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Joint Personnel Recovery in an Urban Environment

Joint Air Power Competence Centre

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FROM:
The Assistant Director of the Joint Air Power Conference Centre (JAPCC)

SUBJECT:
Joint Personnel Recovery in an Urban Environment

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As the urbanization process continues expeditiously, it is clear to the Alliance that the urban environment will be a relevant factor in future operations. With the resurgence of peer competition, the rise of non-state actors, continuous technological advancements, and the strategic significance of cities to potential adversaries, urban areas have become potential battlegrounds for conflicts ranging from low-intensity operations to high-intensity conventional warfare, as evidenced by recent history.

The urban environment presents relevant challenges to Commanders and may be considered among military forces' most complicated operating scenarios. A city should be understood as a complex system of systems in which its three fundamental factors, physical, infrastructural, and social, are dynamically interconnected and interrelated.

Joint Personnel Recovery maintains a significant role in military operations, as the isolation, capture, and exploitation of NATO personnel may negatively impact operational security, force morale, next of kin and families, and public support. In a highly contested urban environment, Personnel Recovery will operate in a limited and constrained space, facing multi-dimensional threats and the presence of non-combatants. Successful accomplishment of JPR mission will be crucial to prevent adversaries from exploiting captured personnel and to prevent social media, particularly present in a city, from sharing unfiltered information that may negatively affect the global perception of ongoing operations if things go wrong.

Highly contested environments, such as the urban one, require us to rethink how we plan and conduct the recovery of isolated personnel, and be aware we are not limited to the military option. In the future, we may face scenarios that we have not prepared for.

Therefore, this study aims to identify gaps and challenges in the current Personnel Recovery system and provide recommendations on the unique requirements needed to accomplish the mission in future urban operations.

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The recovery of isolated personnel remains a moral obligation that requires the Alliance to adapt to new operational scenarios and to maintain the ability to provide an appropriate and effective JPR system.

This study is addressed to the global JPR community and is dedicated to all those women and men who risk their lives in the line of duty.

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Executive Summary

Urban warfare is not a new phenomenon: Syria, Iraq, Ukraine, and Gaza are just some of the most recent examples. As global urbanization accelerates, it becomes increasingly probable that the Alliance will be involved in more Urban Operations (UO) than it experienced in the past. When conducting a military operation in an Urban Environment (UE), two challenges immediately arise: 'One is simply being able to understand the environment.[1] The other is being able to understand how to operate in the environment'. Both these challenges are harder to manage and train for in an UE than in any other battlespace. Moreover, history has demonstrated that technological superiority may be hampered by the complexity of urban terrain, as in the case of the 1993 Black Hawk Down event. Militaries will face challenges in the intricate concrete jungle: short-range engagements, limited manoeuvre room, degraded Command, Control and Communications (C3) and navigation systems, three-dimensional battlespace, and defenders' tactical advantages. Additionally, the high risk of Collateral Damage (CD) due to the density of non-combatants and no-strike targets will limit weapon choices and potentially delay decision-making. The same challenges that an UE poses to military operations will also affect how NATO will conduct Joint Personnel Recovery (JPR).

In operations, the isolation, capture, and exploitation of NATO personnel may have a considerable negative impact, affecting operational security, the morale of assigned forces, and, more widely, next of kin, families, and public support. NATO, therefore, must have a system able to recover all personnel under its responsibility who may become isolated and need to survive, evade, resist exploitation, and escape.

> *'By pledging to put every effort into recovering our highly trained [personnel], we send a powerful signal about their importance and help sustain their spirit under the stress of combat.'*
>
> General Henry H. Shelton, US Army, 14th Chairman of the Joint Chiefs of Staff, 27 October 1999, JP 3-50

JPR is considered a high-visibility tactical mission with potential operational, strategic, political, and social implications. Particularly in UEs, the success or failure of recovery operations will be magnified and widely publicized via the numerous social media and networks present in a city, thus increasing the burden of responsibility for planners and decision-makers. Therefore, the capability to conduct urban JPR will be an additional operational prerequisite for the Commander, who will have to face the risks intrinsic to the mission and its consequences should it fail: loss of strategic, operational, and tactical momentum and loss of public support.

NATO defines Personnel Recovery as 'The sum of military, diplomatic, and civil options to effect the recovery and reintegration of isolated personnel'.[2] It is a joint and integrated capability in NATO; it requires readiness that involves leadership and force, a robust planning process, and a solid Command and Control (C2) structure.

The question is: Is NATO and the overall JPR community ready for urban JPR? Is the current JPR system, based on its four phases **(Preparation**, **Planning**, **Execution**, and **Adaptation)**, robust enough to manage isolation events in contested areas and accomplish the mission? What changes are needed, and, if needed, in what phases?

This study intends to identify gaps and challenges of the current JPR system related to doctrine, education and training, technologies, and capabilities and provide recommendations to increase the awareness of the global JPR community of interest on the unique requirements UO place on all four phases of the JPR system. To achieve this objective, this study first analyses urban environments and their challenges to military operations, specifically to JPR. It then concentrates on doctrine and new education and training requirements, future technologies, and developing operational concepts deemed necessary to conduct JPR in an urban context successfully. It concludes with considerations and recommendations for the way ahead.

JPR doctrine and Tactics, Techniques, and Procedures (TTPs) do not adequately support urban scenarios. Today, current doctrine and TTPs are focused mostly on air-centric options, as they have historically been the fastest and most effective solutions to recover Isolated Personnel (ISOP). Little or nothing has been written on maritime and land considerations, while SOF employment related to Unconventional Assisted Recovery (UAR) and Non-conventional Assisted Recovery (NAR) has its own specific TTP. Little is mentioned in relation to the diplomatic and civil options for JPR.

> *'The future character of conflict has been described by the 5Cs. They may not be applicable for all environments, but they absolutely resonate with the future urban battlespace: it will be more congested, more cluttered, more contested, more connected, and more constrained...It is critical for NATO to think in this space, and remain adaptable and resilient enough to operate in the most challenging physical and human environment. It is not if we have to, but when we have to...and we need to get it as right as possible, when we do.'*
>
> Brigadier Ian Rigden, British Army, Head of Land & Research Development, Concepts and Doctrine Centre

In terms of education and training, an urban Survival, Evasion, Resistance, and Extraction (SERE) training programme already exists for potential ISOP. However, no specific training programme has been developed for Recovery Forces (RF) and PR Staff elements working at the Joint Personnel Recovery Centre (JPRC) and Personnel Recovery Coordination Cell (PRCC). Education and training for all three elements of a JPR system (Commanders and Staff, RF, and ISOP) should incorporate robust UE scenarios and consider multi-domain mission requirements. Education and training upgrades in urban JPR must be coupled with modern technologies, aiming to make training more realistic and efficient. In the near future, the most effective solution will be investing in virtual reality simulation and a dedicated military metaverse combined with real-life training.

New capabilities, procedures, and techniques will be necessary to conduct effective JPR missions in an UE. RF and ISOP will operate in the same three-dimensional battlespace where friendly, neutral, and hostile actors interact in a large, congested environment. Information superiority and a holistic multi-domain strategy are essential for mission success. To succeed, a new generation of conventional and non-conventional capabilities, manned and uncrewed systems, advanced integrated and synchronized information technologies, and multi-domain systems will be necessary.

Urban JPR will also need to involve external governmental and non-governmental agencies in supporting/supported relations with the military. An all-encompassing strategy for JPR should consider the potential for strong collaboration with pertinent non-military organizations to open diplomatic channels in cases where the military option is not viable.

The recovery of isolated personnel in a hostile environment has always been a challenging mission. An isolation event can occur unexpectedly, requiring Commanders to be ready to respond at a moment's notice. Failing to rescue our personnel could have dire consequences for the entire operation. In urban environments, these challenges are heightened due to the nature of the surroundings and how the threat can easily blend in. As military operations in urban areas become more common, NATO must reassess its approach to JPR planning and execution.

The challenges that NATO may encounter while operating in an urban environment are not exclusive to JPR, but are relevant to all operations. This study, aimed primarily at the JPR community, may also be of interest to a broader audience, including military planners and all military entities participating in NATO operations.

1. J. Spencer, 'The City is Not Neutral: Why Urban Warfare is so Hard', 2020, https://mwi.usma.edu/, accessed 3 February 2023.
2. AJP-3.7, 'Allied Joint Doctrine for Recovery of Personnel in a Hostile Environment', Edition A, Version 1, 2016.

Chapter 1

Introduction

By Commander Andrea Magi, Italian Navy, JAPCC

1.1 Background

NATO defines Personnel Recovery (PR) as 'the sum of military, diplomatic, and civil efforts to effect the recovery and reintegration of isolated personnel'.[1] PR is an integrated capability in military operations and plays an important role in NATO. It is conducted within a Joint Operations Area (JOA) in support of NATO missions or operations and where specific security requirements for NATO personnel are deemed necessary. Within this wider concept of a hostile environment, the Urban Environment (UE) represents one of the most challenging settings in a potential future conflict for the Alliance. Urban Operations (UO) may be defined as those 'operations planned and conducted on, or against objectives within, a topographical complex and its adjacent natural terrain, where man-made construction or the density of population are the dominant features'.[2]

Indeed, military operations in UEs are not new. Stalingrad and Berlin in World War II, Hue City in Vietnam, Baghdad, Mosul, Ukraine, and lately Gaza are just a few examples of urban warfare scenarios in recent history. However, the constant growth of urbanization is such that NATO forces must be

prepared to conduct UO in the future. As stated by the UN, the current trend of urbanization is projected to continue. Today, more than 50% of the world's population lives in urban areas, which is expected to increase to 66% by 2050.[3] The trend of urbanization, combined with the global population increase, has transformed some of these areas into megacities or megalopolises. As urban areas continue to increase in number and size, they will likely become focal points for unrest and conflicts, as the ongoing war in Ukraine suggests. Although military forces have faced urban conflict throughout history, the sheer magnitude of today's and tomorrow's megacities and other urban areas with populations below 10 million make these operations appear even more difficult than in the past.

Military operations in urban areas face a challenging environment. Location, topography, history, climate, the cultures of their residents, economic development, and many other factors all contribute to their complexity. One way to consider the factors that influence the UE is to think of it as an urban triad, which includes complex man-made physical terrain, a population of significant size and density with varying sociocultural groupings, and diverse infrastructure, such as rapidly advancing commercial and military communications, surveillance, and drone technology.[4] Across the complete range of military operations, UO–characterized by symmetric threats, asymmetric threats, and emerging technologies – will be necessary in low- and high-intensity conflicts.

While traditional JPR remains sustainable in more permissive scenarios, highly contested environments make most PR missions too risky to accept. Recent technological advancements and better-prepared adversaries have resulted in highly contested battlespaces where military freedom of action may be severely limited. For JPR, the changing nature of the threat environment is a critical factor. The Multinational Capability Development Campaign (MCDC) JPR 2040 project team highlights that high-density UEs have the potential to 'fundamentally alter' the way in which JPR needs to be considered.[5] The project team's in-depth assessment of the future operational environment reveals that the global JPR community will face challenges different from those in the past and must adjust to these new conditions.

Consequently, new TTPs to operate in high-intensity and denied situations, particularly those including Anti-Access and Area Denial (A2/AD) threats, as well as degraded or denied communications, and aids to navigation, will need to be developed to offer effective solutions. These changing physical and operational conditions will require the JPR community to collaborate more closely across government agencies and with international and multinational partners and make changes to education and training. In addition,

Figure 1: *The PR System (AJP 3.7).*

information control will play a key role in supporting and protecting JPR operations in densely populated environments, where access to social media and the broadcasting of negative or discrediting images or information in real-time may have a devastating effect not exclusively at a tactical level, but also at an operational, if not strategic level. The strategic communication plan must be understood at all headquarters.

While the wide-ranging concerns of operating in UEs are understood, a framework to guide the development of JPR concepts and technology to operate successfully in these complex and challenging situations is lacking. Current doctrine is limited to Survival, Evasion, Resistance, and Extraction (SERE) aspects and only generally highlights the greater challenges potential Isolated Personnel (ISOP) will face in an UE. No subordinate doctrine or other detail elaborates on how commanders, staff, and Recovery Forces (RF) should plan and conduct JPR in an UE. This paper outlines the scope of requirements, including new education and training standards, and new technologies and capabilities. Considering a generalized doctrinal void in this specific topic, the following questions must be addressed: What challenges will JPR face in future operating environments? How should the global JPR community react to these challenges? What changes to policy, doctrine, and TTPs are required? What new education and training standards are necessary to adapt to this new environment? Lastly, how important will the diplomatic and civil options for JPR be to the Commander as opposed to the military one? JPR is an inherently reactive and complex mission that responds to a tactical emergency: the isolation of friendly forces in a hostile environment. As such, future JPR in an UE will require a robust system to be in place before the start of operations. The four pillars of JPR – Preparation, Planning, Execution, and Adaptation – must be adapted and tailored to include UO.

1.2 Aim

This study will characterize UEs and the related challenges to JPR. It will also identify current and future technologies and operational concepts that show promise in addressing these challenges. The findings of this study will provide valuable insights for NATO and the global JPR community regarding crucial mission requirements that have been overlooked. The authors aim to motivate JPR stakeholders to enhance all four phases of the PR system, Preparation, Planning, Execution, and Adaptation, with a particular emphasis on UO.

1.3 Methodology

This study is founded on analysis and research conducted using open-source documents, in collaboration with the JAPCC Combat Air Branch, and with the valuable contributions of SMEs from the European Personnel Recovery Centre, CAOC Uedem, and the civilian sector. The study is kept at an unclassified level to facilitate potential dissemination. In cases where classified sources were reviewed, only unclassified information was utilized.

1. AJP-3.7 'Allied Joint Doctrine for Recovery of Personnel in a Hostile Environment', Edition A, Version 1, 1 February 2016.
2. US Joint Staff JP 3-06, 'Joint Urban Operations', Washington, DC, DOD, 2013, p. VII.
3. UN, 'Department of Economics and Social Affairs 2014 Revision of The World Urbanization Prospects', New York, US, UN, 2014.
4. M. Konaev, Margarita, 'The Future of Urban Warfare in The Age of Megacities', Paris, FR, IFRI, 2019.
5. MCDC, 'Joint Personnel Recovery 2040 – A Global Perspective', 2021.

Chapter 2

Urbanization: A New Challenge for Military Operations and JPR?

By Commander Andrea Magi, Italian Navy, JAPCC

2.1 Introduction

As urbanization steadily progresses, different studies suggest that future competition and armed conflicts will likely impact the dense and congested UEs. To better appreciate the issues that military operations, and particularly JPR, will face in an urban scenario, it is necessary to understand the dynamics of its elements – Political, Military, Economic, Social, Information, Infrastructure (PMESII), and geographic. At the same time, it is also important to recognize that these attributes represent a complex system, different for each urban context, which can affect the conduct of JPR. In this regard, history already offers us a striking case study, namely the 1993 Black Hawk Down case, which occurred in Mogadishu, Somalia. Today, this event – the way it started, how it ended, and what it led to – represents a valuable reference for the JPR community. This chapter seeks to identify, based on the understanding of the complicated nature of UEs and drawing on the Black Hawk Down experience, the challenges that such a potentially complicated scenario poses to the three elements of the JPR system (commanders and staff, RF, and ISOP) in preparing, planning, and executing a recovery operation.

2.2 The Urban Environment

Over half of the world's population lives in urban agglomerations, which is expected to increase to two-thirds in the next three decades. Moreover, many of the world's political and economic urban centres reside within 300 kilometres of the sea, making the littoral domain one of the most contested, as water still represents the primary means of communication and global trade. In 2018, The United Nations reported a total of 33 global megacities (cities with a population of more than 10 million people), with 27 (82 %) of them in the world's less-developed regions. The number of megacities is rapidly increasing and is projected to rise to 43 in 2030.[1] According to a 2020 RAND Corporation study, the growth dynamics of megacities in the near future will differ from the patterns that have characterized them to date.[2] It is reasonable to assume that the expansion of such urban agglomerations will continue over the coming decades and will become 'further limited by physical land constraints and burdened by vehicular congestion and costly infrastructural legacies, entrenched criminal networks and political gridlock, and deteriorating sanitation and health conditions'.[3]

Urban areas, which include cities, megalopolises, and megacities, embrace complex and dynamic interactions and relationships between their key characteristics: natural geography, human constructions, supporting infrastructures, and population density. The population itself differs in ethnic, religious, cultural, political, and economic aspects. Each urban agglomeration is unique in how its human and physical elements interrelate. An UE's density and accessibility are dynamic, as human circulation and traffic may change constantly. The complexity of the modern UE is perhaps best described as 'the cumulative effect of a series of interconnected layers of society and infrastructure'[4] or an interconnected 'system-of systems'.[5]

These composite asphalt jungles range from modern, well-functioning, and multi-ethnical neighbourhoods to highly dense slums, shantytowns, or small, desolate peripheral settlements with very poor infrastructure and social and economic challenges. Poverty, discrimination, social exclusion, and uncertainty can be breeding grounds for violent instability. Weak governance and institutions may further facilitate unrest and exacerbate violent non-state actors. With their 3D operational environment, these unstable and unsafe urban agglomerations may represent an ideal territory for criminality, corruption, terrorism, and insurgency. In addition, the recent conflict in Ukraine has shown that cities, such as Bakhmut, Mariupol, and Avdiivka, can also be the focus of conventional forces for their symbolic, economic, or strategic value, despite the high risk to lives and resources. The way military operations, and JPR in particular, need to be thought about is drastically altered by this urbanized and densely populated operational environment compared to more traditional JPR scenarios.

