**CHAPTER**

**3**

**UNMANNED WEAPON SYSTEM: HIGH-PERFORMANCE COMPUTING APPROACH FOR FUTURE WARFARE**

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* 1. **INTRODUCTION**

The distance factor, which accounts for the time required for personnel, units, and equipment deployment, affects the military operation area. The operative region could be inaccessible due to geographic factors and natural obstructions, especially during intelligence or reconnaissance operations. Although it is feasible, it will take some time to remove the barriers and hurdles before the military units can go forward to the enemy line. Therefore, it is the ideal time to advance toward augmented and autonomous robotic technology to reduce cost and limit human involvement while maintaining the security of military aid.

Defense technology is changing due to the current global technological growth that is occurring so quickly. Due to these modifications, conventional combat has given way to electronic and digital warfare. The defense industries have advanced by optimizing the Virtual Reality (VR) technology that was adopted in the Virtual Interactive Small Arms Training System (VISMARTS) for small arms training simulation toward UWS development, in line with the development and advancement of global technology and toward the 4th Industrial Revolution (4IR). UWS is a cutting-edge concept that combines virtual reality (VR) and augmented reality (AR) into mixed reality technology while capturing and processing visual pictures from its platform, which is a UAV.

By providing a wider field of view and improved identification capabilities, having UWS onboard a UAV gives soldiers a competitive edge against invading forces. This enhances their information, surveillance, and reconnaissance (ISR) capabilities. With the help of AI technologies, data input from the payload sensors on UAVs as well as other integrated data input from sources like surveillance radar, air defense radar, satellite images, IoT, thermal sensors, and forward-looking infrared sensors can be used to identify hostile targets automatically. Once ground control has confirmed and approved target acquisition, UWS will quickly fire to eliminate hostile capability.

This paper is organized as follows. In section 3.2, a review of related works about the existing system and the future system that exists in the military domain will be outlined. This section consists of an explanation of the current technology used and existed, which triggered an idea towards the development of a future system, the concept and design of a future system of UWS, and the features together with the capabilities designed for military’s UWS including the technology used to achieve the mission’s objectives.

This includes the importance of HPC to optimize the whole UWS process will also be roughly explained. In section 3, a review of the use of HPC in various recent research will be outlined. In this section, the relevance and importance of HPC to UWS and how HPC assists the development and operation of UWS will be explained further. In section 4, the disruptive technologies related to how they will enable the development of the UWS will be discussed. The expected changes towards the UWS developments perspective caused by the existence of the disruptive technologies also will be explained. In the final section, the paper will be concluded with the outcomes and future work for this research.

**3.2 RELATED WORKS**

**3.2.1 Existing Works**

The existing virtual interactive training system in the military, VISMARTS, served as the inspiration for UWS. To simulate the performance of small weapons systems and the surroundings of warfare, this system uses modern technology that is based on computer science, distributed simulation, virtual reality, and artificial intelligence. It increases the effectiveness of their training by letting trainees and instructors experience a setting that is near to the actual installation and combat environment.

Weapon training requires balance, coordination, timing, and discipline. By constructing a realistic virtual interactive training environment, the system is less affected by time and effort, weather, weapon condition, and personnel, which effectively reflect the individual and team training level. It also reduces the technical wear of weapons and equipment and is widely used in various types of military equipment training.

By providing a realistic training environment, a virtual training system continues to improve the training standard and enhance trainee capabilities. By using interactive technology, the trainees can begin their training in a situation that closely resembles an actual battle, ensuring the consistency between simulated training and actual fighting. The virtual interactive weapon training system can be divided into the fundamentals of a weapon, skill simulation training, and also simulation training for tactics and strategies. The data technology information capabilities and weapon operation will be taught to trainees and instructors. Additionally, the simulation training will enhance knowledge and proficiency in handling the weapons. To help commanders think strategically and make decisions, tactics, and strategy virtual training simulates the command and coordinated action drills in a combat zone.

