



novatech

**THE FUTURE OF DEFENCE:
TECHNOLOGY'S ROLE IN DEFENCE
TRANSFORMATION**



INTRODUCTION

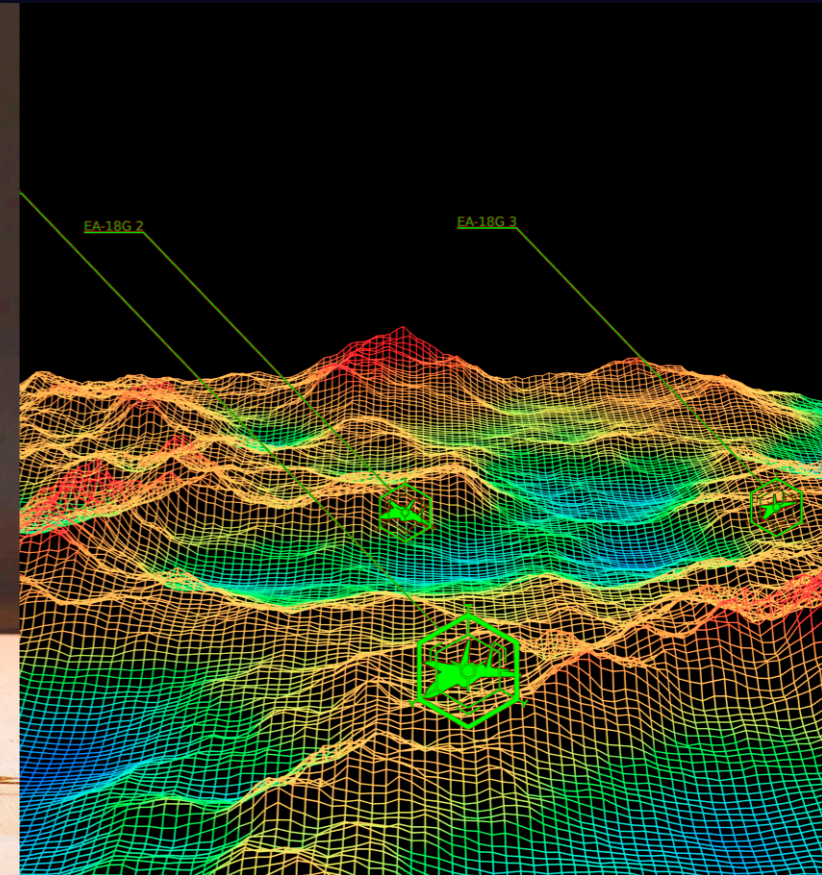
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INTRODUCTION

For decades, the defence industry has been essential in driving technological progress, often leading to remarkable innovations that find applications in the private sector. Lately, investments within the sector have seen a significant increase, in part due to the UK Government's allocation of an extra £5 billion for defence and £3.5 billion to promote technological and scientific advancements^[1]. New solutions and applications have emerged, altering the landscape of ongoing conflicts and opening up novel opportunities for military institutions, defence organisations and private companies alike.

This whitepaper delves into the diverse aspects of technology and innovation within the defence sector, focusing on non-combative applications. At Novatech, we are committed to addressing the ever-changing challenges our clients face. By investigating current industry trends, numerous cutting-edge projects and the direction of technology, we aim to offer valuable insights for future-minded professionals.

GOVERNMENT ENDORSEMENT AND FUNDING FOR INNOVATION WITHIN THE DEFENCE SECTOR

The UK Government's recent commitment of £5 billion to the defence sector emphasises the importance attributed to innovation in this sphere. This financial backing is essential for stimulating research and development, and incorporating emerging technologies such as artificial intelligence, machine learning, supercomputing and hardware development, all of which can have a significant impact in both military and civilian settings. Competitions are even being used to encourage innovations in Human Machine Interaction (HMI), such as the recent Defence and Security Accelerator (DASA) competition, in which defence companies were encouraged to share a 'Wizard of Oz' demonstration of an AI-assisted project in a bid for funding^[2].

In 2022, the UK's Defence Procurement Minister, Jeremy Quin, affirmed the critical nature of emerging technologies in determining the defence sector's future. He observed, "*Future conflicts may be won or lost on the speed and efficacy of AI technology, and our approach to AI must be rapid, ambitious and comprehensive*"^[3]. This viewpoint underscores the developing influence that technologies such as AI will have on the defence industry in the near future.

CONTEMPORARY INDUSTRY TRENDS AND FORTHCOMING DEVELOPMENTS

The defence sector is in a constant state of flux, with numerous trends guiding its future direction. Ranging from non-combative applications of technology in conflicts – such as communication and intelligence systems – to advancements in simulation and training, these innovations are forging new avenues for approaching security and warfare. As we examine these trends comprehensively throughout this whitepaper, it is crucial to recognise that hardware and software innovation form the foundation of these advancements.

