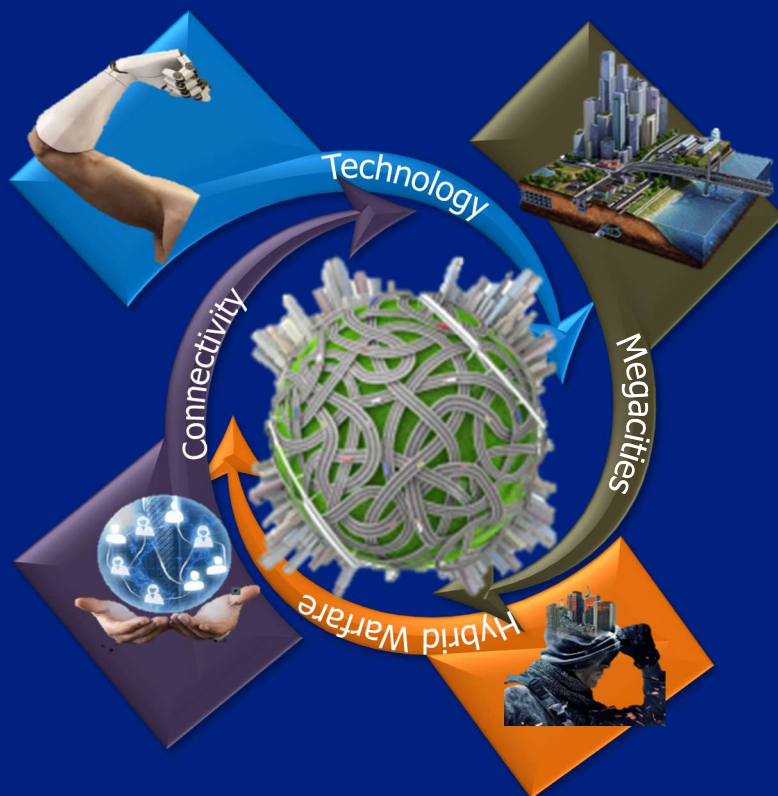




# ESERCITO



## ***FUTURE OPERATING ENVIRONMENT post 2035 – IMPLICATIONS FOR LAND FORCES***



Italian Army Headquarters  
General Plans Department  
Plans Office

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# CONTENTS

INTRODUCTION.....	1
AIM.....	2
OBJECTIVE.....	2
METHOD .....	2
CHALLENGES AND THE STRATEGIC ADVANTAGE.....	3
1. THE STRATEGIC CONTEXT .....	4
1.1. STRATEGIC FUTURE TRENDS AND FUTURE OPERATING ENVIRONMET.....	5
1.1.1 Introduction.....	5
1.1.2 Future Scenarios .....	6
1.1.3 The centrality of the human factor.....	8
1.2. Threats and actors .....	9
1.3. Warfare: Past, Present and future .....	11
2. CHARACTERISTICS OF THE FUTURE OPERATING ENVIRONMENT .....	13
2.1. Disruptive technology and a new character of warfare.....	13
2.2. Convergence, technology and the game changer .....	14
2.2.1 Potential game changer pre 2035.....	15
2.2.2 Potential game changer post 2035 .....	16
2.3. Degradation of the Megacities.....	17
2.4. The subterrean frontier.....	18
2.5. The Space dimension.....	19
2.6. Multi-domain Operation and the Urbanised Environment of the Future .....	19
2.7. Humanisation vs alternative international competition scenarios: the littoral and the Arctic.....	23
3. MILITARY IMPLICATIONS AND DEDUCTIONS FOR LAND FORCES.....	23
3.1. PREPARE .....	24
3.2. PROJECT .....	26
3.3. ENGAGE .....	28
3.4. PROTECT.....	31
3.5. SUSTAIN.....	33
3.6. INFORM.....	35
3.7. CONSULT, COMMAND AND CONTROL .....	37
4. CONCLUSIONS.....	39
5. TRENDS.....	41
PRINCIPAL REFERENCES.....	47



## INTRODUCTION

The divergence between the speed with which the threat changes form and identity and the slow adaption with which the Army modernises its capabilities, clearly highlights the difficulty faced during the process of transformation of land forces.

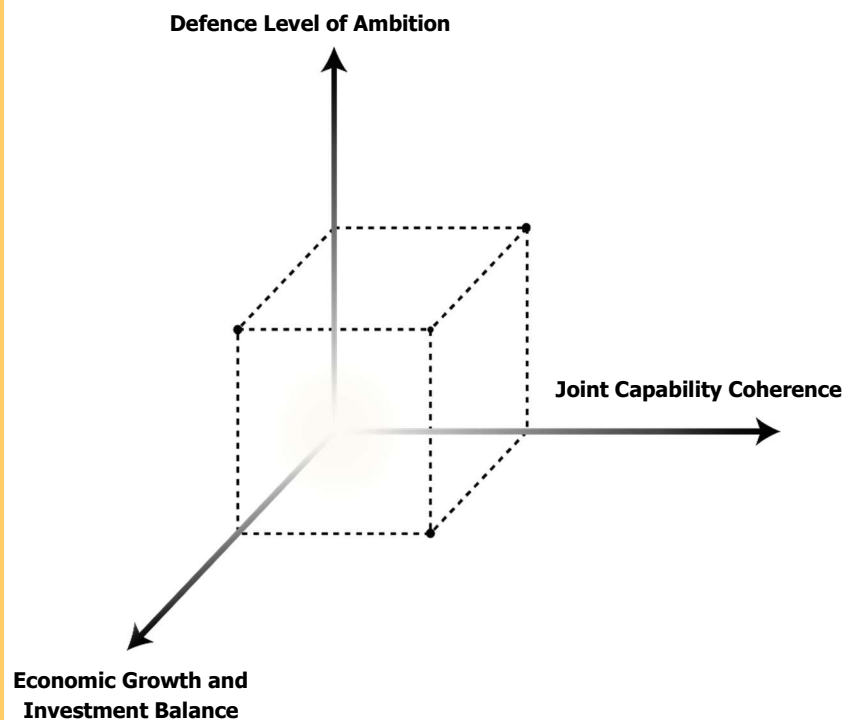
A continuous process of modernisation is required in order to meet the operational challenges faced by the Army. This situation is exacerbated by the extreme pace of technological development and the ever changing global strategic environment.

The Army therefore must effectively employ organisational processes able to anticipate as far as possible future needs and offer effective solutions able to raise awareness at the strategic level of the need to implement an adequate transformation process. The Army's urgent transformational requirement can be graphically demonstrated using the model in fig 1. The model combines national economic growth (Y axis), the level of integration of the Army with the other armed forces (Z Axis) and the level of defence ambition (X Axis). When regular in shape the model shows a system in a state of equilibrium, however when it is irregular it highlights critical areas.

### Model of reference

If we assume that we know the missions and the funding available to the Army (defined by special legal arrangements), the transformational need of the land component can be represented in a three dimensional model whose Cartesian axes indicate:

1. The level of defence ambition;
2. The National economic growth;
3. The level of capability integration with the other components (joint nature). The regularity of the shape that is created between the axes is dependant upon the state of equilibrium between the factors. A regular polyhedron indicates a process of transformation that adheres to changing scenarios and technology. Conversely, an irregular shape indicates a requirement to reassess the process of transformation to find a position of equilibrium.



**FIGURE 1 - IMPETUS FOR INNOVATION MODEL.**

## **AIM**

The current study aims to guide the long term process of transformation of land forces. It will be the principal conceptual reference for:

- directing future adaptation studies through the production of functional concepts that will shape the future Army;
- hypothesizing what the possible future requirements will be in order to support the operational activity of the Army in the near future (post 2035),

the aim of the whole document is to outline the future capability developments that will be required by the Italian Army, often within a NATO context.

## **OBJECTIVE**

This document forms part of the conceptual work conducted by the Army with the objective of defining and identifying the principal actors and the nature of the future environment in which land forces may be called upon to operate. The objective of this document is therefore to describe hypothetical scenarios and the main challenges which the Army will confront. The aim will be to find possible solutions that will be able to drive the process of capability development in support of Defence.

The document introduces a wide range of theses and their implications which the commanders of the future will have to confront in order to better manage what will become known as the “new challenges for the commander of land forces”.

## **METHOD**

This document will use elements already identified within NATO’s “Global strategic trends analysis” document and within “Strategic Foresight Analysis” while also introducing elements of the farsight approach in the complex environment with particular reference to the planning scenario.

This study (that also takes into consideration the wayfinding methodology that forms part of the farsight approach) considers not only the principal tasks assigned to the Army but also the evolution of strategic trends (geopolitics, demographics, technology, economics and the environment). It hopes to outline the future areas in which the Army will have to maintain a substantial advantage.