Virtual simulation has several advantages over conventional training, including advanced technology, sophisticated equipment, an intrinsic process, and objective outcomes. Virtual training combines knowledge from various fields to improve and advance conventional training methods. The technology for simulation training will advance with the further development of Virtual Reality (VR) and interactive technologies. The simulation platform can model a variety of dynamic operational factors, including joint forces and enemy circumstances, geographic environment, weather, and so forth.

Administrators, instructors, and students make up the three user categories in this system. A developer, engineer, and technician who are in charge of the system's technical aspects make up the group of system managers known as admin users. An instructor is a group specifically designed for the weapon instructor at the same time. Every course's component, such as the syllabus, readings, quizzes, test questions, and homework assignments, must be fed into the system by the instructors. They have constrained the use of the system since they are students. Before being permitted to handle a real weapon, students must first enroll in and complete a course or class, moving from the beginning to the end of the course.

The five main components of this e-learning environment include a 3D view of small weapons through VR or AR, 360 movies, virtual tours, virtual firing ranges, and virtual simulations. Students have access to virtually every small arm type, which they can disassemble and assemble collectively. They will be able to see every part of the weapon, which will help them fully understand what each part performs and how it works. This is a considerable advantage, particularly for students in the weapon technician program who specialize in mastering every part of a weapon.

A new type of weapon data will occasionally be introduced, along with features that their inventory does not currently include. For research objectives as well as providing military personnel with more exposure and information, the data addition is beneficial. A virtual firing range is also part of this technology. In the virtual setting, students can practice firing weapons either alone or in a group with a teacher, allowing for interaction much like at a real firing range. Every safety standard procedure was practiced in this virtual setting to make sure they were familiar with them and prepared for the actual firing practice.

The most sophisticated part of the system is the virtual simulator, which was created especially for students and special forces. An instructor can create a training scenario using this simulator, such as rescuing captives from an abandoned building. There are several levels of difficulty in this virtual training depending on the obstacles, the number of enemies, the condition of the prisoners, etc. With a VR or AR-equipped device, trainees will experience a setting that is identical to the actual installation and combat situation. This simulator's availability enables training to occur whenever requested.

**3.2.2 Future System**

Technology and war have always been closely related. Without technology, there most likely would not be a war. However, considering the conditions, war is still going on. Nations must safeguard their territorial integrity, advance their technological prowess, and demonstrate their military strength. Tactics have always influenced the development of weapons, which in turn influenced the organization, operations, strategy, and command and control systems. All of these were propelled by the technology that was in use at the time. The culture of technological dominance never ends.

War most likely might not have occurred without technology. War is continuing, nevertheless, as a result of the situation. Nations must defend their sovereignty, advance their scientific prowess, and display their military strength. Weapons development has always aided in the determination of tactics, which in turn aided in the definition of organizational structures, operational plans, strategic initiatives, and command and control mechanisms. These were all driven by the technologies in use at the time. It will always be a race to have the best technology.

The UWS is an avionics and weapon system for the UAV. UWS aims to conduct complex security and surveillance operations, find and recognize possible threats, and automate the use of the weapon system. The concept is to capture and interpret visual images from sensors onboard UAVs by combining VR and AR into mixed reality. The UAV's engine controls such as navigation, communications, flight control systems, flight recorders, lighting systems, threat detection, fuel systems and electro-optic (EO/IR) systems. An integrated avionics system in UWS controls the UAV's flight speed, pitch, roll, and yaw axis appropriately during firing operations to ensure the firing accuracy of a weapon on board to hit the right target at the right moment.

The objectives of the military’s UWS development are to:

* Automate the current operating system for the unmanned weapon system using the most recent technology.
* Use AI to increase the effectiveness of a weapon system.
* Improve the operation zone and battlefield coordination, accuracy, perseverance, and speed.
* Minimize resource use and the risk of human intervention.
* Assemble command and control to successfully make a pivotal decision.
* Make military operations more robust to safeguard national sovereignty.