NOVATECH'S DEDICATION TO NON-COMBATIVE SOLUTIONS AND TECHNOLOGY

At Novatech, we have faith in technology's ability to create a safer, more secure world. We acknowledge the distinctive challenges faced by the defence sector and are devoted to crafting innovative and ethical solutions with an emphasis on non-combative applications. By collaborating with leading industry stakeholders and maintaining a forward-thinking position in technology, we strive to offer our clients insights into ground-breaking hardware and software solutions that positively impact the world.

EXPLORING ADVANCEMENTS IN DEFENCE

As we investigate the diverse aspects of technology and innovation in the defence sector, this whitepaper will supply valuable perspectives and captivating case studies that showcase the potential of non-combative solutions, while minimising examples of defence-related solutions. We hope that by examining these subjects, we can assist decision-makers, researchers and academic institutions in understanding the opportunities ahead and the pivotal role technology will assume in shaping defence's future.

Emphasising novel solutions, ethical considerations and the future of technology, this whitepaper serves to deliver a thorough analysis of the ever-transforming landscape of the defence sector. As we navigate the challenges and opportunities on the horizon, Novatech remains dedicated to equipping our clients with the innovative and ethical solutions necessary to thrive in an increasingly intricate world.

PIONEERING TECHNOLOGIES

TRANSFORMING THE DEFENCE SECTOR

“SUPERCOMPUTING, MACHINE LEARNING,
ARTIFICIAL INTELLIGENCE, DEEP LEARNING
AND ENGINEERING ARE ELEVATING
DEFENCE INDUSTRY SOLUTIONS **AT A PACE
NEVER SEEN BEFORE**”

Over the past decade, the defence industry has undergone a remarkable transformation. As state-of-the-art technologies are employed to bolster military capabilities, strengthen security protocols and improve strategic decision-making processes, technologies like supercomputing, machine learning, artificial intelligence, deep learning and engineering are elevating defence industry solutions at a pace never seen before.

SUPERCOMPUTING

Supercomputers, also referred to as high-performance computers (HPCs), feature extremely high processing abilities and power capacities. In the defence industry, they enable the:

- Simulation of highly complex and intricate military scenarios
- Deep-level data analysis
- Advanced research in areas like cryptography, encryption and communications

The impressive power of supercomputers provides defence industry organisations with the ability to rapidly develop robust solutions and iterate on existing systems.

For example, the United States Department of Defense's High-Performance Computing



Modernization Program (HPCMP) features over seven billion core hours of advanced computing and high-speed networking capabilities. The program is used to support research, development, testing and evaluation initiatives across various defence-related domains. It was introduced in 1992 and has been instrumental in bolstering the defensive capabilities of the US and its allies. As recently as 2017, the initiative has more than 2,400 scientists and researchers working on the program, performing a wide range of R&D activities^[4].

MACHINE LEARNING

Machine learning (ML) is another groundbreaking technology with significant implications for the defence sector. ML algorithms can process extensive data, making accurate predictions and identifying patterns that humans couldn't possibly discern without tech-based assistance. In defence, this translates to being able to predict enemy movements based on historical data, identify potential threats in real time or optimise logistical operations using data-driven insights.

In particular, Monte Carlo simulations can be used to model the probability of various outcomes in uncertain situations. By running the same scenario thousands of times with

completely randomised variables, they can be used to generate data-backed predictions of combat outcomes. This can prove invaluable to decision and policy-makers, by presenting them with concrete results and preventing projects from running overbudget^[5]. Applied to defence, Monte Carlo simulations can be used to evaluate scenarios which cannot be tested in practice; such as flight trajectory^[6] and the survival ability of defence structures^[7]. They can also be utilised in reverse; if the desired outcomes are set in advance, the simulations can determine the most effective way to reach these goals, allowing performance objectives to be derived.

ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) has countless applications in defence. From automating routine tasks and freeing up personnel for more strategic work, to enhancing decision-making and complex data set analysis, the power of AI is near limitless and is only projected to keep on growing in coming years. For example, the Pentagon's Project Maven uses AI to analyse drone footage, improving accuracy and efficiency in identifying potential threats^[8].

The UK Royal Navy has also begun leveraging AI to help ease maritime operations. In May

2021, for the first time in history, the Royal Navy deployed an AI system that delivers real-time analysis, notifications and recommendations on tactical manoeuvres while at sea^[9]. The AI solution was developed and managed by scientists and researchers from the UK's Defence Science and Technology Laboratory (DSTL).

The U.S. Air Force has also been exploring the use of AI for a wide range of applications, from mission readiness to organisational efficiency. The Massachusetts Institute of Technology (MIT)

“FOR THE FIRST TIME IN HISTORY, THE ROYAL NAVY DEPLOYED AN AI SYSTEM THAT DELIVERS REAL-TIME ANALYSIS, NOTIFICATIONS AND RECOMMENDATIONS ON TACTICAL MANOEUVRES WHILE AT SEA”

and the Department of the Air Force (DAF) work together in the DAF-MIT AI Accelerator laboratory at MIT, to develop novel AI solutions such as Air Guardian, which augments human decision-making capabilities by relying on advanced, end-to-end machine learning algorithms^[10].