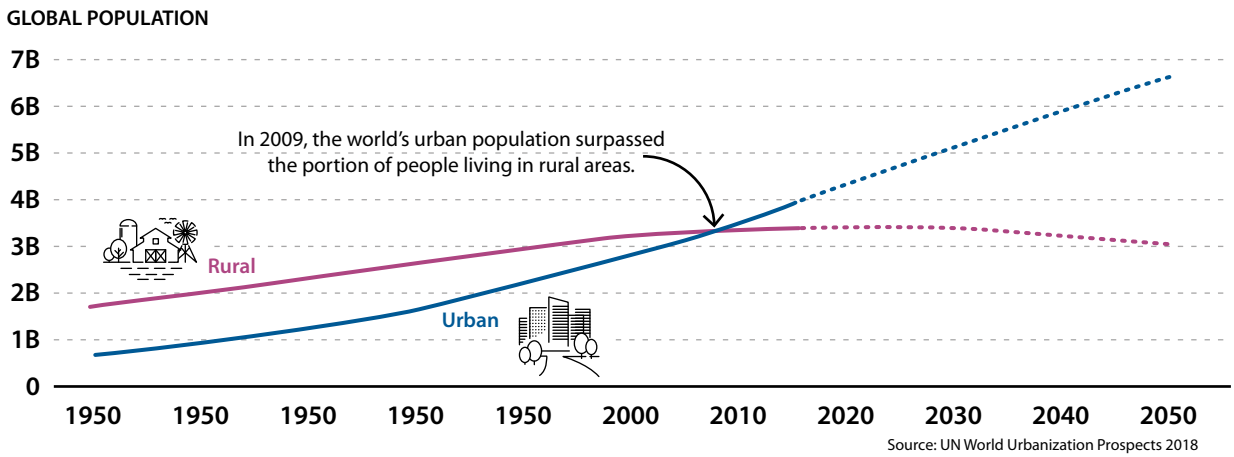

***Figure 1:** World's urbanization growth will continue and reach 6 billion people and beyond by 2050.*

Representation of air operations in a megalopolis – flying over a concrete jungle.

2.3 Black Hawk Down: A Case Study

Black Hawk Down is probably one of the most significant urban JPR events in recent military operations and is the starting point of this study. On 3 October 1993, during a special forces' operation aimed at capturing two of Somali warlord Mohammed Farah Aideed's top collaborators, two MH-60L helicopters providing fire support to ground troops were shot down. From that moment on, the operation became a desperate Combat Search And Rescue (CSAR) mission in which heavily armed Somali gunmen overwhelmingly confronted US forces. At the end of the operation, eighteen Americans were killed in action, seventy-three were wounded, and one pilot was held captive for eleven days. The pilot was eventually released through the International Red Cross. The strategic outcome of Black Hawk Down was the withdrawal of US forces from Somalia due to the shock and criticism in the US that led to the loss of support for the broader Restore Hope operation.

The event itself prompted a number of considerations regarding the conduct of JPR in high-density UEs.[6] First, modern technology is not, by itself, a guarantee for success in an UE. The Somalis' asymmetric tactics successfully confronted the United States' highly sophisticated assets in the streets of Mogadishu. The event reinforces the importance of understanding military power limitations in such a scenario and the need to balance the military option with other non-military options (diplomatic and civil) that can be more suitable for an urban context.

Second, the operation involved multiple units from different services of the US and other countries' military forces, all with different communication systems and procedures. As a result, communication was difficult, and coordination was challenging. Therefore, the need for integration, interoperability and standardization was one of the most important lessons learned.

Third, the human factor is key when preparing to operate in an UE. Developing awareness of human terrain, understanding local and regional social dynamics, identifying links between civil society and adversaries, and the country's overall political and cultural context are fundamental steps in the planning process. Local population presence and behaviour can change based on events and may become a key factor when conducting operations on the ground. The Black Hawk Down event, and the operation in Somalia more generally, highlighted how the lack of knowledge of the local population's social aspects increased the risk of mission failure. Fourth, the urban terrain in Mogadishu proved difficult for US troops and highlighted the need for better training and equipment for urban warfare, characterized by close combat, degraded C2, and non-combatants.

2.4 Challenges to Military and JPR Operations in UE

The urban area may be considered a 'dynamic system, with the unique Political, Military, Economic, Social, Information, and Infrastructure (PMESII), and other components'.[7] Highly dense urban terrains pose distinctive and different challenges to military forces and may considerably limit the overall ability to conduct operations. UO pose 'a serious physical and moral challenge for the soldier' as they embrace a combination of high risks due to tactical fluidity intrinsic to the environment – and high cognitive loads and physical demands on individuals due to uncertainty and chaos.[8]

UEs vary widely from permissive to non-permissive. A permissive urban environment is one in which host-nation security forces govern the area and have the intent and capability to aid military activities. In a non-permissive or hostile environment, the host government lacks the motivation or capability to assist in a military operation and authority over the territory or population. Moreover, in general, a non-permissive UE is the one in which PMESII factors impede or hamper the conduct of operations. In non-permissive urban scenarios, it must be assumed that threats can come from any direction or domain (including from underground).[9]

2.5 Challenges for Recovery Forces

An UE can be relatively sprawling or extremely compressed. In a highly dense UE, the multi-dimensional battlespace, characterized by super-surface, surface, and subsurface man-made architecture, offers defenders a wide range of opportunities and asymmetric advantages to counter military and, specifically, JPR operations, especially when fighting on home terrain. Vertical structures and underground construction provide the defender with rich opportunities to engage from multiple positions, rapidly withdraw while remaining undetected, and eventually blend with the population. 'Every window, every balcony, every manhole cover, every doorway, every corner in a street is a possible firing position.'[10] Aircraft flying over urban areas can be exposed to a concentration of Man Portable Air Defence Systems (MANPADS), Anti-Aircraft Artillery (AAA), Rocket

Devastation and destruction can change the character of a city and hamper military operations.

Propelled Grenades (RPG), and Small Arms (SMARMS) fire. The lowest layer of airspace may be pierced by high-rise buildings or canalized by 'urban canyons', where cunning adversaries can easily ambush friendly forces.[11] Enemy fire can be directed both horizontally and vertically. Adversaries can engage aircraft 'from the roof of a sixty-story residential structure or the fourteenth-story window of a thirty-seven-story residential building'.[12]

Similarly, ground forces may be easily trapped and ambushed in narrow streets or encounter man-made obstacles, hindering tactical manoeuvres. Urban tangle, debris, and rubble can significantly slow down all activities compared to other types of terrain and make the movement of vehicles and troops difficult. Local adversaries' knowledge of the topography of a specific urban area may represent a decisive tactical advantage during close combat. US Army analysts 'believe a ratio as high as 6:1 is sometimes necessary to achieve success in urban operations because of the increased strength of the defence in urban terrain'.[13]

Conversely, urban areas could degrade or even deny modern military forces' material and technological advantages. The effectiveness of Intelligence, Surveillance, Reconnaissance (ISR), aerial assets, and long-range weapon systems may be limited. Command, Control, Communications, and Intelligence (C3I) is undoubtedly hampered more by urban topography than by most other types of open terrain. In urban warfare, up-to-date information on the adversary's position, movements, and intentions may be difficult

to achieve. Tactical information is frequently obtained directly on the battlefield while engaging with the enemy, therefore, initial detection and tracking of enemy movements within an urban area can be challenging.

In addition, densely built-up areas make navigation demanding. For instance, GPS navigation systems require a link with at least three satellites, which may be impossible to achieve due to the obstruction of tall buildings. Even when it is possible to pinpoint a specific location, reporting this information may be difficult. Line-of-Sight (LOS) and directional radio communications are hindered in built-up areas, particularly inside buildings. Furthermore, the proliferation of drones, Electronic Warfare (EW), cyber systems, communication and navigation jammers, air defence systems, and a host of other emerging weapons will increase the overall risk.[14]

One of the major challenges to consider in urban warfare is the presence of large numbers of non-combatants, which can have a major impact on JPR operations. Civilians may adopt a neutral posture or play a direct role in support of either friendly forces or adversaries. Adversaries may use civilians and constrained urban areas as cover against friendly forces' superior manoeuvrability and firepower. In addition, civilians are highly vulnerable to the effects of hostilities and often are trapped between opposing forces, taking enormous risks as they attempt to move to safer areas. Civilians may sometimes be forced to act against their will as human shields or may be targeted by opposing forces regardless of their behaviour.[15]

Urban warfare poses serious threats to the security and integrity of civilians and civilian objects in times of war and, consequently, represents one of the most demanding areas for applying International Humanitarian Law (IHL). Poorly planned operations in urban areas that do not consider all aspects of IHL will considerably increase the exposure of civilians to lethal threats and can, thereby, turn legitimate military operations into humanitarian tragedies. Furthermore, social media is crucial in this context as it is considered a primary information channel. The prevalence of social media in urban areas serves as a platform to draw attention to civilian casualties, influence global opinion, and diminish local support.

Consequently, legal restrictions and ROEs may limit the conduct of military operations and the use of force. Moreover, in coalition operations, national caveats or limitations on specific ROEs may restrict options or limit the availability of capabilities. Proper risk analysis and risk mitigation processes are vital to plan a successful recovery operation. Risk management assists the commander in defining the best tactical solution, avoiding further loss of friendly assets, and preventing civilian casualties. It follows that the timeframe to plan and conduct urban JPR may be prolonged, consequently exposing the ISOP to an extended period of isolation.

2.6 Challenges to the ISOP

The amount of time an evader can survive and avoid capture and the overall efforts to recover him depends on his training, capabilities, and limitations. In an UE, the ISOP will face a much different and potentially far greater challenge than in rural and scarcely urbanized areas. The possibility of blending among the local crowd is an obvious benefit in highly populated environments. Nevertheless, the prevalence of surveillance cameras, particularly in modern cities, increases the likelihood of being located, tracked, and eventually captured. In addition, racial and linguistic disparities could make it more difficult or impossible for the ISOP to merge with the local population in a crowded urban situation. One of the main obstacles in an UE is avoiding direct contact with unfriendly civilians, which is harder to accomplish in an UE than in a rural or lightly inhabited area.

It is also likely that the isolation event may occur near civilians and hostile elements, possibly including those responsible for the hostile action. Once aware of the ISOP's initial location, civilians may approach the area out of curiosity or with aggressive intentions, highlighting the ISOP's position.[16]

Because time is of the essence, ISOP must focus their initial activities on reporting location and status to allow recovery as rapidly as possible. However, although the best chances of successful recovery statistically occur within the first hours of isolation, the complexity of the UE and its intrinsic risks to the RF, particularly

in a high-threat environment, potentially suggests deliberate missions, which necessitate thorough planning, rather than immediate or on-alert ones. Therefore, the ISOP's survivability may well depend on the ability to evade the threat for longer periods. Specific urban SERE training, combined with the PR Staff's (JPRC/PRCC) capability to support long-term isolations, will improve the ISOP's potential to evade.

To improve the chances of successful evasion, the ISOP needs to develop a thorough Evasion Plan of Action (EPA) and consider their short-and long-term evasion plans, including contact procedures with the RF. In doing so, the ISOP should consider those communication means that best adapt to an UE. A pre-determined course of action allows for immediate and quick evasive actions from the isolation location, as they will probably occur near non-combatants. The ISOP must quickly apply navigation skills while simultaneously trying to stay unnoticed and avoid detection or tracking.

The presence of civilians and their interaction with hostile forces play a critical role in the ISOP's survival and evasion. Hostile forces may merge with the local population or with members of their own tribe or clan and remain unnoticed. They may also employ civilians to search and detect evaders by organizing a 'locate and report' system throughout the city.

Ultimately, the method of survival and evasion the ISOP applies in an UE will depend on its topography and on specific factors, such as the location of the isolating event, the density of the local population, the presence of adversaries, the time of day, concealment opportunities, communication capabilities and limitations, ROEs, and other legal aspects.

The ISOP should be aware of additional recovery considerations for urban evasion. For instance, RF may have limited time to operate or may need effective support from the ISOP as the situation deteriorates and Situational Awareness (SA) blurs. Moreover, if recovery is not practicable inside the urban environment (i.e., the unavailability of pick-up points), the ISOP may have to relocate to a pick-up point outside the urban area and make his way while remaining unlocated. Regardless of the circumstances, the connection between RF and ISOP is necessarily based on mutual support as the ISOP, if properly trained, is an active contributor to his or her own recovery.

2.7 Challenges to Commanders and JPR Staff (JPRC/PRCC) during JPR Execution

The JPRC/PRCC manages the recovery process after an isolation event by conducting the five execution tasks **(report, locate, support, recover, and reintegrate)**. The **report** or notification of an isolation event may come from any source, and it is of the utmost importance for the PR Staff to verify the information contained and the source. UEs may complicate this validation process due to overwhelming information from multiple and diverse sources. Uncertainty may be further increased by the possibility of deliberately manipulated information by adversaries or their supporters.

The second task, **locate**, is to find, fix, and authenticate the ISOP, and represents a pre-requisite for the JPRC or PRCC to launch and execute a recovery mission. Without proper authentication, the recovery force may face adversaries disguised as ISOP, thus luring the recovery force into a trap or ambush. In an UE, obtaining the accurate and timely location of the ISOP's position may present major challenges. Modern urban areas with tall buildings or narrow alleys may create problems for visibility and communications and, therefore, represent an obstacle in authenticating an ISOP. Moreover, buildings, walls, and other obstacles may also interfere with or even block GPS signals hampering localizing the ISOP. Finally, adversaries' spoofing, and communication jamming may also increase challenges to locating the ISOP.

The third task is focused on the **support** of the ISOP during isolation. Support may include the establishment of two-way communications and morale sustainment, aerial resupply, and may further encompass suppressing adversary threats. While rural environments offer the potential of establishing a physical connection

and airdrop supplies, in a highly dense UE, communications may be difficult to maintain, and air delivery is nearly impossible. Moreover, in highly dense areas, when using force to physically suppress adversaries, one needs to consider the risk of collateral damage and the population's reaction to the ISOP in case of civilian casualties or damage to civilian properties. Finally, as recovery may not be immediate due to threats and complications induced by the UE itself, the support phase may last for a long period. The overall JPR mission could put other high-priority operations at risk during this period by diverting critically needed assets.

The decision to launch a PR mission to **recover** the ISOP can only be made after careful risk analysis. Commanders at all levels must weigh the benefits of rescuing the ISOP against the potential costs. The analysis is implicit in the mission planning cycle, and the results will determine the PR package's composition and the conduct of the PR mission. Risk analysis requires sufficient situational awareness and information superiority. As a prerequisite for success, the JPR Staff requires a comprehensive understanding of the adversaries' interactions and the multi-dimensional, dynamic elements of UEs. When an isolation event occurs in a highly dense and compressed UE, the tactical situation is fluid and difficult to monitor in real-time. This is a factor weighing on the planning process and the choice of the most suitable, feasible, and acceptable Course Of Action (COA). Maintaining information superiority and controlling the information environment is also critical to prevent adversaries from manipulating information or disseminating their messages to the civilian population and the outside world, swaying the narrative in their favour and negatively shaping public opinion. While coordinating the JPR mission, the Staff must carefully consider where to transfer the recovered ISOP for **reintegration**. As highlighted in 'Combat Search and Rescue in Highly Contested Environments Proceedings of a Workshop – in Brief', due to the presence of A2/AD in highly contested environments, friendly bases will need to be dispersed and positioned far from the objective area. Distance and dispersal of bases and related assets 'complicate personnel recovery planning, and the increased operational ranges, which increase stand-off range from areas of operation, will make the Combat Search and Rescue CSAR/PR mission even more challenging'.[17]

Above all, in highly contested UE, a conventional military JPR option, which encompasses both CSAR and Combat Recovery (CR), may not be feasible due to the high risk to the ISOP, RF, and overall mission. JPR Staff will need to find and coordinate alternative solutions. Non-conventional Assisted Recovery (NAR) and Unconventional Assisted Recovery (UAR) may be the best choice. NAR will be particularly demanding, as it needs a net of externally trained actors. In addition, nonmilitary options may be more suitable to manage, thus requiring JPR Staff, particularly the JPRC, to establish robust coordination procedures with civil and diplomatic counterparts.

As the world urbanizes rapidly, cities, megacities, and megalopolises increasingly become the focal points of potential conflicts. The era of permissive or semi-permissive battlespaces is fading, making way for highly contested environments where JPR will face significant challenges. In light of this shift, it is imperative that the JPR community undergo a significant transformation in its strategies, doctrines, TTPs, and education and training requirements to respond effectively to any isolation event.

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Chapter 3

New Education and Training Requirements for JPR

By Lieutenant Colonel Javier Aguilar Gonzalez, Spanish Air Force, General Staff

3.1 Introduction

As cities become more complex and interconnected, it is crucial to establish comprehensive JPR training programmes that prepare individuals for operating, surviving, and thriving in UEs. With a general lack of actual urban training facilities, modern simulation technology, such as Virtual Reality (VR), provides innovative solutions to enable training in simulated UEs as close to reality as possible. Furthermore, future SERE training must consider the opportunities and challenges that a potential ISOP may face in hyper-connected environments, such as smart cities. These metropolitan areas utilize the Internet of Things (IoT) networks, cameras, and sensors to gather data to enhance municipal decision-making processes.[1]

Both NATO and the EU are fully aware of the evolution of warfare towards highly contested and hyper-connected environments such as UEs and have updated the relevant documentation in the last few years. In addition, recent urban warfare in Ukraine and Gaza confirms the pivotal role of technology in UO. Applied advanced technology drives many aspects of modern

warfare. For instance, it can support decision-making processes by merging large amounts of data from different sources, provide assessments and recommendations faster and more accurately, or linked with weapon systems. However, modern technology is nearly non-existent in JPR, which is currently penalized by a disconnect between doctrine, real-life demands, and current training requirements. This disconnect and lack of technology support also relates to the field of education and training.