Therefore, the proposed UWS will extend the operation to deterrence, where the system can deny and attack the threats when forced. The three concepts behind the UWS:

* For the purpose of detecting threats, and optimizing intelligence, surveillance, and reconnaissance (ISR).
* Ident; tracking and information-delivery networks through ISR to identify hazards. The processing and analysis of information for decision-making by commanders will be aided by AI capabilities.
* Deter; and execute barrier prevention through constant UWS presence in the operational area and coordination of a joint operation as a surface intervention in deep focus regions. Should the need arise and the threats materialize, fire will be let loose.

UWS will use AI technology to automatically detect and categorize citizens, captives, and friends or foes using facial recognition. In addition to the data from the payload sensors of the UAV, additional sensor data input from surveillance radar, air defense radar, satellite images, IoT, thermal sensor, and forward-looking infrared sensor will also be combined to produce a rich visual image in pertinent data. It is anticipated that the identification procedure will take only a few seconds to complete from the initial touch trace to its complete identification. The soldier will always have a major advantage over his adversary with this kind of superior intelligence.

In addition to operating in war mode, the UWS can also be used in peacetime for data analysis and reconnaissance. UAVs operated for this purpose and outfitted with UWS will fly within the chosen sector and gather as much data and information as they can about the targeted area or sector. Natural data like geophysical and weather data and local data like identification, daily schedule, traffic, etc. are all included in the data collection. For future purposes, all of this data is processed and archived. UWS itself, with its AI capabilities, can recognize and identify locales by repeatedly flying in this mode. However, it can also pick up on anomalies that are probably part of or a threat from crime, terrorism, or foes.

A UWS operator is capable of managing close to ten UWS units in safe mode at once. This circumstance is a result of the UWS's capacity to fly, conduct reconnaissance, acquire data, and independently return to the ground station. Additionally, the on-duty operator does not have to worry about determining the database's information gap and designating each UWS unit's goals and tasks. If there is a shortage of information from the available data or if an operator requests data, UWS is capable of programming itself for subsequent reconnaissance aircraft missions. As a result, multiple UWS units can fly independently at once for reconnaissance, which will allow for the collection of more data.

If an operator-manual control is required, a UWS that is currently flown and running automatically can also be modified to semi-automatic. In this mode, each contact that is picked up by the UAV sensor input and displayed visually can be focused on for in-depth data collection or extensive monitoring. Operators can select to operate one thing at a moment, such as a UAV's mobility, sensors monitoring, or a weapon, or more. The operation of any elements not chosen for manual control will be determined by the UAV and UWS's present state. In the case that the operator operating the system makes a mistake or is careless, this benefit is designed to allow the system to regulate itself.

UWS has the ability to concurrently target several adversary targets or moving targets. With AI technology's capabilities, it can also do precise calculations to establish the priority of a target among numerous targets at once according to the circumstance and location of the adversary. Priority is given to figuring out how to aim precise rounds at every target without missing a single one. If hostages are found, the target's priority will alter in accordance with the circumstances and the options available to guarantee the hostages' safety and the target's complete destruction. If the probability rate falls below the predetermined threshold level, UWS will trigger an alert requesting human assistance in handling the problem.

UWS is designed to be future-proof and can be integrated with both current and upcoming systems. UWS is ready to be configured and integrated if it needs to work with other platforms, like various kinds of UAVs. The UWS also has the ability to work with various existing weapon systems. The results of many fire tests utilizing UWS will be transmitted to the mainframe, where AI technology will be used to assess the weapons data and ammunition parameters from the current weapon system. Shooting accuracy can then be acquired and achieved.

From the moment the UAV onboard until it safely lands at the ground station, continuous and quick two-way communication between the UWS onboard the UAV and its mainframe will take place. Such a heavy load of data input, including high-resolution topographic images, visual images, sensors, and avionics I/O sent to the mainframe, required a lightning-fast, highly reliable infrastructure and massive data storage, which is high-performance computing capability for an extensive computing process, such as image processing, data analysis, data fusion, classification, and cognitive function of AI.