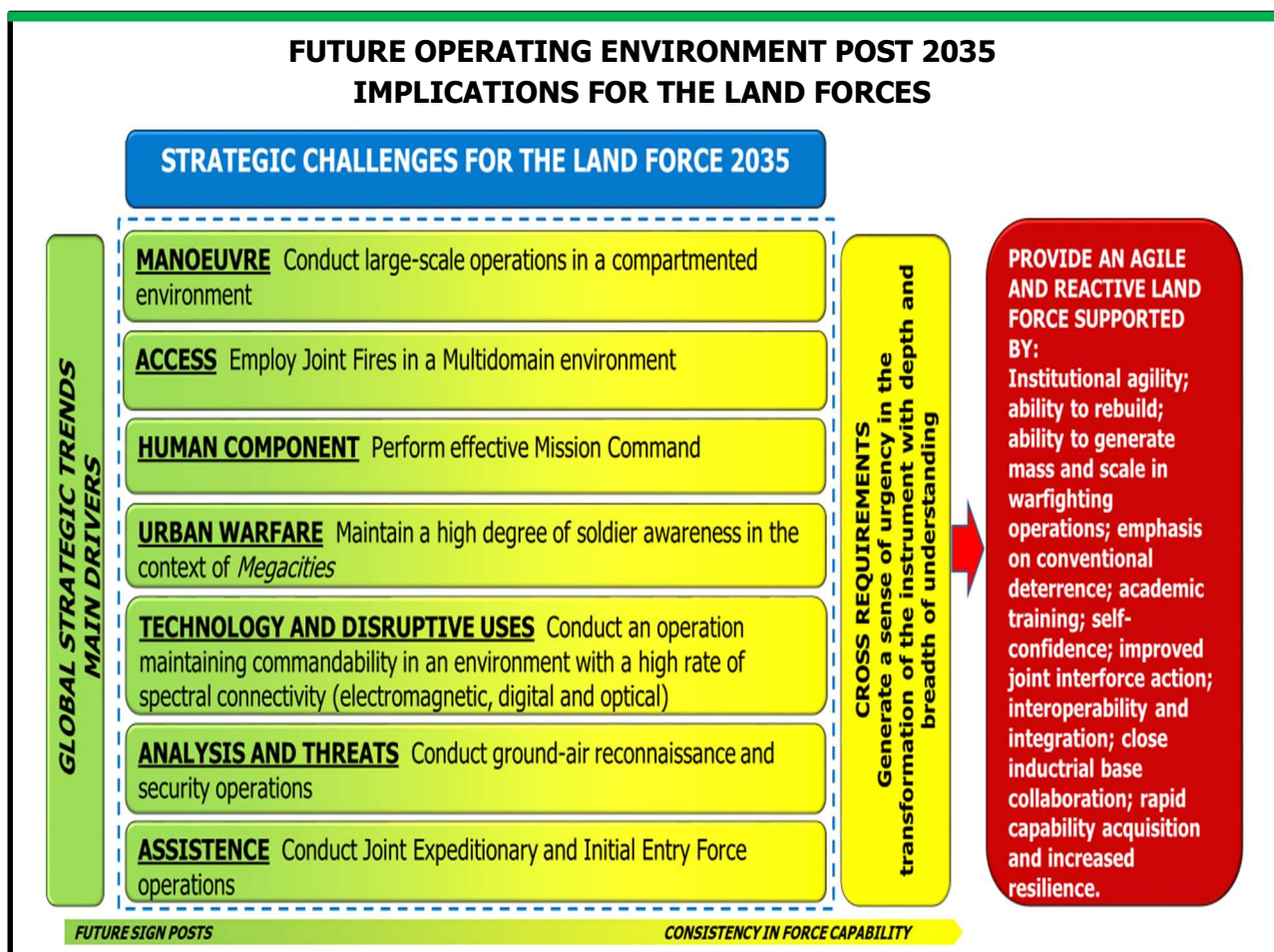
## THE CHALLENGES AND THE STRATEGIC ADVANTAGE

While considering the objective with the aid of the previously mentioned methodology, it is essential to remember the areas in which the commander of land forces must remain competitive, namely: Manoeuvre, Access, Human Component, Urban Warfare, Technology, Analysis and Threat, Assistance.

These areas represent the true challenges that the Commander will have to tackle if he is to:

- conduct large scale operations in a compartmentalised environment;
- employ joint fires in a multi-domain environment;
- employ effective mission command;
- maintain a high level of awareness when operating within megacities;
- conduct operations whilst maintaining effective command and control in an environment with a high rate of connectivity;
- conduct ground-air reconnaissance and security operations;
- conduct joint expeditionary and initial entry force operations.

Generally speaking, advanced technology and effective interoperability with the other components of defence will be fundamental for the success of land operations. Such ambitions will need to have the strong support of strategic decision makers.



**FIGURE 2 - COMMANDER'S CHALLENGES.**



## 1. THE STRATEGIC CONTEXT



**FIGURE 3** - ARIETE TANK DURING AN EXERCISE.

The strategic picture has never been so uncertain and continuously evolving, it is influenced by many dynamics including those of a politico-social, demographic, environmental, economic and technological nature. There are threats that have the potential to impact upon the global strategic equilibrium in the coming years.

The military must confront an emerging challenge that, in terms of its size and nature, is without precedence. This is true both for the new forms of hybrid warfare which are unpredictable and changeable and the need to equip the Army with a streamline decision making model that facilitates timely decision making.

Within this new strategic context the transformation of land forces will have to consider not only the capabilities of current and future platforms but also the other elements that play a decisive role in the transformation process:

- the future operating environment;
- the balancing of capabilities within land forces;
- the availability of funds to make acquisitions as part of the transformation process (in light of the global economic crisis).



## 1.1. FUTURE STRATEGIC TRENDS AND OPERATING ENVIRONMENT

### 1.1.1 Introduction

The principal allied publications used to assist the drafting of this document highlight the following situations of instability that are likely to characterise the future:

- competition for access to the global commons;
- the possibility of the opening of an eastern flank;
- the impact of disruptive technology;
- increased cyber threat;
- widespread natural disasters;
- a demographic explosion in megacities;
- the emergence of conflict between non state actors;
- the ability to dominate space;
- the threat of interstate conflict;
- the use of weapons of mass destruction.

From this complexity NATO has derived the 5 prospective military strategies that underline the characteristics that will define a modern military force; such a force will have to be: credible, agile, aware, networked, resilient. These characteristics are not only important within NATO but are equally essential at a national level.

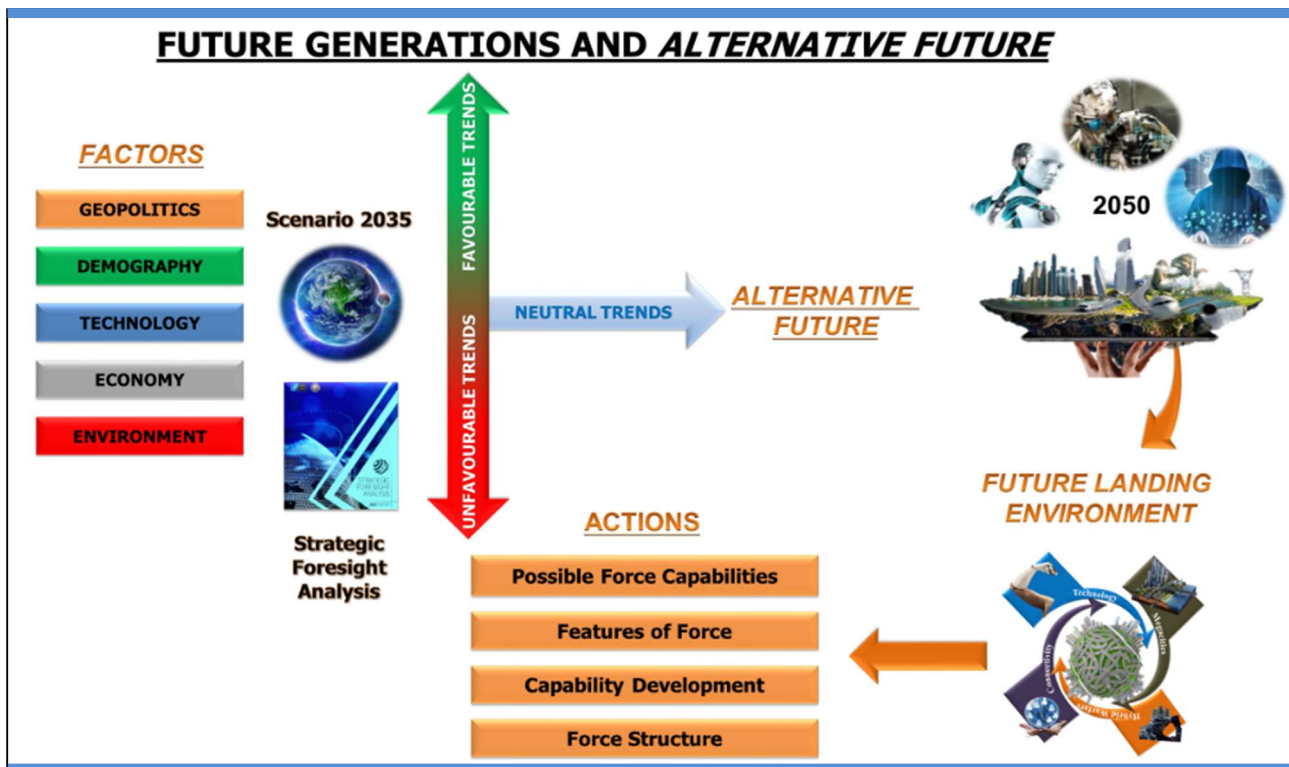


**FIGURE 4 - STRATEGIC VISION OF NATO.**

### 1.1.2 Future Scenarios

There is consensus among global analysts who all agree that the following factors are those that contribute most to the creation of instability: geopolitics, demographics, economics, technology and the environment.

The document considers these factors fundamental in outlining the development of future scenarios. It also aims to introduce further trends which, within the limits of plausibility, will help describe a wider range of hypothetical scenarios (Alternative Future).



**FIGURE 5** - FUTURE GENERATIONS AND ALTERNATIVE FUTURE.



## GEOPOLITICS

Geopolitics concerns the structures that have evolved within the international system and pays particular attention to the dynamics and the distribution of power. Traditionally, in the field of International Relations, Realism is the school of thought that is closely aligned to strategic-military needs. It deals with how the international order evolved and considers the threats that contribute to unbalance the international order. As far as Italy is concerned and therefore the European community, geopolitical analysis is particularly focused on the crisis of sovereignty of the nation state. A high level of conflict is deemed possible between transnational, non-state and sub-national actors. The link with the United States is widely considered essential not only for the strategic-military survival of Italy but also for the entire alliance. Two possibly key actors have emerged on the recent international stage: on the

one hand the People Republic of China, that has a rapidly growing economy and a reinvigorated military, and on the other hand, Russia with its consolidated western flank has renewed its interest in the Mediterranean area.

## **DEMOGRAPHICS**

In contrast with geopolitics, demographics allows us to make predictions for the next 25 years with a high degree of accuracy. Precise mathematical models allow us to estimate in a very detailed manner the global demographic changes of the coming years. This analysis shows us that there will be a net growth in the population in underdeveloped areas. Data relating to regional demographic trends tend to be harder to interpret, especially in light of the development of megacities where there is the possibility of large influxes of migrants set against the traditional difficulty a population has adapting to life outside of its cultural base.

## **ECONOMICS**

The global economy at the start of the 21<sup>st</sup> century is a complex mechanism, in essence the antithesis of what occurred in the previous centuries. Reactivity of demand, evolution of consumption, conflicting interests between public institutions and private business have overturned the previous operating mechanisms of this sector, creating wild speculation in all segments of the market.

The principles of maximum profit and massive exploitation of resources have created an economic world that is able to decisively impact upon the political-social equilibrium. The adoption of mechanisms of control applied by global leadership, will lead robust economies such as those of the US and Europe to suffer periodic crises and sustainable fluctuations, however it will cause emerging economies to suffer due to the negative perception of financial investors and the volatility of the market. This will result in a perennial failure of these economies to flourish.

## **TECHNOLOGY**

In a similar fashion to the events at the start of the 20<sup>th</sup> century where technological developments contributed towards to the revolution of modernity, the 21<sup>st</sup> century is characterised by the close dependence of globalisation upon the process of digitalisation begun in the 90's.