According to the MCDC prospective document 'JPR Personnel Recovery 2040 – A Global Perspective', it is imperative to adapt to new environments and adopt new technologies to accomplish new, challenging tasks.[2] Adaptation and technology adoption requirements apply also to education and training. The time has come for the JPR community to update the JPR system. Starting from the preparation phase, technology will support education and training and enhance readiness in operations within NATO and EU forces.

Moreover, the systematic analysis of data collected during exercises and courses will enable the identification of areas for interoperability development and potential dangers and challenges derived from new technologies applied to urban JPR.

The upcoming chapter explores the challenges and solutions involved in JPR training in urban settings. We begin by discussing the Training Requirement Analysis (TRA) conducted by the European Personnel Recovery Centre (EPRC), which highlights existing gaps in training methods and the need for a revised approach, especially when considering the complexities of urban warfare. The chapter delves into the difficulties of creating authentic urban training scenarios, the impact of simulation technology on personnel recovery training, and the changing landscape of JPR staff education. It also addresses new obstacles, such as the strategic use of fake media technology and the importance of data-driven training to continuously improve mission planning and TTPs. The overarching focus is on adapting training programmes to the ever-evolving nature of urban environments and emerging technologies to ensure successful JPR operations.

3.2 Background

In June 2021, the EPRC completed a long and ambitious project to identify existing opportunities and gaps in education and training of the EPRC member nations by conducting a TRA.[3] Within NATO's Global Programming, a TRA defines discipline-specific performance requirements for personnel working in a NATO environment. Performance requirements derive from the Alliance's specific tasks covering operations and job positions within NATO's Force and Command Structures.

After adopting the NATO training methodology and conducting live and VTC workshops with representatives from different services of the EPRC nations, the project was successfully finalized, and the report was endorsed by the Steering Group. The project aimed to revise the training methodology within the EPRC and improve support for the EPRC nations' training programmes within a multinational environment, identifying existing training gaps and redundancies. This study was never considered an EPRC product for the exclusive use of the EPRC nations. Since its inception, the TRA was also conceived as a valuable tool for other organizations, entities, and nations to analyse their training programmes.

Although the study resulted in several deliverables and interesting findings, the TRA report did not cover some important topics and considerations. The framework used for the TRA did not include any requirements for challenging training scenarios, such as highly contested, anti-access, denied, or urban environments, or the use of new technology. As a result, these areas were not addressed in the seminars, and no specific training requirements were identified or included in the conclusions. Recognizing this gap, the TRA recommends that a revision be made soon to incorporate these topics once they have been addressed in JPR doctrine or when technological advancements may impact current conceptions of JPR and its development in upcoming years.[4]

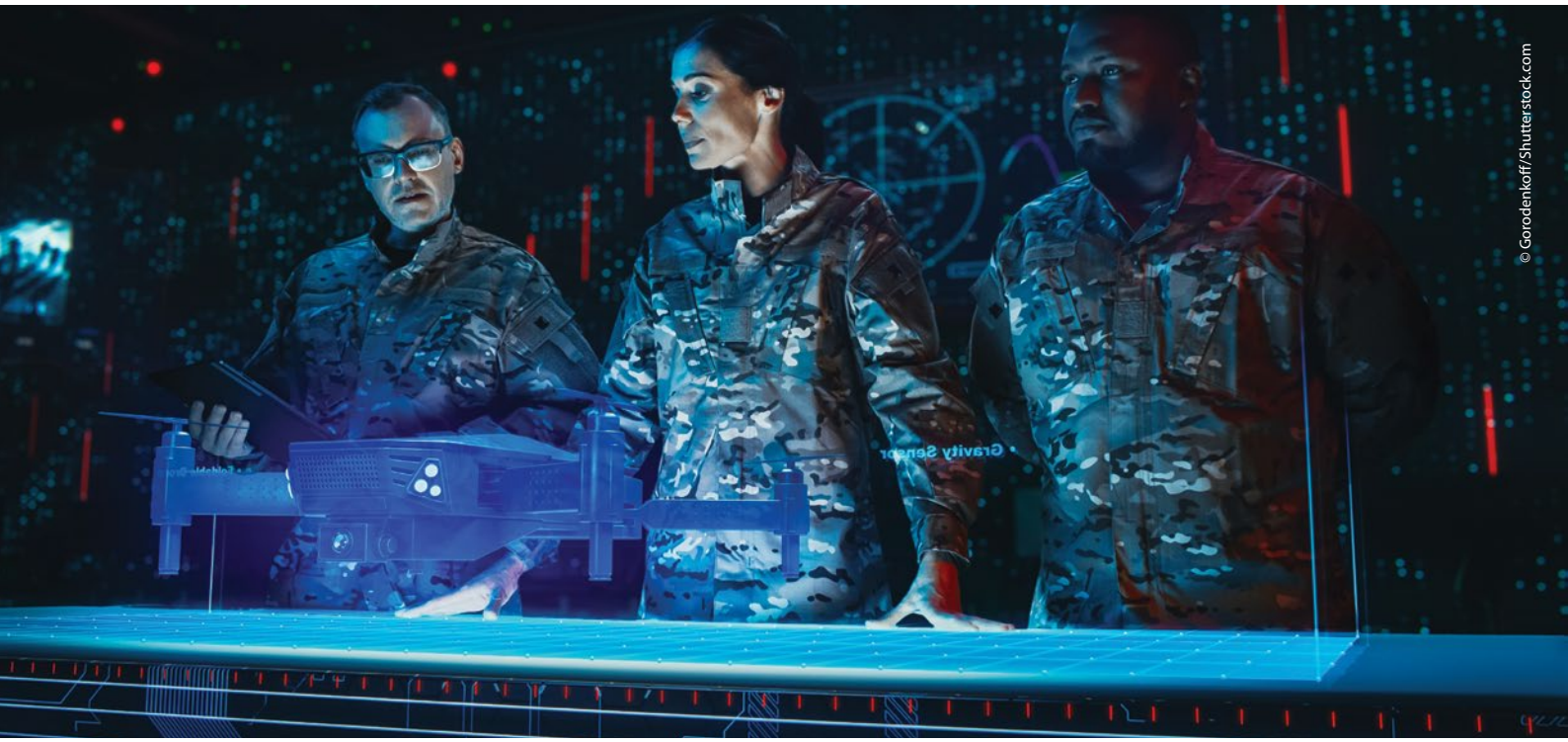
In urban warfare, 'the number of small unit engagements, troop movements and interactions with non-combatants per minute within that space is much greater than in any other environment'.[5] Therefore, the chances of having isolation events and potentially increasing the number of JPR missions are considerably

Training for urban scenarios – Are training facilities enough to replicate the complexity of an urban environment?

higher. The logical consequence is to include training programmes for the three elements of the JPR system (commanders and staff, RF, and ISOP) to plan and execute recovery missions in urban areas specifically. Nevertheless, determining an effective training programme encompassing the broadest range of real-world urban environments is highly challenging due to the substantial differences in characteristics and complexity between urban and rural cities.

3.3 Chasing the Elusive Realistic Urban Training Scenario

One of the main challenges in becoming proficient and capable in urban operations is the ability to recreate realistic urban environments for training purposes. Some nations already use mock villages in military installations as training ranges for UO. The US National Training Centre at Fort Irwin (California) and the Centre d'entraînement aux actions en zone urbaine (CENZUB) in Sissonne (France), where personnel can train in Military Operations in Urban Terrain (MOUT), may be considered proper facilities for large scale training. The primary purpose of these facilities is to train in the use of organic weapons in a combat environment, with mental conditioning as a second goal.[6] However, these training sites are generally scarce and do not usually allow for the integration of forces from different countries because of their location, lack of airspace, or logistical limitations to accommodate many participants. Furthermore, these facilities can hardly replicate urban scenarios that combine various aspects of contemporary cities. The current training facilities appear to be more of an abandoned ghost town, a mere skeletal appendage torn from form and function and thrown together in the middle of nowhere. A barren wasteland, unable to mimic the hustle and bustle, diversity, and complexity of urban life. Cities today are not considered dead, isolated structures as represented in the training centres, but rather interconnected systems encompassing water, economics, transportation, and, notably, technology form integral



Simulation technologies introduce new opportunities for training warfighters.

components. They should be comprehended as comprehensive environments – a network of systems.[7]

Creating a replica of every aspect of an UE that could influence training, such as technology, connectivity, dimensions, infrastructure, and morphology, would be a costly endeavour. Finding a technological solution, such as the newest simulators, to simulate these aspects accurately is also not without expense. During a workshop organized by the Air Force Studies Board of the National Academies of Sciences, Engineering, and Medicine, which focused on CSAR in highly contested environments, representatives from the USAF expressed similar sentiments. The board's primary objective was to gain insight into the changing threat landscape and its impact on the CSAR/PR mission. They also acknowledged the limited availability of specialized training centres that can reliably recreate all types of environments that an ISOP may face, like deserts, jungles, arctic regions, or maritime areas.[8] In addition, several times NATO has recognized the need for constructing urban and urban littoral training areas to refine and further develop TTPs for all services.[9]

However, PR education and training opportunities, such as flying courses like the EPRC Air Centric Personnel Recovery Operatives Course (APROC) in Europe or the Red Flag Rescue in the United States, are mainly conducted in large open areas that allow for air-surface integration in scarcely inhabited areas. None of them includes urban scenarios that offer different challenges, constraints, and restraints for well-rounded training. Therefore, opportunities to train a joint recovery force in a UE are limited. Generating new training areas is indeed quite challenging. In addition, integrating and coordinating with local authorities, public and private services, and population may only be possible in those countries where the state already integrates a whole-of-effort approach.

The scarcity of available airspace in Europe and potential conflicts with civil air traffic operations are also critical factors when integrating airborne assets into large-scale exercises. A lack of realistic urban training capacity generates combat training gaps for all the services, especially for the Air Force with relation to specific aspects, such as the Combat Identification (CID) environment, the likeliness of CD, the need to preserve infrastructure, restrictive

ROE, LOS obstructions (to include targeting and communications), and freedom of manoeuvre.[10]

This lack of urban training scenarios could be partially mitigated using simulation technology. While simulation can never fully replace training, this capability can support learning procedures, practicing of mission planning, and coordinating between different assets before going to actual training, which would reduce costs and increase the learning curve. The benefits and limitations are discussed in the following section.

3.4 Transformative Technologies in Personnel Recovery Training: Virtual Battlefield Simulation and Virtual Reality Integration

Simulation technology has rapidly evolved in recent years, introducing significant changes to the armed forces' training opportunities. The advent of this technology has reduced learning times in the initial phases and accelerated the overall proficiency curves.

Technology has primarily improved two features: the fidelity of simulated environments to natural battlefield environments and the connectivity between different systems, which facilitates collaboration and improves coordination among members of the same group, thus enhancing interoperability.

In relation to the first feature, the lack of realism in lower fidelity simulated environments may create misleading sensations that can result in negative training. To avoid such outcomes, synthetic training supported by VR and increasingly realistic virtual environments have grown substantially in recent years. The most advanced nations have embraced synthetic training technology for more efficient and realistic training. Nations have also invested in ambitious programmes to overcome the primary deficiencies of traditional virtual training systems: lack of realism and dynamism, difficulty in simulating human interactions, inadequate data collection for subsequent improvement, and lack of interoperability.

The improvement of virtual training environments has been closely associated with Virtual Battlefield Simulation (VBS) technology. VBS is the digital simulation of conflicts, generally accomplished by combining simulators and very detailed customisable digital scenarios. Joint training involving different nations and services can be supported with VBS, which would not be possible otherwise because of financial constraints, asset availability issues, or geographic limitations.[11]

Simulation technology has the potential to enhance JPR training significantly because European Nations have rare opportunities to provide their forces with live JPR training. These opportunities are often restricted to yearly national or international exercises and courses like the APROC. Many countries find joining challenging because of the significant logistical and financial burden associated with the training range's location in southern or northern Europe. Simulation technology may solve this problem by developing realistic training scenarios. Simulators allow trainees to execute JPR missions and familiarize procedures in a virtual environment, therefore avoiding costly deployments. Simulation technology may be beneficial during exercises as well. Participants may execute training range familiarization flights virtually, focusing on range regulations and procedures in simulators. This could allow for executing more live mission training, thus optimizing the course or exercise schedule.

European Defence Agency's (EDA) prototype VBS, the Tactical Personnel Recovery Mission Simulator (TPRMS), is a first step towards integrating simulations into the PR mission. This simulator, officially inaugurated in November 2021 at Poggio Renatico, Italy, consists of twenty computer workstations replicating the elements of a PRTF, allowing the crews to rehearse PR missions. The TPRMS has marked a significant achievement for the European Personnel Recovery community, given that no such capability is available in Europe. This project is a synthetic training tool based on the VBS4 technology and has a potential value for PRTFs' training activity in all environments.[12]

Although European nations do not yet have plans to link synthetic and live training, the combination of simulation tools such as the TPRMS with a follow-up of live training in exercises could lead to a better performance of personnel and a faster revision of TTPs, thus increasing interoperability amongst services.[13] Following the

paradigm, 'virtual before live' training consolidates and confirms skills learned in a virtual environment'. Therefore, 'optimum PR training opportunities would consist of a virtual training component followed by a national or multinational practical phase'.[14]

The interoperability of simulation systems across several organizations is a major challenge. Each Service or Defence agency typically develops or purchases its own virtual solutions, which may be incompatible with those of other services or agencies. Some of these issues have been solved by developing the Distributed Interactive Simulation (DIS) protocol and, subsequently, the more sophisticated High-Level Architecture (HLA) family of standards. These standards describe a unified method and typical architecture for building interoperable simulation systems.

Furthermore, the connection of this simulation architecture with real weapon systems or real combatants is already possible. National defence organizations worldwide are implementing Live Virtual and Constructive (LVC) education and training programmes. LVC represents the different environments a trainee experiences while undergoing training. In live environments, real assets and weapons systems are employed; in virtual environments, assets and weapons systems are computer-generated; in constructive environments, 'most often combined with virtual training, constructive adds the element of Computer-Generated Forces (CGF) to control entities, opposing forces, allies, and other elements. Example: A pilot performing formation training in a simulator and wingmen are computer-controlled'.[15]

Therefore, creating urban JPR training which integrates simulators and real assets is technologically possible. The main limitations are the high integration costs, the latency of connection to provide the most realistic experience, and the willingness of nations to share training results and capability data.

Nonetheless, the expenses of simulation technology and its integration are relatively modest compared to constructing and maintaining real-life training facilities, given their authenticity, adaptability, and rapid evolution advantages. Regretfully, most NATO nations have not yet adopted this cutting-edge simulation technology, and the hefty expenses involved prevent its widespread use inside the Alliance.

Supporting initiatives like the previously mentioned TPRMS is a good first step towards acquiring solutions that meet the training needs of many countries. However, funding needs to be sustained over time to ensure these initiatives' medium- to long-term viability and expansion.

3.5 New Challenges and Solutions for a Comprehensive JPR Staff Education

PR staff members receive training from several national and international programmes. These programmes include the PR300/PR350 delivered by the US Joint Personnel Recovery Agency (US JPRA) and the UK Defence SERE Training Organization, the JPR Staff and Leader Courses provided by the European Defence Agency (EDA) and the JPR Staff course by the EPRC and Italian Joint Air Operations School (JAOS). These courses aim to educate participants on the roles and responsibilities of a PR Staff member in a PRCC or JPRC. Subsequently, proficiency should be maintained by participating in national or multinational exercises. Unfortunately, JPR missions that call for extra planning, coordination, and preparation are not always given priority in the training objectives. Moreover, isolation events in UE may force the ISOP to evade for an extended period, yet high risks make it difficult or impossible to carry out a recovery mission. To train the JPR system effectively, it is necessary to incorporate exercises involving extended evasion situations. The focus of training must be shifted to align with potential real-world scenarios.

The war in Ukraine has proven that regular PR TTPs are insufficient when operating in a UE. According to Ukraine's Ministry of Defence figures, 81 Russian helicopters were brought down during the first month of the conflict.[16] Helicopters may become very vulnerable to threats, and performing an aerial recovery can increase the overall risk for the mission. A traditional PRTF, based on air assets, will not be a viable recovery option in a high-threat environment.[17] As a result, PR C2 Staff must be able to plan in accordance with these constraints and identify more appropriate

alternatives. Otherwise, the Commander should investigate alternative recovery solutions such as NAR or UAR. Where a military alternative is not practicable, the Commander may choose a diplomatic or civil one, for which the Alliance and the countries must provide education and training.

Civil initiatives have proven very effective in Ukraine, while military solutions have not. Courageous Ukrainian people spontaneously established an escape network in occupied portions of their territory by merely using the contacts on their mobile phones to chart escape routes, avert traffic, and find backups at clogged checkpoints.[18] If properly planned and coordinated, these efforts can become a vital component of a knowledgeable PR C2 staff's toolkit.

A significant challenge for the staff is the strategic impact of an isolation event and the use of Psychological Operations (PSYOPS). Recent experiences in the Ukrainian war have demonstrated how important PSYOPS can be to winning the hearts and minds of public opinion. Since the first days of the war, Ukraine has shown a fierce determination to win the narrative fight, putting into effect a set of initiatives to win worldwide public opinion. One of these initiatives, called ***Ishchi Svoikh*** (Look for Your Own), was designed to help family members identify Russian personnel killed in action or captured.[19] This Telegram channel has also been exploited to document the Russian forces' crimes against their comrades. Footage depicting units tasked with keeping soldiers from fleeing combat with lethal force were displayed, undermining Russian public morale and support for the war.[20] This activity in social media has side-stepped the Russian government's censure and compromised the official narrative at the highest level, the political one.

