). This was pronounced as 'original sin' by a respondent as all of the actors in Afghanistan were categorised as good guys or bad guys, with al-Qaeda and Taliban forming the latter category while any entity helping to fight these bad guys were labelled as 'good guys.' Rumsfeld famously said that the Taliban had two choices - to either surrender or die. Although, this approach felt acceptable for the public due to 9/11 but in retrospect this was flawed. *The Afghanistan Papers* even reveals that the CIA hired criminals, war lords, and drug traffickers, and former communists to fight the 'bad guys.'

Whitlock also writes about the sprawling supply chain issues which caused rampant corruption. An analysis of 3000 Department of Defence contracts worth over USD 106 billion showed that 18 percent of the war funds went to the Taliban and other insurgent

groups, the enemy that the US was supposed to defeat with those funds, while corrupt Afghan officials received another 15 percent (p. 183). Through the 'Lessons Learned' it was revealed that US officials had complete visibility on the flow of cash but did nothing because the 'political world gets in the way.' Even if one wanted to bring the anti-corruption narrative forward, nobody would own it, so it was never brought up. Meanwhile, the US agencies hesitated to take action because they did not want to antagonise the Afghan contractors who were on their payroll. As various US Presidents (during their tenure) also kept declaring victories at different occasions these proclamations became the reason behind their unwillingness to admit defeat and risk their public image. Therefore, as the Taliban kept regaining ground, and the strategy to fight the war kept getting more confusing, the harder it became for US Presidents inheriting this war to admit that the US was losing in Afghanistan.

Furthermore, the US' attempt at nation-building also resulted into a hopeless situation as huge sums of money were spent on projects which Afghans did not want or did not need. The goal to 'create an American-style government,' with all three pillars of power while ensuring women's rights was impossible to achieve. Similarly, the institution-building effort was not successful as well. One of the interviewees in the book recalled that the US built a high-end, fancy police headquarters building but the Police Chief at that station did not even know how to open the door. This particular event summed up the entire US experience in Afghanistan (p. 156).

The book has also been compared with the 'Pentagon Papers' which was about the history of US role in the Vietnam War. It was commissioned by Robert McNamara and was leaked to the press. Although there are a number of similarities between the two, the basic difference is that the 'Pentagon Papers' was a classified study with secrecy level so high that McNamara ordered not to interview anyone and instead just rely on already existing documentation. *The Afghanistan Papers* is based on interviews and was not a confidential study. However, one similarity between the

two is that both reveal high-level systemic concealment of truth by US administrations during the periods of war.

Whitlock's book bears more importance when seen in the backdrop of what transpired in Afghanistan in August when this book was published. The fact that the participants expressed pessimism about Afghanistan's future particularly vis-à-vis the dim prospects of a self-sufficient Afghan Army, corruption, and reinforcing the Taliban, turned out to be true.

The book is an eye-opening read that unravels the machinations of US' longest war in history and what made it so. It sheds light on spectacular failures of the country's foreign policy which is not normally talked about (at least in South Asia, particularly Pakistan), and of its military planning and war execution which stays concealed from the public eye.

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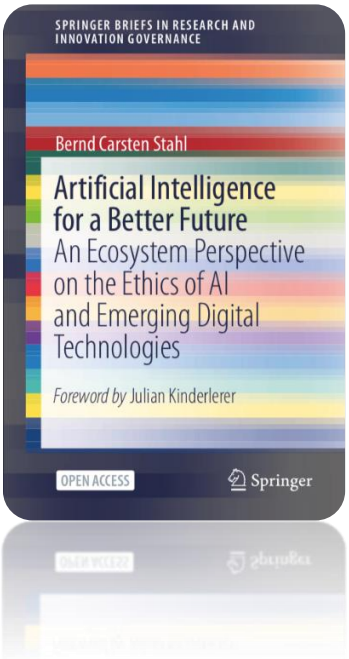

Bernd Carsten Stahl, *Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies* (Switzerland: Springer Nature, 2021).

Reviewed by Maheen Shafeeq
Researcher, Centre for Aerospace & Security Studies, Islamabad, Pakistan

Artificial Intelligence for a Better Future: An Ecosystem Perspective on the Ethics of AI and Emerging Digital Technologies is authored by Professor Bernd Carsten Stahl who is serving as Director of the Centre for Computing and Social Responsibility at De Montfort University, United Kingdom. It was written based on the work undertaken in the SHERPA (Securing a Hybrid Environment for Research Preservation and Access) project.