DEEP LEARNING

This subset of machine learning shows

significant promise in the areas of image and speech recognition. It's proved particularly useful for identifying potential threats in surveillance systems and differentiating between targets in autonomous weapons systems. The US Army Research Laboratory, for example, has embarked on research into the use of deep learning for facial recognition in thermal images. It trained its solution using over half a million images from just 394 people^[11], making it one of the largest image recognition datasets ever created for low-light and thermal scenarios^[12].

Similarly, deep learning can also help in the development of natural language processing (NLP) capabilities, which military personnel can draw upon to analyse large amounts of textual data (e.g. social media posts) in order to gather intelligence and identify potential threats. The U.S.'s Defense Advanced Research Projects Agency (DARPA) has been funding projects to develop NLP technologies that can automatically detect and analyse foreign-language content in real-time, in-field use^[13].

ENGINEERING

Innovations in engineering continually drive the development of novel defence technologies. From advanced materials that make military

equipment lighter yet stronger, such as nano-based coatings, to the design of stealth technology that renders aircraft invisible to radar. Since the dawn of defence, engineering has played a pivotal role in maintaining a competitive edge on the battlefield.

In particular, breakthroughs in areas such as nanotechnology and biotechnology have opened up new possibilities for enhancing the capabilities of military personnel and equipment. MIT's Institute for Soldier Nanotechnology is focused on developing leading-edge nanotechnology applications for areas such as waterproofing and ballistic protection^[14].

One area where engineering advancements are making a significant impact is in the development of exoskeletons. These wearable systems can augment the physical abilities of soldiers, enabling them to carry heavy loads, move at faster speeds and endure longer periods in the field. For example, Lockheed Martin has developed the ONYX exoskeleton, a lower-body wearable system that uses sensors, motors and a computer-controlled artificial intelligence system to enhance soldiers' strength and endurance^[15].

Emerging technologies like high-performance computing, machine learning, artificial intelligence, deep learning and materials engineering are increasingly empowering militaries around the



world with enhanced capabilities, improved defensive capabilities and better strategic decision-making. As these technologies continue to evolve, they will undoubtedly play a critical role in shaping the future of defence and the world at large.

ADDITIONAL DOMAINS OF ADVANCEMENT

ROBOTICS

Autonomous systems and robotics are playing an increasingly vital role in modern defence strategies. These systems enable humans to perform hazardous tasks, such as bomb disposal or surveillance, without putting their lives at risk. One example is the Boston Dynamics' Spot robot, which the French military recently tested for use

alongside human soldiers in an experimental reconnaissance training operation^[16].

QUANTUM COMPUTING

Quantum computing has the potential to revolutionise encryption, cybersecurity, intelligence and a wide range of other defence-centric areas. One of its more fascinating applications is its potential ability to create ultra-secure, near-unhackable communication lines^[17].

CYBER WARFARE

As nations become increasingly reliant on digital infrastructure, cyber warfare has emerged as a significant area of concern. Cyber-based attacks are used to disrupt military communications, compromise sensitive information and damage critical civilian infrastructure, such as the attacks

seen in the Russia-Ukraine conflict. Defence organisations are investing in advanced cyber defence capabilities, including AI-driven threat detection and response systems, to protect against such attacks^[18].

SPACE

The increasing importance of space in defence has led to a strong surge in the development of space technologies. Examples include advanced satellite communication systems, missile warning systems and space-based surveillance and reconnaissance capabilities. Companies like Boeing and Northrop Grumman are heading the charge in numerous areas of space, including the development of tactical satellite systems for the US Air Force, a project worth more than \$20 billion^[19].

“AS NATIONS BECOME INCREASINGLY RELIANT ON DIGITAL INFRASTRUCTURE, CYBER WARFARE HAS EMERGED AS A SIGNIFICANT AREA OF CONCERN”



SIMULATION & TRAINING

AN OVERVIEW OF SIMULATION AND TRAINING TECHNOLOGIES IN THE DEFENCE SECTOR

“SIMULATION AND TRAINING TECHNOLOGIES HAVE EXPERIENCED SIGNIFICANT ADVANCEMENTS OVER THE PAST 30 YEARS. FROM VR AND AR-BASED TRAINING SOLUTIONS, TO CUTTING-EDGE HARDWARE DEVELOPED FOR THE US MILITARY”

Governments have long used advanced simulations and training solutions for everything from infantry combat and flight manoeuvres to space travel training. Even as far back as 1979, NASA was using hardware-based space flight simulators to prepare its astronauts for the demands of complex, highly dangerous missions^[20].

Needless to say, simulation and training technologies have experienced significant advancements over the past 30 years. From VR and AR-based training solutions, to cutting-edge hardware developed for the US military, the following sections detail some of the latest advancements in the areas of defence training and simulations.