The use of authentic images and videos of captured soldiers is a powerful weapon to win the narrative fight. Such media can be even more powerful in the current fake media era. A fake image or video can be created quickly and spread worldwide through social media within seconds. Fake media should be covered in the PR C2 staff's first education and training, along with how to recognize and counteract them with the appropriate tools.[21] Recent events in the Gaza conflict demonstrate the strategic use of fake videos. Hamas distributed fake videos of already executed civilian hostages appearing alive and in good condition to further its deception campaign and induce the adversaries to try to recover them or negotiate their release.[22]

If they are not properly verified, fake videos may lead to the planning and execution of unnecessary JPR missions. It is, therefore, essential to train members of the PR structure to validate and classify events properly. To this end, PR Staff course curricula should include dedicated education on the risks of fake video technology, while exercises should train personnel to deal with fake information. VBS technology should also be considered in PR Staff education. This technology can generate training scenarios in minutes or, at most, hours. It would offer flexibility for preparing, planning, executing, and assessing, and particularly for rehearsing PR operations in changing urban scenarios. The Ukraine war may serve as a recent example. Ukrainian cities have been dramatically carpet-bombed, changing their morphology in days and causing a catastrophic situation where electricity, water, food supplies, and communications no longer exist.[23]

Virtual scenarios can be easily modified and tailored in minutes to precisely match the area of operations. Staff officers can optimize their planning and decision-making process if supported with VBS technology.

3.6 Possible Evolution of Urban SERE Training

As highlighted in the previous section, UEs present unique challenges, making evasion particularly difficult for the ISOP. Evasion in a UE requires an in-depth knowledge of the area's local demographic, and sociocultural aspects, including the local population's attitude.[24] Greater cultural awareness and knowledge of the specific environment will considerably improve the chances of a successful recovery.

The main goal of urban survival training is to enhance the ISOP's survival skills (protection, location, water, food – PLWF) acquired during SERE training in urban-specific scenarios. Most military SERE schools and specialized civilian SERE

training providers have incorporated evasion courses in real UEs by using old, abandoned factories, or scarcely populated urban areas, improving the overall quality of the training outcome.

However, evasion in hyperconnected smart cities, may be an arduous task to achieve. In smart cities, biometric data may be available to the adversary via biometric sensors, surveillance videos, or even social media outputs.[25] Moreover, data can be obtained through easily accessible commercial products, like a vast and open database of 100 billion face images acquired from 'social networks and other online sources without the consent of the websites or the people photographed'.[26] This powerful tool, developed by Clearview AI and initially designed for law enforcement and government agencies, can power up surveillance systems, easing the adversaries' ability to search for an ISOP. This system can also identify people based on pictures taken more than 30 years ago through AI-supported powerful search engines easily accessible through its applications.[27] Additionally, Clearview AI is working on a system able to recognize people based on their walking patterns or locate them quickly based on the background of a photo, making the ISOP's evasion more challenging.

If the ISOP is ultimately captured, a straightforward set of deep-fake products and applications, such as those mentioned above, may likewise be employed against him 'to indoctrinate, psychologically destabilize and manipulate the captive's mental state' through deep-fakes of family members or unit comrades.[28]

The proliferation of commercial applications to generate deep fake images or videos has grown exponentially in the last two years. Nowadays, anyone can create photographs or films from social network posts in a matter of minutes with hundreds of free applications. These easy-to-make, inexpensive tools can be modified to operate as a weapon against captured personnel. Deep-fake activity should be covered during Conduct After Capture (CAC) training to properly educate personnel on the possibility of being used against them while in captivity.

Surviving in urban areas requires a deep understanding of demographics and socio-cultural dynamics. Training programmes must incorporate real-world situations and evasion tactics to prepare ISOPs effectively. However, the rise of smart cities and advanced technology like facial recognition poses new challenges for avoiding capture. Therefore, it is crucial for training programmes to continuously adapt and address these emerging threats to produce highly capable responses from potential ISOP.

3.7 Data-driven JPR Training and Continuous Improvement

Continuous improvement and learning rely heavily on analysing data gathered from completed activities. In JPR training and coaching activities, valuable lessons are often drawn from instructors' observations. However, there is currently no method in place for systematically collecting and analysing data to improve mission planning or TTPs.

For instance, the EPRC recently introduced the Blue Tracker tool employed by flight crews during the APROC live-fly course held at the Tactical Leadership Programme (TLP) facilities in Albacete, Spain. The Blue Tracker device serves as a visual aid during mission debriefings, providing a detailed performance overview. However, instructors and SMEs have not fully utilized its potential. The results of the analysis are typically shared only with the participating PRTF elements to enhance their learning. As a result, the insights obtained from the initial mission analysis are not transformed into recommendations that could benefit the development of new TTPs, standardization, or interoperability among nations. Additionally, no established mechanism for monitoring trainee performance progression over time exists.

Therefore, establishing specific metrics for training activities during APROC would allow for measuring the impact of simulation tools (such as the TPRMS) before each course. This measure would facilitate assessing RMC candidates' improvement over the years and their competence in handling more complex scenarios, such as JPR missions in urban environments.

3.8 Conclusions

The conflict in Ukraine has shown that current TTPs may not always be applicable in the UE. The lack of urban training facilities hinders the proper analysis of the lessons identified and their application to urban JPR education and training. With simulation systems being used for a wider range of operations, combining powerful software with incredibly realistic and detailed scenarios will be possible. This will improve training in its early stages and shorten the time needed to become familiar with basic tasks or procedures. Additionally, it will make it possible to test and evaluate new TTPs for PR in urban environments, after which they can be modified and put into practice.

Using simulation technology in PR staff education and training will significantly enhance decision-making. Being in unfamiliar environments – like urban ones – as opposed to those that are typically included in courses and exercises, will enhance the staff's and RF's critical thinking skills and decision-making abilities in quickly changing scenarios. It will also boost their resilience and motivate them to look for different answers.

The widespread use of technology in smart cities presents the ISOP with additional challenges and risks during evasion and even captivity. The SERE curriculum must unquestionably cover the difficulties of evading in a hyperconnected society and identify new technological tools that could be employed against it.

Developing joint initiatives, like new simulation programmes involving multinational organizations or creating protocols for linking existing ones, should be encouraged. It is recognized that acquiring and employing cutting-edge technology requires a significant financial investment for nations. Collaborations and joint efforts would aid in setting and practising TTPs and standards throughout the Alliance and lower costs for each individual country.

However, technology alone does not guarantee better learning and, consequently, better performance. Coaching and training must be well-designed, as well as a method of continuous improvement that exploits data analysis derived from exercises and courses. In military operations, the human factor always plays a key role. Simulations will never fully replicate the experiences, first-hand engagement and communication with peers, and real-world training situations. Nevertheless, simulation technology already significantly enhances soldiers' readiness for action, whether in training or on the battlefield. To meet the 'Train as you fight' paradigm, JPR education and training must progress quickly because our soldiers work in highly complex urban situations requiring sophisticated, cutting-edge systems.

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Chapter 4

Emerging Disruptive Technologies Applied to JPR

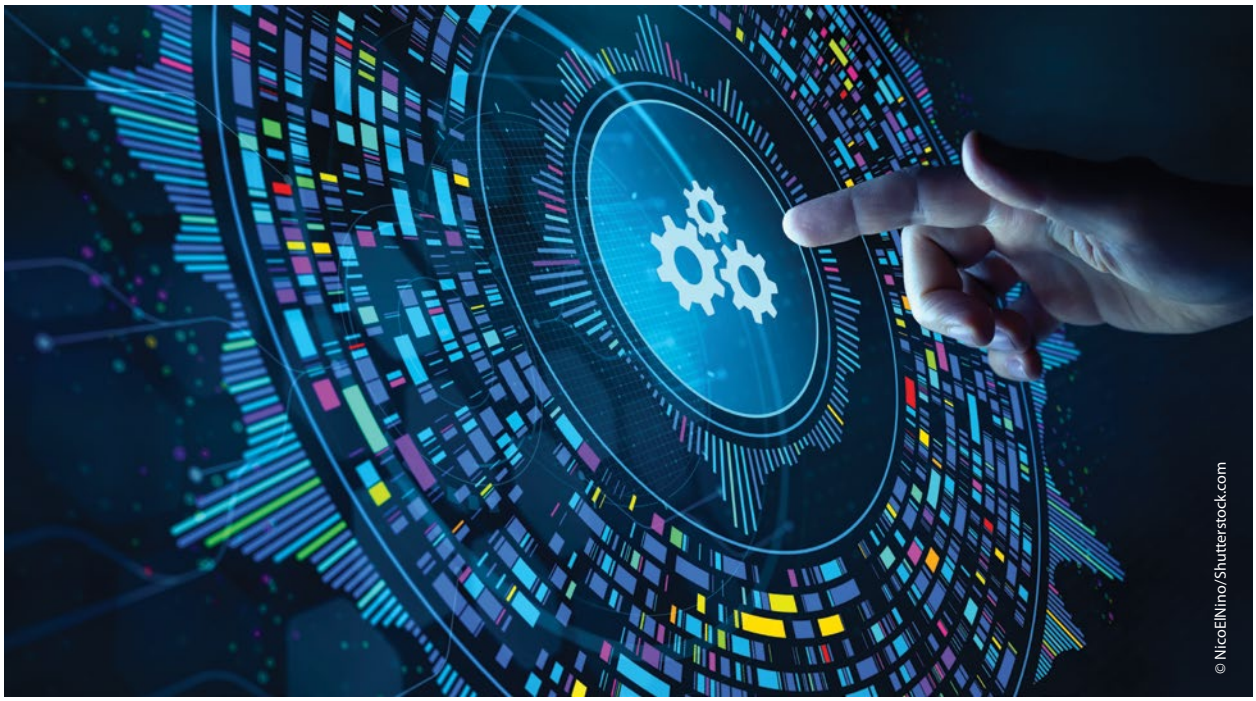
By Commander Andrea Magi, Italian Navy, JAPCC
and Mr Marco Gazzaniga, Centre for Land Forces Studies, Italy

4.1 Introduction

Strategic success in the Future Operating Environment (FOE) will depend upon ascertaining reliable multi-source information and making decisions at the speed of relevance to counter future opponents' use of multi-domain or hybrid warfare. There will be an increased need for constant situational awareness to operate with minimal or no CD in complex environments where the difference between combatants and non-combatants may be difficult to discern. Moreover, Electronic Warfare (EW), electromagnetic spectrum congestion, and the limitations of the UE, coupled with the vast amounts of data derived from the IoT will significantly increase the complexity of future operations compared to the experience of the past 30 years.

Emerging and Disruptive Technologies (EDT) represent the forefront of technological innovation, with significant impact on NATO members' doctrine and capabilities, and which could be vital to supporting military operations in complex scenarios or significantly hamper our operations if not accounted for. EDTs are defined as 'technologies or scientific discoveries that are expected to have a major, or perhaps revolutionary, effect on NATO defence, security, or enterprise functions'.[1]

EDTs have the potential to substantially change JPR, specifically in the planning and execution phases of current doctrine. In particular, the execution phase – Report, Locate, Support, Recover, and Reintegrate – will require planners and staff to process large amounts of information to build, validate, and maintain situational awareness. Adopting the currently envisioned EDTs will



Emerging and Disruptive Technologies (EDTs) are a critical part of the Alliance's ability to maintain its tactical and strategic edge in the Future Operating Environment (FOE).

reduce the overall risk of failure and optimize the JPR system to the FOE.

This chapter aims to identify applicable EDTs, verify their applicability to JPR, and explicitly focus on the execution phase, emphasizing the overall benefits.

4.2 Emerging Disruptive Technologies

For the scope of this chapter, the following definitions are used:

- *Emerging:* Technologies or scientific discoveries that are expected to reach maturity in 2020 – 2040 and are currently not widely used or whose effects on Alliance defence, security, and enterprise functions are unclear.
- *Disruptive:* Those technologies or scientific discoveries that are expected to have a major, or perhaps revolutionary, effect on NATO defence, security, or enterprise functions in the period 2020 – 2040.
- *Convergent:* A combination of technologies combined in a novel manner to create a disruptive effect.

The EDT categories described in the following paragraphs applicable to JPR in complex and contested environments, and their specific impacts are summarized below. Since these technologies are still in developmental phases, they should not be considered as off-the-shelf solutions applicable to existing scenarios, but rather as guidelines to enforce and accelerate their maturity for early adoption into our doctrine and capabilities.

4.2.1 Autonomy & Autonomous Systems (AS)

Autonomy is 'the ability of a system to respond to uncertain situations by independently composing and selecting different courses of action to accomplish goals based on knowledge and a contextual understanding of the world, itself, and the situation'[2]. Autonomy is characterized by different levels of self-directed behaviour, ranging from fully manual to fully autonomous. For instance, an operator may remotely control systems, or an Artificial Intelligence (AI)-controlled uncrewed systems (UxS) may act autonomously depending on the mission. Levels of

The Avilus Grille uncrewed aerial vehicle, an innovative solution capable of performing medical evacuation, could also recover isolated personnel.

autonomy are a function of sensors, mission type, communication links, onboard processing, and legal/policy constraints.

Nevertheless, given the operational advantages to both NATO and potential adversaries, there is little doubt that autonomous systems will significantly enhance operational capabilities over the next 20 years.[3] Focusing on JPR, UxS could perform the following tasks in support of a recovery mission:

- Support the find-fix-track and authentication process of ISOP.
- Ensure persistent eyes on the objective area and maintain communications with the ISOP.
- Suppress potential threats.
- Airdrop goods.
- Assist or effectuate recovery.

Missions conducted with autonomous systems have already been successfully tested. In 2018, Tactical Robotics, an Israeli firm, demonstrated an uncrewed cargo delivery and casualty evacuation mission. The Cormorant, a vertical take-off and landing uncrewed air vehicle, performed a medical evacuation from a predetermined point back to the point of origin. During the mission, a monitor relayed the patient's condition to a ground base and a video camera capable of two-way communication was also tested.[4] Although CASEVAC is not doctrinally part of the PR realm, the experiment conducted by Tactical Robotics demonstrated the effective use of an uncrewed system to recover personnel that could be repurposed for a JPR mission.

4.2.2 Artificial Intelligence (AI)

AI – the ability of machines to perform tasks that usually require human intelligence – is changing the global defence and security environment. AI capabilities underpin automated and autonomous technologies deployed in theatre and generate advantages in intelligence collection, C2, and data management. These

technological developments span all domains of military operations, including JPR.

AI enables real-time data exploitation from multiple sources to aid sense-making, knowledge generation, and decision-making. Multi-source exploitation includes the contextual understanding of current and future events. An ISOP event is a time-critical, unforeseen event; real-time data exploitation would expedite building up situational awareness and the entire planning and decision-making process, thus increasing the probability of a successful recovery.

Moreover, AI-Human Machine Symbiosis (HMS) may enable control of uncrewed PRTF recovery assets with increasingly automated features in the future, thus putting the operator in a supervisory role. In addition, UxS could enable military forces to plan and execute remotely controlled or autonomous recoveries, reducing risk to recovery forces, similar to the Remotely Assisted Medical Evacuation (RASEVAC) system.[5] In this regard, the German technology firm Avilus has developed the Grille UAV which is designed to revolutionize Medical Evacuation (MEDEVAC) Operations, based on advanced uncrewed AI-based technologies.[6] As reported in 'A Concept for Next Generation Combat Search and Rescue', the employment of uncrewed recovery packages reduces risk to human forces, avoids the diversion of critically needed forces from ongoing operations, and conducts the recovery rapidly, which could give future PR missions a probability of success in the highest threat scenarios.[7]

AI-powered Training, Modelling, and Simulation (TMS) techniques can help integrate Embedded Virtual Simulation (EVS) and Intelligent Tutoring Systems (ITS) into military training. As already highlighted in Chapter 3, the deficit of purpose-built urban training facilities incorporating all aspects of an UE, such as dimensions, infrastructures, morphology, and society, may find a solution by substituting advanced simulators enabled by AI to create UE ISOP scenarios. PRTF elements, such as RMCs, RV, RESCORT, RESCAP and RF, could train in more realistic, AI-augmented, simulators combined with live exercises.

4.2.3 Big Data and Advanced Analytics (BDAA)

BDAA is a product of the increasingly digital and virtual world and the subsequent need to make sense of the deluge of available information. It may be defined as 'the use of advanced analytic techniques against very large, diverse, big data sets that include structured, semi-structured and unstructured data from different sources and in different sizes from terabytes to zettabytes'.[8]

The large amounts of data available create the opportunity for analytical tools 'to deliver insights and predictions, provide real-time decision support, and highlight early indicators of success and warnings of crises'.[9] Ultimately, BDAA could support decision-makers in building their situational awareness, identifying potential risks to operations, and adjusting plans accordingly.[10]

BDAA is applicable to all JPR phases but could play a pivotal role during the Planning and Execution phases of the JPR system at the operational and tactical levels. The ability to process and analyse large volumes of information properly and present real-time situational awareness to planners and decision-makers will expedite COA development and the execution of recovery missions.

