CASS

CENTRE for AEROSPACE & SECURITY STUDIES

ANALYSIS REPORT

Role of New & Emerging Technologies in Comprehensive National Security

CENTRE for AEROSPACE & SECURITY STUDIES

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INTRODUCTION

The concept of 'Comprehensive National Security', expands the traditional view of national security to include internal and external affairs of the state and society. It encompasses both traditional military security and non-traditional dimensions of human security. Pakistan's first formally declared 'National Security Policy' is based on this concept, emphasising a whole-of-nation approach to develop a cohesive and responsive security policy.

Emerging technologies such as Internet of Things (IoT), Artificial Intelligence (AI), 3D printing, Quantum Computing, 5G, block chain, autonomous systems, robotics, hypersonic missiles, and biotechnology are rapidly transforming societies, economies, as well as warfighting capabilities leading to a shift in global power centres. These technologies have implications for both human security and state security, requiring a futuristic approach.

Technological advancements driven by the digital revolution are revolutionising various fields by gathering, analysing and utilising vast amounts of data. They offer numerous social and economic benefits, enhancing productivity in sectors such as health, energy, finance, education, agriculture, and environment. In the realm of traditional security, these advancements lead to the development of new weapons, integration of existing systems, and changes in operational concepts and organisations. Acquiring these technologies will impact power balances and create challenges at national, regional, and global levels.

In this regard, on 8 June 2023, the Centre for Aerospace & Security Studies (CASS) organised a seminar on the subject of *'Role of New & Emerging Technologies in Comprehensive National Security.'* The aim of the seminar was to examine the formulation of policies and implementation strategies for investing in the development of newer technologies to achieve Pakistan's Comprehensive National Security goals.

Advisor National Command Authority and former Director General of Strategic Plans Division, Lieutenant General Khalid A. Kidwai, NI (M), NI, HI(M) (Retd), delivered the Keynote Address on, 'Blend of Changing Technologies with Comprehensive National Security.' President CASS, Air Marshal Farhat Hussain Khan, HI(M), SBt (Retd) delivered the Concluding Remarks. Director Emerging Technologies and Advisor to the Chief of Air Staff on CASS Affairs, Air Marshal M. Ashfaque Arain, HI(M), SBt (Retd), moderated the discussion.

Other eminent panellists, who spoke at the seminar, included:

- o Prof Dr Rabia Akhtar, Director, Centre for Security, Strategy and Policy Research, University of Lahore, Pakistan
- o Ms Aamna Rafiq, Research Associate, Arms Control and Disarmament Centre, Institute of Strategic Studies Islamabad, Pakistan
- o Dr Syed Arif Ahmad, Former Advisor, Pakistan Atomic Energy Commission, Government of Pakistan
- o Air Commodore Khalid Banuri, SI, SI (M) (Retd), Former Director General Arms Control & Disarmament Affairs Branch, Strategic Plans Division, Government of Pakistan

EXECUTIVE SUMMARY

In his *Opening Remarks*, **Air Marshal Ashfaque M. Arain (Retd)** highlighted the significant shift in the concept of national security from traditional military security to Comprehensive National Security (CNS). He emphasised the need for an inclusive framework that encompassed all internal and external factors of the state and society to protect national security and various dimensions of human security. Referring to Pakistan's National Security Policy, he stressed the importance of recognising the connectivity between traditional and non-traditional elements of security and adopting a whole-of-nation approach for a cohesive and responsive security policy. Discussing technological advancements, he noted their transformative impact on diverse fields, fostering interconnectivity, and altering global power structures. However, he also warned about the potential misuse of technologies, such as privacy violations through increased surveillance.

In his *Keynote Address*, **Lieutenant General Khalid A. Kidwai (Retd)** highlighted diverse threat scenarios, emphasising the importance of political stability, a robust economy, and social cohesion for CNS. General Kidwai discussed the strategic effects of emerging technologies, their potential for disruption, and the need to incorporate them into national security plans, innovatively. He pointed out that nuclear deterrence had deflected major wars but had led to non-traditional strategies, including hybrid warfare and cyberattacks. Urging prompt action, he recommended strategic partnerships, national technology plans, and enhanced understanding and application of emerging technologies. He proposed a national task force, involving academia and the scientific community, to lead these efforts and spread technological benefits across Pakistan.

Prof. Dr Rabia Akhtar highlighted the impact and challenges of emerging technologies in traditional security, focusing on cyber warfare, AI-powered weapons, and bioengineering. She shared ethical concerns about Lethal Autonomous Weapons (LAWs) and other disruptive technologies which could adversely affect data security, and public health. She addressed challenges of uncertainty, costs, regulation, and privacy while proposing strategies like international cooperation, regulation, research investment, and strong data governance. Active engagement in the international arena and the establishment of rules and norms were deemed crucial for effective management of emerging technologies.

Ms Aamna Rafiq discussed the impact of emerging technologies on non-traditional security and human development, using the 17 Sustainable Development Goals (SDGs) as a framework. She emphasised that emerging technologies had the potential to address major challenges such as social, cultural, economic, developmental, and the environmental. In her view, the use of technology could improve education, healthcare, poverty eradication, and gender equality. It could also contribute to sustainable agriculture, creating new jobs, fostering economic development, and promoting clean energy systems. However, Ms Rafiq highlighted challenges such as the digital gender gap, environmental impact of raw material mining, and the lack of resources for developing countries to fully benefit from emerging technologies. She emphasised the need for regulations and guardrails to ensure responsible and inclusive application of these technologies for global prosperity.

Dr Syed Arif Ahmad addressed the challenges faced by planners in formulating policies regarding emerging technologies. He emphasised the need for collective efforts to ensure the responsible use of technology for the benefit of society. Dr Ahmad discussed

various aspects, including the uncontrolled development of AI and information technology, the changing character of war due to rapid technological advancement, and vulnerabilities associated with automation of critical infrastructure. He highlighted the importance of adapting to new technologies for national security and assessed a wide range of technologies, such as AI, LAWs, hypersonic weapons, Directed Energy Weapons (DEWs), biotechnologies, and quantum technologies. Dr Ahmad stressed the need for regulation and ethical considerations in the application of these technologies and emphasised the importance of acquiring advanced technology weapons and supercomputers to serve Pakistan's strategic interests.