The use of HPC for UWS would ensure that there is sufficient processing power, flexibility, and scalability architecture to quickly process a large dataset, such as the hundreds of thousands of high-resolution and large-scale topographic images, as well as high-definition visuals of video and still images, used in UWS operation, which is anticipated to be above the level of terabytes. The AI computing process that creates a cognitive output for each input feed into the mainframe will also result in quick autonomous judgments for the entire UWS operation thanks to HPC's ability to evaluate massive amounts of data and boost processing speed.

Utilizing the complete system of these high-performance computers could result in a substantial increase in workflow performance. The exponential reduction in multithread command processing time that bottlenecks the simulated multi-host approach on a single server would permit near-real-time, high-resolution data processing.

**3.3 HIGH-PERFORMANCE COMPUTING**

Recent investigations by current researchers demonstrate that there is an increasing need for HPC in a wide range of computer applications. This situation arises as a result of the exponential development and expansion of data over time, which increases algorithm complexity and necessitates particularly intense data processing capabilities to handle the specific volume of data. Additionally, there is a high need for computationally expensive procedures like the employment of AI robots to simulate "cognitive" abilities in people or autonomous systems, which take a lot of resources. Due to this circumstance, HPC gained a lot of attention and started to appear regularly in academic writing and research.

The US government has performed research to develop a high-performance payload processor that combines high-resolution pictures and spectra with other real-time data streams. Future spaceships will be able to autonomously navigate and converge utilizing feature detection and spatial transformations, and unmanned aerial systems will be able to do so as well (UAS). To manage the predicted data rates from earth observation and planetary research instruments on future space missions, the computing infrastructure of the next generation must be capable of independent operation.

Increased host computer processing power, instrument interface performance, payload data processing, and communications are needed for this capacity. View-based guidance and navigation are essential to remote autonomy. A self-sufficient spacecraft with supercomputing capabilities may process up to 100 Gigabits per second (Gbps) of aggregated data throughput from many sensor inputs (Alena et al., 2016). This autonomy is vital, particularly for UAVs that have encountered problems or lost touch with the ground control station. In this instance, autonomous capabilities can ensure that the UAV can execute the task as instructed, provide its own self-defense, and return safely to the ground station when the operation is complete.

Real-time data from onboard sensors must be made available in addition to a large amount of computing power in order for unmanned aerial vehicles (UAVs) to be able to operate autonomously and without human intervention in this scenario. Without the use of HPC to assess data from all available related sensors, decision-making in real time for completely autonomous and cognitive reasoning based on real-time scenario awareness would become extremely difficult to achieve. A complex component that demands the onboard processing resources to collect and analyses sensor data, extract the features and critical parameters, and allowing real-time decision-making regarding the success of the mission or even the safety of humans is required for such a level of autonomy. One example of this tough component is making a precise landing on any surface, whether solid or liquid, without the intervention of a human. In addition, the characteristics that are most essential include a low fault tolerance and a high degree of energy efficiency.

To generate a better battle evaluation, one of the most critical requirements is accuracy, which can be achieved through the use of high-quality 3D topographic pictures. The production of higher-quality three-dimensional (3D) photographs has been shown to be possible when various high-performance computing (HPC) systems. For example, terrestrial laser scanning, and image-based modeling techniques are used to create a 3D image of the metropolis in Ancient Hermione, Greece. 3D data information can be used to reconstruct lost topographic relationships between archaeological and natural components that constituted ancient urban environments. Hence, 3D reconstruction with the analytical tools provided by geographical information systems (GISs) requires the use of HPC. In addition, more complex analyses are now capable of being carried out, and particular topics, such as visual perception and mobility to and from notable buildings and spaces, can now be researched (Landeschi et al., 2020). These benefits can be incorporated into the UWS used by the military for a photogrammetry mission in order to construct a topographic image of high quality.