VIRTUAL REALITY & AUGMENTED REALITY

The implementation of virtual reality (VR) and augmented reality (AR) in the defence sector has become increasingly prevalent in recent times. In 2020, the “AR/VR in defence” market was valued at \$0.5 billion. By 2025, Statista projects its value will triple to \$1.5 billion, indicative of the rapid adoption of these technologies across the defence sector^[21].

These ground-breaking technologies facilitate the creation of immersive, customised training settings tailored to various military situations. VR transports users into an entirely digital environment and is especially valuable for training military personnel in urban warfare, hostage rescue operations and other high-stakes scenarios. In contrast, AR superimposes digital data onto the physical world, making it an optimal choice for enhancing situational awareness, equipment maintenance applications and navigation training exercises.

One of the best recent examples of the use of AR in defence is the US Army’s partnership with Microsoft. In 2021, the US Army and Microsoft conducted 80,000 hours of prototyping and user testing to develop a custom AR headset for soldier training, based on Microsoft’s commercially-available HoloLens technology. The AR headset

enables soldiers to experience ultra-realistic training scenarios across countless environments, serving to better prepare them for real-world combat interactions^[22].

THE EVOLUTION OF FLIGHT AND COMBAT SIMULATORS

Over the years, flight and combat simulators have undergone considerable advancements. Refined graphics, sophisticated motion systems and authentic controls closely resemble real-life aircraft and the uncertainty of flying in the real world. In the below section, we highlight some of the latest advancements in flight training systems by the world’s leading defence companies.

“IN 2020, THE “AR/VR IN DEFENCE” MARKET WAS VALUED AT \$0.5 BILLION. BY 2025, STATISTA PROJECTS ITS VALUE WILL TRIPLE TO \$1.5 BILLION”



SIMULATION & TRAINING

CASE STUDIES OF SUCCESSFUL PROJECTS IN SIMULATION AND TRAINING

“AUGMENTED AND MIXED REALITY TRAINING SIGNIFICANTLY IMPROVED THE QUALITY OF INSTRUCTION BY REDUCING RELIANCE ON PASSIVE, TRADITIONAL METHODS SUCH AS POWERPOINT-BASED CLASSROOM TRAINING”

VECTRONA'S ACE-XR – AR, 3D, AND MIXED REALITY (MR) SOLUTION FOR THE U.S. AIR FORCE

In an effort to heighten its ability to rapidly train mission-critical personnel, AFWERX, the U.S. Air Force's innovation wing, began an initiative to develop and implement novel solutions to bolster its training processes^[23]. Recognizing the potential of solutions like AR and MR technologies to improve the effectiveness of its training programs, the Air Force contracted Vectrona, an innovator in immersive technologies, to develop a unique training solution for maintenance and munitions training.

A key aim of the project was to support novice trainees fresh from basic training, who may not

have any prior experience in maintenance. The steep learning curve these individuals face, especially in terms of grasping the language of maintenance and the intricacies of sophisticated equipment, required a highly innovative and effective training platform.

MIXED REALITY SIMULATIONS FOR IMPROVED TRAINING OUTCOMES

Vectrona's vision was to create an immersive, software-hardware AR and MR training system that would engage trainees across different learning modes. This involved providing visual instructions, visual cues, synthetic voice narratives, multi-media images, and highly realistic 3D digital representations of the aircraft. Importantly, the training applications needed to function both in network-connected environments and offline, such as in hangars or remote areas.

The AR and MR training solution significantly improved the quality of instruction by reducing reliance on passive, traditional methods such as PowerPoint-based classroom training. It enabled trainees to engage in preliminary training rehearsals before live training on physical assets, preparing them to maximize the value of hands-on training opportunities.



THE POWER OF COLLABORATION – JOINING FORCES WITH PTC AND MICROSOFT

To build this solution, Vectrona partnered with technology companies PTC and Microsoft. The resulting AR training applications were user-friendly, intuitive, and highly scalable, allowing students to interact with 3D models in a fully digital environment that was highly immersive and felt realistic. The solutions used to create ACE-XR include:

- Vuforia Studio (PTC) – transforms IoT and CAD data into 3D visualizations
- ThingWorx (PTC) – Industrial Internet of Things (IIoT) platform
- Creo Illustrate (PTC) – 3D visualization and design platform

“THE RESULTING AR TRAINING APPLICATIONS WERE USER-FRIENDLY, INTUITIVE, AND HIGHLY SCALABLE, ALLOWING STUDENTS TO INTERACT WITH 3D MODELS IN A FULLY DIGITAL ENVIRONMENT”

- HoloSun 2 (Microsoft) – Mixed reality device that features physical movement tracking, integrated voice commands, eye movement detection, environmental scanning, and an expansive viewing range

The impact of Vectrona’s solution was noteworthy. The AR and MR training modules allowed trainees to familiarize themselves with equipment and understand their operations in a highly tactile and realistic manner. The training experience was designed to be engaging and encourage interaction between the students and 3D models of equipment. This wasn’t passive learning, but an activated training approach that fostered intrinsic student motivation to learn.