4.2.4 Novel Materials (NM) and Additive Manufacturing (AM)

NM and AM have the potential to dramatically change the availability, cost, useability, and uses of current and future capabilities 'and maintain NATO technological advantages over adversaries during long conflicts'.[11] Novel materials are advanced materials manufactured using nanotechnology or synthetic biology. NM offer superior performance characteristics, durability, flexibility, or strength compared to standard materials.[12]

AM is required to fully develop the potential of novel materials. AM, also referred to as 3D printing, is the technique of creating actual 3D items from a digital model or computer-aided design. This technique is critical for NM to have their greatest impact. AM allows for faster solutions by integrating new technologies or incorporating them into old products.[13]

Overall, investing in new material and manufacturing research 'is essential to enhancing the Allies' resilience to future economic and security shocks'.[14]

NM could serve as the foundation for improvements in numerous military applications:[15]

- Reduced equipment loads due to the implementation of lighter-weight materials.
- Covert wearable devices made possible through lightweight, flexible electronics that can be woven into fabrics.
- Faster communications and improved computation.
- Extended physical range of operating platforms used for communications, range-finding, identification (visual/infrared) and improved signal detection.
- Protection against and/or better detection of biochemical attacks and explosive vapours.
- Lightweight, high-impact resistant materials for body armour and digital systems worn by soldiers.
- Reduced radar reflections from land, sea, and air platforms through radar-absorbing coatings.
- Improvements in energy storage capabilities.
- Coatings for wearable fabrics that include weather-resistant and chemical protection; capabilities and/or coatings that enable monitoring using smart/intelligent textiles.

Once tested and validated, NM will benefit all three elements of a JPR system: Staff, Recovery Forces, and the ISOP. Faster long-range communications will facilitate C2 and coordination between the JPRC/PRCC and the PRTF operating in contested or congested environments. Lightweight, high-impact resistant materials for body armour and new water-resistance and chemical protection coatings for wearable fabrics will enhance survivability and combat capacity for warfighters, such as the extraction forces or the ISOP. Lastly, radar-absorbing coatings will reduce radar reflections of the recovery assets, reducing the risks associated with operating in a contested environment or detection by a third party.

In summary, EDT offers the prospect of faster, more efficient, safer, or just a better way to accomplish difficult tasks, such as conducting JPR in an UE. Whether by identifying new ways to apply existing technology or developing entirely new technological concepts and materials, the prospects for enhancing the capability of the global JPR community are boundless.[13]

4.3 EDTs Applied to the JPR System

Understanding UEs is complicated. Cities are complex adaptive systems of systems. Like all complex systems, they are constantly evolving and changing, and their complexity makes it difficult to fully understand the second or even third order effects of social, civil and economic changes.[16] In addition, terrain, adversary tactics, communication and coordination issues, collateral damage concerns, psychological factors, stress derived from close combat, media, and information warfare will further complicate urban operations and influence their outcome. These complexities require a solid JPR system that provides specialized training and equipment, adaptive plans and tactics, a comprehensive understanding of the operating environment, and close coordination with civilian and diplomatic authorities. In this respect, EDTs offer several ways to support urban JPR. Leveraging EDTs can enhance situational awareness, improve operational efficiency, and mitigate risk when conducting recovery operations in complex UEs. This section will focus on the benefits that EDTs could provide to the five tasks in JPR Execution phase (Report, Locate, Support, Recover, Reintegrate).

- **Report**

  All PR events start with a notification of isolated personnel. Regardless of the source, it is of the utmost importance for the JPR staff to receive and validate the notification, which translates into verifying both the source and the information itself. In an UE, more sources of information such as local TV channels or radios, social media, uncorroborated reports to military or local authorities, and civilians may complicate the validation process by providing excessive or contradictory information to be verified. Moreover, the possibility that information is intentionally altered by adversaries or originates from unreliable sources adds to the uncertainty. Recovering an ISOP is

time-critical; BDAA and AI allow processing and analysing vast amounts of multi-source information in less time, therefore improving JPR C2 in the validation process, situational awareness build-up, and early decision-making.

- **Locate**

  The aim of the Locate task is to find, fix, track, and authenticate the ISOP. The requirement to know the position of the ISOP is a pre-requisite to execute a recovery mission, as efforts and further lives can be lost if not accomplished.[17] While completing the locate task, it is critical to avoid revealing the ISOP's position. Once a precise location of the ISOP is attained, the ISOP must be authenticated to avoid possible deliberate ambush by adversaries. Location and authentication are difficult steps in the Locate task and are further complicated by dense environments such as urban ones. EDTs can support the locate task with autonomous, uncrewed systems. These systems could be equipped with low-noise hybrid-electric aero-propulsion systems and lightweight high-resolution hyper-spectral imaging technology for surveillance missions, which are an emerging solution for many modern military missions, especially urban warfare and tactical Intelligence Surveillance and Reconnaissance (ISR). Mini, micro, and nano UxSs could support localizing and authenticating isolated personnel, reducing risk to the RF.

- **Support**

  The Support task is the effort to ensure the physical and psychological sustainment of the ISOP during their isolation. Common tasks include establishing two-way communication, aerial resupply, and suppression of threats. The goal of the support task is to aid the ISOP to survive, evade, and avoid capture until recovery. Autonomous UxS could deliver supplies to the ISOP, such as water, food, ammunition, and clothing in contested environments, reducing the risk of detection by adversaries in UEs and over long distances. For example, the US Army recently tested the Soaring's Vertical Take-Off and Landing (VTOL) UAS Gabriel G1, a multi-purpose, multi-payload autonomous aerial vehicle. The system autonomously resupplied ground personnel with ammunition and food.[18] Similarly, the US Marine Corps and Navy are testing Elroy Air's Chaparral hybrid-electric Vertical Take-Off and Landing (hybrid-eVTOL) cargo aircraft. Compared to legacy aircraft, the h-eVTOL sophisticated carbon composite airframe and automated modular payload reduces logistic requirements and human intervention.[19] Emerging EDTs could increase the effectiveness of supporting assets and sustain the ISOP for long periods without placing additional personnel at risk.

- **Recover**

  The recovery of ISOP will depend on the overall threat, the ISOP's position, the environmental conditions, and the available forces. In an urban scenario, the combination of environment and threat may provide an unacceptable risk to recovery forces, forcing the Commander to pursue a non-military solution. Developing new, high-end technologies, such as the RASEVAC example in para 4.2.2, could replace traditional crewed PRTFs, allowing commanders to maintain the military option and operate in previously inaccessible areas to larger crewed platforms. In 'A Concept for Next-Generation Combat Search and Rescue', the authors envision big PRTFs, composed exclusively of high numbers of expendable uncrewed systems, able to accomplish the mission and sustain high losses without impacting mission success or risking additional personnel. The concept envisions the employment of autonomous RVs, supported by loitering munitions in lieu of crewed helicopters or aircraft to suppress ground and surface-to-air threats, which should be able to perform authentication and recover the ISOP in the same manner as a conventional PRTF. As the authors recognize, this revolutionary concept is still immature, with significant concern for the ethical and practical considerations regarding the employment of fully autonomous loitering munitions. Yet, as technology develops, it is plausible in the near future that as the possibility to operate in complex and high-risk scenarios is increasing, forces may operate fully autonomous, uncrewed PRTFs.

- **Reintegrate**

  Reintegration is the final task and is the process of providing medical and psychological care to personnel recovering from an isolated situation.[20] Psychological and medical care may be a long-term process

with no end date or guarantee of success. Reintegration includes Intelligence and SERE debriefings. Emerging technologies may offer numerous tools to facilitate the physical and psychological care of recovered ISOP, combining traditional interventions with digital innovations.

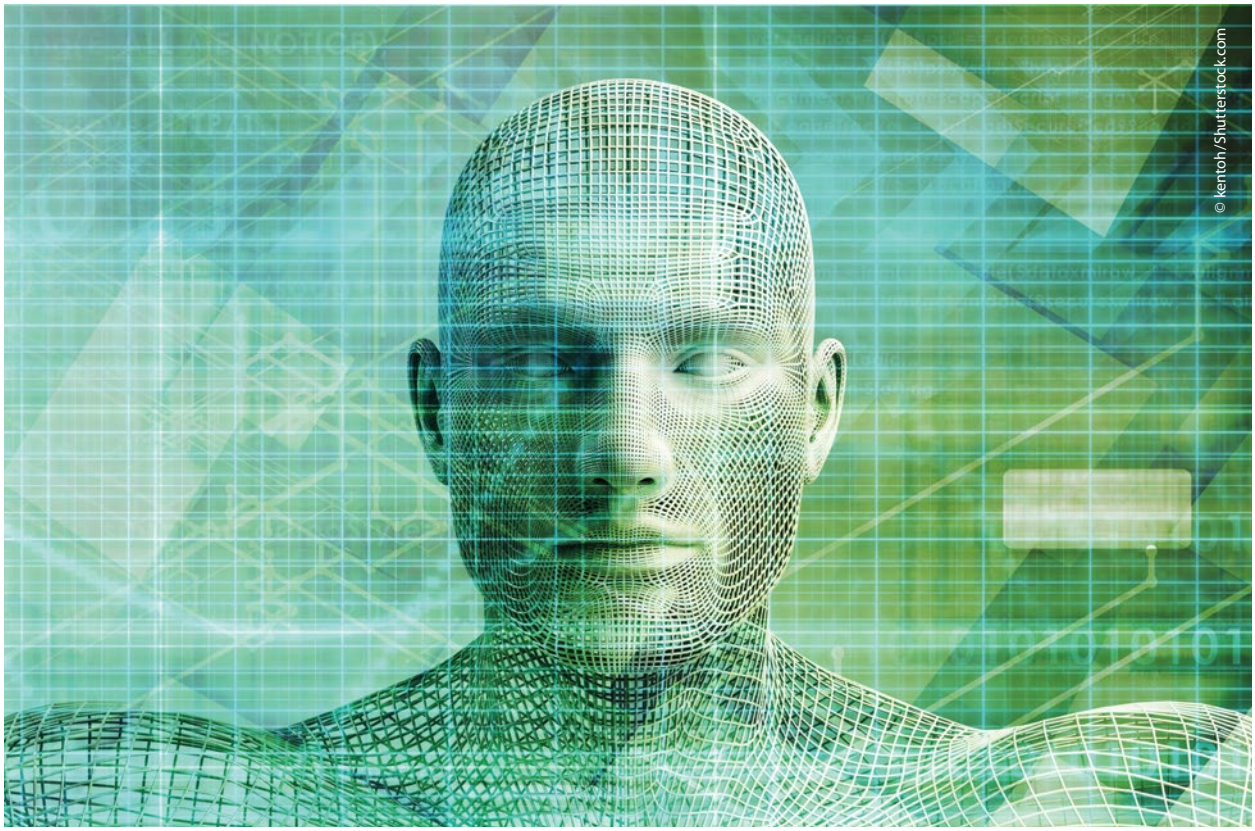
Telemedicine and online therapy, for instance, allow personnel to receive psychological support even in difficult settings.[21] Online platforms could provide a safe space for personnel to share experiences, receive emotional support, and find solidarity with those who have experienced similar situations expanding their choices by offering significantly improved choice of location.

Virtual Reality (VR) and Augmented Reality (AR) can recreate safe and calm environments where personnel can gradually cope with the trauma they have experienced under the supervision of a therapist.[22]

AI can analyse data collected from a patient's interactions with apps and devices to personalize physical and psychological treatment, tailoring pathways to the individual's specific needs. Moreover, AI technologies can help monitor behaviour and vital signs to predict acute stress or regression episodes, enabling timely interventions.[23]

AI-powered health chatbots could provide an alternative mental health support and therapy system through conversational interactions. By providing accessible and personalized assistance, these chatbots improve patient engagement, give real-time support, and contribute to proactive healthcare management, particularly in mental health.[24]

EDTs could play a key role in successfully reintegrating recovered ISOP, allowing for better physical and psychological care of patients and facilitating their return to duty and normal life.



EDTs in healthcare seek to tailor treatment plans based on individual genetic profiles. This personalized approach increases treatment efficacy and minimizes adverse effects.

4.4 Conclusions

EDTs have the potential to revolutionize modern warfare and significantly enhance military capabilities across the five domains. Modern technology can enable superior and faster decision-making, increase operational efficiency, and ensure redundancy while reducing risks and preserving the human factor. The Alliance is aware of how innovative technologies 'are providing new opportunities for NATO militaries, helping them become more effective, resilient, cost-efficient, and sustainable'.[25] The impact of emerging technology will shape the requirements across all military aspects, including information and cognitive superiority, new weapons and platforms, and sustainment and logistics.[26]

EDTs will also profoundly impact operations in UO, enhancing forces' capabilities and addressing the unique challenges of operating in densely populated and complex areas. Some benefits emerging technology could provide are enhanced situational awareness, advanced ISR, precision engagement, improved mobility and logistics, and increased coordination and control. In JPR, the contribution of EDTs will be crucial in enabling operations in high-risk conditions, both for RF and ISOPs, reducing risk to the PRTF. Adopting new technologies for a possible future confrontation in a complex environment, such as UE, is a race against time, and JPR is no exception.[27] The global JPR community needs to position itself better to identify possible innovative solutions and recommend early adoption.

In conclusion, the global JPR community should strive to quickly incorporate available COTS technologies into the system whenever and wherever possible and adapt them for JPR.

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Chapter 5

JPR as a Multi-Domain Force in Urban and Congested Areas

By Major Brian Nielsen, CAOC Uedem, Royal Netherlands Air Force

5.1 Introduction

With the Russian invasion and annexation of Crimea in March 2014, followed by its wholesale attack on Ukraine in February 2022, NATO faces a rapidly changing security environment throughout Europe. As a reaction, the Alliance has introduced the Deterrence and Defence of the Euro-Atlantic Area strategic concept as a flexible, tailorable, and adaptable strategy to counter emerging challenges. It seeks to unite national, regional, and theatre-wide military efforts by providing nations with a framework to align deterrence activities in peacetime and, if directed, defend in crisis and conflict.

However, to truly align the activities of the Military Instrument of Power (MIoP) within this strategic context, NATO is developing a new concept for Multi-Domain Operations (MDO).[1] This concept seeks to converge the effects from not only the five military domains (Air, Land, Sea, Cyber, and Space) but across all domains, systems, and environments, synchronized between all stakeholders (military as well as non-military) and other IoPs at the speed of relevance. Multi-Domain Operations Command & Control (MDC2) will become an integral concept of NATO and the standard method of operation in the near future.

The challenging security environment and MDO developments will affect the traditional way of executing JPR operations within the constraints of current doctrine and the present legacy C2 structure. This chapter will examine how an MDO approach may affect the JPR system's ability to recover ISOP from urban and congested areas in the future.

5.2 Personnel Recovery of ISOP is Multi-Domain by Nature

To establish along which Lines of Effort (LOE) the NATO JPR system needs to develop to be effective in this challenging security environment and integrated into a future MDO system, we need to understand the nature of JPR, and its present position related to both subjects.

JPR is defined as the 'sum of military, diplomatic and civil efforts to affect the recovery and reintegration of isolated personnel.'[2] From this definition, we can see that JPR is about activities and effects in the five military operational domains as well as the civil and diplomatic realms.

The JPR system supports and recovers ISOP at the tactical level using traditional effects from the military services. Simultaneously, at the operational level, ISOP recovery is coordinated in cooperation with the civil sphere, such as Host Nation (HN) Search & Rescue (SAR) and emergency services, Governmental Organizations (GO), Non-Governmental Organizations (NGO) and International Organizations (IO). Finally, at the strategic level, the ISOP recovery is coordinated through interactions at the state actors' level via diplomatic channels, using various IoPs to effect a variety of the opponents' systems.

Referencing Figure 1, a holistic view of the operational environment shows how interconnected the domains, environments, and systems truly are.[3] The aforementioned required efforts and effects, from tactical, operational, and strategic levels of a NATO JPR system, simultaneously navigate the Physical Areas and Factors (five military operational domains), the Information Environment, and PMESII systems while being affected by the EM Spectrum, Meteorological Factors, and potentially Other Actors.

Since JPR is always a race against the clock, it is vital for success that all efforts are simultaneously aligned in all domains, environments, and systems in a holistic view. For instance, while ISOP apply their survival and evasion skills, recovery efforts typically rely on conventional

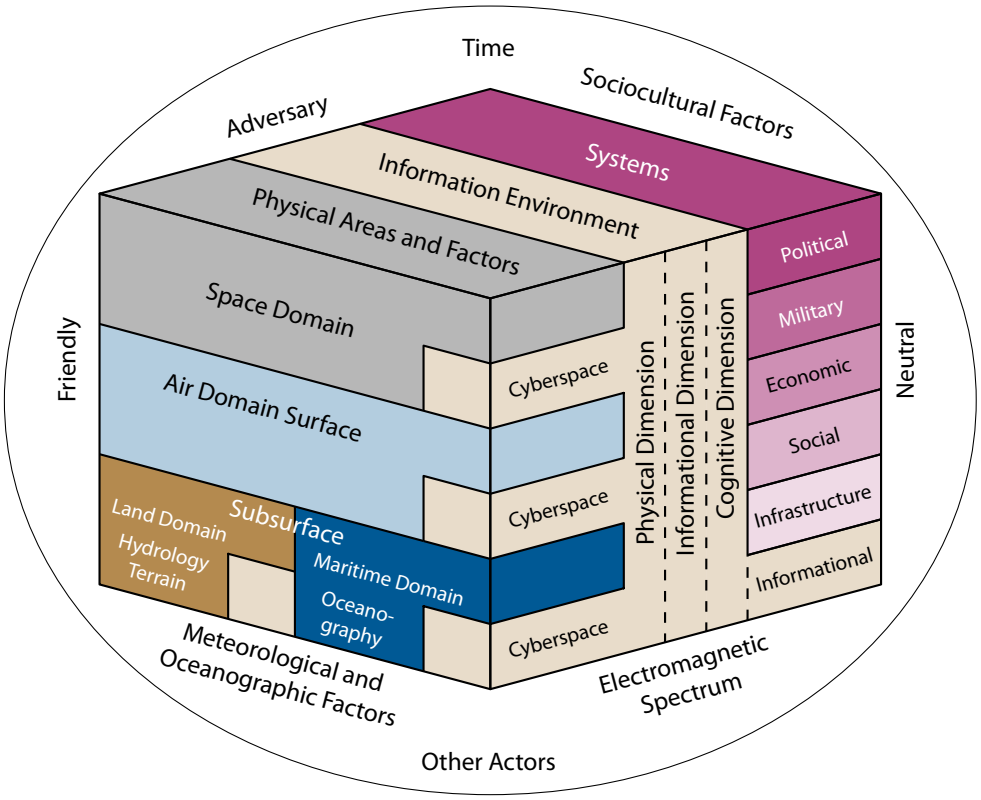

Figure 1: *A Holistic View of the Operational Environment from Joint Publication 2-01.3 – Joint Intelligence Preparation of the Operational Environment, 2014.*

military JPR forces. Yet, once ISOP are captured and apply their resist to exploitation skills, they potentially become either hostages or Prisoners Of War (POW).