A project using high-performance computers to accurately estimate the fighter and transport aircraft's static and dynamic stability, control, and pilot input response with different storage configurations. This method was created to precisely determine fighter and transport aircraft characteristics computationally. For rigid F-16Cs in forced motion, which simulate flying test movements without control surface movement, computational data were obtained. Continual sweep, sinusoidal pitching, coning motion, oscillatory coning, configuration plunge pulse, plunge chirp, pitch chirp, Schroeder plunge, yaw chirp, and composite pitch-yaw chirp are invented to build a complete reduced-order model.

Due to this effort, even complex aerodynamic phenomena, which are often only present during dynamic flight manoeuvres and are therefore not identified until flight tests are undertaken, can be discovered early on. The eventual goal of the modelling technique is to precisely anticipate the aircraft's stability under motions that replicate real-world situations. During flight testing, wind-up rotations, yaw-roll doublets, and steady heading sideslips are frequently employed to evaluate an aircraft's stability and flying qualities with a new weapons load or configuration. The simulation findings and proposed analysis technique demonstrate exceptionally promising outcomes, resulting in greatly better stability and control model construction timeframes compared to the conventional method of employing a wind tunnel to generate the database. In addition, the suggested analysis method permits better adaptability when addressing new configurations during the design phase (Morton et al., 2007). The knowledge gained from a variety of flying tests might be used to train an AI how to execute enhanced computational manoeuvres for the UWS platform. Because it possesses these characteristics, an AI will be able to learn, adapt, and adapt to any future UWS platform.

The HPC was utilized by the researchers so that they could carry out tests to evaluate the modeling methodologies for armor–anti-armor applications. During a high-velocity impact, complex interactions might take place, such as the perforation of the target plate and the deformation of the penetrator. The survivability and lethality technology used by the Army includes numerical models that go beyond impacting and penetrating physical objects. The blast loading that is caused by explosive charges has a significant impact on both the survivability and the lethality of military equipment.

The United States Army Research Laboratory (ARL) has been looking into the effects that surrounding explosive charges have on nearby lightweight structures. More specifically, they have been looking into the implications that charge geometry and initiation have on the ensuing explosion field. The researchers use full-scale tests, analytical models, and numerical simulations in order to describe the blast environments produced by different charge configurations and the behavior of structures that are subjected to the blast. The findings contribute to the process of determining the influence that the position and timing of the initiation sites have on the shape and intensity of the blast field.

These simulations can be utilized to fine-tune explosive charges and initiator combinations in order to attain particular blast field characteristics that inflict the greatest amount of damage. In addition, the positioning and timing of the initiation points for a certain charge geometry can be altered to customize a blast area for a particular need. This allows a single weapon to perform a wide variety of roles, which expands the weapon's potential applications (Schraml et al., 2002). It is possible to conduct a test of this kind using HPC in order to simulate the large explosive and ammo effect that will be employed on UWS. This test will support the military's organizations in future weapon shooting missions conducted by UWS, particularly those involving close proximity target circumstances between hostiles and hostages.

Because unmanned aerial vehicles (UAVs) only have a limited amount of computer power on board, computation-intensive tasks like image processing often take place on the ground. Deferring computing tasks to ground stations can, however, result in significant delays, data loss, or even transmission failures. This is because the bandwidth resources of the UAV-to-ground control center are limited, and there are environmental disturbances that can affect the performance of communication links. Real-time information needs, particularly those associated with military activities, such as a high-definition live video stream for recognizance chores, will be rendered nearly impossible as a result of this circumstance.

The amount of computer resources that a UAV is able to carry is extremely limited. It is imperative that unmanned aerial vehicles (UAVs) make the most of the limited computing resources at their disposal by shifting less time-sensitive processes to other computing devices. The superior resource management features and live migration support that virtualization provides for dynamic workloads make it possible for virtualization to be of assistance (Ahmad et al., 2015). Virtualization offers a wide variety of additional benefits, many of which can contribute to improved UAV performance. For example, it can separate unreliable and untrustworthy functionalities and make unmanned aerial vehicles more resistant to hostile attacks (Yoon et al., 2017).