THE FUTURE OF TRAINING – AR & MR SOFTWARE-HARDWARE PLATFORMS

The training modules were also designed to be flexible and could be used even when physical aircraft and equipment were not available, thereby ensuring continuity in training. An independent study conducted by researchers from Old Dominion University and The University of North Carolina at Chapel Hill found that trainees who used these devices achieved an eight percent

higher score on assessments compared to those using only the legacy training program, after just five to ten hours of training with the AR/MR tools over a two-month period.

Furthermore, the AR and MR training modules improved trainee confidence and cross-training abilities. Trainees were found to be more prepared for hands-on training and less likely to make mistakes that could lead to injuries or equipment damage. The training modules also increased the effectiveness of remote learning scenarios, further extending their benefits.

The collaboration between Vectrona, PTC, and Microsoft demonstrates how innovative technologies, like AR, 3D, and MR, can play a transformative role in defence training, enabling trainees to learn more effectively and perform better in their roles.

SIMCENTRIC’S SAF-TAC – VR TRAINING PLATFORM FOR THE UK & AUSTRALIAN ARMIES

In early 2023, the UK and Australian governments announced a partnership with SimCentric, a Sri Lanka-based provider of advanced training and safety solutions, for a new VR training initiative^[24].

“TRAINEES ACHIEVED AN EIGHT PERCENT HIGHER SCORE ON ASSESSMENTS”

Funded under the Defense and Security Accelerator (DASA), this virtual reality innovation by SimCentric has undergone trials by several units in the British Armed Forces and has been licensed by the Australian Army for further evaluation of VR training applications.

IMMERSIVE VR TRAINING ENVIRONMENTS

SimCentric’s “SAF-TAC” Virtual Training Environment, funded with £300,000 from DASA, combines gaming software with commercial VR headsets. Built on Unreal Engine, the system offers immersive graphics, sound design, and physics to emulate realistic scenarios. The VR headset tracks real-life user movements, which provides a more intuitive and realistic training experience.

The SAF-TAC system enhances skills such as situational awareness, posture, positioning,

movement, and weapon handling. SimCentric's VR solution offers several advantages:

- **Immersion:** The immersive nature of VR eliminates the detachment associated with keyboard and mouse control, providing trainees with a more realistic and potentially stressful training environment.
- **Situational awareness:** VR offers a more natural way of training situational awareness, as users must physically look around using the headset.
- **Ease of use:** VR employs natural gesture recognition, reducing the need for complex controls.
- **Availability:** The stand-alone VR headset allows users to train anywhere, without being limited by classroom space or desktop computer availability.

VR FACILITATES MORE EFFICIENT AND INTUITIVE TRAINING EXPERIENCES

SimCentric trialled SAF-TAC with the Parachute Regiment, 4 Princess of Wales's Royal Regiment, Royal Air Force Regiment, and the Royal Marines. The trial feedback was vital in improving SAF-TAC's user experience and developing relationships with potential military end users.

The trials demonstrated that VR-based training had a much lower learning curve compared to traditional methods, leading to more efficient training sessions.

Following their success with DASA and UK Armed Forces trials, SimCentric partnered with Australian company Applied Virtual Simulation (AVS) to deliver SAF-TAC to the Australian Army as part of their Land Simulation Core 2.0 Program.

“THE TRIALS DEMONSTRATED THAT VR-BASED TRAINING HAD A MUCH LOWER LEARNING CURVE COMPARED TO TRADITIONAL METHODS”

BOEING DEFENCE UK'S GLADIATOR – VIRTUALIZED SHARED-FLIGHT TRAINING

One example of a recent advancement is the UK Government's introduction of Boeing Defence UK's Gladiator system. This flight training solution enables multiple groups of trainees to experience the exact same training environment all at once,

from aircrew and support personnel to pilots. Gladiator draws on advanced software capabilities to deliver realistic environment details such as terrain and weather, as well as advanced mapping functionalities. The system features a combination of commercial hardware and software combined with proprietary technologies.

BAE SYSTEMS' PIONEERING FLIGHT SIMULATORS

BAE Systems, one of the key innovators in developing modern flight simulators for military and civilian applications, has contributed significantly to the technology's evolution^[25]. Its forward-thinking simulation solutions offer life-like training environments featuring high-quality visual



“BY LEVERAGING VR TECHNOLOGY, AIRBUS HAS MANAGED TO REDUCE TRAINING DURATION AND COSTS WHILE MAINTAINING HIGH INSTRUCTIONAL STANDARDS”

experiences, ultra-precise control feedback and full-motion platforms. As a result, pilots can refine their skills across a range of aircraft types and scenarios. BAE simulation technology features numerous capabilities and functionalities that leverage emerging technologies:

- Hyper-realistic training environments based on 3D and AR technologies
- Interconnected virtual training environments that allow maintenance, engineering and aircrew to train together
- “Next-generation” cockpit simulators that feature interchangeable cockpit layouts and hardware designs for the testing of numerous types of human-machine interfaces

AIRBUS’ GROUND-BREAKING VR TRAINING MODULE – VPT

Airbus has also been a leader in integrating virtual reality into its training programs. Its VR modules provide flight crews with immersive experiences, allowing them to practise procedures, safety protocols and cockpit operations interactively and engagingly^[26]. In 2022, Airbus debuted its Virtual Procedure Trainer (VPT), which places trainees in a fully immersive environment using VR technology. By leveraging VR technology, Airbus has managed to reduce training duration and costs while maintaining high instructional standards. Trainees no longer need to rely on physical, hardware-based training systems or use outdated flight simulators on a computer.