Air Commodore Khalid Banuri (Retd), the discussant at the seminar, presented key takeaways from the speakers' presentations. He highlighted the need to carefully consider the reliability of future technologies before rushing to employ them. Achieving social cohesion was deemed challenging but essential, with a focus on embracing existing diversities. He commended Pakistan's initiative to generate ideas for regulating LAWs. The application of AI for food security was emphasised, acknowledging the hurdles but stressing the possibility. Big data was discussed, including its Access, Analysis, and Application challenges faced by Pakistan. Embracing AI was deemed indispensable for Pakistan's progress, with suggestions to improve the recently formulated National Artificial Intelligence Policy. He agreed that adoption of new technologies presented opportunities and issues, including dual use and ethical concerns. Challenges for Pakistan included funding Public-Private Partnerships (PPPs), achieving synergy, and state-level cooperation.

President CASS, **Air Marshal Farhat Hussain Khan (Retd)**, expressed gratitude to the panellists and highlighted key issues discussed. He emphasised the need for a suitable environment for private investment in Pakistan, noting the negative impact of past nationalisation efforts on the private sector. President CASS underscored the shrinking OODA loop timeframe due to AI and stressed the importance of adopting emerging technologies to keep pace with adversaries. He also discussed the significance of political stability for development and CNS, underlining the need for safety and security of citizens as a baseline for progress. Economic and political stability were identified as crucial factors for Pakistan to catch up in various fields.

KEY TAKEAWAYS

- The concept of national security has undergone a major shift from traditional military security to 'Comprehensive National Security,' which requires protecting both state security and various dimensions of human security – often referred to as non-traditional security.
- The disruptive nature of emerging technologies is bringing transformative shifts in diverse fields.
- Emerging technologies foster greater interconnectivity and significantly impact economies and power structures, leading to a shift in global power centres.
- The consequences of wide-ranging applications of emerging technologies necessitate a different and futuristic approach to both human and state security.
- Misuse of emerging technologies can lead to the violation of human rights, such as breaches of privacy.
- The future reliability and strategic effects of new technologies is uncertain.
- Access, Analysis, and Application of big data are three fundamental challenges faced by Pakistan.
- Nuclear deterrence has influenced non-traditional and non-contact means of warfare.
- Intelligence gathering, using emerging technologies, threatens national security.
- New technologies such as crypto currencies and blockchain have enabled large-scale fraud and organised crime.
- AI-powered weapons and autonomous systems raise ethical concerns and bypass human oversight.
- Genetic engineering poses a threat to public health and national security.
- AI and machine learning can support decision-making and enhance operational efficiency.
- Military plays a central role in technology development.
- The integration of algorithms is crucial for efficient decision-making at different levels.
- AI has shortened the OODA (Observe, Orient, Decide, Act) loop and military decision-makers need to adapt.
- Pakistan cannot remain indecisive when it comes to AI.
- Cyberattacks on critical infrastructure pose a significant threat to national security.
- Regulatory matters related to new technologies are challenging due to a lack of awareness and discussion.
- Collaboration between the public and private sectors is crucial for technological advancement.
- Pakistan needs to build on its strategic partnerships to catch up in the domain of emerging technologies.
- Political stability, a robust economy, and social cohesion are essential for Comprehensive National Security.

PROPOSED WAY FORWARD

The seminar concluded with a series of insightful recommendations that emerged from the collective expertise and discussions of the participants. These recommendations serve as valuable guidelines for future actions and initiatives in the field of emerging technologies and national security relevant to Pakistan:

1. **National Planning and Coordination:**

   o Develop national plans for familiarisation, development, induction, and indigenisation of emerging technologies for civil and military use.

   o Establish a focused national task force with a clearly defined lead agency, mandate, objectives, and reasonable resources to drive the implementation of technology plans.

   o Achieve synergy between different initiatives by adopting a comprehensive approach involving all sectors of society.

   o Engage academia and informed scientific and strategic community for the widespread benefits of technological advancements.

2. **Investment and Partnerships:**

   o Massive investments needed in Research and Development (R&D) for defensive capabilities and expertise in emerging technologies.

   o Seek financial support and partnerships to bridge the resource gap and enhance R&D, manufacturing, and training capabilities.

   o Establish Public-Private Partnerships (PPPs) and secure funding for technology development.

   o Address hurdles faced by private investors and provide support and incentives for investment.

3. **Policy and Regulation:**

   o Improve the National Artificial Intelligence Policy.

   o Establish regulatory frameworks involving technically qualified experts.

   o Develop regulations, policies, and ethical frameworks for responsible and safe use of emerging technologies.

   o Strike a balance between restricting technologies and allowing their civilian usage, considering legal and ethical concerns.

4. **Infrastructure and Capabilities:**

   o Focus on acquiring supercomputers to enhance capabilities in various sectors.

   o Act promptly to prevent technology gap with adversaries from widening.

- Evaluate and address potential risks and consequences of automating critical infrastructure.
- Enhance learning and understanding of emerging technologies at technical, application, and operational levels.

5. **Data Governance and Security:**
   - Establish strong data governance to protect all types of data.
   - Collaborate with the private sector to address data protection challenges.

6. **International Cooperation:**
   - Engage in multilateral forums to access knowledge, resources, expertise, and support.
   - Consider bilateral cooperation with countries like China in the domain of emerging technologies.
   - Take a lead role in establishing international norms and rules for emerging technologies.

7. **Counterterrorism and National Security:**
   - Invest heavily in Machine Learning for improved predictability and effectiveness of counterterrorism operations.
   - Adapt and leverage new technologies for national security.
   - Adapt military processes to the growing role of AI in decision-making.
   - Recognise the role of algorithms in assisting human decision-making.

8. **Sustainable Development and Inclusion:**
   - Align the integration of emerging technologies with the UN Sustainable Development Goals.
   - Bridge the digital gender gap and promote inclusion in the digital space.
   - Implement digital literacy programs to equip individuals, especially women and young girls, with necessary skills.
   - Achieve economic stability through sustainable development initiatives and attracting investments.
   - Promote political stability through transparent and accountable governance.