Virtualization can make networked airborne computing activities on several connected UAVs easier, which results in increased processing capability for advanced UAV applications using a UAS-carried communication platform that enables high-speed, long-distance communication between two UAVs. This can be accomplished through the use of a UAS-carried communication platform that allows for high-speed, long-distance communication between two UAVs (Chen et al., 2017; Gu et al., 2015; Xie et al., 2016).

It is absolutely necessary for the accomplishment of real-time UAS activities that the onboard microcomputer has a high computational performance. The virtualization of the CPU that is employed onboard UAS has been the subject of research. In this study, the functionality of the 3D model reconstruction function in OpenDroneMap was tested, together with the performance of KVM and Docker running on Jetson TX2 for supporting UAS applications. It requires performing a variety of complex procedures, including resizing images, obtaining point clouds, and recreating 3D geographical models. The findings demonstrated that virtualization not only considerably increases the usability of UAS but also brings about an increase in performance overhead due to the partitioning, isolating, and emulating of resources (Wang et al., 2018).

**3.4 RESULT AND DISCUSSION**

In the conventional paradigm of computing, infrastructure necessitates the allocation of space, the hiring of personnel, the maintenance of physical safeguards, careful planning, and financial investment. Additionally, it necessitates a lengthy cycle for the acquisition of hardware, which includes the purchasing, deployment, and ongoing maintenance of on-premises infrastructure. In this solution, the resource capacity or appropriate storage and provision capacity to meet operational needs are provisioned by predicting theoretical maximum peaks. This shows the amount of time, effort, and money that is necessary and spent to build a new solution.

As the usage of cloud computing has become more widespread, a variety of service models and deployment methodologies have arisen to assist in catering to the requirements of a wide range of diverse users. Different kinds of cloud service models and deployment strategies each offer their users a unique combination of control, flexibility, and management options. These resources can be put to use in conjunction with one another, much like a set of building blocks, in order to construct solutions that assist in meeting technological requirements.

Computing in the cloud, on the other hand, gives customers the ability to select the cloud services that are the best fit for their requirements, to supply and terminate the relevant resources on demand, and to only pay for what they really use. Cloud computing frees programmers and IT departments from having to perform monotonous tasks such as capacity planning, procurement, and maintenance, which enables them to concentrate their efforts where they are needed the most. The number of available resources can be increased or decreased in an elastic and automated method. Because of this flexibility, firms are able to quickly incorporate new solutions while incurring low initial expenses.

Nowadays, cloud services can be a viable alternative to traditional cluster and grid computing systems. The goal of migrating application infrastructure to the cloud is to reduce costs associated with acquisition and maintenance while simultaneously improving both scalability and availability. On the other hand, cloud service providers are typically more concerned with the distribution of content than they are with HPC. The use of high-performance computing (HPC) on the cloud has entered the mainstream and is now a contentious issue in both academic circles and the business world. The ability to run large programs on dependable and scalable hardware without having to own or manage that hardware is one of the most alluring characteristics of cloud computing for high-performance computing (HPC).

The performance of high-performance computing (HPC) on three of the most prominent cloud providers—Rackspace, Microsoft Azure, and Amazon AWS—has been examined by utilizing the well-known NAS parallel benchmarks as an example of common scientific HPC workloads. According to the findings, high-performance computing (HPC) applications may function effectively in the cloud, with performance and cost efficiency that is up to 27 percent and 41 percent more than a normal cluster, respectively (Roloff et al., 2012).