The need to be permanently connected, the availability of systems able to enhance and facilitate communication and the possibility of analysing large quantities of data in a short time frame will allow the development of more and more extreme technology that will act upon the cognitive and moral aspect of the human component. Progress in the field of



biomechanics and robotics with artificial intelligence will lead to greater automation of civilian services and will involve integrating the human component with robotics.



## THE ENVIRONMENT

Climate change, pollution in all of its forms, increasing food requirements of the population, technological developments linked to the improvement and enhancement of human welfare have all generated and will continue to generate a series of environmental changes that will have serious repercussions for life on our planet. This process will trigger not only catastrophic climate change with far-reaching consequences but will also destroy any hope of the regeneration of natural resources.

Desertification of entire regions, the reduction of water sources, pollution of vast areas of land and the extinction of species are probable consequences that are likely to have serious second order effects. These will include decreased energy production, a decrease in agricultural production and generally unprecedented climatic upheavals. These events will have direct repercussions on social systems which have already been placed under strain by economic factors. The demographics of politics, already precarious, will continue to change and allow malevolent actors to exploit the problems faced by society. The exploitation of natural resources is destined to increase, especially in the countries which will be hardest hit by the changing conditions.

### 1.1.3. The centrality of the human factor

The previous analysis could facilitate a logical argument that there is an unequivocal link between an increase in technology and the reduction of the human dimension. This reasoning is not reflected in current military thought which envisages the essential role of humans within the military process enduring.

The employment of new technologies will not be able to replace the human component of the soldier and the



**FIGURE 6 - LAUNCH OF THE SPIKE MISSILE.**

commander. These figures will become increasingly central in the management of military activity which will require a constant and progressive growth in intellectual capacity that will be the essential element of control over the technological and autonomous components. Underestimating and undervaluing the correct and effective employment of the human element

in favour of a reliance on technology could impact upon the planning and conduct of operations, resulting in:

- reduced contact with the civilian population and a corresponding decrease in situational awareness on the battlefield;
- possible ethical dilemmas involving replacing men with machines to conduct primary tactical tasks;
- difficulty in prioritising requirements in a non-conventional structure.

In conclusion, as effective as advanced technology can be, the principle of ensuring a man in the loop remains. The commander in the post 2035 operating environment will continue to be placed at the centre of military operations and will provide the qualitative advantage.

## **1.2. THREATS AND ACTORS**

Future operations will be characterised by the indeterminate nature of the threats. Adversaries will be able to adapt and modify their posture and their tactics in order to deny access to the operational theatre in all domains, counter superior technology and threaten the international community and local population.

Modern conflicts develop simultaneously in different domains which are all interconnected with effects on the cognitive, moral and physical dimensions through the combined use of military action, diplomacy, economic and political measures as well as other non-military measures.

The operational environment will likely be characterised by a series of threats and risks which will be of different types, size, capacity and origin but with increasing frequency they will be able to be integrated into networks that will multiply their effectiveness and efficiency. The threats and dangers that land forces will face will vary over time. These will range from well organised technologically advanced regular military forces to insurgent forces that wish to overthrow a legitimate government through a combination of violence and subversion.

The growing cyber threat will become increasingly important as it becomes the arena in which various competitors search for space to manoeuvre. This category of threat can be defined as the group of actions aimed at compromising the integrity of data, information systems and critical information structures with particular reference to command and control systems and communications of joint and multinational organisations.



**FIGURE 7 - SOLDIER FROM THE 185° RGT..**

The area of operations will likely be characterised by:

- difficulty identifying and monitoring a variable threat that is in many ways invisible;
- conduct of hostile activity of a predominantly asymmetric/hybrid nature;
- persistent instability that requires operational forces to be adaptable, who must maintain an excellent joint comprehensive operational picture through intense intelligence activity.

In light of that discussed previously, we can define at least three types of potential adversaries:

- nations: as improbable as it may be, it remains possible that Italy may be involved in a clash with other states in the sphere of coalition or alliance operations;
- hostile factions inside of a state: due to the recent proliferation of intra-state conflicts, national military units could be faced by factions hostile to a legitimate government who aim to destabilise a region and oppose the will of the international community;
- transnational non-state subjects: the land component will be called to counter transnational individuals and groups of terrorists and criminals whose level of ambition and capability will grow over time.

Land forces will therefore have to confront any combination of threats (symmetric, asymmetric and hybrid) across the whole spectrum of conflict. In addition, they must be able to confront the other dangers that they may also face within their future operating areas such as widespread disease, natural disasters, industrial pollution and humanitarian disasters caused by drought and famine. Organised crime and insurrection will also continue to impact upon operations in the future.

In the worst case scenario forces may have to face an “insider threat” from within friendly forces while simultaneously facing military action by regular forces of a state that oppose intervention in the area of crisis.

Similarly, within Italy, land forces must have the capacity to manage emergencies arising from serious national disaster such as earthquakes, volcanoes and floods. The Army must retain the capacity to confront xenophobic movements whose racial and religious intolerance leads to violent protests and demonstrations.

### 1.3. WARFARE PAST, PRESENT AND FUTURE



**FIGURE 8 -**  
HYSTORICAL ITALIAN SOLDIER.

Due to factors such as economic systems, technological development, urbanisation and migration, warfare in the land domain has gradually evolved. In the wars of the “short century” (1914 -1991) the physical component (expressed as mass) was the metric against which opposing forces measured themselves through the ability of the commander to employ military strategy. In the post war era other factors began to influence warfare such as the ethical and moral considerations and the rewriting of the power narrative, resulting in a necessity to also consider the cognitive and moral components, such as:

- the perception of human life;
- the control of fundamental needs;
- public opinion;
- the indeterminate nature of the opposing threat and the impossibility of defining the limits of a possible enemy.

These factors assume that new commanders will have to combine diplomatic, psychological, sociological and ethical qualities on the battlefield. A relentless process of evolution can be observed, starting in the trenches of the First World War, then progressing to the use of nuclear weapons in the Second World War and the politics of deterrence that characterise the following Cold War era. Eventually we arrive at a point where social media is employed to influence military operations. Warfare

evolved so quickly that it required an unprecedented effort to adapt both structures and capability. The following historical examples can be used to demonstrate the process of evolution:

- Operation Bagration (1944), this is the last employment of the concept of mass as a factor of success in modern warfare;
- Golan (1973), the concept of mass was replaced by the employment of highly trained and motivated units in order to achieve success;
- The Falklands campaign (1982), the use of a deterrent force through the employment of specialised units put an early end to hostilities through its impact within the moral domain.
- Battle of Debaltseve (2015) a recent example of the focused use of strategic communications to prevented futile bloodshed by directly influencing public opinion.

It is likely that in the scenarios of the future there will be innovation in the combat capability of soldiers. It is imaginable that alongside the challenges faced by the land commander that have previously been outlined, future conflicts will be fought in the following areas:

- in futuristic megacities due to the extreme concentration of the population;



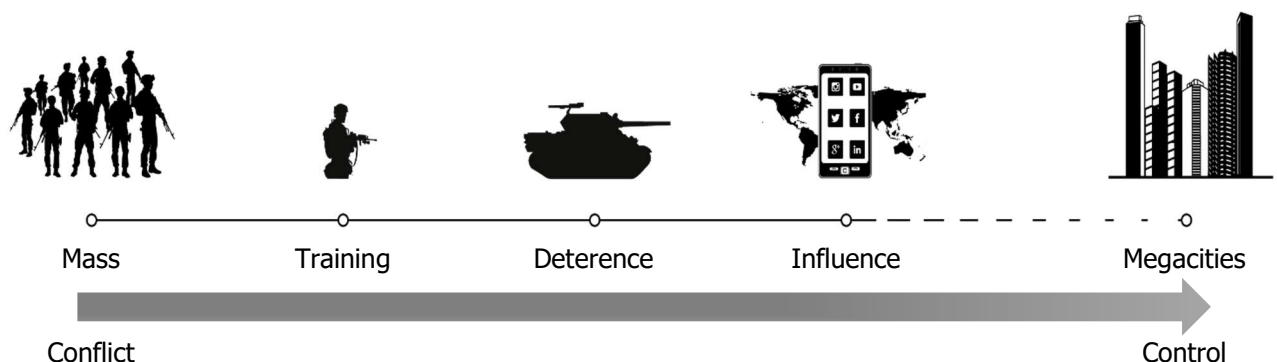
- in littoral coastal areas due to the fact that control of this area is essential for maritime logistical activity;
- in zones that are contested primarily for resources and energy reserves.

Within such a framework the future commander will have to possess:

- an increased situational awareness so as to be able to manoeuvre in the urban multi-domain environment. This will be facilitated by equipment with a very high level of connectivity that will allow the maintenance of an up to date common operational picture;
- combat units modelled on combined arms principles that can operate in an autonomous manner within degraded environments with an more rapid decision making process;
- logistic support (possibly autonomous) that can resupply frontline combat units exploiting the space made available in an urban environment including coastal, riverine and not least underground areas;
- effective strategic communication. Considering the pervasive spread of human activity throughout the environment, in order to gain the consent of the population a commander will have to adopt a more manoeuvrist approach to operations, engaging the cognitive aspect of his adversary and not solely the physical component;
- the capacity to employ the full range of defence capabilities in an integrated manner, treating the land domain as a chess board on which to realise and synchronise the main effects he wishes to achieve on the battlefield;
- the ability to exert control in the non-physical domains (cyber, electromagnetic, spectra) as important advantages over the enemy.



**FIGURE 9 - FUTURE ITALIAN SOLDIER.**



**FIGURE 10 - EVOLUTION OF WARFARE.**

## 2. CHARACTERISTICS OF THE FUTURE OPERATING ENVIRONMENT

Previous analysis suggests that the operating environment post 2035 will be defined by two distinct elements. The first is a progressive globalisation and the second is a continuous fragmentation of identity. The occurrence of events such as the shift of global power, an increased influence and level of pervasiveness of technology, the centrality of information networks, natural disasters linked to the climate, regionalism and separatism and progressively decreasing defence spending, outlines the element of an era characterised by growing unpredictability.

Despite the future operating environment being cast in a disturbing and surprising light, there remains an imperative for humans to retain a preeminent role in the face of the rapid rise of technology.

Even after the employment of intelligent and autonomous systems, the military of the future will assign a critical and unreplaceable role to humans in the management of the battlefield. Humans will have to learn to coexist with and manage the following issues:

- the process of technological innovation and introduction of disruptive technologies (eg robots equipped with artificial intelligence, swarms of drones, nanotechnology, alternative energy, psychological operations);
- manoeuvre in degraded urban environments;
- the continuous permeability of the electromagnetic environment;
- the cybernetic domain;
- underground, the new frontier;
- legal implications on the new battlefield.

