



The Role and Relevance of the Maritime Domain in an Urban-Centric Operational Environment

Study Paper



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Foreword

Confined and Shallow Waters provide ever expanding challenges to military planners and operators. Current and future advancements, not only in technology, but also in warfare tactics and procedures, demand constant adaption and manipulation to this already intrinsically complex environment.

This paper seeks to explore the maritime dimension in the global trend of urbanisation in the period up to the year 2035, when “urban living” will dominate the balance of the world’s population distribution. It has been developed in the context of NATO’s ‘Urbanisation-Project’.¹

By describing vulnerabilities, challenges and opportunities this study provides a basis for rethinking current NATO concepts and doctrines, tactics, technics and procedures as well as for NATO training and exercises. A new approach is needed in order to achieve a more comprehensive effort in this specific operational sphere with stakeholders’ widespread and varying responsibilities.

The findings in this paper are derived from trend analyses concerning population development with regards to growth and location. Furthermore, a nation’s economy, its commodities and information flows as well as related vulnerabilities, will be explored. The transition zones from the maritime domain into landward urban areas (access points, ports and choke points) also need to be adressed as they create implications for military operations. Additional economic considestions such as marine resources and aquaculture have to be taken into account. Lastly, the impact of enviromental changes on coastal areas of living are of vital importance and relevance to this study. Finally, technology and its proliferation, along with the diverse actors exercising power, influence, and control in future coastal urban areas are to be investigated.

¹ Since 2014 NATO is developing a conceptual study supported by simulation and experimentation in order to examine the impact on NATO military operations of potential crises situations in urban systems and consequences of Urbanisation in 2035. Overall 17 NATO nations, 16 NATO Centres of Excellence, academia, industry, and entities from the NATO Command Structure have been involved in researching the challenges and strategic implications of Urbanisation (see <http://www.act.nato.int/urbanisation>)

**“The control of large urban areas will be critical
to the successful accomplishment of
strategic, operational, and tactical objectives
in future conflicts.”²**

² Robert F. Hahn and Bonnie Jezior: Urban Warfare and the Urban Warfighter of 2025, in: Parameters, Summer 1999, pp. 74-86

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Executive Summary

With 80 per cent of the global population currently living within 100 kilometres of the coast, along with a concentration of diverse and intense economic activities in the littorals, urbanisation trends will not just affect but rather cause significant impacts on the maritime domain. These trends will also influence maritime operations and thus require thorough consideration.

Coastal cities, with their location, population concentrations, transportation infrastructure, and above average income levels, have become strategic points of control for those seeking profit or support for their cause. Research suggests that the most prevalent future threats in this environment will arise from non-state armed groups using irregular methods, avoiding direct confrontation, but being able to acquire highly sophisticated weapons. This future threat environment calls for new thinking and a shift in the operational approach.

Dominating the maritime domain today requires a comprehensive inter-agency approach that brings together the entire spectrum of relevant national institutions – navy, coast guard, customs, police, etc. This inter-agency approach may be co-operative or through bilateral, regional or multinational initiatives, taking into account the roots of maritime threats at sea as well as on land.³ As different objectives, end-states and timelines have to be harmonised, coordinated and synchronised, close collaboration of all involved actors is mandatory.

Researchers suggest that "success in the urban environment of 2035 will depend less upon 'boots on the ground' and the delivery of kinetic effect but more on control of the information environment and the ability to influence the entities that exist within it."⁴ Taking also the findings of the urbanisation experiment into account, NATO needs to be able to create temporary secure corridors and SPODs: a fluid, undisrupted mobility from the afloat base to the location of effect and back, absorbing damage while maintaining a superiority in all domains. The requirement to ensure adequate and integrated protection throughout the urban littoral battlespace and a joint operating picture and operational plan for all elements of the force is no longer optional, but rather an essential function of these kinds of expeditionary operations.

A growing number of different actors will compete in the future maritime urban-centric environment for power, influence, and control. In addition, a new paradigm is connectivity: Being able to overcome geographical isolation through the use of global networks to disseminate and receive information, ideologies, weapons, drugs, revenues, and technical expertise. This is affecting traditional power projection in a significant way. NATO has to ask how to defend itself against more and more sophisticated Anti Access / Area Denial (A2/AD) threats amidst a city and within its population in a sustainable way, whilst avoiding to physically occupy a city for a longer period. The ability to stay off, disperse and be highly agile is a fundamental requirement.

³ NATO Sec Gen Rasmussen, Anders Vogt, Maritime Security: NATO and EU Roles and coordination

⁴ The Urban Centre and Urban Environment: Strategy and Operational Warfighting 2015-2035, Oxford 2015, p.107.

This future conflict landscape also suggests that NATO capabilities regarding operations with an amphibious character will gain additional relevance. It is paramount to fully comprehend the engagements against hybrid and networked adversaries, using distributed and dispersed operations in the complex terrain of the global littoral areas – areas almost unanimously identified as vital ground due to demographic, sociological and connectivity changes. Traditional as well as emerging warfare areas are to be adapted in view of the unique and ever changing operational environment of increasingly urbanised littoral zones.

