TRANSFORMATION TO HARNESS DISRUPTIVE TECHNOLOGIES

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Abstract

*A **modern day 'Blitzkrieg'** without any overwhelming force concentration and not an iota of involvement of conventional forces is a reality today with definite outcome in the form of demonstration of the intent to break through the opponent's lines of defence, dislocate the defender and unbalance the enemy.*

The capability to carry out precision attacks at a fraction of cost compared to a conventional strike penetrating and exposing the vulnerabilities in impregnable defence systems is just the tip of iceberg of potential capabilities and threats enabled by technology and an imaginative mind alone.

Emerging disruptive technologies such as artificial intelligence, big data, quantum technology, advanced robotics, autonomous systems, new advanced materials, blockchain, energy storage, hypersonic weapons systems and biotechnologies applied to human enhancements amongst many others are expected to have a disruptive impact on defence and revolutionise future military capabilities, strategy and operations. The manifestation in the form of the drone attack in Saudi Arabia was just one of exploitation of capabilities available. And these are clear indicators that this is an inflection point where transformation to meet the new challenges is inevitable however the level and scope of this transformation needs to be defined.

Introduction

The event of 14 September 2019 wherein drones were used to attack the state-owned Saudi Aramco oil processing facilities at Abqaiq and Khurais in eastern Saudi Arabia causing large fires at the processing facility thereby cutting Saudi Arabia's oil production by about half – representing about 5% of global oil production – and causing some destabilization of global financial markets can easily be termed as the ***modern day 'Blitzkrieg'***. Without any overwhelming force concentration and not an iota of involvement of conventional armoured, motorised or mechanised infantry formations or close air support associated in the classic understanding of the Military Doctrine the outcome in the form of demonstration of the intent to break through the opponent's lines of defence, dislocate the defender, unbalance the enemy by making it difficult to respond, and bring about complete desired annihilation was loud and clear. The capability to carry out such an insertion with precision and fraction of cost compared to a conventional airstrike penetrating and exposing the vulnerabilities in impregnable air defence systems is just the tip of iceberg of potential capabilities and threats enabled by technology and an imaginative mind alone. Stealth, surveillance, avionics, sensors, communication amongst many others with innovation were the basic ingredients of carrying out such an act causing the resultant disruption aka the modern-day Blitzkrieg!!

The world over now there is a buzz centred around the advent of Disruptive Technology which is making waves across all spheres and interestingly has started shaping Military too though much divorced from the deep-rooted hypothesis of Revolution in Military Affairs. Intriguingly this draws away the Military from the familiar hunting ground and comfort zone of remaining embedded in evolution of weapons technology, information technology, military organization, military doctrine as a consequence of evolving doctrines, strategies, tactics and threat perceptions. ***A totally new dimension is staring at the possible ways of exploiting these technologies and waging warfare in different domains and dimensions.*** This not only requires but necessitates a transformation which is transcending from sustainable to disruptive technologies in an extremely dynamic and evolving matrix.

An understanding and evolution of the new paradigm with its possible ramifications and challenges the security forces will face when using disruptive technologies to counter emerging threats is therefore imperative. Rightly so the Indian Army Chief Gen Naravane commented that the Indian armed forces need to invest heavily in "disruptive technologies" that are becoming critical in modern day fighting calling for an overarching National Mission in the arena[1]. This was on the occasion of a seminar conducted on the 'Impact of disruptive technologies on the fighting philosophy in future conflicts' indicating that the concern has been taken note at the highest echelons and thought process initiated to invite adequate emphasis. ***What stands out from the statement is the call for an overarching National Mission*** in the arena which typically does not happen so in preparing to combat a conventional threat.