In both cases, the NATO JPR system supports the ISOP mainly through a diplomatic or civil option, with a possible military option as back up, mainly conducted by SOF, in case negotiation fails.

With a hostage situation in the rear area of an Article-5 JOA, a NATO or EU member whose capture is confirmed will prompt the non-military European Union Agency for Law Enforcement Cooperation (EUROPOL) in Den Hague (NE) to initiate a recovery mission. A national HRO Team will potentially travel to the location, while the NATO JPR system monitors the situation in all domains, environments, and systems, and provides updates to Europol.

Given the above-mentioned widespread effects of the JPR system in all domains and environments as well as the possibility of the ISOP's rapidly changing situation, military and non-military activities must be synchronized at the operational and strategic levels to create converging effects. Therefore, the JPR system must conduct itself in a multi-domain fashion to maximize the opportunity of successfully recovering the ISOP.

5.3 Current Operational Environment

The other factor changing the doctrinal way of executing JPR operations is the current challenging security environment, which is predominantly affected by Russia's conduct of warfare in Europe. According to the Gerasimov Doctrine, Russia operates mainly along the 'Art of Hybrid Warfare'.[4] This doctrine is a 6-Phase

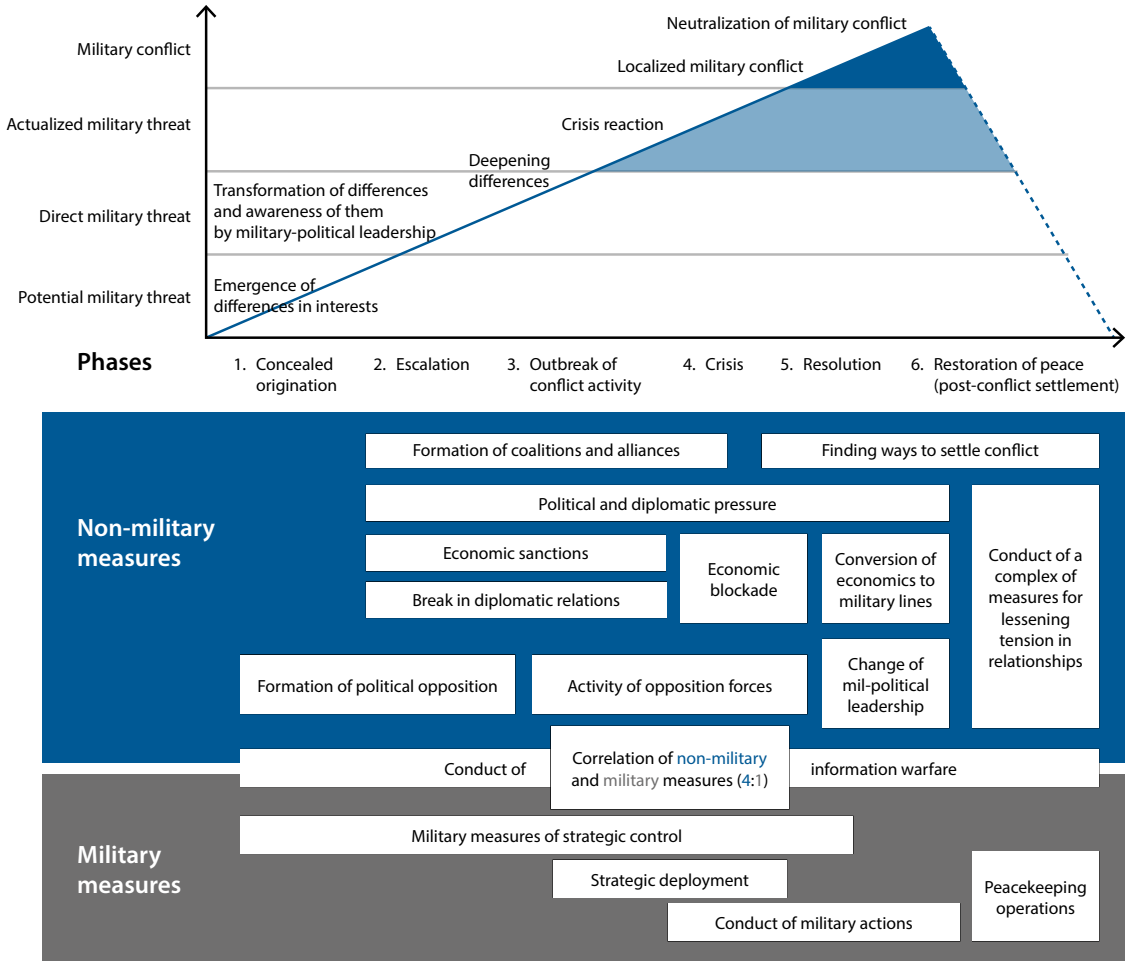

Figure 2: *Gerasimov's Role of Non-Military Methods in Resolving Interstate Conflicts.*

(see Figure 2), whole-of-society engagement with a multi-domain approach against different systems (effectively the PMESII centres of gravity). According to Gerasimov, the non-military measures impact the adversary four to one compared to traditional military measures (see the lower half of Figure 2).[5] The goal is to simultaneously influence the behaviour of all levels of the International Community (including NATO and the EU) and public opinion in the targeted areas.

Russia's geo-political targets are primarily the independent states, from north to south, along the border between Russia and Europe, where attitude and demography are to Russia's advantage. If Russia identifies adversary critical vulnerabilities, it can exploit them with different methods. These methods include studying the demographics and behaviour of Russian minorities, exploiting their cultural, linguistic, and marginalized social conditions (e.g., lower pay, Russian language restrictions, the rewriting of local history, and civil rights restrictions), and granting Russian citizenship to minorities and other inhabitants within targeted nations, thus creating a pretext for Russian intervention.

The means used to achieve hybrid effects include proxy forces such as paramilitary, motorcycle gangs, and cyber criminals, or other security assistance forces such as the Russian mafia, Spetsnaz, and Cossack fighters. Moreover, Russian youth groups, pro-Russian groups, strategic communication, media institutions, and companies are also utilized (Figure 3).

For example, leading up to the Russian military invasion of Crimea in February 2014, demographics, information campaigns, and pro-Russian organizations played a vital role in Phases 1–2 (see Figure 2). Russia amplified existing tensions by granting Russian citizenship to Russian minorities and other inhabitants, followed by a cyber-attack on the banking system. In Phase 3, Cossack fighters and pro-Russian groups seized Crimea's CoGs, followed by Phase 4 with 'Little Green Men' (Spetsnaz) and other security assistance forces entering Crimea. Russia's justification was ostensibly to protect the Russian ethnic minority in Crimea. Russia executed their special military operation along the phases of the Gerasimov Doctrine. Unstable situations deriving from the application of

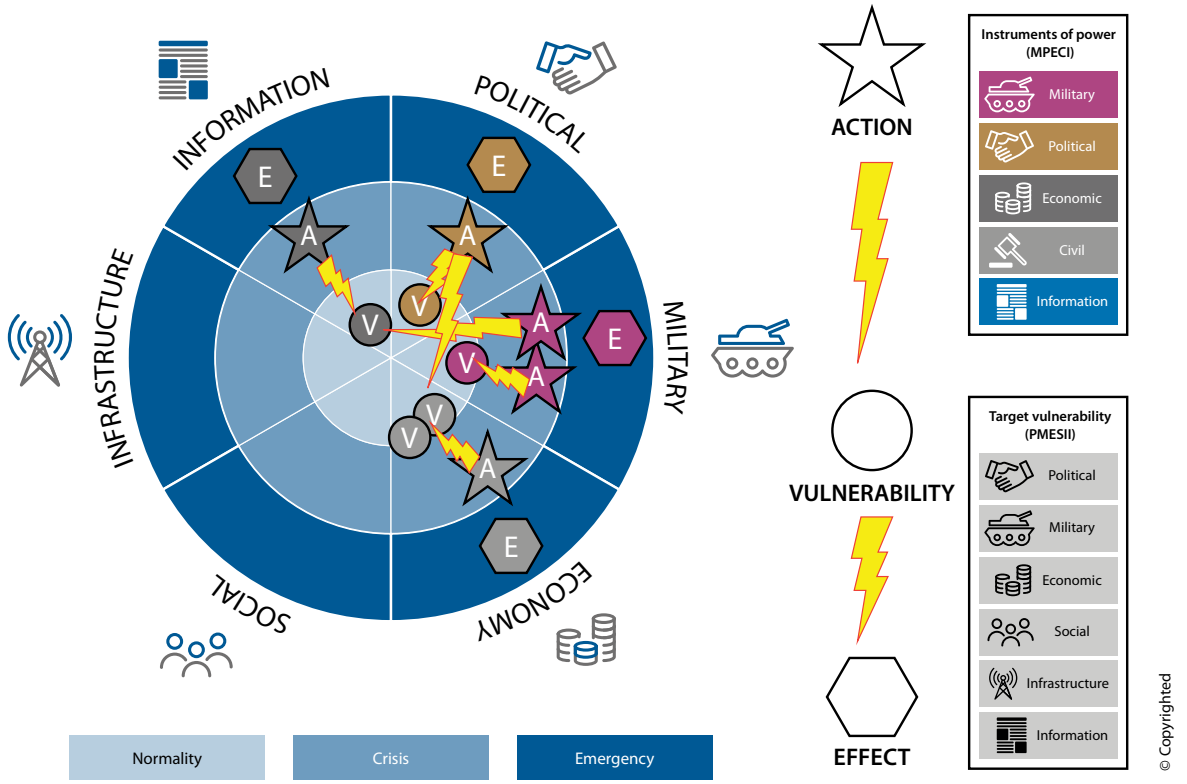

Figure 3: *Analytical framework for visualizing non-kinetic effects (or hybrid) across six core elements of an operational environment.*

the Gerasimov doctrine in a targeted nation could logically lead to an isolation event.

To be prepared to counter Russian hybrid warfare, The Multinational Capability Development Campaign (MCDC) published the 'MCDC Countering Hybrid Warfare Project: Understanding Hybrid Warfare' which describes how Hybrid Warfare may unfold.[6] An aggressor may use a wide range of IoPs aimed at a target system's vulnerabilities (light blue area) to achieve desired effects. The goal is to foment crises (blue area) and emergency situations (dark blue area) within the target state's vulnerabilities while simultaneously avoiding decisive counteraction.

An orchestrated and synchronized hybrid attack exploits critical vulnerabilities via different types of IoPs, including variations in the intensity of each IoP. Effectiveness comes from obscurity and creativity, achieving a synergistic effect from multiple domains. Russia has demonstrated this method in the takeover of Crimea in Ukraine and in the start of the present conflict in Ukraine.

The most effective way for the JPR system to counter Russia's (or another aggressor's) multi-domain hybrid warfare is to implement MDO principles developed by the Alliance. Therefore, NATO needs to synchronize all its JPR activities across all domains and environments, at scale and speed, and in collaboration with all JPR stakeholders, actors, and relevant IoPs. The PR Staff's goal is to deliver tailored Courses of Action (COA) at the right time and place to gain advantages in shaping, contesting, and presenting dilemmas to decisively influence adversaries' attitudes and behaviours. In other words, 'out-think, out-fight, out-pace and out-last' the opponent to recover the ISOP.[7]

5.4 Future Contested Security Environments

The challenges in FOEs will change how JPR systems need to be designed. It is essential to understand the nature of these environments and how JPR systems need to be adapted to be effective in these environments. Developing a future JPR system simply from the present JPR system capabilities, driven primarily by present investments in legacy systems, is too simplified a solution. It must simultaneously be approached from a future force analysis and exploit capabilities and advantages in the yet unknown FOE. The future force analysis should never be static; rather, it should continuously focus on technological developments in the FOE by various research institutes and industrial partners.

The MCDC 'JPR 2040 – A Global Perspective' report analysed several FOEs and their effects on future JPR C2 and JPR Forces.[8] The conclusion was that NATO needs to capitalize on the benefits from all FOEs while countering and denying the opponent's attempt to hamper our JPR system. The only way to defeat an opponent in any FOE we operate in is to simultaneously leverage our advantages and limit the adversary's options within that same FOE. Doing so ensures that Boyd's Observe – Orient – Decide – Act (OODA) loop is faster on our side than the adversary's.

The implication is that the JPR system must continue to adapt in order to remain effective in all domains in any FOE. The Allies must recognize that it won't be easy to forecast the effect of rapidly changing technology on JPR. A centralized organization with JPR SMEs should monitor the upcoming technology via a Concept, Development, and Evaluation (CD&E) approach to constantly evaluate this impact. Hereby, the vision of how the JPR system should operate in these FOEs could closely follow the constant technological developments related to these FOEs.

5.5 Military Committee Approved JPR Action Plan

With the present challenges of our security environment and the progress of MDO in the Alliance, the NATO JPR system should be developed towards the FOE.

When the Military Committee (MC) approved the NATO JPR Action Plan (AP) in 2021, it tasked the Strategic Commands (SC) to 'coordinate and synchronize capability development of PR as a Joint Integrated Capability into the NATO Command Structure (NCS) and Allied structures'.[9] Furthermore, the JPR AP stated

that JPR was to be developed as a mission element in the MDO environment.

The AP establishes a road map for JPR development and proposes a set of measures necessary to recover NATO and NATO Allies' associated personnel isolated in a hostile environment within the scope of NAC-approved missions, operations, and activities. The JPR AP outlines a future, agile, and Ready JPR Force (RJPRF) at SACEUR's disposal at Full Operational Capability (FOC) in accordance with the NAC-approved Operation Plans. The MC considers that significant coordination work is still required on NATO's part to provide the Alliance with a credible and accessible JPR capability.

The JPR AP is organized along four LoEs: Doctrine, Organization, Materiel, and Training, each including decisive conditions and tasks, to reach IOC and FOC of a joint integrated capability in the NCS. The SC have already considered the authority to update the task list to ensure an adaptable capability development, referencing the FOE. The MC has requested the SC report their progress on the JPR AP to the NAC via the MC annually. In conclusion, a clearly defined task to develop the NATO JPR system towards the future integral concept of MDO in NATO was given back in 2021.

5.6 JPR in Future MDO

We need to define the characteristics of a multi-domain JPR system for the NCS that can operate in urban and congested areas to achieve an MDO-ready, agile, and persistent JPR system. Achieving the Alliance's MDO Vision requires focusing on four guiding principles of MDO: unity, interconnectivity, creativity, and agility.[10]

- Unity: Orchestrate military activities and synchronize non-military contributions, which requires collaboration, transparency, and trust to enable harmonized MDO planning and execution.
- Interconnectivity: Shared understanding across all IoPs, partners, and stakeholders, enabling warfighting interoperability between force elements, including technical interoperability and shared data classification.
- Creativity: Develop boundless opportunities tailored to offer surprise and multiple dilemmas, based upon the ability to analyse situations from different viewpoints and turn complexity into simplicity.
- Agility: Take advantage of fleeting opportunities through initiative, relative speed, prioritization, and flexibility of thought and action by applying mission command).

The primary enabler to achieve MDO is a 'data-centric approach', where four data tenets form the foundation for the four guiding MDO principles:[11]

- The foundation for Unity is ***data sharing***, which is directed towards a national willingness, commitment, and dedication to making data accessible to enhance trust, collective understanding, collective protection, and resilience, and to support the development of military plans. It requires a mindset change from ***need to know*** to ***need to share***.
- The foundation for Interconnectivity is ***data exchange***, requiring secure and resilient data exchange through pathways and gateways that link entities to enable data sharing.
- The foundation for Creativity is ***data appreciation***, which requires a mindset of making the most out of the data, including appreciation of the diversity of humans by sex, age, background, etc., to support mission planning and execution.
- The foundation for Agility is ***data exploitation***, which derives knowledge and understanding from big data across all five military domains and other environments to support the Military Decision-Making Process (MDMP).
- Other MDO Enablers include:
  - Technological Advantage: Exploiting technology that provides information and decision advantage, e.g., Emerging Disruptive Technologies such as Artificial Intelligence.
  - MDO C2: Collaborative, agile, and empowered Command and Control.
  - Human Resources: Commanders and staff exploit capabilities across the domains, based on technology-enabled understanding, to creatively generate relative advantage.
  - Collective Training: Investment in technologically-enabled training at the national and NATO levels.

Technology development and incorporating a data-centric approach greatly enhance the JPR system's situational understanding. Tools such as Augmented Reality (AR) and Virtual Reality (VR) are designed for JPR Forces to support commanders and staffs during the decision-making process.[12] When fully implemented, the MDO design should encompass secure and robust connectivity with seamless, resilient, and redundant information exchange to support fully synchronized operations, interoperable between Nations and NATO, including federated networks.