SUMMARY OF PROCEEDINGS
Air Marshal M. Ashfaque Arain, HI (M), SBt (Retd)
Introductory Remarks

Air Marshal M. Ashfaque Arain (Retd) opened the session by establishing that the concept of national security had undergone a major shift from military security of the state against external threats – usually called traditional security – to a wider, more inclusive called 'Comprehensive National Security.' He explained that this change had primarily been brought about with the globalisation of the world.

Contours of Comprehensive National Security

Comprehensive National Security requires an inclusive framework which encompasses all internal and external factors of the state as well as of the society.

Air Marshal Arain elaborated that such a framework contributed to the protection of not only national security, but also various dimensions of human security which were often referred to as 'non-traditional security.' He corroborated his view by recalling that Pakistan's first formally declared 'National Security Policy' (NSP) premised on the concept of 'Comprehensive National Security,' also recognised the connectivity between traditional and non-traditional elements of national security and proposed a whole-of-nation approach towards charting a 'cohesive, unified, and responsive security policy' for the future.

Technological Breakthroughs and Societal Developments

Expanding his reflections, Air Marshal Arain posited that new technologies had always been a central agent of change, affecting the lives of individuals, groups, societies, nations and the world as a whole.

The latest technological breakthroughs with disruptive nature are bringing about transformative shifts in diverse fields.

He asserted that these technological advancements were not only fostering greater interconnectivity, but also exerting significant impact on economies and power structures, leading to a shift in global power centres. At the same time, he cautioned, these technologies could also be misused by state and non-state actors alike. For example, he explained that the violation of basic human rights, such as privacy of citizens through increased surveillance by states, was made possible through the use of such technologies. He reasoned that the impact therefore, necessitated approaching both human security and state security in a different, futuristic manner. To that effect, CASS had organised the seminar to examine the formulation of policies and implementation strategies for investing in the development of newer technologies to achieve Pakistan's Comprehensive National Security (CNS) goals.

Pakistan's Comprehensive Security Calculus

General Kidwai began his *Keynote Address* by establishing the context under which emerging technologies' role in CNS was being analysed. Against the backdrop of cross-currents of international geopolitical power play, Pakistan's CNS dynamics translated into a variety of threat scenarios, ranging from contact warfare to non-contact warfare. He was of the view that national and strategic planners needed to be cognisant of the diverse and complex mix created by the emergence of new and exotic technologies and the evolving notions of traditional and non-traditional security.

> *Comprehensive National Security is a state of preparedness for the threats and risks to vital functions of society.*

He recognised the inherent connectivity between traditional and non-traditional elements of national security and proposed a whole-of-nation approach towards charting a cohesive, unified, and responsive security policy for the future. Accordingly, General Kidwai emphasised three fundamentals of CNS, i.e., political stability with peace within and without, a sound and robust economy, and social cohesion. Without these, even state-of-the-art technologies were unlikely to go very far in the provision of CNS.

Emerging Technological Development

> *Technological developments in any given era are novel and emerging, and they generate profound strategic effects on the strategic stability-instability paradigm in that particular era, time, place and region.*

General Kidwai stated that since technologies were ever-increasing in complexity and lethality, he reminded that it was not possible to project the future reliability or shelf-life of a particular new technology and discern how long its strategic effects would last as a dominant marvel, before an antidote neutralised the tactical or strategic imbalances created by a particular technology.

Changing Nature of Warfare and Traditional Military Methodology

The Keynote Speaker elaborated the straightforward template of military methodology which trained minds to arrive logically at feasible military response options to various threat scenarios and the probability and likelihood of some of those scenarios unfolding in a certain order of priority whether on land, air or at sea, with unity built into plans at a higher level. By and large, the said template led one to workable response options and plans which could then be executed as per the unfolding of a particular operational environment or hypothesis. However, this only applied to threats in the domain of brute conventional forces of the adversary being physically pitched against one's own forces.

Warfare without a Nametag

Reiterating his argument from CASS' GSTAR conference in October 2022, General Kidwai stated that technologies like robotics, AI, DEWs, hypersonic weapons, cyber warfare, space

capabilities, drones, etc., conjured vision of a faceless adversary that could not be pinpointed for possible retribution and retaliation.

In a video-game like environment where an anonymous individual, sitting in Florida, playing on his video-screen can assassinate Ayman al Zawahiri on the balcony of a Kabul apartment with shocking precision; or a faceless cyberspace hacking operation that can switch off the electricity grid of a mega city plunging life into chaos and inflicting massive financial losses.

The effects generated through some of these technologies included shock, awe, surprise and destruction – far in excess of conventional technologies. These were, thus, force multipliers in many ways and 'warfare without a nametag'.

Options in Non-traditional Warfare

The arrival of a variety of emerging technologies had widened the canvas of non-traditional options for response or even initiating operations. General Kidwai advised that such capabilities had to be incorporated and integrated into national security plans in novel and innovative manner.

Various forms of AI, cyber warfare, robotics, information wars, etc., have reduced reliance on violence as the preferred option and allow considerable flexibility of deniability.

He quoted the example of the war in Ukraine, where a subtle combination of traditional and non-traditional means was at play.

Strategic Deflection Effect of Nuclear Deterrence

General Kidwai, reflecting on mere possession of a triad of operationalised nuclear weapons by both Pakistan and India, said that these had seemingly outlawed major wars in South Asia and helped maintain 'strategic deterrence and controlled a rush of blood on both sides in a number of otherwise haywire situations.' Moreover, nuclear deterrence had also created a strategic deflection effect towards strategies of lesser wars by other means, i.e., non-traditional, non-contact means defined by various shades of hybrid war including low-intensity conflicts, opening of a variety of inner fronts, intense information war, water wars in the future, anonymous cyber-attacks on critical facilities, and even aggressive diplomatic and economic policies in Pakistan's traditional areas of influence.

Positive Role of Emerging Technologies

In non-traditional nation-building areas, emerging technologies can play a substantial role in energy, agriculture, IT, trade, health and education sectors, enhancing communications and providing super-fast transportation options for cargo and human travel, and boosting economic growth.