The Advent

The Fourth Industrial Revolution (4IR or Industry 4.0) is the ongoing automation of traditional manufacturing and industrial practices, using modern smart technology. Large-scale machine-to-machine communication and the internet of things (IoT) are integrated for increased automation, improved communication and self-monitoring, and production of smart machines that can analyse and diagnose issues without the need for human intervention[2]. The fourth Industrial revolution what it means and how to respond was the subject of an article by Klaus Schwab, published by Foreign Affairs[3] in Dec 2015 and introduced to the world at large during the World Economic Forum Meeting in 2016. He goes on to say that it is the ***'brink of a technological revolution that will fundamentally alter the way we live, work, and relate to one another***. In its scale, scope, and complexity, the transformation will be unlike anything humankind has experienced before'. However, in essence it is not really a new form of technology, but in fact a revamped

1 Times of India 26 Aug 2020

2 https://www.techradar.com/news/what-is-industry-40-everything-you-need-to-know 16 July 2021

3 https://www.foreignaffairs.com/articles/2015-12-12/fourth-industrial-revolution 16 July 2021

approach inspired by new advancements to achieve results that weren't possible with same technologies years ago. Looking back at the third industrial revolution from the late 1950s to the late 1970s which marked a profound change from analogue, mechanical, and electronic technology to digital technology, the fourth is the move towards digitisation. Industry 4.0 uses the Internet of Things and cyber-physical systems such as sensors to collect vast amounts of data that can be used to radically change the way business is done in virtually all spheres of life. There are a large number of components but the driver has been digitisation and automation over processes such as Internet of Things, Cloud computing, artificial intelligence cognitive Thinking and Cyber physical systems. Innovations in the physical, digital, and biological spheres is transforming entire systems of production, management, and governance in the businesses. The advent of 4IR has resulted in disrupting industries worldwide and living in a connected world and disruption anywhere creates a ripple effect. So, the manifestation of this revolution is the emergence of disruptive technologies.

Spectrum of Disruptive Technology

While surmising that the Fourth Industrial revolution is leading to disruptive technology it would be appropriate to trace the origin of this word. It was Clayton Christensen who popularized the idea of disruptive technologies in The Innovator's Dilemma, published in 1997. It has since become a buzzword in start -up businesses that seek to create a product with mass appeal. A disruptive technology to simply state supersedes an older process, product, or habit with definite superior attributes and finds least resistance for adaptation in innovative and flexible enterprises rather than those entrenched in sustained technologies and rigid mindsets. To simply quote Clayton ***"Disruptive Technologies bring to market a very different value proposition than had been available previously"[4].*** So, what are the components of this disruptive technology leading to the violent disruption. Building on

4 Clayton M Christinsen, The Innovator's Dilemma (Harvard Business Review Press 2016) pp. xix

the basic technology base of Internet, Digitisation, Mobile Connectivity, Cloud Computing, Big Data Analytics the innovations leading to Internet of Things, Block Chain, Cognitive Thinking, Robotics, Nanotechnology, Drones, Next Generation Genomics, Renewable Energy, 3D Printing, Artificial Intelligence, Autonomous Vehicles, Virtual and Augmented Reality, Hypersonic Systems, Smart Grids resonate with Claytons statement that these bring forth a value proposition not thought of earlier.

These emerging disruptive technologies such as artificial intelligence, big data, quantum technology, advanced robotics, autonomous systems, new advanced materials, blockchain, energy storage, hypersonic weapons systems and biotechnologies applied to human enhancements amongst many others are expected to have a disruptive impact on defence and revolutionise future military capabilities, strategy and operations. The manifestation in the form of the drone attack in Saudi Arabia was just one of exploitation of capabilities available. And these are ***clear indicators that this is an inflection point where transformation to meet the new challenges is inevitable*** however the level and scope of this transformation needs to be defined.

Threat Matrix and Defence Preparedness

Countries all over the world have gone back to examine the defence strategy in face of disruptive technologies emergence and implications for Military Organisations. While the US has routinely been redefining, the landscape given their role in Global Context it was in a very well brought out research article by Bulgarian Defence Institute "Prof Tsvetan Lazarov" which comprehensively examines the changing strategic environment and global technological trends with their implications in the defence domain[5]. There is a brilliant analysis of the impact spanning across all EU & NATO nations and concludes that while the future will see significant change in the nature of war but the new emerging technologies do not necessarily have the same effect on all layers and dimensions. A very brief recap of

5 https://www.jdst.eu/publications/defence-strategy-and-new-disruptive-technologies-nexus-implications-military 17 July21

the threat matrix and defence preparedness in our context will be essential to understand the implications of the disruptive technologies.