### 2.1. DISRUPTIVE TECHNOLOGY AND A MOVE TOWARDS A NEW CHARACTER OF WARFARE

The complexity of the future operating environment is linked above all to the speed with which technology is able to provide increasingly innovative solutions. This echoes a concept already present in the academic world which is represented in two key hypothesised eras:

- **“Era of Accelerated Human Progress”**, until 2035, in this period our adversaries will be able to exploit new technologies and develop advanced capabilities in order to be competitive in a multi-domain context.
- **“Era of Contested Equality”**, post 2035, in this period the level of technological maturity will be able to synthesise the known dimensions resulting in changes able to revolutionise the nature of war.

The fundamental prerequisite for land forces will be knowing the innovations of the “era of accelerated human progress” in order to better understand the challenges it will be confronted by in the “Era of Contested Equality”. The combination of biomechanical technology, technologically augmented human cognitive capability, quantum computing and synthetic biology will represent a step towards the post 2035 reality.



**FIGURE 11** - ERA POST 2035.

## **2.2. CONVERGENCE, TECHNOLOGY AND GAME CHANGERS**

The impact of so many new and potentially revolutionary technologies is made more disruptive due to the concept of the convergence of technology, which is the possibility of benefiting, simultaneously and intuitively, from increased capacity through the use of a few components. An example being the smart phone which brings together advances in telecommunications technology, cameras, games, miniaturised computer technology and it represents a convergence of technology which is able to profoundly change the lives of human beings.

This phenomenon principally concerns the following areas:

- biology and bioengineering in order to optimise the human performance;
- neurological improvements;
- nanotechnology;
- advanced material sciences;
- quantum computing;
- artificial intelligence;
- robotics;
- 3D printing.

In light of such considerations and using the previously identified eras, one is able to speculate on possible future game changers.



### 2.2.1 Potential “Game Changer” pre-2035



**FIGURE 12** - DIRECT ENERGY WEAPONS IN THE NEXT OPERATIONAL CONTEXT.

Advance technology able to increase situational awareness in a multi-domain context is often discussed. It would be a genuine force multiplier especially over an enemy who is unable to match our capabilities.

- **Advanced ATGM & MANPADS:** able to outpace the development of active protection systems, putting at risk the armoured component and rotary wing assets.
- **Robotics:** able to support and reduce the human component in many areas and in so doing it will reduce risk and increase the tempo of the decision-making process.
- **Space:** it has always been more difficult to control this environment where more than 50 countries operate simultaneously. We will see technological advances able to inhibit positioning, navigation and timing equipment with important implications for tactical manoeuvre.
- **Chemical weapons:** development of agents designed to defeat mechanisms for detection and protection.
- **Camouflage, Cover, Concealment, Denial, & Deception (C3D2):** able to generate a sense of uncertainty in the conduct of manoeuvre.
- **Missiles:** developed with an enhanced range and level of precision due to inertial guidance systems.
- **Computing/Cyber:** with a focus on human-computer interaction (quantum-computer) able to widen knowledge within all domains such as cyber and increasing the situational awareness of the combatants thanks to a rapid, selective and targeted processing of large quantities of data (big data).

### 2.2.2 Potential “Game Changer” post-2035

We are facing the prospect of the arrival of decisive revolutionary technology that has the capacity to change the nature of combat and in so doing will provide a decisive advantage over adversaries not in possession of such technologies.

- **Laser and radio frequency weapons:** scalable lethal and non-lethal direct energy weapons able to counter air threats (aircraft, swarms of drones, UAS, missiles) or able to defeat a wide range of sensors having a massive impact upon command and control.
- **Swarms:** technology able to increase control of airborne platforms and integrate them with land-based platforms through the use of artificial intelligence, with the potential to greatly enhance situational awareness. Swarms will be able to directly engage the enemy and greatly improve the real time common operating picture of land forces.
- **Rail Guns and enhanced direct kinetic energy weapons (EDKEW):** they will deliver the possibility of having missile launchers with non-explosive projectiles able to engage with high energy and velocity.
- **Synthetic Biology:** the engineering and modification of biological entities will create new weapons.
- **Internet of Things:** the so-called internet of things will create incredible opportunities, but the era of hyper-connectivity is also a weakness we must defend.
- **Energy:** the operational effectiveness of forces will largely depend on the ability of the things previously mention to use renewable and alternative energy resources to reduce their energy requirements. Once established such technology (like small nuclear reactors) will enable logistical autonomy, broadening tactical interventions.



**FIGURE 13** - FLYING TACTICAL PLATFORMS IN THE 3<sup>rd</sup> FUTURE DIMENSION.

### 2.3. DEGRADATION OF THE MEGACITIES

Globalisation has contributed and will continue to contribute to a progressive metamorphosis of global social-cultural norms, due the exchange and reciprocal collaboration between different cultures. This change will involve above all global urban planning, from small urban settlements with a small number of inhabitants they will become more and more extensive and at the forefront of infrastructure development. Recent studies of the sector have indicated that this phenomenon will not only happen in the west and in coastal areas but also in the most deprived areas of the world as a response to desertification and the search for available resources.

Megacities do not represent the evolution of the process but are a representation of the various contradictions of modern society: widespread poverty contrasts with hyper connective systems incorporating artificial intelligence; there is a lack of housing but a simultaneous drive to develop energy saving technology; incredibly tall buildings are built while we only intermittently use the underground environment.

In essence, the megacities represent a new array of threats against which land forces will have to prevail in order to survive, move and fight.

The armed forces of today and tomorrow, will find themselves having to operate in increasingly urbanised environments where the inability to control the electromagnetic spectrum and the cyber domain will result in the decreased situational awareness of the combatants, not only exposing them to higher threat levels but also impacting upon the moral component.



**FIGURE 14** - FUTURE MEGACITIES.

Without adequate modifications to capability the conduct of the primary operational urban combat functions within such megacities will be particularly challenging. Especially when



they have been degraded by CBRN attacks, rubblisation, the severing of the principal ingress routes into the area, natural catastrophes, lack of energy resources, defensive fortifications and much more.

Capability solutions in these areas will become necessary. In this context land forces post 2035 will have to equip themselves with modern technology (mostly automation) but also an organisational structure able to guarantee professionalism, resilience, and flexibility.

## **2.4. THE SUBTERRANEAN FRONTIER**

The challenge of controlling environments such as the underground will put the effectiveness and efficiency of land forces to a stern test and is described by the NATO principle of the “complex environment” and reinforced by the spread of the concept of multi-domain manoeuvre.

It will deprive soldiers of the ability to employ all human senses and is more hostile than the air and maritime domain in which men have spent centuries perfecting the ability to survive. The underground has only partially been explored but in urban areas it is likely to be the decisive element for military operations.

The control of tunnels is already practiced in many middle-eastern countries. The widespread implications of sewerage networks and the infrastructure for the supply of energy and water placed at various levels below ground will play a fundamental role in the sort of battles that are likely to be fought in the future. Even conventional troops will have to learn to fight in such a fashion.

Land forces will have to update as soon as possible their assets for the control of this dimension. The modernisation must follow two guiding principles:

- the planning, development and employment of semiautonomous and autonomous systems.

The physical and physiological characteristics of an environment like the subterranean one will limit the employment of humans (if you think of the difficulties miners have faced over the centuries due to the rarefied atmosphere and the conditions of reduced visibility, it is easy to imagine how fighting in such conditions will place soldiers at the limits of human survival). Together with this, the high risk of death and the impossibility of effectively exploiting the electromagnetic spectrum mean that military forces will have to resort to the use of autonomous/semi-autonomous systems. The opportune employment of these systems will minimise losses and increase the situational awareness of the commander.

The employment of Robotic Autonomous Systems (RAS) within actual military units, in much the same way as actual living combatants are currently used, will enable operations in the subterranean domain without risks to the human component. It will provide commanders at all levels with:

- enhanced combat power;
- more comprehensive situational awareness;
- agility of leadership.



- the training and employment of humans underground.  
As expressed previously, despite its hostile nature the land component will not be able to overlook the employment of conventional forces in this environment. Even though autonomous systems will be able to lower the casualty rate, specific units will have to be trained, equipped and logistically supported to conduct tactical manoeuvre and direct the manoeuvre of RAS in such environments, in so doing guaranteeing the principle of a man in loop at all times.  
The evolution of ad hoc equipment, training and the creation of synergies between man and machine and new and innovative technical-tactical procedures will be essential to prevail in this new environment.

## 2.5. THE SPACE DIMENSION

Between 1950 and 2009 the cost of the production of spacecraft decreased tenfold, while in contrast, the ability to launch them and associated technologies has improved enormously. In such a contest, even following revitalised interest in space by the US and China, we are witnessing a process in which large international companies such as Space X and Virgin (USA) and Onespace (Cina) have begun complex phases of testing of rockets and spacecraft that will be able to be re-used.

Additionally, in this new domain it is important to underline how in the next 20 years the rate of technological innovation will allow non state actors and criminals the ability to access space imagery at low cost thanks to the introduction of the so called nano satellites. The exploitation of space and the technological competition without appropriate international governance will lead to certain risks. Amongst these are the dangers of the congestion of space, accidental collisions, jamming and spoofing and the risk of escalation when one nation claims a collision was an act of belligerence on the part of another. At this moment, due to the extreme vulnerability of navigation, early warning, surveillance and joint fire control systems that are completely dependent on space based platforms, it is essential for the land component to develop alternative systems. These will require a high level of electromagnetic resistance and must include long range durable unmanned platforms and sensors combined with the use of vertical communication towers.

## 2.6. MULTI-DOMAIN OPERATION AND THE URBANISED ENVIRONMENT OF THE FUTURE

On the basis of what has been outlined previously relating to the new underground frontier and the degradation of megacities it is the intention of this paragraph to describe how the principles of multi-domain operations can be applied in the future urban context. In order to operate effectively in this environment one must:

- **calibrate the posture of land forces.** The posture of the force, calibrated for multi-domain operations in dense urban terrain (DUT) requires accurate planning during the so-called phase below the threshold of conflict. Actions in this area will help visualise in

minute detail the urban environment in order to generate intelligence and support the normal planning cycle;

- **carefully positioned forces.** It is envisaged that land forces will have to be concentrated around theatre enabling commands (TEC) that support the intelligence function and the preparation of joint fires (lethal and non-lethal), together the maintenance of an effective C3 capability. In such circumstances it is envisaged that a reinforced land and human intelligence capability will be required in order to focus information gathering efforts in the strategically significant urban areas, such as the underground and the littoral areas adjacent to megacities. Furthermore, in the multi-domain approach, forces will be prepositioned with integrated sustainment units to streamline their function. This method will allow the development of sustainable contractual activity for the basing of forces while not risking the so called notice to effect;
- **balance the footprint.** An increase in forces that have a deterrence function below the threshold of conflict requires a proportional increase in the importance assigned to bases and infrastructure able to host forces in heavily urbanised areas;
- **construct multi-domain units.** From the moment that operations begin in densely urbanised terrain, forces will experience a greater level of attrition compared to other environments. Specialist training, systems and soldiers are required that will provide a mix of capability and resilience that will be necessary to operate against an adversary that wishes to engage in combat in extremely restricted and congested spaces;
- **adopt the criteria of convergence.** The application of this criteria in a selective manner, together with the concept of dispersed forces will be a factor for success in multi-domain operations.