SIMULATION & TRAINING

THE IMPACT OF HARDWARE AND SOFTWARE ON TRAINING EFFECTIVENESS

“TO ACHIEVE GENUINE SIMULATIONS, **HIGH-CALIBRE HARDWARE** THAT DELIVERS VISUAL, AUDITORY AND TACTILE FEEDBACK **IS ESSENTIAL** FOR FOSTERING AN IMMERSIVE TRAINING EXPERIENCE”

HARDWARE REQUIREMENTS FOR REALISTIC SIMULATIONS

To achieve genuine simulations, high-calibre hardware that delivers visual, auditory and tactile feedback is essential for fostering an immersive training experience. Elements such as high-resolution displays, robust graphics processing units and motion platforms – that accurately emulate movement – contribute significantly to the efficacy of modern simulators. As these technologies continue to advance, it’s predicted that defence training simulators will become near-indistinguishable from the real world and heavily rely on AR and VR technologies.

SOFTWARE INNOVATIONS ADVANCING TRAINING OUTCOMES

Besides hardware advancements, software innovations have substantially influenced enhanced training outcomes. Complex physics engines, AI algorithms and data analytics instruments all contribute to generating dynamic and adaptive training situations that test trainees and help them develop their skills more quickly.

As the defence sector persists in investing in state-of-the-art simulation and training technologies, defence sector personnel will profit from more efficient and effective preparation for real-world operations and scenarios. From VR and AR applications to advanced flight and combat simulators using hyper-realistic training hardware, these tools are revolutionising the manner in which soldiers, pilots and support personnel train.



3. COLLABORATION & INNOVATION PROJECTS INVOLVING MAJOR INDUSTRY PLAYERS

In today's defence sector, collaboration plays a crucial role in spurring innovation. Companies joining forces can share ideas, knowledge and expertise, empowering inventive problem-solving and technological breakthroughs. Combining resources allows industry leaders to tackle intricate challenges and deliver efficient, state-of-the-art solutions for military use. From government-to-government collaborations to military universities and company-to-company, collaboration is the fuel that drives the defence sector's technological innovation.

LEADING PARTICIPANTS: LOCKHEED MARTIN, BAE, AIRBUS, QINETIQ AND THALES

Nearly all key industry players are known for championing collaborative efforts in the defence sector. Lockheed Martin, BAE Systems, Airbus, QinetiQ and Thales have engaged in various partnerships, driving innovation in areas such as cybersecurity, air battle management and electronic warfare. These cooperative ventures have led to remarkable advancements in defence technologies, empowering militaries around the globe to better respond to evolving threat matrixes.

CASE STUDIES DEMONSTRATING SUCCESSFUL PROJECTS

LOCKHEED MARTIN AND QINETIQ: JOINT AIR BATTLE MANAGEMENT SYSTEM (JABMS)

Lockheed Martin Australia and QinetiQ Australia are currently collaborating to develop a new Joint Air Battle Management System (JABMS) for the Australian Department of Defence^[27]. The proposed solution aims to enhance situational awareness, threat detection and defensive decision-making capabilities for military forces. The JABMS project focuses on creating a comprehensive air battle management system, integrating sophisticated sensors, data fusion and artificial intelligence algorithms to provide a real-time, unified perspective of the battlefield.

The cutting-edge sensor technology in JABMS permits the system to detect and monitor airborne threats with increased precision, while the data fusion capabilities ensure that information from diverse sources is consolidated into a single, coherent view. Artificial intelligence algorithms further improve decision-making by analysing vast quantities of data and identifying patterns and trends that may not be immediately