General Kidwai added that in the military domain, these technologies would invariably enhance capabilities in conventional and non-conventional strategic forces and provide innovative means of pursuing and influencing outcomes in support of a nation's foreign policy goals and objectives. This could perhaps be achieved through entirely non-violent and surreptitious means with plausible deniability as the benchmark.

Insights for the Way Forward

Cautioning decision-makers, General Kidwai (Retd) injected a sense of urgency given the pace of the development of these emerging technologies.

> *Pakistan must act before the technology gap with the adversary widens beyond local repair, and we belatedly discover the negative effects of time and technology lapses. Pakistan ought to leverage the advantage of a proven and reliable strategic partnership to enhance and secure its comprehensive national security.*

He lamented that currently, there was a considerable lack of clarity on trade, liability and export controls around these technologies. The diplomatic vacuum might be filled with international treaties, conventions or regulations in the coming decades, due to excessive proliferation, ethical concerns or some advanced countries seeking to lock in their technological advantages. 'Before that happens, Pakistan ought to formulate national technology plans for familiarisation, development, induction and indigenisation of emerging technologies,' he said.

Endorsing CASS' whole-of-nation approach, he added that Pakistan must first enhance the learning and understanding of these technologies at the technical, application and operational levels; and then move rapidly to lay out comprehensive national plans for their induction and application in the relevant areas of (civil and military) national life.

> *An appropriately focused national task force, with a clearly defined lead agency mandate, objectives and reasonable resources at its disposal could be a good starting point. Academia and informed scientific and strategic community must relentlessly prompt Pakistan's planners to build a momentum that spreads the benefits of technological advancement widely across the country.*

Prof. Dr Rabia Akhtar

Impact of New and Emerging Technologies on Traditional Security

Prof. Dr Rabia Akhtar began her talk by quoting a statement made by the Chairman Joint Chiefs of Staff Committee General Sahir Shamshad Mirza at the 20th Asia Security Summit during the Shangri-La Dialogue about emerging technologies related to strategic stability in this region.

Impact of Emerging Technologies

From the broader domain of emerging technologies, Dr Akhtar focused on the domains of cyberwarfare, AI-powered weapons and bioengineering. She mentioned that in cyber warfare, state-sponsored hackers had the ability to launch attacks on critical infrastructure; in AI-powered weapons, military drones and autonomous weapons could be programmed to make their own decisions, hence bypassing human oversight; and through bioengineering, bioweapons could be created to only target specific populations or individuals, and hence, these domains were connected to ethical issues.

> *There is disconnect between what the states are doing and the information that trickles down to the general public.*

She suggested the need for synergy, and for Pakistani scholars and experts to expand their expertise in these domains.

Technologies with Disruptive Impact

Elaborating on technologies with disruptive impacts, Dr Akhtar mentioned 3D printing which had revolutionised manufacturing, autonomous systems that could be hacked and turned into weapons and cause accidental collisions, quantum computing that could easily break encryption and steal sensitive data. According to her, states were rightly worried about surveillance and espionage. She articulated that surveillance and espionage, through emerging technologies for intelligence-gathering purposes, were detrimental to Pakistan's national security. She further talked about how social engineering, crypto currencies and blockchain tech were making it easier for fraud and organised crime to operate on larger scale. In the domain of Genetic Engineering, technologies like CRISPR could obviate traditional gene therapy and allow for precision guiding and gene slicing that posed a great threat to public health and national security.

Dr Akhtar added that AI and machine learning could provide decision-making support to policymakers and foster efficiency but were coupled with ethical and political complications. However, Pakistan needed to invest heavily in machine learning as it could offer improved predictability and effectiveness of counterterrorism operations.

Offensive Emerging Technologies in the Defence Sector and Potential Consequences

According to the speaker, emerging technologies in the defence sector included cyber weapons, hypersonic weapons, DEWs, autonomous weapons and nanotechnology.

Pakistan needs to have political stability and the economic spine to invest in its research and development sector in order to cope with the potential consequences of emerging technologies and economic damage.

While reflecting on the potential consequences, Dr Akhtar warned that:

i. Autonomous weapons and bioweapons could cause massive casualties and threaten entire populations.

ii. Disruptive technologies could lead to financial losses for businesses and governments and cause economic instability.

iii. As countries were racing to develop and deploy these technologies, tensions and conflict could escalate, hence, stimulating global instability.

Challenges in Dealing with Disruptive Technologies

Discussing the challenges in dealing with disruptive technologies, Dr Akhtar mentioned the following:

i. **Uncertainty:** Fast-paced development of these disruptive technologies made it hard to predict how they would be used and by whom.

ii. **Costs:** Developing these technologies and defending against their potential consequences could be costly and not all states had the required resources to do so.

iii. **Regulation:** International laws and treaties might not be effective in regulating the use or development of such technologies.

iv. **Privacy:** Disruptive technologies could violate the privacy of citizens and lead to a loss of civil liberties.

Threats to the Security of Pakistan

Dr Akhtar was of the view that disruptive technologies in the defence sphere could pose a substantial danger to countries like Pakistan. The possibility of cyberattacks on critical infrastructure, such as power grids and communication networks, was one of the most serious concerns.

Cyberattacks have the potential to disrupt key services and cause economic harm. The use of autonomous weapons could create problems vis-à-vis attribution and cause unintended escalation. The advancement of hypersonic weapons and other advanced missile systems could also endanger regional security and stability.

Emerging technologies like AI, Quantum Computing, and Biotechnology could pose substantial security challenges. These technologies could be employed to generate new military capabilities as well as improve existing ones, making it more difficult for countries like Pakistan to keep up.

If Pakistan does not act urgently, there will be huge asymmetries just like conventional and nuclear asymmetries that Pakistan is already facing.

Strategies for Managing Disruptive Technologies in the Defence Sector

While outlining the strategies that Pakistan could adopt to manage disruptive technologies in the defence sector, Dr Akhtar reflected on the following areas:

International Cooperation

Engaging in multilateral forums is necessary to ensure international cooperation.