Popularly, high-performance computing (HPC) is associated with on-premise data centers; however, the introduction of cloud computing has begun to change HPC. Recently, the edge has emerged as a new platform for the deployment of high-performance computing (HPC). Since then, the landscape of high-performance solutions a cloud provider may deliver for the hybrid deployments paradigm has grown substantially. Frequently, a hybrid high-performance computing system will contain cloud capabilities that augment an existing on-premises data center. The combination of on-premises and private cloud hosting is useful at overcoming certain drawbacks of public cloud computing. The diversity and complexity of many data-intensive, industry-specific HPC workloads contribute to poor performance and optimization issues. Hybrid systems, on the other hand, can be customized and scaled while maintaining the agility of cloud-based solutions.

The introduction of cloud computing has altered the way HPC deployments are seen, despite the fact that high-performance computing is generally associated with on-premise data centers. A new high-performance computing deployment platform has only begun to reveal its perimeter. Since then, there has been an expansion of the ecosystem of high-performance solutions for hybrid deployment models that are offered by cloud providers. A hybrid high-performance computing system combines capabilities that are hosted in the cloud with capabilities that are hosted on-premises in a data center. The diversity and complexity of numerous industry-specific, data-intensive HPC workloads enable the combination of on-premise and private cloud hosting to ease some of the limitations of the public cloud. These constraints include performance and optimization issues. On the other hand, hybrid systems can be customized to a certain extent, have a tendency to be scalable, and give cloud agility all at the same time.

When it comes to mapping a substantial portion of the Earth's surface, we are faced with ever-growing datasets, which can hinder the ability of the photogrammetric process to build high-resolution topographic models in close to real-time. Time required by the photogrammetric workflow of the free and open-source software (FOSS) to process a big and well-organized dataset of high-resolution photos captured by an unmanned aerial vehicle (UAV). The stages requiring the most expensive computations have been placed on a single server as part of the new high-performance computing cluster at the ReCaS-Bari data centre (la Salandra et al., 2021).

Aside from that, the technology known as exa scale has been identified as yet another disruptive technology that will have an effect on the way UWS is developed. The capabilities of HPC are continuously advancing as a result of the implementation of new technology. In the past, Moore's law played an important part in the acceleration of high-performance computing (HPC) systems. On the other hand, in the case of exascale, the technological advances that are necessary to achieve that level of performance would be far more difficult to accomplish. Increasing the heterogeneity and programmability problem of the systems requires the utilization of multicore processors, special purpose compute accelerators, memory and storage hierarchies, and other similar technologies. This is done so that performance demands can be met within acceptable power envelopes. The ability of a computer to perform one billion computations in one second is referred to as exascale computing, and it is measured in exaFLOPS rather than FLOPS. The term "exascale computing" does not refer to a new type of computing, such as "quantum computing," but rather to the next level of processing power that can be attained with the technology that is now available. On the other hand, exascale high-performance computing is anticipated to bring about significant advancements in complex simulation and modeling. These advancements will address challenges such as the prediction of natural disasters and the discovery of scientific breakthroughs, particularly in the medical industry.

The application of high-performance computing (HPC) for the purposes of research and development is swiftly growing in both the business world and the scientific world. Industrial and commercial applications of concrete are also emerging in a wide range of industries, such as the automotive sector, the renewable energy sector, the climate change sector, and the health sector.

The Irish Centre for High-End Computing (ICHEC) has recognized a pressing need and opportunity to develop programming knowledge for quantum computing platforms and to collaborate on the development of the quantum software ecosystem with European partners. This is something that the ICHEC has recognized as both a need and an opportunity. A new collaborative quantum computing project using Intel's quantum platform to solve a natural language processing problem has received funding from Enterprise Ireland and Intel Ireland.

The Intel Corporation prioritises this area of research not only for its own corporate goals, but also for the greater good of the quantum computing community in Ireland and beyond. ICHEC is currently developing additional quantum programming initiatives in conjunction with industry. These endeavours will concentrate on topics such as quantum chemistry, financial analysis, and machine learning, among others. In a more general sense, ICHEC is pursuing a roadmap for quantum computing in order to create knowledge and leadership in three major areas. These include the design of quantum applications, the investigation and development of quantum software, and quantum education and training.