The complex threat spectrum in our context ranges across nuclear to sub conventional coupled with the terror canvas extending the whole gambit from asymmetric warfare to hybrid in nature. There is no sign of early resolutions of territorial differences with either of the neighbours and the increasing belligerence reflected in the events unfolded in Jun 2020 only go on to make the threat potent and real. Aspirations of China in the Indian Ocean with all the economic and technological might is impacting the global security concerns too. With all resources at its command the stance is aggressive and only indicates that not much has changed or will change. On the other hand, Pakistan in the present state continues to aid terrorism and insurgency and recent events in Afghanistan with the US withdrawal will only further embolden its mischievous intents. The collusion angles between the neighbours are equally worrying and something which cannot be overlooked. Across the eastern borders too there is not much which is going to change though the manner it will be dealt is already shaping up. There are likely implications for us. ***Notwithstanding the above the emerging security environment will still be radically different from what it has been significantly in marking a departure from the era of large scaled protracted conventional conflicts.*** While not reducing the relevance of conventional force levels whether it is Land, Air or Sea, there will be a need for faster swift and decisive capabilities dominating Cyber, Digital, and Space and building capabilities to mitigate asymmetric and hybrid threats as well. To that extent the setting up of the integrated Cyber, Space and Special forces divisions as also the recent restructuring and ongoing validation of the Army Integrated Battle Groups is timely and reassuring. So, to sum up while the threat of a large-scale war may diminish but the threat scenario continues to be same and in fact become more complex with the new dimensions highlighted.

Defence Preparedness and Disruptive Technology

The aim of any defence preparedness is to close the capability gaps

and a continued strive for modernisation to meet the future threats and challenges. It is a continuous process marked by inductions, upgrades, innovations, technology infusion in a balanced manner for near-, mid- and long-term readiness of the armed forces. In a volatile, uncertain, complex and ambiguous environment digital readiness with timely accurate reliable information flow will play a pivotal role. ***Time has now come that we adopt a mixed strategy of retaining the traditional platforms and adopt disruptive transformational technologies leveraging innovations and opportunities available.***

A look at the technologies and their applications will illustrate the host of options and opportunities across all combat platforms: -

TECHNOLOGY	**APPLICATIONS**
Wireless technology, Cloud Computing, Block Chain, Quantum Computing	A revolution in automation and streamlining of processes leading to digital distribution and decision making over range of devices from multiple location options in extreme terrains, Reduction of form factor, signatures, Cyber domains. Diffusion of power and rapid decision cycles.
Small low-cost computing and storage devices	
Big data and advanced analytics	
Internet of Things - High speed Networks and Data centred hardware	
Advanced Low-Cost miniature smart sensors	Communication, surveillance, detection, deception and integrated decision making
Artificial Intelligence and Machine Learning, Computer Vision	Rapid Decision making, quantum change in human and machine behaviour, Predictive Maintenance
Advance display technology with Enhanced Natural user interfaces	Provide real time imagery and possibility of 360° display
Advanced Robotics and Robotic Exoskeletons	Access to areas without risks and enhance efficiency
Virtual and Augmented Reality	Provide a digital real-life experience, enhanced Simulation
Wireless and RFID devices	Reduced footprints, signatures

Autonomous Vehicles	Enhance the reach with low threats to own forces, unhindered access
Renewable Energy and New Generation Battery Technologies	Sustained exploitation of devices at extreme conditions and reduced dependence
Advanced material Technology, Nanomaterial, Memory Metals, Self-Healing Materials	Enhanced Mobility, Survivability of Platforms, reduced payloads, longer exploitation avenues
Selective Laser Sintering	Directed Energy weapons
3D Printing Additive Manufacturing	Availability of solutions in near time frame and in remote locations.
Hypersonic Technology	Launch from standoff platforms