Pakistan was at the receiving tail end of the strategic chain where the global power competition between the United States and China was seen as pressurising India to modernise. Being at the tail end of that strategic chain, the country was absorbing the entire pressure of the second-order effects of the global power competition. Hence, Pakistan needed to engage more actively in the international arena and take the lead role in establishing rules and norms in the domain of emerging technologies.

Regulation and Oversight

Pakistan should implement regulations and oversight mechanisms to guarantee that emerging technologies were used responsibly and safely in the private and public sectors. This included measures such as export controls, licensing regulations, and inspections.

Investment in Research and Development

Since there was a disconnect between the state and the citizen with respect to emerging technologies; massive investments were needed in the development of new defensive capabilities and in fields like Quantum Computing, AI, and cyber security.

Strong Data Governance

Pakistan required strong data governance and the citizens needed to know whether their data was protected. The public sector needed to look at how the private sector could help it deal with that challenge. The government should develop synergies with the public sector and bypass the red-tapism and bureaucracy that stopped the private sector from engaging with the defence industry.

Using New and Emerging Technologies for Enhancing Non-Traditional Security and National Development

The technologies keep on achieving hard things but they remain unsuccessful in achieving small things on this planet like poverty eradication, clean water for all, zero hunger etc.

Defining Emerging Technologies

Ms Rafiq defined 'emerging technologies' as a set of rapidly developing, coherent, and novel technologies with the ability to produce prominent effects in various sectors. These technologies not only had the potential to alter institutional frameworks and stakeholders but also the nature of interactions among them. The true potential of their impact remained ambiguous due to their manifestation in the near future.

> *Keeping in mind the uniqueness of 'emerging technologies', they are not to be confused or interchangeably used with the term 'new technologies'. Although there are certain commonalities between the two, yet they are fundamentally two different concepts.*

She further clarified that new technologies were highly coherent and mature technologies with visibly prominent impacts. The main characteristic that differentiated a new technology from an emerging technology was the manifestation of its impact in the present time. However, in case of emerging technologies, the true potential of their impact remained ambiguous due to their manifestation in the near future.

Emerging Technologies for Non-Traditional Security & Human Development

Ms Rafiq was of the view that emerging technologies would impact almost all major aspects of non-traditional security and national development and used the 17 Sustainable Development Goals (SDGs) and 169 targets internationally agreed in the 2030 Agenda for Sustainable Development as a framework to discuss these impacts. She presented the larger picture using data from World Economic Forum's 'Frontier 2030: Fourth Industrial Revolution for Global Goals Platform' that analysed the role of more than 300 emerging technology applications on the SDGs. According to the report, emerging technologies would produce a high impact across 10 out of 17 SDGs. For instance, big data support for SDG progression was 100%, AI was significant for more than 50% of SDG application and the role of blockchain and Internet of Things (IOT) was 25% and 33%, respectively. Advanced materials contribution was predicted to be 10%. So, overall, innovation in realm of emerging technologies could directly support 70% of 169 targets of SDGs.

Ms Rafiq discussed in detail three SDG clusters of SDGs having impact on society, culture, economy, development, and the environment.

> *The use of technology can help people live a better life through facilitating multiple social and cultural sectors such as education, health, employment and standard of living.*

In this cluster, Ms Rafiq discussed SDGs 1, 2, 3, 4, 5, 6, 10 & 16 and covered the following aspects:

   i. The advancement and accessibility of digital financial services and social media had been instrumental in lifting people out of poverty by providing access to markets, customers, and resources for start-ups. Additionally, AI could contribute to poverty alleviation by utilising satellite images to identify areas of poverty and foster international action.

   ii. In the agricultural sector, AI and ICT-enabled solutions had the potential to make practices more data-driven and efficient. This could help farmers increase crop yields by providing insights on energy usage, seed quality, fertilisers, accurate weather patterns, and disaster predictions.

   iii. Improving healthcare through better ICT connectivity was another promising area where technology could have a positive impact, e.g., telemedicine and remote medical imaging.

She emphasised promoting connectivity and automation in schools and universities which was crucial for equipping young men and women with job-ready digital skills. According to her, the International Labour Organization (ILO) was spearheading the Digital Skills for Decent Jobs Campaign, aiming to empower 5 million youth with these skills by 2030.

> *Addressing the digital gender gap is vital. While progress has been made, disparities still exist, particularly in developing countries. More efforts are required to encourage and promote women and young girls in digital spaces.*

Cluster 2: Economy and Development

In this cluster Ms Rafiq covered SDGs 7, 8, 9, and 12, and discussed the following key aspects:

   i. Technology played a pivotal role in creating new jobs, fostering resilient work environments, and driving social and economic development.

   ii. It was crucial to accelerate digital transformation through innovative entrepreneurship and supporting Small and Medium Enterprises (SMEs) for sustained growth.

   iii. The implementation of smart grids, incorporating AI, ICT, and advanced materials, could lead to more efficient and controllable energy systems.

She highlighted challenges in this respect where digital currencies, such as Bitcoin, had gained significant attention but consumed a substantial amount of electricity, posing challenges to clean energy goals and climate action targets outlined in the SDGs.

> *The increasing electricity demand From Information and Communications Technologies (ICTs) and related technologies like AI and blockchain can account for up to 20% of global electricity demand by 2030.*

In this cluster Ms Rafiq covered SDGs 11, 13, 14, 15, and 17 and highlighted the following points:

i. The implementation of AI-enabled smart and low-carbon cities held promise for interconnected technologies like autonomous vehicles and smart appliances.
ii. Mining of raw materials required for new technologies, such as silicon and cobalt, relied on fossil fuel-generated power, posing health hazards and impacting SDG 3 on health.
iii. Additionally, the research and design of products had high energy requirements and would increase carbon footprint leading to e-waste which was a global concern.

Challenges for Developing Countries

While highlighting challenges for developing countries, Ms Rafiq said that new and emerging technologies lacked basic guardrails and their increased application and productivity did not necessarily mean increased prosperity. Despite the fact that data flow would grow by 400% by 2026, activity was focused on a few global players, largely excluding the developing world due to huge requirements of financial resources for research, development, manufacturing, product design, testing and training.