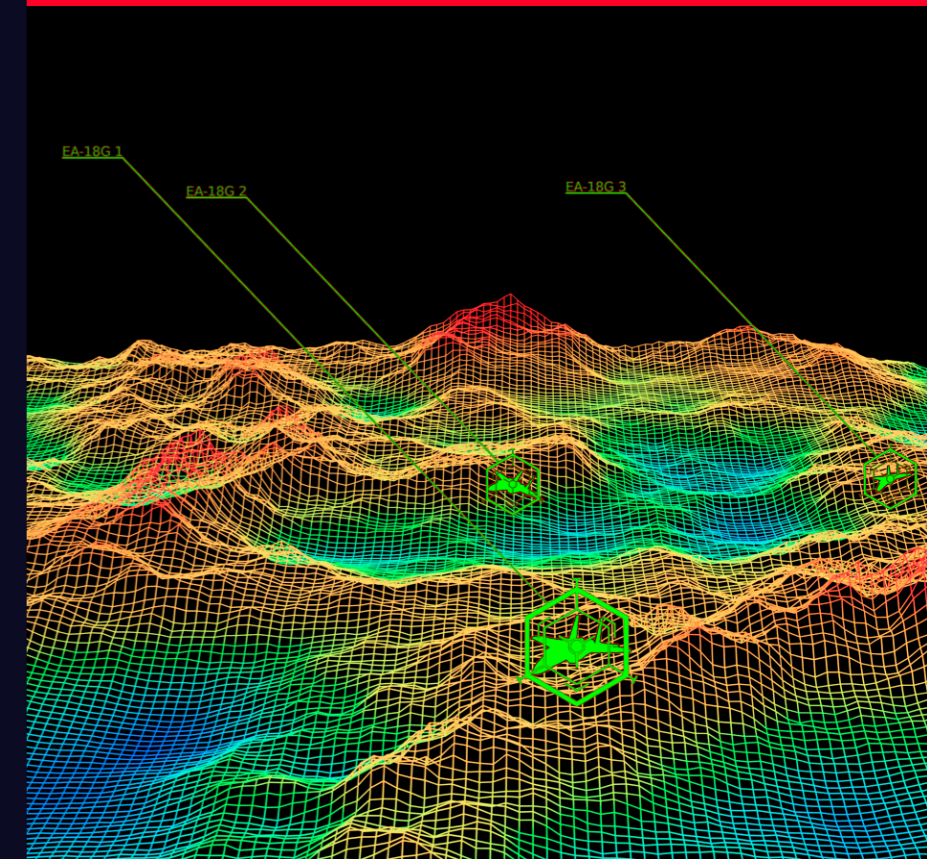
apparent to human operators. The solution will integrate numerous resources from air, land, sea, cyber and space into a singular system for advanced threat detection and defence capabilities.

This partnership leverages Lockheed Martin's extensive experience in developing complex air defence systems and QinetiQ's proficiency in advanced air defence systems testing, evaluation and assurance technologies^[28]. The collaboration allows both companies to build a system that guarantees more effective command and control, equipping Australia's military forces with the data and tools required to make informed decisions and respond swiftly to emerging threats.

CGI, BAE AND THALES: MARITIME ELECTRONIC WARFARE SYSTEM INTEGRATED CAPABILITY (MEWSIC) INCREMENT 1

Industry leaders BAE Systems, CGI and Thales have partnered to create the Maritime Electronic Warfare System Integrated Capability (MEWSIC) Increment 1, a cybersecurity solution intended to safeguard naval and maritime fleets for the UK Royal Navy^[29]. The MEWSIC project concentrates on delivering essential components of electronic surveillance sensors, electronic

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warfare command and control, and electronic warfare operational support for the Ministry of Defence and the UK Royal Navy.

Electronic surveillance sensors in MEWSIC offer real-time situational awareness by identifying and tracking potential threats. Electronic warfare command and control capabilities enable rapid decision-making and defensive measure coordination. Meanwhile, electronic warfare operational support ensures that the system stays up to date with the latest threat information and tactics, allowing for continuous adaptation to new challenges.

This collaboration combines BAE Systems' comprehensive background in electronic warfare systems and Thales' high-tech cybersecurity and radar solutions to establish a robust, adaptable defence mechanism against emerging cyber threats. The MEWSIC project highlights the importance of collaboration in promoting the development of technologies that ensure the security of military forces in an increasingly dynamic and interconnected world.

THE FUTURE OF TECHNOLOGY AND INNOVATION IN THE DEFENCE SECTOR



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“INNOVATIONS IN HARDWARE ARE CONTINUOUSLY EXPANDING DEFENCE SECTOR CAPABILITIES. ADVANCES IN MATERIALS SCIENCE, HIGH-PERFORMANCE COMPUTING AND SENSOR TECHNOLOGY CONTRIBUTE TO THE DEVELOPMENT OF LIGHTER, FASTER AND MORE EFFICIENT DEFENCE SYSTEMS”

EMERGING TRENDS & TECHNOLOGIES

AI and ML are playing increasingly significant roles in defence technology. From identifying war-damaged infrastructure to analysing military conflicts, these advancements are revolutionising the sector and enabling innovative solutions.

BEYOND WAR – USING MACHINE LEARNING TO REBUILD POST-CONFLICT REGIONS

Machine learning algorithms are being utilised to help rebuild post-war regions, such as Ukraine. The United Nations Country Office in Ukraine developed a ML-based tool in 2022 to help identify infrastructure damage. By analysing publicly available satellite imagery, ML tools can identify war-damaged infrastructure and prioritise areas in need of reconstruction^[30]. This innovative application of ML technology demonstrates its potential in aiding humanitarian efforts, moving beyond warfare to support peace and recovery.