In conclusion, urban environments are intrinsically multi-domain. The interconnection of urban areas allows the flow of information, people and goods but creates innumerable variables that make human interaction, and therefore also armed conflicts, incredibly complex. Dense urban terrain with littoral parts creates obstacles and requires simultaneous execution of activities. This means that while operations are slowed, the rhythm and complexity of technical tasks increases. The employment of the principles of multi-domain operations will mitigate the risk of not achieving operational objectives.

## 2.7. HUMANISATION vs ALTERNATIVE INTERNATIONAL COMPETITION SCENARIOS: THE LITORAL AND THE ARCTIC



**FIGURE 15** - COSTAL AND RIVERINE ENVIRONMENT IN THE FUTURE SCENARIOS.

In the model of urbanisation described in the previous paragraphs, the coastal city is the centre of a wider system which is in continuous growth even in the regions with scarce infrastructure and resources. This phenomenon of uncontrolled centralisation of the population from the countryside to periphery of cities will create degraded peripheral urban areas with a proliferation of enormous slums that aim to exploit the energy resources and water supply of the city.

Such growth will put infrastructure under stress, this will result in a high level of criminality, unemployment and possible conflicts in both the old urban centres and the new peripheral urban areas. The lack of food, fuel, electricity and water will only exacerbate these problems. In turn the connectivity of the city will allow the population to participate in off shore illegal activities and to connect to global networks including the migratory masses. This will create an interaction that will influence the dynamics of local and international conflicts.

It is reasonable to assume that a part of international competition, especially the part that falls below the threshold of conflict, will take part in the Arctic.

Recently, it has been suggested that the Arctic will be the driving factor behind a conflict for resources or even a new Cold War.

The gradual thawing of the ice is making the area far more accessible. The existence of hydrocarbons and mineral resources below the sea and the continuous international debate over the sovereignty of the region are facts that reinforce this point of view.

As a direct consequence we see the emergence of security disputes, the presence of land forces and the triggering of a new so called security dilemma to add to an increasingly urgent search for access to energy resources.

Potential conflict prevention activity and deterrence on the part of the armed forces (primarily land forces) are often needed wherever NATO must intervene to offer support in the face of threats of aggression, even below the threshold of conflict. This in turn implies that a confrontation with a peer competitor will develop in an isolated and non-permissive operational scenario characterised by adverse environmental conditions for the conduct of support activities to deployments and combat.



**FIGURE 16** - ARCTIC ENVIRONMENT.



### 3. MILITARY IMPLICATIONS AND DEDUCTIONS FOR LAND FORCES



**FIGURE 17** - LIGHT INFANTRY UNIT CONDUCTING A FIRING EXERCISE.

From the analysis of factors that will influence future military operations the so called military strategic implications have been deduced, which do not yet represent the needs, in the true sense of the word but outline a recommendation of the skillset to be achieved.

The military implications have been grouped in homogenous categories which correspond to the fundamental operational capabilities: **“Prepare, Project, Engage, Protect, Sustain, Inform, Consult, Command and Control”**.

With the aim of identifying the lines of development that will allow the Army to confront the challenges of the future, it is necessary to constantly check, through a process of capability adaption and transformation (force planning and force development), how much/if the above mentioned implications generate the need to transform the principal organisational sectors in terms of force development.

The previously mentioned military implications will be grouped as indicated below so as to attribute to each of them the characteristics that support the **capability theses** for the development of land forces in the post 2035 future operating environment. Such theses will drive the analysis of the possible innovation and transformation and also support the political-strategic decision making process of the Army.

### 3.1. PREPARE

*"With the aim of preparing to confront the threats of the future operating environment a thorough period of preparation will be essential for the commander"*



**FIGURE 18** - EMBARCATION PHASE BEFORE ATTACKING ENEMY POSITIONS.

- **Cooperation with partners:** interoperability through the full sharing of doctrine, techniques, tactics and procedures, collaborative planning, training, exercises, education and the standardisation inspired by NATO and other communities.
- **Manoeuvrist Approach:** a widening of the indirect approach to operations from the purely physical domain to attacks against the cognitive one in order to lower the lethality of the engagements and minimising bloodshed.
- **Modular and scalable units and organisations:** the principle of interoperability of assets will give way to the principle of integration between units where the components of systems, the level of training and the standardisation of procedures will allow the replacement or scaling of units without impacting upon the effectiveness or efficiency of the assets.
- **Creative use of soldiers:** land forces will require specialist competences. The ability to manage talent and the involvement of people external to defence will be essential in order to reach important economies of scale and a culture of loyalty between the military and civil society.
- **Training and exercises in urban environments:** the use of the NATO Systemic Approach to Training which will include threats and emerging technologies such as cyber and hybrid warfare. Virtual capabilities that are increasingly immersive will become the training platforms that increase the performance of combatants while limiting costs and the use of resources. In urban environments an understanding of containment measures and the graduation of the response as well as the use of non-lethal means will be decisive in the management of the battlefield.
- **Best Practises:** constant improvement in the identification and learning of lessons through operational analysis will allow a quicker and enhanced understanding of the scenario and will connect tactical units with leadership at the operational level.

Implementation of collaborative planning will produce synchronized effects that will rapidly alter tactical technical procedures and best practises.

- **Mission Command:** future military operations will require decentralised execution, the application of mission command and a compressed C2 chain.
- **Leader Development:** future military leaders will have to rapidly understand cultural, social and political phenomena and employ all the available assets to enhance military capability.
- **Human Factors:** the adoption of new technologies will enable a significant increase in the level of human/combatant performance. This will pose conceptual and ethical challenges that must be evaluated separately in every sphere of interaction.
- **Cyber Operations:** the capabilities within this sector will evolve in an exponential manner even at the tactical and operational level. Specific training will have to allow the integration of other allied nations and function within the structure of the Alliance.
- **Procurement:** it must be ensured that the equipment corresponds to the operational requirements of NATO and that they deliver fundamental capabilities to the Alliance while always remembering that collective defence is the cornerstone of NATO. The following factors are deemed essential when acquiring new platforms and future components:
  - the purchase of combat proven material;
  - the acquisition of appropriately certified off the shelf equipment;
  - the integration of concurrent generations of systems with a balance of assets aimed at enhancing joint capabilities.

Within such a framework, subsequent strategic directives will have to consider the need to balance the components, the distribution of financial resources and subsequent investments with the aim of harmonising the different generations of technology and reducing the technology gap. When applying the principles of Combined Arms operations in a multi-domain environment it would not be effective to employ 5<sup>th</sup> generation aircraft that are not interoperable with a 3<sup>rd</sup> generation armoured vehicles.

## CAPABILITY THESES



Development and implementation of techniques and platforms dedicated to the collection, analysis and dissemination of situational information in a collaborative manner.



Widening of the specialist capabilities of Special Forces with technological ISTAR support and dedicated C3-I adhering to the principles of swarming and vertical ISTAR.



Training and simulation platforms optimised with 4<sup>th</sup> and 5<sup>th</sup> generation systems and the capability to integrate test bed capability models constructed to analyse big data.





Widening and generation of commands posts at the tactical level that are able to integrate the principles of mission command in an agile manner.



Integration and optimization of structures and platforms able to generate cyber effects with particular reference to CEMA threats in an urbanised environment and the ability to limit an adversary's freedom of movement.



Creation of joint training infrastructure which is predominantly land focused but with enablers from the air and maritime components in order to enhance the ability to confront peer competitors in urban and littoral areas.

### 3.2. PROJECT

*"The future operating environment will be congested, contested, cluttered, connected and constrained (NATO 5 Cs), therefore the planning and employment of land forces will have to display an enhanced adaptability and resilience in the face of the increased relevance of space, time and forces".*



**FIGURE 19 - SURGICAL ACTIVITY.**

- **Mounting:** the development of A2AD capabilities demonstrate the possibility of operating in less permissive environments contested by hostile forces, sometimes irregular. This will result in an increasing necessity to resort to forcible entry operations.
- **Deployment and Redeployment:** as well as guaranteeing a regular logistical flow to and from theatre with air and naval strategic transport assets, national contingents will also have to be ready and able to project teams to engage with local authorities (electricity production, drinking water, public finance, education and public administration).
- **Reception and Staging:** even if logistic support activities will frequently be conducted together with the host nation, land forces must be able to conduct independent and autonomous logistical manoeuvre.

- **Basing:** land forces must maintain adequate accommodation and logistics facilities within their national territory in order to guarantee strategic flexibility and resilience. Ports and airports must be established that are able to support the expeditionary concept.

## CAPABILITY THESES



The development of vertical take off strategic projection platforms to support logistics.



Reliance on "on demand" sustainment in urban and littoral areas.



Development of flexible and efficient structures that are able to be deployed.



Development of platforms able to produce and sustain, even in autonomous and robotic forms, highly specialized health activity in heavily degraded environments.



Development and employment of Robotic Autonomous System (RAS) for logistics support to frontline combat in urbanised scenarios utilising the underground environment.



Rotary wing capability to facilitate vertical manoeuvre within megacities guaranteeing integration and support between aerial sensors and terrestrial receivers.