Dr Syed Arif Ahmad

Prudent Harnessing of Technological Developments to Support Comprehensive Security: Options for Pakistan

Dr Syed Arif Ahmad began his talk by recognising the challenges faced by planners in terms of formulating policies considering the vastness of the field of emerging technologies.

Uncontrolled Development of Artificial Intelligence & Information Technology

The development of information technology and AI has gone so far that it is getting out of control.

Dr Ahmad underscored that the idea of 'Technological Singularity' suggested that a time might come when technology could take over with robots all around. He said that Geoffrey Hinton, the Godfather of AI, resigned from Google since the technology he helped develop could be misused. Dr Ahmad further stated that it was up to the users to use it for the benefit of the people. Also, institutions needed to collectively devise ideas in this regard for the benefit of society as a whole.

Interconnection of Electric Grids with Power Plants

Dr Ahmad pointed out that it could be disastrous if linkages between power plants and electric grids were automated. He advised Pakistan against this and also said that its power plants, including Guddu Station, Tarbela Dam, and Mangla Dam ought to be disconnected from each other unless it was absolutely necessary as in the case of the nuclear power plant, where it needed to be connected with two independent electrical sources to ensure that its cooling systems remained operational at all times.

Adaptation of the New Technologies and Scope for Isolationist Policies

Adaptation of new technologies will ensure that nations are well prepared for future conflicts.

The speaker stressed the importance of being technologically advanced for national security. So, isolationist policies, particularly in the context of AI and emerging technologies, could no longer work.

Wide Variety of New Technologies

Dr Ahmad elaborated on the adoption of the following specific new technologies:

Artificial Intelligence

He defined three categories of AI - Narrow AI, General AI, and Artificial Super Intelligence. Narrow AI performed specific tasks; General AI could perform a broad range of tasks; and Super Intelligence greatly exceeded the cognitive performance of humans in virtually all domains of interest. He further stated that Narrow AI was being incorporated into a number of military applications by technologically advanced nations. He emphasised the importance of using AI in the civilian and military systems as that system would react significantly faster than a human-operated system. An AI-enabled system could cope with an exponential increase in the amount of data available for analysis. AI could also enable new concepts of operations like swarming, that could confer a war-fighting advantage by overwhelming the adversary.

Lethal Autonomous Weapon Systems

He stated that LAWs were also commonly known as drones. LAWs as a class of weapon systems were capable of identifying a target and employing an on-board weapon to engage and destroy a target without human control. This concept was also known as human 'out of the loop' or 'full autonomy'.

> *The aspect of 'full autonomy' is dangerous as it removes human responsibility from the decision-making process.*

He also talked about the moral implications for the people who were part of such operations in areas like Afghanistan, involving the application of LAWs.

Hypersonic Weapons, Directed Energy Weapons (DEWs), Biotechnologies & Quantum Tech

Dr Ahmad opined that in the last decade, nations had started publicly admitting to possessing *Hypersonic Weapons*. He briefly discussed two categories of hypersonic weapons - hypersonic glide missiles and hypersonic cruise missiles. According to him, *DEWs* used concentrated electromagnetic energy rather than kinetic energy. These weapons could offer low costs per shot assuming access to sufficient power supply was ensured.

> *Not much attention has been given to high-powered microwave weapons that can be used as non-kinetic means of disabling electronics, communications systems, and improvised explosive devices.*

He signalled that some countries would field a ground-based laser weapon that could counter low-orbit space-based sensors and by the mid-to-late 2020s, they might field higher power systems that extend the threat to the structures of non-optical satellites. Furthermore, he explained that *Biotechnology* could be used to create adaptive camouflage, cloaking devices, or lighter, stronger, and self-healing body and vehicle armour.

> *Internationally, concerns have been raised that some countries may not hold high ethical standards in the research and application of biotechnology particularly regarding biological weapons.*

He also talked about the complexity of *Quantum Technologies* and stated that they could lead to secure communication hotlines. There were small quantum devices that could fit in a shoe box and could prevent data leaks. In his view, the complexity of quantum technology and required computational power could make it difficult even for advanced countries to break the code of secure communication lines. He stressed that there was a need to regulate new and emerging technologies but the international community was talking about laws or legal guidelines on LAWs because they wanted to constrain the developing countries from breaking out of the fold.

Acquiring Advanced New Technology Weapons

Dr Ahmad mentioned that Pakistan would need approximately 10-15 years to acquire state-of-the-art new technology weapons including advanced LAWS, hypersonic missiles, and DEWs. He stated that it would take a considerable time for the country to attain large-scale 3-D printing machines capable of printing runways at any desired place. Other countries like the US possessed this technology but Pakistan currently had smaller and less expensive 3D printing machines.

Regulatory Matters

The speaker specified that regulatory matters regarding new and emerging technologies could be challenging due to a lack of awareness and discussion surrounding them.

> *Proper understanding and comprehension of new technologies is required to frame relevant policies, including technically qualified experts in the regulatory decision-making process.*

Need for Pakistan to Acquire Supercomputers

Dr Ahmad underscored the need for Pakistan to buy supercomputers at the earliest. He stated that if drones had to be moved in a synchronous manner, supercomputers could be used to test those movements beforehand. They could also be employed to enhance weather forecasting, increase food security and benefit agricultural output. He also pointed out that countries like Saudi Arabia and India had invested in supercomputers but Pakistan had not done so yet.

> *Pakistan needs to prioritise acquisition of Supercomputers.*

It could even consider purchasing second-hand supercomputers from all over the world.

Air Commodore Khalid Banuri, SI, SI (M) (Retd)
Takeaways from the Speakers' Presentations & Some Reflections

The seminar discussant, Air Commodore Khalid Banuri (Retd), highlighted the following key takeaways from the speakers' presentations:

On the issue of the future reliability of new technologies as discussed by General Kidwai, he related it with the idea of the intense desire to put new technologies into employment, as they had really matured.

> *Rushing towards employment of these technologies can be dangerous.*

Air Commodore Khalid Banuri stressed that achieving social cohesion was easier said than done. Learning to live with existing diversities was necessary as a state of perfect social cohesion could not be attained.