As the title elaborates, the book offers parallels between Artificial Intelligence (AI) and a biological ecosystem. This conceptualisation hinges on the understanding that AI uses various types of algorithms such as machine learning (narrow AI), general AI (strong AI) and sociotechnical AI systems. For this reason, AI algorithms cannot be clubbed under one generic term rather AI and its distinct applications form a complete ecosystem with different functions and operations. The author uses the term 'ecosystem' as a metaphor to elaborate this concept. The central theme of this

book dictates that AI ethics should be employed in a manner that promotes ethical human flourishing. Professor Stahl draws the idea of human flourishing from Aristotelian roots whose key tenets dictate that human flourishing is central to ethics. He argues that the aim of 'human flourishing' is to promote emancipation.

What is most interesting is that the ethical theories explained in the book (consequentialism/utilitarianism-outcome, deontology-motivation, and virtue-ought to do) hold great value. Every ethical theory pulls in a manner that one may end up aligning oneself with the theory. Unfortunately, the theories of ethics mentioned in the book, if put into application, may end up justifying acts that seem unethical. If, for example, the 'motivation' (under the deontology theory) behind an unethical act was right; the unethical act can become ethical. Similarly, some ethical theories may end up justifying the use of autonomous weapons on the battlefield. For instance, by stating that the 'intention' (under the virtue theory) was to protect the soldiers from volatile situations. Professor Stahl also realises these limitations and proposes a method to promote ethics. He proposes that whatever act AI applications perform, they must promote 'human flourishing.' He defines use of AI for human flourishing by using a quote by Virginia Dignum (professor in social and ethical AI, and Wallenberg Chair on Responsible Artificial Intelligence), 'Responsible Artificial Intelligence is about human responsibility for the development of intelligent systems along fundamental human principles and values, to ensure human flourishing and well-being in a sustainable world' (p. 25). From this, the author extracted that 'the explicit aim to do the ethically right thing with AI can be described with reference to human flourishing' (p. 25).

Furthermore, Professor Stahl attempts to analyse the ethical issues that stem from AI and draws analysis from the SHERPA project case study. According to this study, the most immediate ethical issues can arise from machine learning, and he specifically indicates that privacy and data protection, reliability, transparency, and safety need immediate attention (p. 49). He also mentions that

there are ethical issues of living in a digital world such as issues related to economy, justice and fairness, freedom, lack of human contact, loss of human decision-making and so on. However, he feels that these require only 'medium attention.' He also provides an interesting list of metaphysical issues, such as what would happen if machines displayed human reasoning abilities (p. 46). The author does not seem too worried about such metaphysical issues as he is convinced that such a form of AI does not exist and states that even if research is being conducted in this domain, it is slow. He believes that matters such as job loss due to AI and discrimination are more important worries as compared to conscious machines (p. 46).

The book offers three options in which ethical issues of AI can be mitigated - policy level, organisational level and through guidance mechanisms. The options offer a wealth of ideas about policy initiatives, regulations, regulators, governance, strategic initiatives, frameworks, tools and methodologies that can be adopted to address ethical AI issues. Professor Stahl also points to stakeholders who could play a special role in these areas. However, he highlights that those various stakeholders have different interests. For example, he mentions that 'there are corporate end users of AI, but these tend to have different interests and motivations from individual end users' (p. 73). Due to conflicting interests, he suggests that there is a need to look at various aspects with a 'higher-level view' (p. 74).

The 'higher-level view', that the author recommends, is to develop ethics for an AI ecosystem. In an AI ecosystem, however, the relation between ethics and the ecosystem is not straightforward (p. 87) as it inculcates a 'system of systems of systems' (p. 92). The author explains that interventions designed to address ethical challenges of AI can be developed in a multitude of ways (p. 96) and recommends that in order to develop ethical AI, there is a need to clearly define boundaries around the AI ecosystem and learn and evolve the concept. For example, the governance of an AI ecosystem should be sensitive to motivations and incentives of the

members of such an ecosystem. This needs to be carefully balanced with possible as well as expected benefits and downsides as only then can developments in AI technology promote human flourishing. Professor Stahl confesses that implementation of ethics in an AI ecosystem that promotes human flourishing would require more thought and research.

The best part of the book is that it delves into the concept of AI from theories to their practical implications. Moreover, it cites a number of renowned authors working in this area. Unfortunately, while the author talks about different forms of AI, he does not dig into specific ethical AI issues. Rather, he offers a generic overview such as what ethical issues may arise in the field of business, military, or education. Hence, *Artificial Intelligence for a Better Future* would be useful for those who have some prior knowledge of AI and the debate that surrounds it to help them better understand the author's point of view. In comparison to other books on the subject, this one offers a unique perspective on the nexus between ethics and AI.

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Journal of Aerospace & Security Studies

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