The application spectrum virtually affects man and machine in a manner never comprehended in the past. From enabling an Infantry soldier by empowering him with real time information and decision-making tools, providing him battlefield transparency and ability to unleash lethality against any form of threat to light weight, agile, extremely mobile, connected platforms with enhanced survivability attributes. This is true for Mechanised assets, Artillery Guns. Radars, Aviation, Battleships, Space Crafts, Communication, Command Control Centres, Logistic Network and Infrastructure and Battlefield Sustenance & Predictive Maintenance. ***Compressed OODA cycles will demand from the Commanders a dynamic and complex mind set change to respond to these technology enabled systems in a real time frame marking another form of preparedness for which a transformation is not only essential but imperative***.

Disruptive Technology and Transformation

Interestingly world across the mantra doing rounds today is 'Transform or Perish' as a consequence of the impact of these disruptive technologies and is not industry specific but all over be it manufacturing or service sectors such as banking, tourism, medicine, hospitality, education, cyber security, communication, media or entertainment amongst host of many

others. However, the same when it comes to our threat perception, preparedness, organisational structures and future modernisation the impact is not in the same measure though still alarming. To adopt any technology the foremost requirement is a shift in mindset which is not academic but a personal adaptation. ***Further implementing a technology alone does not produce a transformation till the time the organisation is not convinced of taking advantage of the potential of that technology or in other words fully internalise what it means.*** Further as evident the impact of these technologies has two dimensions one being on the entire force structure and the other on selected applications.

When it comes to the entire force structure it implies a mid to long term roll out as it finds a place in upgrades, plug-in solutions, acquisitions, and modernisation. There is an element of inherent risk aversion in adapting to new solutions being familiar with set technologies and being confident and assured of the performance so it will be a tardy process. These would virtually include new generation platforms fully networked, with enhanced capabilities in the form of mobility, lethality, enhanced survivability capable of exploitation in extreme conditions over protracted employment cycles. This would necessarily force a transformation towards leaner, agile, theatre and threat-based capabilities rather than holding a conventional force for catering to any eventuality. The theaterisation and integrated battle groups are good start points to move towards the transition. However strategically the intent shall remain same the difference being in the radical tactical gains provided by these technologies.

The short-term diffusion is more intriguing. These will ***need re-shape in thought process and will follow the technologies with imagination, innovation which will cause disruption.*** Therefore, structurally there is a need to raise a viable force compact in composition but empowered with operational knowledge and experience, technically competent and with full flexibility. It should be a ***homogeneous mix of combatants, technocrats, cyber experts, research scientists, young systems engineers and academic experts. They will not own***

assets or command troops but constantly look at opportunities to be exploited in all domains be it space, communication, cyber, surveillance, data processing, artificial intelligence in a collaborated environment. They will be problem solvers and sharp shooters armed with technology and hungry for opportunities to counter emerging threats, Domain specialisation with limited relevance is the need. Examples of Drone strikes, cyber warfare, spoofing, disruption in communication networks, data breach, psychological warfare, disabling surveillance grids, mapping of terrorist network, cognitive modelling, disabling control centres, penetrating decision networks are just a few scenarios which can be made live. A broad array of low-cost, unsophisticated technological advancements such as drones and robotic technologies are readily accessible and can be employed innovatively as weapons. This is easier said than done. The forces need to think in this direction critically whether it is integrating in Operations, Cyber division or perhaps a new de novo structure. It is Special Forces Division in a totally different dimension armed with a variety of skill sets and hence the need of a cross functional dynamic team. So, in essence an ***'Emerging Defence Technology Bureau'*** comprising of an integrated structure under the CDS will be an optimum requirement with a National Mission footprint.