### 3.3. ENGAGE

*"Land forces are the component in which the operational objectives of the joint campaign are synchronised, they will assume conventional and non-conventional capabilities which will give great emphasis to the principle of discrimination thanks to stand off weapon systems and precision weapon systems with increased potential."*



**FIGURE 20** - MEDIUM INFANTRY ON OPERATIONS.

- **Joint Manoeuvre:** the ability to manoeuvre will encompass all the dimensions and will engage all the levels from tactical to strategic. Military forces will be pushed towards joint operations with the aim of making the adversary unable to effectively resist.
- **Increased manoeuvrability:** land forces will have to maintain access to the global commons and be able to conduct the entire spectrum of operations whilst maintaining the lowest possible force levels. Increasingly focused manoeuvre with less mass will required an enhanced capability to communicate at distance even at the lowest levels and an agile logistics element.
- **Cyber Manoeuvre:** the units employed on operations must be able to maintain freedom of action and influence all areas of cyberspace. Cyberspace will become the primary communicative domain.
- **Rapid response:** frequent employment of Special Forces who must maintain and enhance their ability to rapidly deploy low visibility assets with reduced footprints in uncertain and non-permissive environments.
- **Joint Fires:**
  - enhanced firepower: forces must continue to be equipped with a wide range of weapons systems producing a range of effects. The evolution of the threat requires a corresponding evolution and enhancement of the weapon systems available to land forces. This must happen in close coordination with allies to ensure standardization which will enable such weapon systems to be used with foreign platforms. A particular effort must be made in the search for weapon systems with a low cost per use (direct energy weapons).
  - kinetic operations in urban areas: the capability to accurately employ joint fires within an urban context while minimising collateral damage must be developed. The

capability to designate accurately the specific point to be engaged is fundamental considering the numerical inferiority that NATO may have in future.

- networked targeting capability: forces must be able to create and maintain a precise target identification network to estimate collateral damage and to engage with precision. If possible, forces will be able to employ scalable and multirole weapon systems that have the ability to engage a wide range of targets and missions (lethal and non-lethal).
- EW: advanced capabilities of protection, attack and support must be provided in the electromagnetic spectrum.
- employment of autonomous systems: they should be considered a force multiplier that enables operations across wider spaces at a lower risk for the human component of the future force.

– **Joint Influence:**

- Cyber Influence: these activities require a deliberate and well planned communication strategy to allow their correct integration to maximise their impact on the target audience. Military forces need a holistic understanding of cyberspace that is not limited to technical implications but also includes the effect on humans and the decision making process.
- Cyberspace Engagement: as the activities and the threats in cyberspace continue to increase, it will be necessary to develop corresponding policies, SOPs, capability and training to assist in widening activity in cyberspace.
- Engagement through the Comprehensive Approach: the armed forces must continue to provide their contribution together with relevant actors in other sectors (diplomatic, information, military and economic).

– **Influence activities in the domain of human perceptions:** influence activities are and will continue to be an integral part of the manoeuvrist approach and the information function, highlighting the importance of the cognitive aspects of future operations. The sphere of perceptions constitutes a dimension that must continue to be exploited to manoeuvre and obtain an advantageous position over an adversary.

Such activity is not limited to the production and distribution of messages or to the use of media, but concerns also the ways in which the actions of the military force will be interpreted, primarily by the local population but also by the press. All military personnel will have to be educated so that they understand the effects of a single action on the outcome of a campaign.

Furthermore, due to the growing relevance of the cognitive domain influence, activities will have to be planned and conducted even in the sector of mass communications such as social media so as to counteract the eventual campaigns of adversaries.

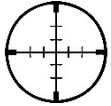
## CAPABILITY THESES



Improvement of tracked platforms in terms of protection, mobility and accuracy of fire with particular reference to passive engagement systems.



The use of ground combat systems equipped with beyond line of sight weapons with a stand-off capability beyond 10 km and capable of direct/guided engagement in urban environments.



Selective use of high volume of fire from tracked platforms at divisional level in close coordination with light units characterised by high levels of decentralisation.



Capacity to generate decisive actions through a combined arms approach able to integrate EW and intelligence enablers.



Development of high yield munitions able to be deactivated in case of potential collateral damage.



The ability to guarantee mobility and counter mobility in a heavily degraded environment (construction of bridges, controlled demolitions, removal of rubble).



The development of Anti-Tank Guided Missiles and Man Portable Air Defence System able to assist C2 in decentralised but connected surface and subsurface manoeuvre.



Improved Ground To Air Missile and SHORAD capability to protect ground manoeuvre.



Social Media and Information Operations detachments able to be integrated in real time with land forces through the employment of technology.



Synchronised employment of UAV, UGV and rotary wing assets.



## PROTECT

*"The supply of emerging technology on the part of indeterminate actors makes the protection of the force against direct and indirect kinetic action of primary importance for campaign success."*



**FIGURE 21** - ROUTE CLEARANCE ACTIVITIES.

- **Counter area denial:** land forces will have to be able to create a permissive environment for their operations and in so doing ensure that they are able to enter and operate in an area of operations despite A2AD tactics and technology. The ability to find, localise, exploit and neutralise the effects of mines (land, naval, anti-ship), IEDs and a conventional and unconventional CBRN threat will be increasingly decisive on the battlefield.
- **Lines of communications:** in future the global commons and allied lines of communication will be congested and contested by hostile actors. The proliferation of A2AD technology and disputes over the global commons will create significant challenges for the deployment for forces and the conduct of alliance operations. These confrontations will be particularly problematic in the choke points found in every domain.
- **Expedition forces and the defence of bases:** the protection of the force and the defence of bases will continue to be key for the success of expeditionary operations.
- **Comprehensive Protection:** a future crisis could overwhelm the local authorities and exceed the civilian capability to respond, forcing an intervention. In some cases land forces could be required to defend critical infrastructure, vital networks and lines of communication against a wide range of threats. In these cases the armed forces could be employed protecting key national services (governance, health, the law, finance, transport, energy, public services, agriculture and national icons). In this event, as well as the employment of special forces, the drafting of an accurate contingency plan to create synergy in the management of the apparatus of state is essential.
- **Security of CIS systems:** land forces should be ready to operate in a degraded cyber environment and be ready to contribute to a complete information security strategy. The Alliance should be prepared to defend itself against forms of information attack. The Army will have to protect itself from the manipulation of data and information within the cyber

domain. Units and command will have to be able to verify their own data to ensure that they are accurate, reliable and that they come from trustworthy sources.

- **Emergent Technology:** land forces must understand the technological challenges and be able to innovate tactics, techniques, procedures, capabilities and doctrine in response. The Army should be aware of the acquisition and innovative use of technology by others. Despite appearing impossible to predict all the areas in which technology could revolutionise warfare, some areas demand attention. These include: direct energy, autonomous systems and sensors, quantum computing, unmanned systems, electromagnetically launched projectiles, renewable energy, artificial intelligence, 3D printing, biotechnology and nanotechnology. In general, one must consider the ethical implications of technological progress and ensure man retains control of autonomous and unmanned systems.
- **Unmanned systems:** the proliferation of low cost unmanned systems has widened their availability to a vast array of actors. Their employment in military missions and by non-state actors will surely increase allowing future adversaries to conduct surveillance and battlefield management as well as resupply and trafficking and transport of arms and materiel. Land forces will therefore have to be able to exploit technological developments in this field and limit the ability of an adversary to access this type of technology.
- **Swarm tactics:** land forces must have the ability to employ swarm tactics and also counter them in all domains, which could be useful countering the A2AD threat.
- **Defence against RAMM (Rocket Artillery e Mortars Missile):** the proliferation of technology will increase the risk to allied forces from rockets, artillery projectiles and mortars and will require an adequate level of protection.
- **Defence against WMD (Weapon of Mass Destruction):** the department of defence will be able to exploit emergent technology and develop new ways to protect the force against the WMD threat. Technology that allows containment such as enzymatic technology or the production of nano-material that makes CBRN equipment more durable will be employed in such an environment. The land force will find itself having to develop smart materials not only to enhance CBRN protection equipment but also survey equipment. In this strange environment the use of autonomous and semiautonomous platforms to conduct surveillance, recognition, exploitation, recovery and extraction of elements linked to the CBRN threat will be extremely important.



## CAPABILITY THESES



The development and engineering of active and passive radar protection systems able to protect the force.



The development of battlespace management systems that include innovative radar systems that disable the network of an enemy swarm system to protect the land and particularly the tracked and armoured component.



Development of assets able to quickly neutralise threats both in choke points common to each domain and in the countering of IEDs and booby-traps.



Development of remotely managed C/UAS and GBAD systems which will be essential for protecting expeditionary forces and their command posts especially in a heavily degraded urban environment.



The development of swarm technology to assist early entry and strike forces to degrade anti-access and area denial systems of an enemy.



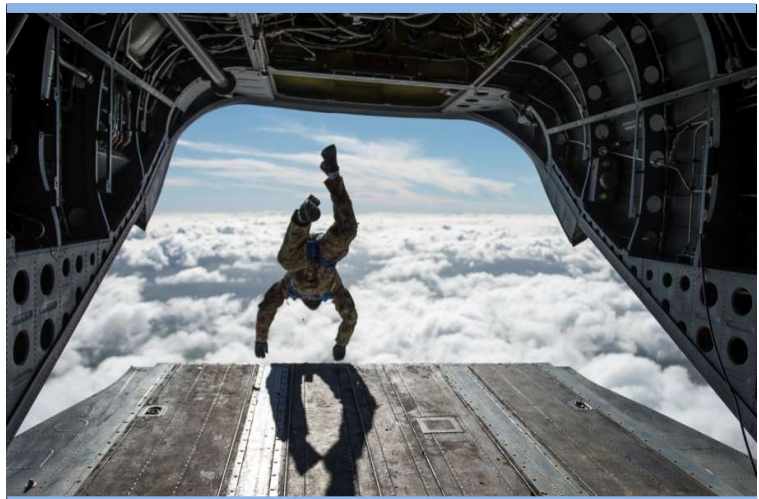
The development of an early detect and management system to counter the CBRN - RAMM threat and facilitate manoeuvre.

### 3.4. SUSTAIN

*"The strong aggregation and disaggregation of forces in the post 2035 operating environment will require an on demand logistical concept the like of which has never been seen before".*

- **Innovative resupply:** National and alliance forces will have to try to reduce their logistical footprint while ensuring that supplies continue to flow to units that operate in the deep battlespace.

Future technological progresses such as 3D printing, the use of alternative energy sources, robotic evacuation systems and driverless delivery will revolutionise support offered to forces in the fields of maintenance, repair, resupply and healthcare. The exploitation of new technologies will allow the force to simplify and improve logistical support techniques decreasing operational risk and increasing the range at which activities can be conducted



**FIGURE 22 - PARACHUTING ACTIVITY.**

due to the shortening of procedural timeframes. The production of consumables in theatre and the energy recycling of waste will increase self-sufficiency.