While referring to Prof Dr Akhtar's reference that Pakistan could take the lead in ideas over regulations, the discussant noted that Pakistan was already spearheading an initiative at Geneva to generate ideas for regulating LAWs.

Regarding the non-traditional usage of new technologies, discussed by Ms Rafiq, Air Commodore Banuri agreed that the application of AI for strengthening food security was an important area and ought to be translated into something more practical. He said there were hurdles surrounding it, but it was still possible.

Big data is an issue of 3 As - Access, Analysis and Application.

Air Commodore Khalid Banuri opined that Pakistan was lacking in each of these areas. Data was available in various pockets but the challenge was providing access to it. He further stated that the issue of analysis was an entire subject in itself, and the application side was another major hurdle for the country.

Sharing his thoughts about the idea of 'technological singularity,' i.e., the superiority of machines over humans mentioned by Dr Ahmad, the Discussant stated that humans told computers how they thought with all their human follies and were now looking at AI to do it for them. According to him, algorithms would present decisions to humans, but humans were now reluctant to act on those, especially in the context of sensitive subjects. This was an area that humans had to think more about and deal with.

The world will get much more complicated, and not doing anything about getting into AI is not an option for Pakistan.

Air Commodore Khalid Banuri appreciated the government's recent step of drafting Pakistan's '*National Artificial Intelligence Policy*' and stated that the policy focused on four key areas - market enablement; building a progressive and trusted environment; enabling AI through awareness and readiness; and transformation and evolution. However, he emphasised the need to improve the policy as, in his observation, there were several problems with some of the ideas mentioned in the draft.

The Discussant noted that there was an opportunity for smaller states, such as Pakistan, to access or develop new technologies as a heavy industrial base was not required in every case. However, he specified two major issues surrounding the adoption of new technologies.

First was the dilemma of the dual use of technologies, which also raised legal concerns. He elaborated that in the traditional laws of war, the uniformed soldier was a legitimate target, but it was debatable if a drone operator could also fall under this category.

Imposing outright controls on technologies is not an answer, but there is a need to balance their dual use.

He cited the case of the US defence sector which traditionally invested in new technologies because of its own requirements despite recognising that there would eventually be some civilian usage. For instance, the cell phone was introduced because the US Army wanted to get away from corded telephones on the battlefield. Similarly, GPS or navigational systems were a need of the Navy.

Second, Air Commodore Khalid Banuri suggested that the new developments and the use of autonomous weapons raised ethical concerns. However, Pakistan ought not to be solely focusing on the negative sides of AI, such as the concerns surrounding chatGPT, but look at the potential of AI and tap into it. Privacy, as an ethical concern, would forever be affected and humans had to learn to deal with it.

Moreover, Air Commodore Khalid Banuri highlighted some challenges for developing and accessing new technologies in Pakistan.

Funding Public-Private Partnerships for the development of new technologies in Pakistan is easier said than done but is necessary.

He also agreed that achieving synergy and adopting a whole-of-nation approach was vital but like state-to-state level cooperation (e.g. between Pakistan and China), would remain major concerns. The speaker concluded by stating that Pakistan ought to get into the race of developing new technologies as the speed of decision-making had become so tremendous that the human mind alone would not be able to do handle it. Algorithms would have to assist human decision-making but there was a need to find the right technology and a fine balance between man and machine.

President CASS Air Marshal Farhat Hussain Khan, HI (M), SBt (Retd)

Concluding Remarks

In his *Concluding Remarks*, President CASS Air Marshal Farhat Hussain Khan (Retd) thanked the esteemed panellists for their contribution. He also commented on several important issues raised during the seminar.

Suitable Environment for Private Investment

While discussing the hurdles faced by the private investors, President CASS shared that CASS had held two seminars on the subject and the common point of both seminars was that the environment was not conducive for private investment in Pakistan.

Potential investors need to be treated with utmost regard.

He highlighted that the government's nationalisation drive in 1972 seriously hit the private sector and the country's industry had not been able to recover ever since. The private sector was willing to invest and was waiting for support from the public sector but that support was not forthcoming. He added that development in terms of technologies was pushed by the military because of its own requirements.

Impact of Artificial Intelligence on the Future of Warfare

While discussing the impact of AI on the future of warfare, Air Marshal Khan said that AI had shrunk the timing of the OODA loop at the tactical, operational and strategic levels. Although decisions in the military were made by humans; the growing role of AI in decision-making ought to be absorbed by military decision-makers.

Delaying the decision-making process is not an option as the enemy can also integrate AI into its OODA loop, reduce its decision-making time and also inject false information into our loop. Thus, those who lag behind may lose the war or the battle.

He further added that the application of non-kinetic tools of warfare, particularly AI and cyber, would change the concepts, doctrines and nature of war at all three levels.

Significance of Political Stability

President CASS emphasised the importance of political stability for development and Comprehensive National Security; and concluded that for the latter, Pakistan had to ensure the safety and security of its population.

> *The state cannot progress if citizens do not feel integrated into the system. The security of the people ought to be the baseline, especially if they are expected to play the role of an effective and supportive citizenry. Pakistan is lagging behind in many fields and the only way to catch up is through economic and political stability.*

Profile of Speakers

Lieutenant General Khalid A. Kidwai, NI(M), NI, HI (M) (Retd), Advisor National Command Authority & Former Director General, Strategic Plans Division, Government of Pakistan

Lieutenant General Khalid Ahmed Kidwai has led a meritorious military service spanning over 54 years. He has held a variety of prestigious command, staff and instructional appointments and is a graduate of Pakistan's Command and Staff College, National Defence University, and the US Army Field Artillery School, Fort Sill, Oklahoma. After the May 1998 nuclear tests, Lt. General Kidwai pioneered the establishment of Pakistan's National Command Authority (NCA) and was appointed as the founding Director General of Strategic Plans Division (SPD) in December 1998. He served as DG SPD for over 15 years, and since 2014, is an Advisor to the National Command Authority. As DG SPD, he conceived, articulated and executed Pakistan's nuclear policy and deterrence doctrines and translated these doctrines into a robust nuclear force structure, oversaw and ensured the establishment of the Army, Navy and Air Force Strategic Force Commands, including the development and operationalisation of a variety of nuclear weapons. He put in place state of the art Command and Control Systems, as well as an effective nuclear security regime for Pakistan's Strategic Assets. He is also the architect of Pakistan's civilian Nuclear Energy Vision-2050. Lt. General Kidwai has been awarded Pakistan's highest civil award the Nishan-i-Imtiaz, the second highest civil award Hilal-i-Imtiaz, in addition to Hilal-i-Imtiaz (Military).