USING ADVANCED AI TOOLS FOR MILITARY CONFLICT ANALYSIS

The US Naval Information Warfare Center,

Pacific, is leveraging AI to deploy deep-level analysis covering all aspects of the war in Ukraine^[31]. By employing advanced AI tools to process and evaluate vast quantities of data, military experts can gain valuable insights that inform future conflict strategies and tactics.

THE ROLE OF HARDWARE & SOFTWARE IN DRIVING FUTURE ADVANCEMENTS

HARDWARE INNOVATIONS ENABLING NEW CAPABILITIES

Innovations in hardware are continuously expanding defence sector capabilities. Advances in materials science, high-performance computing and sensor technology contribute to the development of lighter, faster and more efficient defence systems across numerous areas. These improvements enhance performance as well as reducing maintenance requirements and increasing durability, ultimately resulting in more effective military operations and defensive capabilities. Numerous efforts are underway to develop novel hardware products in the defence sector, such as the US Government's 2021 program to help fund hardware start-ups^[32].

SOFTWARE DEVELOPMENTS SHAPING THE FUTURE OF DEFENCE TECHNOLOGY

Software advancements are crucial for shaping the future of defence technology. Innovations in data processing, encryption and automation enable more sophisticated and secure military systems. And, the integration of AI and ML in software applications empowers decision-makers with improved analytical tools and insights, driving more informed and efficient decision-making processes that can be rapidly iterated and improved. From networking, logistics and operational support to training, encryption and intelligence, the role of AI and ML in software innovation will be enormous over the coming years.

ETHICAL AND SOCIETAL CONSIDERATIONS IN TECHNOLOGY ADOPTION

RESPONSIBLE DEVELOPMENT AND DEPLOYMENT OF EMERGING TECHNOLOGIES

As the defence sector continues to embrace emerging technologies, it is imperative to consider ethical and societal implications.

Deploying and developing these innovations responsibly needs ongoing dialogue between industry leaders and policymakers, and other stakeholders who may be involved.

Key issues include ensuring the transparency and accountability of AI systems, balancing privacy concerns with security requirements and addressing potential biases and inequalities that may arise from the adoption of new technologies. By engaging in these discussions and developing appropriate regulations and guidelines, stakeholders can effectively work together and develop technological advancements that serve to benefit society while maintaining ethical standards.



CLOSING WORDS

This whitepaper dove deep into the vital role technology and innovation play within the defence industry. Emphasis was given to the significance of government backing, the emergence of novel technologies and fruitful collaborations among prominent industry stakeholders.

As demonstrated, progress in hardware and software is key to devising solutions that can boost military prowess and fortify security efforts, as well as streamlining strategic decision-making.

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[5] Using Monte Carlo simulation to mitigate the risk of project cost overruns

[6] Methodology of an event-driven Monte Carlo missile simulation

[7] Optimization of Defence Ability of Defence Structures by Using Monte Carlo Simulation

[8] Project Maven: Machine Learning in the Military Target Selection Process

[9] Artificial Intelligence used at sea for first time

[10] DAF-MIT AI Accelerator Research Projects

[11] Army Trains AI to Identify Faces in the Dark

[12] A Large-Scale, Time-Synchronized Visible and Thermal Face Dataset

[13] DARPA to fund culturally aware natural language processing models

[14] Waterproof Soldier Nanotechnology

[15] Power Move: Forging the future of endurance-boosting technology

[16] The French army is testing Boston Dynamics' robot dog Spot in combat scenarios

[17] Quantum technologies in defence & security

[18] AI cyber attacks are a 'critical threat'. This is how NATO is countering them

[19] Northrop Grumman developing military communications satellite for 2025 launch

[20] Building on a Mission: Astronaut Training Facilities

[21] Forecast size of the augmented and virtual reality (VR/AR) market worldwide in 2020 and 2025, by segment

[22] U.S. Army to use HoloLens technology in high-tech headsets for soldiers

[23] The U.S. Air Force Adopts Immersive Mixed Reality Training to Fuel Better Engagement, Learning Retention, and Outcomes

[24] DASA funded virtual reality training technology is licenced by the Australian Army

[25] Gaming technology and F1™ set to transform the future of cockpit development and military training

[26] Airbus Virtual Procedure Trainer offers an innovative way for pilots to learn procedures using Virtual Reality - Lufthansa Group becomes launch customer

[27] Lockheed Martin Teams with QinetiQ for Australian AIR6500 Joint Air Battle Management System Bid

[28] Sensors, Integration & Interoperability

[29] Thales, BAE Systems, and CGI Team to Offer World-Class UK Electronic Warfare Force Protection to the Royal Navy

[30] In Ukraine, machine-learning algorithms and big data scans used to identify war-damaged infrastructure

[31] AI Is Already Learning from Russia's War in Ukraine, DOD Says

[32] New Program Helps Dual-Use Hardware Startups Accelerate Product Development



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