Observing how the MDO guiding principles are applied from the battlefield towards a ***cloud*** (Figure 4), each authorized user and platform at the ***edge*** should contribute data via multi-layered security. Utilizing bi-directional communication and local storage in an overarching meshed network, including AI capabilities, will ensure seamless data exchange and sharing within the battlespace. This will support the full range of operations of the JPR system at the tactical level, including near-real-time JISR information from embedded sensors in both the military domain and civil environment simultaneously. At the ***core***, AI, including Deep Learning and Machine Learning, should augment data appreciation, exploitation, and exchange/sharing. Data can be gathered in a cloud to accomplish data exchange and sharing at operational and strategic levels, including between all entities where needed. This will improve situational understanding and support faster decision-making for the commanders and staff of the entire JPR system.

Figure 4 shows the necessary MDO clean data pathway from the edge on the battlefield through the processing of its core to the collected data in the cloud.[13]

The Alliance projects that SACEUR will have a fully integrated MDO JPR system at his disposal, making the agile MDC2 in the NCS from the tactical edge to the operational and strategic core and cloud levels available for the JPR Forces and the JPR C2 system simultaneously in all phases of the JPR mission, ensuring the right data for the right user at the right time.

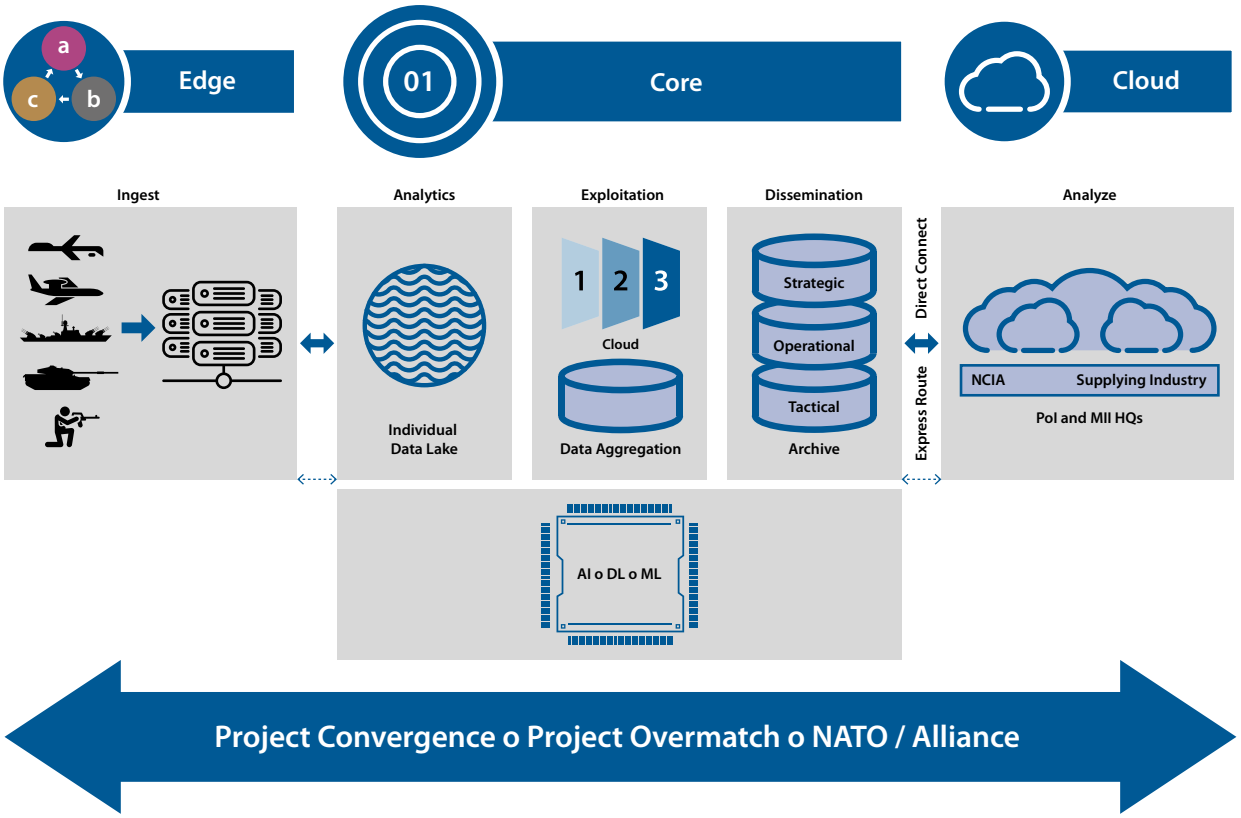

Figure 4: *Data-Centric Warfare from Edge to Core to Cloud.*

Exploiting new technologies to provide information and decision advantage through data-sharing and data exploitation.

5.7 Conclusion and Solution: A Centralized JPR Knowledge Centre

JPR operations have holistic efforts and effects throughout several domains, environments, and systems, from tactical through operational to strategic level, including multiple IoPs, making JPR operations multi-domain by nature. To counter both the present challenging security environment and future contested environments, all JPR activities need to be multi-domain. All JPR stakeholders, actors, and relevant IoP must collaborate at the right scale and speed to gain advantages in shaping, contesting, and presenting dilemmas to the adversary to decisively influence his attitude and behaviour and recover the ISOP in time.

Likewise, JPR operations in the FoE must constantly adapt to emerging technological developments and implement changes in the multi-domain concept into the JPR system.

Unfortunately, with the present NCS Peacetime Establishment (PE), no JPR Subject Matter Experts (SMEs) or dedicated JPR Staff Officers are established at the Strategic Level in NATO. At the Operational Level, sporadic JPR expertise exists, but JPR SMEs are seldom engaged primarily in developing the JPR system. However, throughout the 32 NATO Nations, many very experienced and capable JPR SMEs are available.

Therefore, to support the transformational task given in the JPR AP, a centralized organization or entity must be formed to consolidate the NATO JPR expertise under a single roof. Examples could range from a JPR Project Team formed under SC, to a multinational-formed NATO JPR entity, to exploiting the Centre of Excellence (CoE) enterprise.[14] Such a multinational entity would offer recognized expertise and experience on JPR throughout NATO and would contribute to the development and effectiveness of the JPR system in the NCS in the future, as requested by the MC.

In Figure 5, we identify how the JPR AP tasking along the LoE could be accomplished through the four pillars typical of a CoE: Education, Training, Exercise and Evaluation (ETEE), Analysis and Lessons Learned, Doctrine Development and Standardization, and Concept Development and Experimentation (CD&E). If adopted into a new or existing COE, the centre's Steering Committee would translate

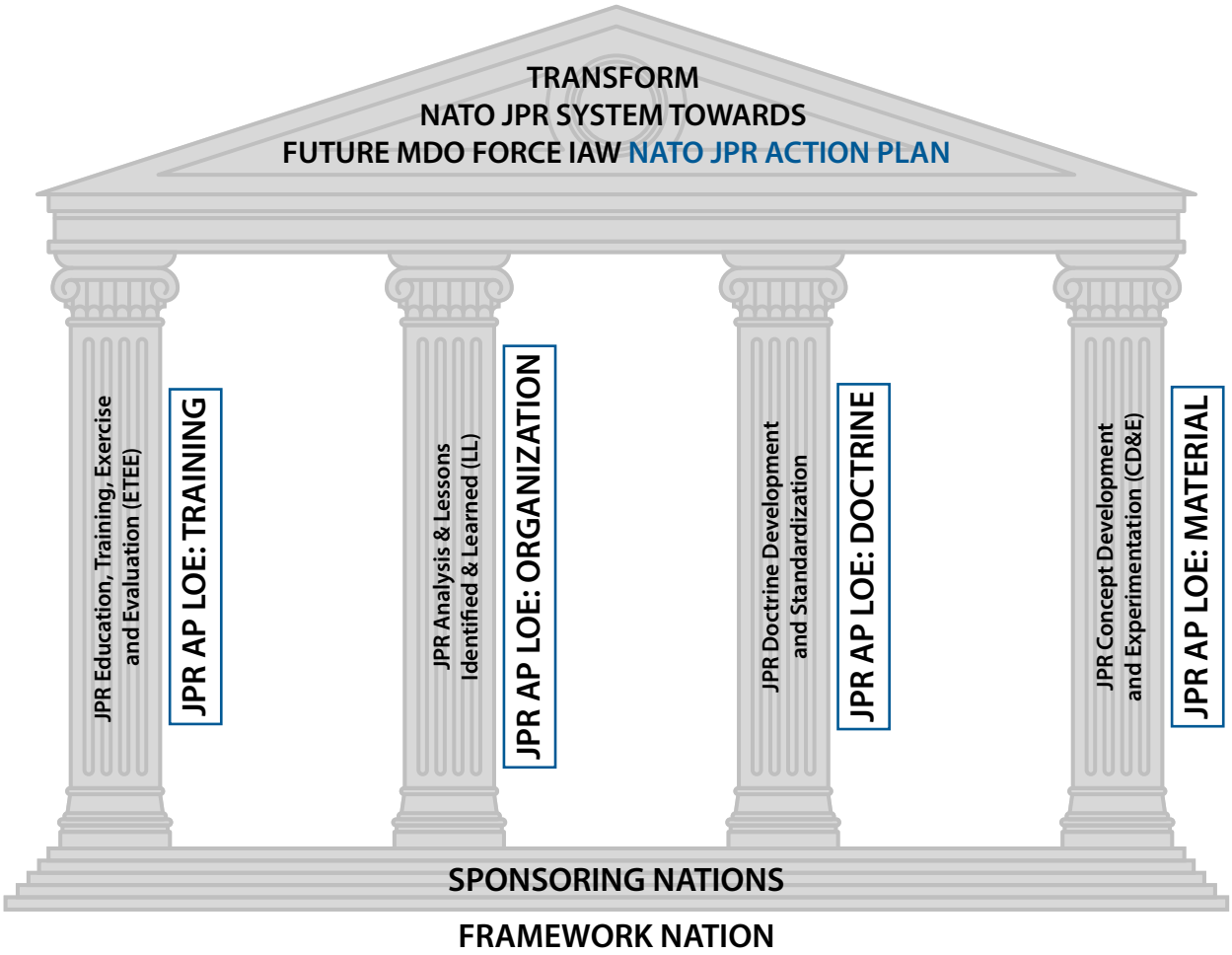

Figure 5: *The Four Pillars of the JPR Action Plan.*

the JPR AP into its governing documents and annual Programme of Work (POW), also considering the priorities of its Sending Nations.

Whatever the form, establishing a centralized JPR knowledge centre would deconflict and consolidate the activities of other stakeholders, such as Strategic Headquarters, NATO nation Headquarters, US Joint Personnel Recovery Agency (JPRA), and EU EDA. Such a centre is an essential foundation for supporting the SCs in the transformational tasks given in the JPR AP and consolidating the future multi-domain JPR system to ensure we can continue to recover the ISOP so that others may live.

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Chapter 6

Conclusions and Recommendations

By Commander Andrea Magi, Italian Navy, JAPCC

6.1 Introduction

The way we understand and plan for JPR needs to be reconsidered. Today's security environment is unpredictable and dynamic, with escalating conflicts and challenging situations in which the Alliance may find itself unprepared. The likelihood of future military operations occurring in highly contested environments will increase the vulnerability of personnel and the possibility of isolation events. Those contested environments will likely occur in or near UEs which represent one of the most complex scenarios for JPR. Urban environments range from small towns to megalopolises with complex and intricate interconnections between their populations, various geographical and artificial features, and their related infrastructure. Moreover, emerging threats, ranging from capable non-state forces to peer and strategic competitors equipped with A2/AD systems, will render the recovery of isolated personnel in UEs much riskier.

Emerging disruptive technologies will likely increase the speed of warfare and proliferate cheap and available capabilities amplifying the threat to the ISOP and RFs, dramatically increasing the risks to the overall JPR mission. The 'transformation of personnel recovery is, therefore, essential…it cannot be a gradual evolution; it must be dynamic. PR needs to transform because warfare as we know it is transforming'.[1]

As the world urbanizes, avoiding urban conflict will become increasingly difficult. The immediate challenges for the JPR community in UEs are to provide a system capable of performing the Execution tasks – Report, Locate, Support, Recover, and Reintegrate – in highly compressed, congested, and complicated environments. Continual transformation must occur in totality across the entire JPR spectrum, including the Preparation, Planning, and Adaptation phases. Successful transformation translates into a thorough review of JPR doctrine, TTPs, and education and training standards for the three JPR elements (Commanders and Staff, RF, and ISOP), and the exploitation of emerging disruptive technologies and fielded into JPR capabilities.

6.2 Doctrine and TTPs

As stated in ***Personnel Recovery and the DOTMLPF changes needed for the twenty-first century***, 'the pace of warfare is at an ever-increasing tempo with new concepts and capabilities emerging quickly. Therefore, doctrine must evolve or at least keep pace with this speed of warfare, providing forces and commanders with the appropriate guidance'.[2] To shape future doctrine, it is necessary to question whether the current JPR construct suits a highly contested projected environment. Losses and isolation of friendly forces will likely occur at a higher rate than the ones experienced by the Alliance in past operations, while RFs will face increased risk. Increased losses in a denied environment may result in more ISOPs than the available dedicated or designated JPR forces are built for. New guidance must account for these challenges and stress the importance of modifying survival and evasion TTPs to include extended periods of isolation.

Commanders need to adapt tactics, techniques, and procedures to meet the operational demands of UEs. What was operationally efficient in rural settings may not be sufficient or feasible in metropolitan areas, where infrastructure, surface and subsurface terrain, and population density constantly change.

To support the overall JPR effort adequately, planners must identify the JPR capabilities needed for current and future UEs and request those capabilities from NATO members before they are needed. Member nations' commitment to supporting urban JPR is crucial, whether directly with dedicated resources, or indirectly by being ready to contribute with designated units when requested. The new JPR doctrine must also account for emerging technologies and capabilities and align with the MDO warfare concept.

The military option in highly contested UEs may not always be a viable solution to recover future ISOP, regardless of technological advancement and capabilities. Doctrine should include and improve diplomatic, civil and interagency, and Non-Governmental (NGO) options and their interconnections and build coordinating processes with the military instrument of power. Current doctrine and subordinate TTPs mainly focus on the military option, failing to provide JPR staff with sufficient operational tools and processes to include diplomatic and civil options. As the MCDC JPR 2040 Project states, 'at the very least, national and service policy and doctrine should be updated to cover operations with integrated diplomatic options and cooperation with NGOs, especially the different circumstances and perspectives they operate under'.[3]

The Planning phase should establish solid connections and networks with diplomatic and civil organizations, including them in the operational planning process. Once an isolation event occurs, cooperation with embassies, other GOs, and NGOs is significantly more effective if coordinated and arranged in advance. In this respect, Annex V (JPR) to the OPLAN should lay the foundations for the relationship between the NATO military, the member nation's diplomatic representatives, and the Host Nation equivalents, if involved. The JPR Annex should also define the related coordination needed to share information, synergize specific capabilities efficiently, and maximize JPR efforts. Moreover, depending on the circumstance, the responsibility to plan and execute ISOP recovery may switch from the military to the diplomatic or civil option. In this case, the military should be ready to assist non-military organizations in conducting recovery operations.[4]

Lastly, updated doctrine must highlight the importance of controlling the information environment

Virtual Battlefield Simulations (VBS), together with live training, improve overall military staffs' and forces' performance.

during a JPR event. While adversaries 'will exploit the connected, networked nature of modern cities with new tools and social at their disposal', including social media, to discredit friendly operations, the JPRC and PRCCs will need to closely collaborate with the Public Affairs Officer (PAO) and Strategic Communication teams to plan and coordinate a robust information activity in support of the PR event.[5]

6.3 Education and Training

A solid JPR system relies on well-educated and trained commanders and staff, RF, and all personnel at risk of isolation. The JPR community will face broader tactical and operational obstacles in future UEs. Commanders and staff must be prepared to respond to the rapidly changing, multidimensional situational awareness requirements that will dominate UEs. Insufficient personnel have the necessary skills and competencies to plan and conduct urban JPR operations effectively. Moreover, new education and training are needed to develop the mindset, knowledge, skills, and comprehension for the complexity of urban JPR. JPR, particularly in a UE, requires robust Preparation and Planning phases, which can only be achieved over time. Commanders need the required training and expertise to lead the mission and make appropriate and critical decisions, or a hard and uncomfortable lesson may be learned.

Moreover, JPRCs and PRCCs need to be filled with educated and trained personnel before the start of a new operation. JPR staff courses should include specific modules for urban JPR operations supporting all five tasks of the Execution phase of JPR. These modules must cover managing and coordinating civil and diplomatic options in addition to the military option. JPR staff must be prepared to handle long-term isolation events and, therefore, will need additional training for the Support task in future courses.

As UEs may preclude quick recovery of ISOP(s), all personnel at risk of isolation should be trained to survive and evade capture for longer periods than current training provides. New and more diverse training facilities are needed to support training of both RFs and potential

EDT can potentially revolutionize warfare and provide new opportunities to NATO.

ISOPs. Each city is a system of systems with unique characteristics, and the simple mock villages currently in use do not offer practical training opportunities for RFs or at-risk forces. A possible solution to bridge the current training deficit may be to combine virtual training, capable of replicating specific UEs, with live training in mock villages. As PR is a joint capability, virtual and live training in simulated UEs should be accessible to all military and civilian services involved in the JPR system.

The Alliance is increasingly investigating UO, and the JPR community must do the same to allow the development of effective education and training and reduce risks and probability of failure.