Another significant transformation is to realise that this time this revolution is not being driven by the Forces, but it is ***being driven by the market and commercial ventures and they must follow and adopt soon*** before the emerging and disruptive advantage is seized by someone else, or it is no longer in the realm of disruptive technology. The pace and rate of technological change is neither under control of the defence forces nor responsive to what the forces want. This is not about designing and building systems that can adapt and align to threats. The conventional emergence of the likes of Internet, Radar, GPS etc through Defence R&D and applications is past and now the equation goes a change and clearly the curve has tilted. A related challenge is therefore adaptation and become fast followers of these technologies. They will not be driven by the Forces in the form it can serve the end means but means will have to be invented to meet the ends. The commercial

enterprises too which have been quick to adapt are emerging winners and others struggling even to retain their place. If Zomato and Uber can virtually drive a service out of a room without owning the assets and yet be effective in their venture it is just the human intelligence, creativity, innovation and an imaginative application. Yet another challenge is finding an anti-dote in a near time frame – there is a drone threat – we need anti-drones, there is jamming we need jammers, there is malware we need healers, and this is a new world for the forces. It is the mind of wars in the most intense form armed with technology. The disruptive impact is in the hand of the user.

A fall out of the above is ***how to acquire this disruptive technology in a process driven bureaucratic framework.*** The solutions are in the form of innovations, start-ups, cross functional, non-platform based and often in the cognitive domain. They will also not necessarily be in the military domain and will invariably be associated with be a great element of risk in their ultimate utilisation, sometimes the ultimate utilisation too may be hazy and hence an integrated and empowered structure is essential. It will also mark a departure from monopoly suppliers and impinge on the conventional sources and methods. The bright side of all this is however that ***these do not carry the baggage of old entrepreneurial model and are neither capital, equipment, platform or infrastructure intensive and have noticeably short gestations and relevance*** and hence an agile and empowered framework should be able to deliver.

So, while working out an acquisition reform concurrently there are related issues of Regulatory Reforms, Intellectual Property Reforms, Security Collaborations and a continuous engagement with industry to be positioned back as drivers rather than as followers. This is feasible through investments in innovation and exploring alternative strategies and provide an ecosystem to deliver technologically advanced solutions towards modernizing. The ***initiatives like Innovations for Defence Excellence, Technology Development Fund, Invest India, promotion of start-ups, incubation cells in leading academic institutions are fine examples*** and need to be earnestly followed up. Ideally, they

all should be structured around a composite structure rather than be fragmented under different verticals and here is the connect with the structural reform discussed earlier.

In Summation

The fourth industrial revolution has unleashed a fundamental change in the way we live, work, think, communicate and operate by bringing forth a host of technologies capable of disruption to the established norms and processes. ***And we are not talking about breakthrough technologies but innovative technologies with easier accessibility but profoundly different in outcomes***. Driven on computation, data analytics, artificial intelligence, nano material, smart sensors, advanced human-machine interface, augmented realities coupled with imagination, human intelligence, cognitive processes the scope has no boundaries,

This characterises a new chapter which is tending to merge the physical. digital and biological worlds in a way that creates huge promises and the speed, breadth and depth of this is forcing all to realign and create values in whichever space we operate. It is more than tech driven and opportunity lies to look beyond these technologies and create value proposition***. For the defence forces it brings forth an opportunity to augment the military modernisation without impinging on the fiscal constraints.*** The new emerging technologies do not have the same effect on different layers and dimensions of defence strategy neither do they have the same impact across all operational and tactical domains. Hence, an incremental and calibrated adaptation is necessary to prepare for tomorrows warfare dominated by digital battles interconnected in networks without compromising on the defence preparedness in light of our long-term security threats and concerns.

The ***clear challenge for the leadership is to create an environment which facilitates the transformation*** because this needs a new soldier to think differently and behave differently something the mindset is not used to. People and not technology alone are the most important piece in the digital transformation puzzle. And to quote Steven

Johnson “If you look at history innovation doesn’t come just from giving people incentives, it comes from creating environments where ideas can connect”. So going beyond technology and people it is the environment and space which is critical.

We are at a cusp where options are closed and there is no alternative and while it is not question of transform or perish but it is at the peril of losing out an opportunity to find ways and means to wage warfare in a manner never comprehended earlier, so the sooner we get on board the better it is for our quest of modernisation and capability enhancement and addressing security concerns across all spectrums and domains.

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