- **Theatre movement and transport:** the land component must have sufficient transport means to sustain the maintenance, the employment and the redistribution of forces in all possible missions across a broad spectrum.
- **Diversification of logistics:** in order to maintain adequate levels of self-sufficiency, national and allied forces they must identify a network of partner military forces and non-military organisations to help sustain multi-domain operations with scalable logistics. The logistical networks would have to include local commercial suppliers or third party actors able to provide logistical support even in non-permissive areas.
- **Support of future forces:** manoeuvre will be characterised by decentralisation and autonomy including in the field of logistics. Forces of the future will require modular and flexible logistic structures, with common stocks and logistic support procedures. Leaders will have to be trained to conduct advanced operations with limited logistic support through the exploitation of resources available within the area of operations.
- **Military Engineering:** Expeditionary operations, especially in urban areas, could encounter significant A2AD challenges. This will increase the mobility and counter mobility requirement as a key enabling factor for achieving and maintaining freedom of manoeuvre and will enhance protection of units at all levels. Engineer assets will have to provide support to critical infrastructure (military and civilian) which will contribute to the maintenance of a broad interoperability even with non-military elements.
- **Sustainable medical support.** Serious health crises and pandemics could rapidly overwhelm local health services which will then have to turn to the international community for support. Forces will need to be able to rapidly deploy medical personnel and equipment in order to respond to these situations which could be in heavily degraded environments. Future technologies will be able to improve medical assistance while at the same time reducing the logistic footprint. Innovative methods will enhance reach-back through robotics, information technology (IT) systems, video cameras and other technologies that will enable remote medical interventions.

## CAPABILITY THESES



3D printing, automated resupply, renewable energy sources, and the extraction of primary resources in situ (mobile power stations, waste recycling systems) will allow a reduced logistics footprint which will in turn lower the environmental impact and provide a sustainable mechanism through which land forces will be able to live, move and fight.



Create specific stocks which are readily usable and low cost for the member states of the Alliance while using elements of civil defence of the nations involved.



Civil Military engineering Interaction will safeguard critical national infrastructure on the modern battlefield especially within a warfighting context by providing building and engineering capabilities.

### 3.5. INFORM

*"The cognitive characteristics (demography, human society, institutions and governance) influence the political decisions inside a campaign and its associated strategy."*



**FIGURE 23** - UGV RECOGNITION.

- **Collect:** land forces will have to have the capability to locate, trace, monitor and share information on threats in all domains, including cyber and space. The use of nano-satellites and space based platforms to support more common tower based terrestrial platforms will confer a notable advantage. The use of ISR systems will be increased to improve the collection of information. This will include the use of both manned and unmanned systems alongside alternative sources (commercial, private and national). The land component must be able to identify objectives despite advances in stealth technology, camouflage, concealment and deception, especially in the urban and subterranean environments. Open sources including social media must continue to be exploited to obtain, share and integrate information with the objective of creating an improved operating picture. This information fusion will enable military forces to quickly notice and anticipate eventual anomalies in activities that take place in the fight for the global commons, on lines of communication or within the management of big data. It is essential that this information can be integrated with that of allies and other multinational organisations in order to increase the operational picture of the armed forces. The use of remote sensors and intelligence networks will allow the effective identification of potential threats.
- **Analysis:** the armed forces will have to improve the processing phase of their intelligence cycle due to the large quantity of data available and the growing number of sources and sensors. Therefore it will be necessary to increase the current indicators and warning mechanisms to help manage potential threats and optimise the decision making process. The Alliance and consequently Italy will have to maintain an archive of knowledge on the operational environment that will allow collaborative planning using advanced technology including AI, virtual reality, and modelling and simulation. The proliferation and increase of networks of various complexity and uses will require a sophisticated capacity to develop a detailed understanding not only at the strategic but also at the tactical level. The Army will need tools and competences to collect and

analyse big data to support the decision making process and increase operational situational awareness.

- **3D Mapping:** land forces should possess an increased ability to rapidly produce and distribute geospatial products (maps of the future) in order to support operations in three dimensions (including tall buildings, underground structures, slums). Reconnaissance and surveillance of urbanised areas will be required in order to guarantee accurate plans. Such activity will have the double aim of contributing to the development of a deeper understanding of an area, particularly densely populated areas which the military will be able to study the human terrain of an area as well as the physical terrain. In the near future we will be able to create an interactive biometric map able to monitor an area in a timely fashion. The 3D mapping of areas will provide forces with an improved standard of information that will allow them to pre-empt social disorder and identify possible points of crisis.
- **Distribution:** the distribution of intelligence products requires accurate management of the intelligence sharing agreements that have been created to facilitate this process. In future it will be necessary to improve the information framework and increase such agreements even with organisations which by nature are not military. In order to carefully monitor and evaluate the requirement for an intervention, forces will need data from outside the military environment that concerns areas such as demographic indicators, energy sources, flow of migrants, natural disasters and food provision.

## CAPABILITY THESES



Increase in Human intelligence to improve the capacity to understand and assess within an area of intervention.

Xp

Automated detection framework able to automatically detect exploitation and indiscriminate access to the global commons by organisations and transnational networks.



Development of artificial intelligence able to process and archive information acquired in support of military operations.



3D printing, digitalised three dimensional mapping and social media assets to support down to divisional level.



Enhancement of biometric collection and interpretation capability to support the intelligence cycle.



Development of space based early warning, surveillance and control platforms.



### 3.6. CONSULT, COMMAND AND CONTROL

*"The UHF e VHF bands will not be dominant in the congested future operating environment post 2035."*

- **Future C2 systems:** C2 systems will have to facilitate command and control through an automatic and timely exchange of data and information able to support the leadership resolve complex problems. In particularly degraded environments or where flows are denied or jammed, C2 systems should be able to reactivate themselves autonomously and so provide robustness, redundancy and resilience.
- **Future decision making process:** senior leaders will be assisted in the decision making process by automated tools able to ensure the secure transmission and protection of orders facilitating the internal and external coordination at all levels of command. Within NATO every ally will have to have access to a complete information picture so they are able to carry out their tasks in an effective and collaborative manner.
- **Integration of multinational C2 systems:** C2 systems should be interoperable allowing a wide number of partners to communicate. This will concurrently protect sensitive and classified information. In future we will require a collaborative environment based on the sharing of various levels of classified information. The Alliance may have to support external communication with local governments, NGOs, and business organisations.
- **Reduced organisational footprint:** some types of military activities could benefit from compressed C2 structures that accelerate the decision making process and improves the management of the congested and complex future operating environment. Units should be scalable and modular to enable capabilities to be decentralised to lower levels to carry out various types of missions (Alliance, EU, coalition).
- **Integrated command and control:** the integration of specific operational images within a specific situational framework will give commanders a comprehensive understanding of the actions of all the actors and allow them to accurately direct all the assets at their disposal. In a similar fashion to integrated NATO air and missile defence, land forces will need C2 systems that conduct a continuous surveillance through a series of sensors and that are able to integrate all the information together to create a specific operating picture within the AoO. Alliance and coalition leaders will discover that it is



**FIGURE 24** - OPERATIONS CENTRE.

indispensable when monitoring non-military organisation and also non-military environments such as financial networks, cultural aspects of a community, processes of demographic evolution.

- **Communications:** land forces of the future must dominate the electromagnetic spectrum and require access to forms of communication other than line of sight systems. Critical communication networks will therefore require resilient networks and systems and land forces must be able to guarantee full functionality even in a contested electromagnetic or cyber environment. The development of nanosatellites and networks of unmanned platforms capable of providing a backup to space based platforms will provide a valuable capability to absorb shock due to intense competition in the space domain. The Alliance will need long range communications that will reduce the clutter of equipment and allow the chain of command to perform its function from great distances and in real time. The military will have to possess sufficient band width to allow a rapid, secure and timely flow of information between tactical, operational and strategic commands.

## CAPABILITY THESES



Engineering of more reliable and resilient platforms and data transfer mechanisms that are able to automatically integrate the collection of data from UAVs and UGVs (even through the employment of RAS).



Increase in the cognitive capability of soldiers (*agile soldier*) and decrease the equipment burden (Palm projection implants, cerebral implants – exoskeletons and implants to support mobility).



The development of Joint Common Operational Picture (JCOP) systems



Full use of commercial networks which will support military systems or ciphering devices.

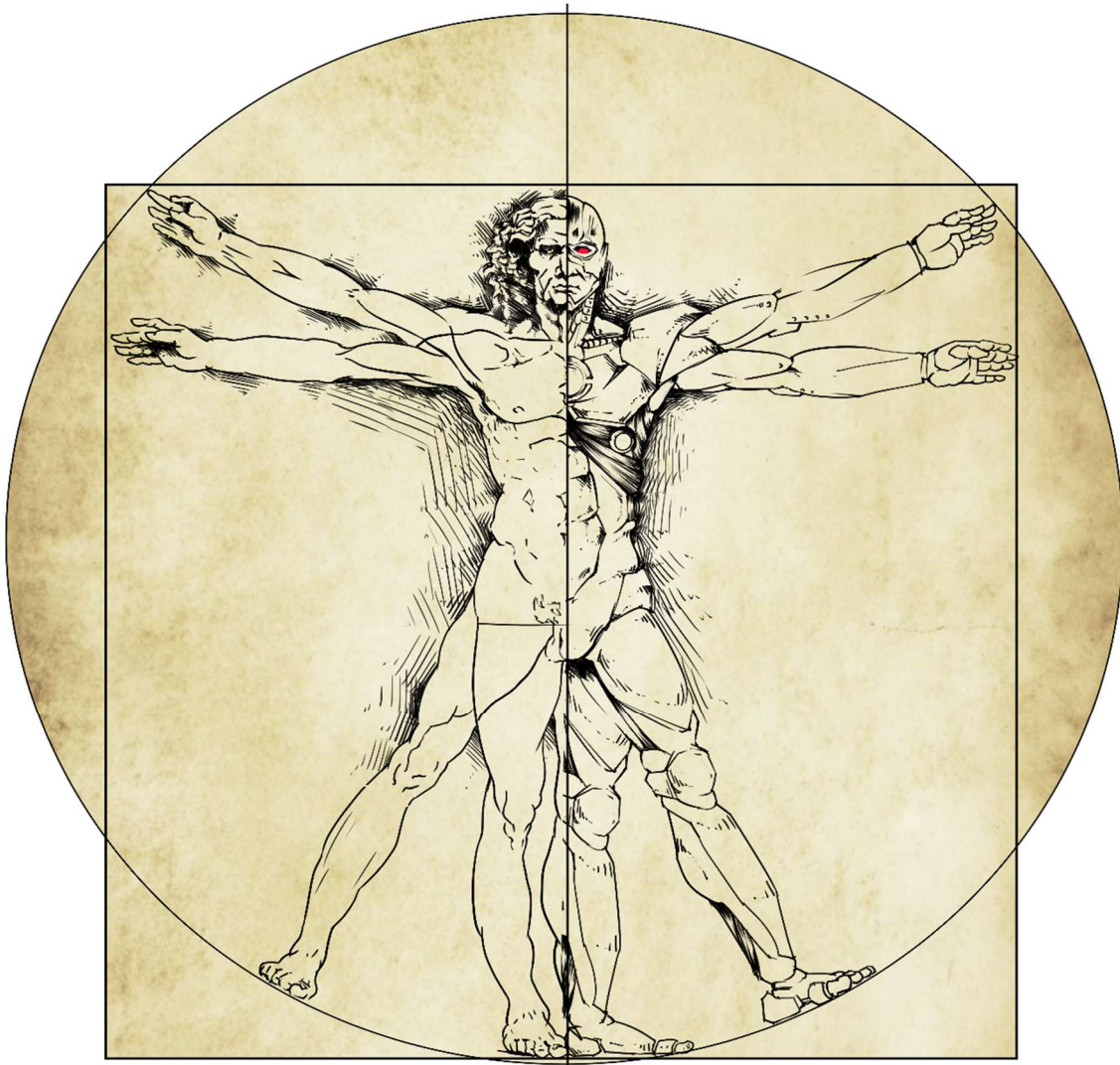


Development of SICRAL systems based upon swarms of space based platforms.