Since software-based high-performance computing (HPC) simulators and small-scale quantum computers are already commercially available, software ecosystem and programming expertise are needed to target quantum platforms in the next decade. The global research community will benefit greatly from this ICHEC program's quantum high-performance computing technologies and best practices (Desplat, 2019).

Quantum computing is a subfield of computer science that makes use of quantum mechanical phenomena to perform data operations. Some examples of these phenomena are entanglement and superposition. Yuri Manin and Richard Feynman are credited with being the first individuals to put up the idea in 1980 and 1982, respectively (Imre & Gyongyosi, 2012). Quantum computing is still in its infancy and has a long way to go before it can be considered a fully working technology. This is true even in the present day. Quantum computers will be a significantly more effective alternative to their traditional computer counterparts since they are able to complete the majority of algorithms and jobs in a significantly shorter amount of time. One example of this is the factorization of integers. In addition to the factorization of integers, the application of quantum computing techniques allows for the faster resolution of a vast number of other issues and procedures (Bohr, 1935).

Cloud computing is a disruptive technology that will progressively replace traditional on-premises installations' rigid software and services licensing arrangements with flexible, on-demand software and services. This will happen because of the cloud computing's ability to scale rapidly. The capacity to manufacture and distribute computing resources to customers on demand while maintaining the scalability and flexibility of shared computing solutions provided by virtualization technologies in cloud computing has emerged as a standard technological competency and a requirement in the industry. When cloud computing becomes the dominant business paradigm, further variables that are disruptive will develop, further integrating and differentiating the cloud computing ecosystem.

If the military has already started to engage in cloud computing, it will never be free from being affected by disruptive technologies because it will have already started engaging in cloud computing. The old paradigm of on-premise deployment, with which they are currently familiar, will feel quite foreign to them once this new paradigm is implemented. If they're truly serious about shifting to the cloud, they must begin planning to train troops in a cloud computing environment that is different from the way the military deploys resources at the moment. There is a requirement for military professionals with specific skills to aid in the refinement of development planning, particularly architectural design, particularly in the field of data security. In addition, the design of the system architecture needs to take into account the ability to modify itself in response to emerging technologies; this must be done in order for the system to continue to be relevant.

**3.5 CONCLUSION**

High-performance computing is essential for designing and developing new large-scale, sophisticated weapon systems, which are synonymously referred to as a significant military edge on the battlefield with combat superiority. This advantage can be achieved by designing and developing new weapons systems. It makes it possible for a group of scientists and engineers from a variety of fields to tackle computationally difficult and difficult defense-related issues that were previously difficult to explain. The military ought to make use of this technology in order to maximize the potential of the UWS in order to realize military edge capability and gain superiority in combat.

It is quite improbable that the purchase of exascale supercomputers will be a target for the creation of UWS for the military sector. However, by utilizing cloud computing technologies, it is possible to acquire HPC capabilities at a reduced cost. When compared to various other ways of cloud computing, hybrid deployment strategies are the most suitable option. It is possible that the scalability and flexibility of shared computing solutions and the capabilities of HPC could unquestionably increase UWS operations' vitally important AI processing capacities.

Although the laws of government information security in the majority of the military's operational information do not permit any storing of information and data in the cloud, these existing limits can be adjusted and reassessed. Cloud service providers are responsible for developing and implementing a wide range of safety protocols and safeguards, which they also guarantee. Through the utilization of cloud technology, specifically, UWS is able to optimize its high-performance computing (HPC) skills on the cloud and leverage its artificial intelligence (AI) capabilities across all military operations.

With the help of cloud computing technology, cloud providers' high-performance computing (HPC) technology will be able to boost AI processing skills in each UWS operation, which will further strengthen the military's electronic and digital combat capabilities. It is in line with current technical breakthroughs and the future threat landscape, which also makes use of existing technology, so the military's future combat perspective will evolve and become more secure in the future. This is because of the future threat landscape.

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