Professor Dr Rabia Akhtar, Director Center for Security, Strategy & Policy Research, Professor of International Relations, University of Lahore, Pakistan

Dr Rabia Akhtar is Director Centre for Security, Strategy and Policy Research, University of Lahore. She is also the founding Director of the School of Integrated Social Sciences, University of Lahore. She holds a PhD in Security Studies from Kansas State University. She is a Fulbright alumna (2010-15). Dr Akhtar received her Masters in International Relations from Quaid-i-Azam University, Islamabad and her Masters in Political Science from Eastern Illinois University, USA. She has written extensively on South Asian nuclear security and deterrence dynamics. She is the author of a book titled 'The Blind Eye: U.S. Non-proliferation Policy Towards Pakistan; from Ford to Clinton'. Dr Akhtar is also the Editor of 'Pakistan Politico', Pakistan's first strategic and foreign affairs magazine. She is a Non-resident Senior Fellow at the South Asia Center, Atlantic Council, Washington, D.C, USA.

Ms Aamna Rafiq, Research Associate, Arms Control and Disarmament Centre, Institute of Strategic Studies Islamabad (ISSI), Pakistan

Ms Aamna Rafiq is working as a Research Associate in the Arms Control & Disarmament Centre (ACDC) at the Institute of Strategic Studies Islamabad (ISSI). Previously, she has worked with the Arms Control and Disarmament Affairs (ACDA) Branch of the Strategic Plans Division (SPD) and Pakistan Institute for Parliamentary Services (PIPS), Islamabad. As a Young Parliamentary Subject Expert, she also assisted the Senate's Standing Committee on Defence Production at the Parliament of Pakistan. As a young public speaker, she has represented ISSI at various prestigious national and international conferences and seminars organized by the United Nations, the United Nations Institute for Disarmament Research, the Sri Lankan Army (Colombo Defense Seminar), Kings College London, UK, and Air University Islamabad, among many others. Her research focuses on the security issues related to the military and civil applications of emerging technologies and the establishment of a global regulatory regime for them. Ms Rafiq holds an MPhil degree in International Relations from Quaid-i-Azam University.

Dr Syed Arif Ahmad, Former Advisor, Pakistan Atomic Energy Commission (PAEC), Government of Pakistan

Dr Syed Arif Ahmad holds a PhD (Nuclear) degree from California, USA. He has a 20 years teaching experience in various universities including PIEAS, NUST, AIR University and University of California, USA. His expertise includes nuclear system design, NBC Warfare, Nuclear Safety, Nuclear Security, Energy, Computational Methods, S&T Development, Physics, Mathematics etc. He has over 15 publications and has been Member Editorial Board of PAEC's Journal 'Nucleus' and has served for 42 years in PAEC in different appointments including Advisor.

Air Commodore Khalid Banuri, SI, SI(M) (Retd), Former Director General Arms Control & Disarmament Affairs Branch, Strategic Plans Division, Government of Pakistan

Air Commodore Khalid Banuri (Retd) is a practitioner and a scholar with diverse interests and experience spread over 44 years in public service, in four broad realms – aviation, training, education and outreach. He commenced his career as a fighter pilot and flight instructor from the PAF, rising to the rank of Air Commodore. He was the first Director General Arms Control & Disarmament Affairs (ACDA) Branch at the Strategic Plans Division (2012-17) and Advisor on Arms Control & Diplomacy (2017-21), wherein he contributed to policy making in nuclear, missile, space, chemical and biological control, strategic export controls, South Asian security & policy and international law. With postgraduate qualifications from three Pakistani and two British Universities, in security,

strategic, defence, international law and war studies, he has taught at three public sector universities in Pakistan.

Air Marshal M. Ashfaque Arain, HI (M), SBt (Retd), Advisor to the Chief of Air Staff on CASS Affairs, Pakistan

Air Marshal M Ashfaque Arain is Advisor to the Chief of Air Staff, PAF on CASS Affairs at CASS, Islamabad, Pakistan. He is a graduate of Combat Commanders' School, PAF Air War College and National Defence University. He holds a Master's Degree in Defence & Strategic Studies from Air War College (AWC) and a Master's Degree in War Studies from National Defence University (NDU), Islamabad. In his 41 years of illustrious career as a fighter pilot with Pakistan Air force, the Air Marshal flew various top of the line fighter aircraft with a singular honour of being first PAF pilot to achieve 2000 hours on the F-16 aircraft. During his career, he has served in senior command and staff assignments including command of a fighter squadron, an operational base, Air Adviser Pakistan's High Commission in New Delhi, Chief Project director Horizon, Assistant Chief of the Air Staff (Operations), Assistant Chief of the Air Staff (Plans), Director General Air force Strategic Command (AFSC), Director General Projects, and Deputy Chief of the Air Staff (Administration).His specialist areas of research include Emerging Technologies, Global Conferences. The Air Marshal has been decorated with the distinguished awards of, Tamgha-i-Imtiaz (Military), Sitara-i-Imtiaz (Military), Hilal-i-Imtiaz (Military) and Sitara-i-Basalat.

Air Marshal Farhat Hussain Khan, HI(M), SBt (Retd), President, Centre for Aerospace & Security Studies (CASS), Islamabad, Pakistan

Air Marshal Farhat Hussain Khan has rich experience in aviation and industrial management, diplomacy, and negotiations. During his service, he remained on various important command and staff appointments, including Vice Chief of the Air Staff and Chairman Pakistan Aeronautical Complex Board. He has also served as Pakistan's Air Attaché in New Delhi, India. He is the co-author of 'The Aviation City' and 'Milestones' about the growth of military aviation industry in Pakistan and its way forward.