Development of a deployable C3 capability in a contested CEMA context without increasing the footprint in an area already densely populated.

#### 4. CONCLUSIONS



**FIGURE 25 - THE NEW ERA OF VITRUVIANO.**

Land power of the future, i.e. “the comprehensive capability of the armed forces of a nation to conduct and influence activity, towards, through and inside the land domain in order to protect its interests and pursue predetermined objectives”, will have to adapt in the years to come.

The armies of the future will have to confront varied challenges that are markedly changeable. Some concepts of the recent past will be overturned and replaced. The concept of mass has already given way to the concept of “selectivity of action”, the control of public opinion will occupy the pages of tactical doctrine pamphlets. Collaboration with autonomous and robotic elements including tactical manoeuvre units will not be considered unusual.

The improvement of all platforms, particularly armoured and tracked ones, will be particularly important for the land component. The creation of command and control systems that are interoperable with defence actors within an integrated national force will also be of paramount importance.

As manoeuvre will happen predominantly in urban, littoral and arctic areas, the leadership will have to be able to train commanders capable of operating in physically and temporally constricted terrain with the ability to act simultaneously on all levels. This means that while operations will be slowed, the rhythm and the complexity of tactical tasks will increase.

The current operational functions of the army will change in the post 2035 era and will have to be able to support forms of manoeuvre in a multilevel environment where lethal and non-lethal effects will happen in real time. This will be facilitated by the connectivity of global communication systems which are becoming increasingly “real-time” not only in the physical but also the cognitive domain.

The principle of mission command will be one of the principles of reference for commanders together with that of agile leadership as indispensable prerequisites to be able to manoeuvre different assets whilst at the same time increasing situational awareness of the operational environment. Underground, disruptive activities, influence, RAS, big data, use of non lethal weapons and space based effects will be the common phrases of the future.

For all of these reasons, land forces must continue to focus on manoeuvre in complex and multi-domain environments, maximising their employment of the combined arms concept which will enable forces to remain competitive. The physical and cognitive characteristics of the aforementioned context do not change the cardinal principles of manoeuvre, direct and indirect fire and protection whose correct application will continue to be essential for success.



## 5. TRENDS



### GEOPOLITICS

The geopolitical context:



The optimistic trend envisages that the US will remain the only global superpower, the institutionalisation of liberal power and the principal sponsor of all foreign security policy. The US exerts enough soft power over the economies and the cultures which are historically linked to it to allow it to maintain and legitimise the US model as the model of reference even for aspiring rival superpowers;



The neutral trends predicts that in the next 25 years China is the state most likely to fulfil the role of “peer competitor” of the United States. Thanks to unprecedented economic growth, its proximity to important world economies such as India and emerging and developing Asian economies and its constant attention to its military revolutionary model, China has the ability to create strategic appeal like the United States of America. Although today it is often considered a neutral actor, it is evident that the People's Republic of China imposes on its main commercial partners a regional policy completely independent from those of the western world.



The pessimistic trend sees an increasing number of small non-state actors with transnational interests that have developed an importance greater than actual states (thanks to hybrid influencing techniques) which could create security situations in various strategically important regions. False multinationals, trade union organisations (such as those in China), organised crime and fundamentalist religious groups sometimes motivated by xenophobia represent an increasingly significant threat.



### DEMOGRAPHICS

The demographic context:



The optimistic trends for the national interests of western countries including Italy are represented by the achievement of a fine balance between factors of demographic growth and a sufficient corresponding allocation of primary resources. The implementation of careful policies by international organisations aimed at balancing the distribution of resources between rich and poor countries while at the same an emergence of mass consumption of alternative food energy

sources (such as insects which have a high protein content) would enable us to confront the problems arising from global population growth in a positive manner. Such processes could also have a decisive impact on climatic conditions by reducing desertification through a reduction in the cultivation of cereal crops.



The neutral demographic trends underline an unstable situation, unbalanced population growth and regional consumption models will have important social consequences. A limited availability of resources, especially in underprivileged areas, with growing populations could lead to localised conflict aimed at subverting governments and contribute to a more general destabilisation of the world. Afghanistan and Pakistan, as well as south west Asia and the outlying peripheral regions of some European cities are ideal candidates for the outbreak of social tensions due to demographic factors.



The pessimistic trends suggest that the gap between population growth and available resources is clear. Areas such as Latin America, Sub-Saharan Africa, South Africa and the Middle East will reach a critical mass that is difficult to manage and prevent and that will bring unsustainable implications for the rest of the global population. Migration towards more wealthy zones that are easily accessed could transform into a true mass migration that will require global institutions not only to manage the politics of the phenomenon but to also ethical and moral choices that effect the survival of humanity.



## ECONOMICS

The economic context:



The optimistic trends indicate that in the developed nations of the north, economic growth will return to sustained periods of growth (in the range of 3-5%). There will be long term low inflation, single figure unemployment and a moderate budget deficit (and maybe even years of surplus for countries such as Germany). There will be constant innovation and pension funds will remain solvent in the public sector and medical assistance and functional social programs to improve the welfare of citizens will be provided. The trend towards welfare provision will become increasingly important in Europe, Japan and North America.

The neutral trends suggest economic growth will reach 2-3% but will not influence employment in a structured or systemic manner (due to policies that focus excessively on the consolidation of public debt at the expense of spending that would stimulate the economy) meaning that this growth is likely to benefit only those already wealthy.



Unemployment will continue to represent the main threat even for wealthy countries especially in the southern European area. Where there will be a consequent danger of recession. In this context, political regimes of a semi-democratic type may create the perfect conditions when supported by criminal organizations and/or fundamentalist regimes, to transform the uneasiness of the population into heated conflicts for the control of primary resources.

These possible conflicts represent a new test bed not only for the maintenance of the old alliances, but also the creation of new and potentially unexpected interests. In contrast to the growth in the market that has no employment effect in Europe, Japan would be the only world power to produce profit after directing its investments towards biotechnology within agriculture and in the primary sector.



The pessimistic trends highlight the risk of inflationary stagnation in the context of a high and rapidly rising unemployment rate. These factors would lead to apocalyptic economic situations in the main European countries and in North America. The analysts have used calculation models to show how such a hypothesis is not unrealistic and that, if combined with the other tendencies, it would make accessing the global commons so difficult as to cause very serious imbalances to the current international order. This would cause a corresponding recession in a large part of the developing world that alongside a speculative management of the main energy resources could cause an unmanageable economic imbalance.



## TECHNOLOGY

The technological context:



The optimistic trends indicate that technology can lead to a "long-term boom" in economic productivity and a general increase in the quality of life worldwide. In this vision of the future, the period between 2035 and 2050 is likely to witness four waves of progress: completion of the information technology revolution, start and acceleration of the biotechnology revolution, robotisation of systems and automation of logistics and the start of an alternative energy revolution.

The final part of the IT revolution will focus on the expansion of the internet. We will see greater accessibility to the internet, the birth of much faster processors, more advanced personal wireless communications, the creation of a new interactive and personalized media industry. Online commerce will become absolute and networks and organizations distributed throughout the private sector that will be able to operate faster and more efficiently than was possible with the old hierarchical system will proliferate.

The neutral trends could lead to a slowing of economic growth. In particular, the information technology revolution could suffer the greatest slow down due to high costs and unexpected difficulties in the speculative dominance of financial markets. However, the spirit of innovation, regardless of future circumstances, will continue to grow in terms of know-how with the emergence of technologies such as: artificial intelligence, biotechnology, autonomous systems and the synthetic development of prototypes with human genetic modification. Automation and artificial intelligence in particular, together with the development of more powerful processors able to process big data in an increasingly logical manner, will allow a change in industrial models, centralizing these tools in the hands of a few.



The pessimistic trends indicate that there will be enormous disparities between the technological applications produced and the capacity of the state to control them and monitor their legality. In extreme synthesis, the gap between the technologies produced and the structures that aim to control them will grow out of all proportion, generating a management dichotomy with important implications, above all, from an ethical-moral point of view.



## ENVIRONMENT

In terms of the environment, the statistical data for the coming years is linked to current international and Community policies (although available for various research segments) and are therefore susceptible to imminent and sudden changes in very short time frames. The assumption that the entire international community is already oriented towards a greener world that is willing to look for welfare models with low environmental impact allows us to affirm that:



The optimistic trends of re-appropriation of natural assets will be seen and man will increasingly seek renewable energy and sustainable development models, with a view to coexist synergistically with the environment without damaging it. This phenomenon, initially linked to a cultural revolution of man, will have a specific impact on the disappearance of certain materials (such as plastic), with important and potential repercussions on the components used by the defence industry, which will necessarily have to look at the development of alternative technologies.





Then neutral trends show that international agreements between the large global powers will create policies to protect the planet's energy resources and environmental heritage which may put at risk policies aimed at mitigating the risk related to major natural disasters, which could bring countries with weak economies to their knees without access to primary resources.



The pessimistic trends suggest that human egocentricity and financial speculation do not care about sustainable environmental policies but increasingly seek profit-oriented economies that are unsatisfactory in terms of their effects on the climate and on the exploitation of resources. The persistence of environmental effects, expanded on a large scale, together with a lack of respect could lead us to a real global apocalypse. This situation, in which, for example, the natural order of weather phenomena would no longer make sense and where normal crops would not bear fruit, could trigger a wild struggle for human survival with direct implications for collective defence systems. From this point of view, the Military would be called upon to play a paradoxical role, that is to say, to be the guarantor of the defence of the human community "in favour of man but against man".



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