6.4 New Technologies

Innovative technological solutions may enhance accomplishing the JPR mission in a contested UE. New technology will benefit the search for, support, and recovery of an ISOP. Uncrewed vehicles may extend and improve ISR support to find, fix, and track ISOP and possibly provide supplies with precision. Additionally, future technology will allow complementing conventional PRTFs with large uncrewed recovery packages, specifically RESCORT and RV, which will be able to sustain attrition losses whilst performing successful recovery operations. Directed energy weapons and autonomous weapons systems could help minimize civilian casualties and reduce physical damage. Lastly, using autonomous vehicles, drones, and other robotic technologies may allow quicker and more efficient reactions, reducing the time it takes to recover personnel in distress.

Military operations in a UE are particularly dynamic, and the tactical situation on the ground can change rapidly. Information can quickly become obsolete and cause a loss of situational awareness, not only for the troops on the ground but also for staff at the operational centres. The impact of the new technology on the decision-making processes, where time is essential, could fundamentally change the speed of warfare.

AI applications could enhance decision-making at all levels by increasing the accuracy of data analysis, prioritizing real-time, actionable ISR information, thus offering the best solutions and most suitable COAs to the Commander. Moreover, new data networks and other advanced communication technologies could provide high-speed, low-observable communication between warfighters, vehicles, and command centres. This will enable better coordination and collaboration, allowing personnel on the ground to request assistance and quickly receive updates on the situation. Command centres, conversely, will be able to track the movements of rescue teams, improving the overall efficiency and speed of personnel recovery efforts. The JPR community should prepare itself to quickly adopt emerging disruptive technologies that are most advantageous to the entire JPR system.

As new and modern technologies are developed more regularly through or in conjunction with the commercial sector, COTS solutions will spread and become more available to the military. The JPR community must be ready to identify potential dual-use or COTS technologies that could quickly improve the JPR system. COTS systems have a variety of benefits over technology that are specific to military requirements. Initially developed for a non-military audience, such solutions can be more accessible on the open market and sometimes less expensive than customized solutions, allowing countries with limited resources to access modern technology.[6]

New technologies should not apply exclusively to niche assets or portions of the C4ISR system. Traditional RFs could still be an option in contested and urban environments, assuming they could be provided with tailored training for the UE and EDTs that enhance their survivability and SA, improving their chances of surviving the urban fight. Thoroughly reliable and integrated communications and navigation systems could provide continuous situational awareness and allow the employment of lethal and non-lethal weapon systems suitable for densely populated areas. Which could significantly lower overall risk to the JPR mission. Integrating emerging disruptive technologies into JPR operations could improve the speed and efficiency of the recovery process, aiding the safe return of ISOPs.

However, reliance on highly sophisticated or exquisite technologies raises two potential problems. The first is practical: Future contested environments will be characterized by degraded communications and military-specific systems are not immune to adversaries' cyber and electronic attacks. COTS technologies can be reliable, but they may also have vulnerabilities. If COTS or traditional military technologies fail or degrade, it can impede the planning and decision-making process or cause delays in executing the JPR mission, ultimately resulting in failure. Therefore, it is crucial to prioritize high-end technologies that are resistant and reliable. Additionally, having a backup system that is less sophisticated but trustworthy is essential to ensure mission success.

The second problem is ethical: the development and use of some EDTs raise practical, legal, and ethical questions that must be addressed, specifically related to the use of lethal force.[7] As an example, Neil C. Rowe evaluates AI as an EDT and suggests, 'A key worry with AI software is whether it can be trusted to think and act substantially as humans do, on the assumption that humans are generally more ethical than machines since humans have higher-level goals'.[8] Moreover, he adds that 'sub-issues are whether AI systems can know everything that humans do to make decisions and whether they will reason similarly to humans with the same information.'[9]

There is no doubt that EDTs will be important in future operations – including JPR – and revolutionize modern warfare by enhancing decision-making processes and increasing operational efficiency. Yet, it is also essential for the Alliance to employ these technologies without adding further risks to own forces and civilians, thus deteriorating the overall military situation and risking political and public support.

6.5 Multi-Domain Operations

A JPR capability in NATO will always be a pre-requisite in operations, as isolation events may lead to a loss of strategic and operational momentum with impacts to

political decision-making. At the same time, the complexity of UEs will represent a significant factor in all future NATO operations, and should be carefully considered by all operational planners, although the UE brings even greater challenges to JPR than conventional operations. The proliferation of new A2/AD technologies could enable future adversaries to deny access and freedom of movement to NATO forces, increasing the risk of unacceptable losses. These aspects, paired with the asymmetrical threat of cheap off-the-shelf technologies complicate military efforts. Planning and the conduct of operations, require more options and capabilities to enhance effectiveness while reducing exposure to risks.

JPR, inherently a reactive and complex mission, requires a robust system to overcome existing and emerging challenges. RFs, adversaries, and ISOPs will operate in a dynamic three-dimensional battle space: above, on, or below the surface of the urban environment. Information superiority and a holistic approach to planning the recovery of ISOP in a battlespace where operational factors and diverse actors interact in a complex and contested area will be critical enablers.

Historically, operations have been planned and executed in a single domain or by a single service. In the future, multiple domains and services will be necessary to create the required tactical superiority through synergy, integration, and interoperability. Commanders will achieve success by rapidly integrating and synchronizing air, land, maritime, cyber, and space efforts. Mission accomplishment will require advanced information systems and the employment of a new generation of conventional and non-conventional capabilities across all domains and dimensions. The new JPR doctrine should consider all domains coordinating and synchronizing with other governmental and non-governmental agencies. MDO, which integrates and synchronizes capabilities across air, land, sea, space, and cyberspace domains, can better support JPR in several ways.

First, fusing sensors and communication systems across multiple domains will enable a more accurate and timelier common operating picture, allowing for better decision-making. Enhanced situational awareness and info sharing will enhance JPR mobility and access into UEs, resulting in better access to personnel needing recovery. Second, a multi-domain approach could provide greater flexibility in employing military forces coupled with civilian resources to respond to different JPR scenarios. Third, by incorporating non-lethal capabilities such as electronic warfare and cyber operations, JPR efforts could be conducted more precisely, reducing the likelihood of collateral damage. Ultimately, MDO could provide a more comprehensive and integrated approach to JPR in UEs, leading to faster and more effective personnel recovery.

In conclusion, by adapting JPR to the new requirements of growing UEs, the international JPR community will improve its ability to successfully rescue ISOP from UEs, allowing personnel to return honourably and safely despite UEs' demanding challenges. These requirements encompass the necessity to approach the challenges of highly contested environments with a holistic multi-domain mindset. The military option will rely on emerging technologies, adaptive doctrine, and cooperation with the other instruments of power.

Future operations in UEs requires the Alliance and Nations to quickly adapt doctrine, organization, training, materiel, and facilities to enable for effective responses to emerging challenges. This process 'will be neither easy nor cheap nor quick. But given that urban combat somewhere is a near certainty, it must be done'.[10]

This is particularly true for Joint Personnel Recovery.

.....THAT OTHERS MAY LIVE.....

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Annex A

Acronyms and Abbreviations

AAA	Anti Air Artillery
ACO	Allied Command Operations
AD	Additive Manufacturing
AI	Artificial Intelligence
AOO	Area Of Operations
AP	Action Plan
AR	Augmented Reality
AS	Autonomous Systems
A2/AD	Anti-Access Area Denial
BDA	Battle Damage Assessment
BDAA	Big Data and Advanced Analytics
CAC	Conduct After Capture
CAOC	Combined Air Operations Centre
CASEVAC	Casualty Evacuation
CBRN	Chemical, Biological, Radiological, Nuclear
CC	Component Command
CD	Collateral Damage
CD&E	Concept Development and Evaluation
CGF	Computer Generated Forces
CID	Combat Identification
COA	Course of Action
CoI	Community of Interest
COTS	Commercial Off the Shelf
CPX	Command Post Exercise
CR	Combat Recovery
CSAR	Combat Search and Rescue
C2	Command and Control
C3	Command, Control and Communications
C3I	Command, Control, Communications and Intelligence
C4	Command, Control, Communications and Computers
DIS	Distributed Interactive Simulation
ECM	Electronic Countermeasures
EDA	European Defence Agency
EDT	Emerging Disruptive Technologies
EF	Extraction Forces
EM	Electromagnetic
EPA	Evasion Plan of Action
EPRC	European Personnel Recovery Centre
ETEE	Education, Training, Exercise, Evaluation

EU	European Union
EVS	Embedded Virtual Simulation
eVTOL	Electric Vertical Take-Off and Landing
EW	Electronic Warfare
FOC	Full Operational Capability
FOE	Future Operational Environments
GO	Governmental Organizations
HFM	Human Factor and Medicine
HLA	High Level Architecture
HLZ	Helicopter Landing Zone
HMS	HumanMachine Symbiosis
HN	Host Nation
HPRF	High Power Radio Frequency
HRO	Hostage Release Operation
ICRC	International Committee of the Red Cross
IED	Improvised Explosive Device
IHL	International Humanitarian Law
IO	International Organizations
IOC	Initial Operational Capability
IoP	Instruments of Power
IoT	Internet of Things
IR	Infra-Red
ISOP	Isolated Personnel
ISR	Intelligence, Surveillance and Reconnaissance
ITS	Intelligent Tutoring Systems
JOA	Joint Operations Area
JAOS	Joint Air Operations School
JFC	Joint Force Commander
JPR	Joint Personnel Recovery
JPRA	Joint Personnel Recovery Agency
JPRC	Joint Personnel Recovery Centre
LOS	Line of Sight
LVC	Live Virtual and Constructive
LZ	Landing Zone
MANPADS	Man-Portable Air Defence System
MC	Military Committee
MCDC	Multinational Capability Development Campaign
MDO	Multi-Domain Operations
MDC2	Multi-Domain Command and Control
MDMP	Military Decision-Making Process
MEDEVAC	Medical Evacuation
MIoP	Military Instrument of Power
ML	Machine Learning
M&S	Modelling and Simulation
NAR	Non-conventional Assisted Recovery
NCS	NATO Command Structure

NGO	Non-Governmental Organizations
NVD	Night Vision Device
OODA	Observe, Orient, Decide, Act
OGD	Open Government Data
OSC	On-Scene Commander
PAO	Public Affair Officer
PDSS	Personnel Designated Special Status
PE	Peacetime Establishment
PIERIE	Personnel Identified at an elevated risk of isolation and exploitation
PLWF	Protection, Location, Water, Food
PMESII	Political, Military, Economic, Social, Information and Infrastructure
PRCC	Personnel Recovery Coordination Cell
PRTF	Personnel Recovery Task Force
PZ	Pick-up zone
RAS	Robotic Autonomous System
RASEVAC	Remotely Assisted Medical Evacuation
RESCAP	Rescue Combat Air Patrol
RESCORT	Rescue Escort
RF	Recovery Forces
RJPRF	Ready Joint Personnel Recovery Force
RMC	Rescue Mission Commander
ROE	Rules Of Engagement
RPG	Rocket Propelled Grenade
RTG	Research Task Group
RV	Recovery Vehicle
SA	Situational Awareness
SACEUR	Supreme Allied Command Europe
SACT	Supreme Allied Command Transformation
SAM	Surface-to-Air Missile
SAR	Search And Rescue
SC	Strategic Command
SERE	Survival, Evasion, Resistance, Extraction
SHAPE	Supreme Headquarters Allied Power Europe
SMARMS	Small Arms
SoR	Speed of Relevance
S&T	Science and Technologies
ST	Space Technologies
STO	Science and Technology Organization
TMS	Training, Modelling and Simulation
TPRMS	Tactical Personnel Recovery Mission Simulator
UxS	Uncrewed system
VR	Virtual Reality

Annex B

Terms and Definitions

Combat Recovery (CR). A method to recover isolated personnel from a situation where hostile interference may be expected, and either the recovery force, or the isolated personnel, or both, have not been trained in combat search and rescue.

Combat Search And Rescue (CSAR). The detection, location, identification, and rescue of downed aircrew in hostile territory in time of crisis or war and, when appropriate, isolated military personnel in distress, who are trained and equipped to receive combat search and rescue support.

Dedicated Assets. Dedicated assets are those assets of which the sole purpose is to satisfy the PR requirements.

Designated Assets. Designated assets are those multi-mission assets which are only momentarily assigned to fulfil PR duties.

Evasion Plan of Action (EPA). A course of action, developed prior to executing a combat mission, that is intended to improve a potentially isolated person's chances of successful evasion and recovery by providing the recovery forces with an additional source of information that can increase the predictability of the evader's action and movement.

Extraction Forces (EF). Designated NATO or coalition forces who should be PR trained and are tasked to contact, authenticate, support, move and extract ISOP.

Isolated Personnel (ISOP). Military or civilian personnel who are separated from their unit or organization resulting in a loss of positive and/or procedural control, that may require them to survive, evade, resist exploitation, and either have to make their way back to friendly control or require assistance to do so.

Joint Personnel Recovery Centre (JPRC). The JFC has overall responsibility for PR in the JOA. He exercises his PR responsibility through the JPRC, staffed by appropriately PR trained personnel, embedded in the joint staff (usually in the joint operation centre).

Non-conventional Assisted Recovery (NAR). A recovery method used to deal with situations that may need the assistance of non-conventional forces or other types of assistance when conventional means are not suitable.

Reintegration. The operational process of providing medical and psychological care to personnel recovered from isolation and debriefing them for intelligence and lessons learned purposes.

Personnel Recovery (PR). The sum of military, diplomatic and civil efforts to affect the recovery and reintegration of isolated personnel.

Personnel Recovery Coordination Cell (PRCC). Component commanders plan, coordinate, conduct and control PR operations in assigned areas of operations. The component commander exercises his PR responsibility through the PRCC, staffed by appropriately PR trained personnel, embedded in the staff. If designated by the JFC, one of the component commanders may have to establish a JPRC on his behalf.

Personnel Recovery Task Force (PRTF). All forces tasked to a specific PR operation to locate, identify, support, and recover isolated personnel.

Rescue Escort (RESCORT). Armed aircraft or vehicles capable of effectively supporting and protecting recovery forces.

Rescue Combat Air Patrol (RESCAP). An aircraft patrol provided over that portion of an objective area in which recovery operations are being conducted for the purpose of maintaining air superiority as necessarily during the PR event.

Rescue Mission Commander (RMC). The RMC is appointed by the appropriate level commander, through JPRC/PRCC, and is responsible for the tactical planning and execution of the PR mission.

Survival, Evasion, Resistance, and Extraction (SERE). A set of tactics, techniques, and procedures that is intended to give isolated personnel the skills to survive in any environment and to evade capture. Failing that, to resist exploitation by captors and, if the situation permits, escape captivity to finally support their own or assisted recovery and return with dignity.

Unconventional Assisted Recovery (UAR). A recovery method conducted to search for, locate, identify, rescue, and return personnel, sensitive equipment, or items critical to alliance security from contested or adversary-controlled areas. Special operations recovery missions are characterized by detailed planning, rehearsal, and thorough intelligence analysis. These operations employ unconventional tactics and techniques, discreet search, and the frequent use of ground combat elements.

About the Authors

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Commander Andrea Magi joined the Italian Navy in 1990. After serving on board frigates and on the ITS Garibaldi as the Electronic Warfare Officer, he was assigned to the Gruppo Aerei Imbarcati, the Italian Navy Harrier AV8B+ Squadron, as an Intelligence Officer and served on board Italian Navy aircraft carriers. In 2014, Commander Magi was appointed Fleet Air Arm Intelligence Branch Chief. He participated in operations in the Balkans, Middle East, Libya, and Afghanistan. He was also appointed to the Coalition Intelligence Fusion Cell in CAOC Al Udeid during Operation Inherent Resolve. In September 2017, he was posted at the European Personnel Recovery Centre, in Poggio Renatico (Italy) as an Education Staff Officer and JPR Instructor. Commander Magi is currently assigned at the Joint Air Power Competence Centre, Combat Air Branch, Maritime Air Operations, including Carrier Operations (RW).

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Lieutenant Colonel Javier Aguilar Gonzalez joined the Air Force in 1999. After graduating from the Air Force Academy in 2004, he was assigned to the 48th Wing, 803 PR Squadron. He completed six tours in Afghanistan during ISAF as a MEDEVAC pilot. After three years in the Spanish Helicopters' School, 78th Wing – Armilla, Granada, he was posted again at the 48th Wing and appointed Commander of the 803rd Squadron. After attending the Spanish Staff Officer School, Lieutenant Colonel Aguilar was assigned to the Air Plans & Policy Division in the Air Staff and eventually was posted at the European Personnel Recovery Centre (EPRC) as the Education Manager. He currently serves in the Spanish Air Staff as Chief of the Digital Transformation Section.

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Major Brian 'NIL' Nielsen joined the Danish Armed Forces in 1988 in the Army, transferring to the Royal Danish Air Force in 1992 to fly F-16 and later within the AIR C2 system. In 2001, he transferred to the Royal Netherlands Air Force to become an instructor pilot. First NATO tour in 2004 in a Combined Air Operations Centre, working in A5 PLANS and A7 E&T simultaneously. Afghanistan Veteran with three tours: 2007 ALO RC(S), 2008 NLD F-16 LNO ISAF HQ, and 2010 Air Planner RAOCC RC(S). Became a C-130H pilot in 2010, and in 2016 the ALO of the 11th Air Mobile Brigade. Working with SOF since 2008, designing and participating in the C-SOATG SOFEVAL. Presently the JPR/CSAR Staff Officer of CAOC UE and designated Dep PRCC Director of the NCS JFAC.

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