NATO training and exercises have to take this consideration into account. A multi-domain, cross-service training and education centre, which leverages emerging technologies that accurately replicate environmental conditions both physical and virtual, needs to be considered.

A further analysis of the Urbanisation trends and consequent implementation of respective requirements is mandatory for preparing NATO forces to counter threats in a future urban-centric environment, but also to increase the awareness of military and civilian leaders in the future.

1. The Urban Littoral Environment

As of 2014 more than 54 per cent of the world's population resides in urban areas.⁵ With the trend towards increasing urbanisation, and the fact that 80 per cent of the global population currently already live within 100 kilometres of the coast, the proportion of the global population living in littoral urban areas will remain high and is likely to grow in the future.

The fastest rates of urbanisation are occurring in medium-sized cities with populations of 1 to 5 million, while approximately half of the global population lives in small cities hosting below half a million people. Only 8 per cent lives in cities of 5 to 10 million. Megacities, defined by the United Nations as cities with populations exceeding 10 million people, account for 12.5 per cent of the world's population.⁶

Urbanisation trends, and the size of a city, do not necessarily imply a higher risk of instability. However, taking into consideration that most of the population growth will happen in the developing world, it is not unlikely that urbanisation will take place in a more or less loosely integrated⁷ way. Instability situations may arise due to the emergence of ungoverned and fragile areas, where different actors might settle and pose challenges to safety and security.

Subject matter experts covering different domains and fields of competence in the 'NATO-Urbanisation-Project' mostly agreed that in 2035 there will be a need to consider the virtual domain and all the physical domains as one comprehensive operating environment, where numerous actors will move and act pursuing very different agendas with various motivations and intents. Information and communication technology will provide agile non-state actors with the possibilities to be as or even more influential and effective than state actors. The ability to remotely access and manipulate structures and people of interest will have effects in every physical domain and forces the Alliance to look beyond the traditional boundaries of a battlespace.⁸

The current projections towards the growing urbanisation and increasing "littoralisation"⁹ of the world's population, and the demands those trends will place on the resources necessary to support that growth, as well as the logistics and global supply chains required to facilitate their flow, will result in a significant impact on the maritime domain.

⁵ By 2050, 66 percent of the world's population will be urban, with Africa and Asia urbanising faster than other regions with nearly 90 percent of the global increase.
(see UN World Urbanisation Prospects, the 2014 Revision, New York, 2014)

⁶ In 2014 28 cities were rated as megacities and it is projected to increase to 41 megacities by 2035.
(see UN World Urbanisation Prospects, the 2014 Revision, New York, 2014)

⁷ Decentralised, informal systems with a poor quality of infrastructure and unregulated flow capacity, according to Chief of Staff of the Army, Strategic Studies Group, Megacities and the United States Army, Preparing for a Complex and Uncertain Future, 2014.

⁸ Fairclough, Graham, Rolling ODD DICE: Operations in the Future Urban Warfare, Oxford UK, 2015.

⁹ A term used by academia to describe the trend that a significant proportion of the world's population will be living in the littorals.

The oceans account for 72 per cent of the earth's surface. 'Freedom of the High Seas' is the term referring to the legal regulations – set out in the 1982 United Nations Convention on the Law of the Sea (UNCLOS) – applying to vessels, aircraft and submarines when moving on, over, and under the sea. The Rule of Law is a vital condition for the security of the global economy as well as the economic stability of any state and city, as it constitutes a basis for maritime trade.¹⁰

Under the UNCLOS set of rules, the maritime domain is divided into a series of maritime zones, in which the state control in terms of law and capacity, diminishes in each zone as distance from the land increases. The stabilising effects of UNCLOS, and in consequence maritime security, may be challenged in the future as economic and national power balances change, or in case other legal perceptions occur. This regime, as we know it today, could be fundamentally undermined by excessive maritime claims, damaging the careful balance that currently exists in the world's littoral regions.

There are many definitions of the littorals. In military operations, the littoral zone is commonly understood as a coastal region consisting of the seaward area, from the open ocean to the shore that must be controlled in order to support operations ashore, as well as the landward area ashore that can be supported and defended directly from the sea.¹¹ The most challenging sphere along the coastlines is perceived as Confined and Shallow Waters (CSW). CSW are areas where the courses of action of both friendly and opposing forces are limited due to some of the following factors: Shallow waters, narrow straits, jagged and rugged coastlines, archipelago-like environments with small islands, tidal areas and extensive flats and shoals, often changing in size and shape under the influence of currents and/or weather conditions. It also includes those coastal areas from which opposing forces may be able to act against own forces.¹²

The urban littoral zone also hosts major ports and trade hubs throughout the world. An area like this will represent a complex, cluttered and crowded environment concentrating large amounts of coastal shipping traffic at sea, through key transportation hubs ashore supporting the global energy and supply chains as well as the movement of people.

Constricted sea approaches, crowded airspace, industrial hazards, and coastal inundation make the urbanised, networked littoral zones an increasingly complex and difficult operating environment¹³, complicating military access as well as creating vulnerability in the global energy and supply chain.

It is obvious that there are more natural challenges to military operations in a coastal area than out on the high seas. The impact of oceanography and meteorology are more

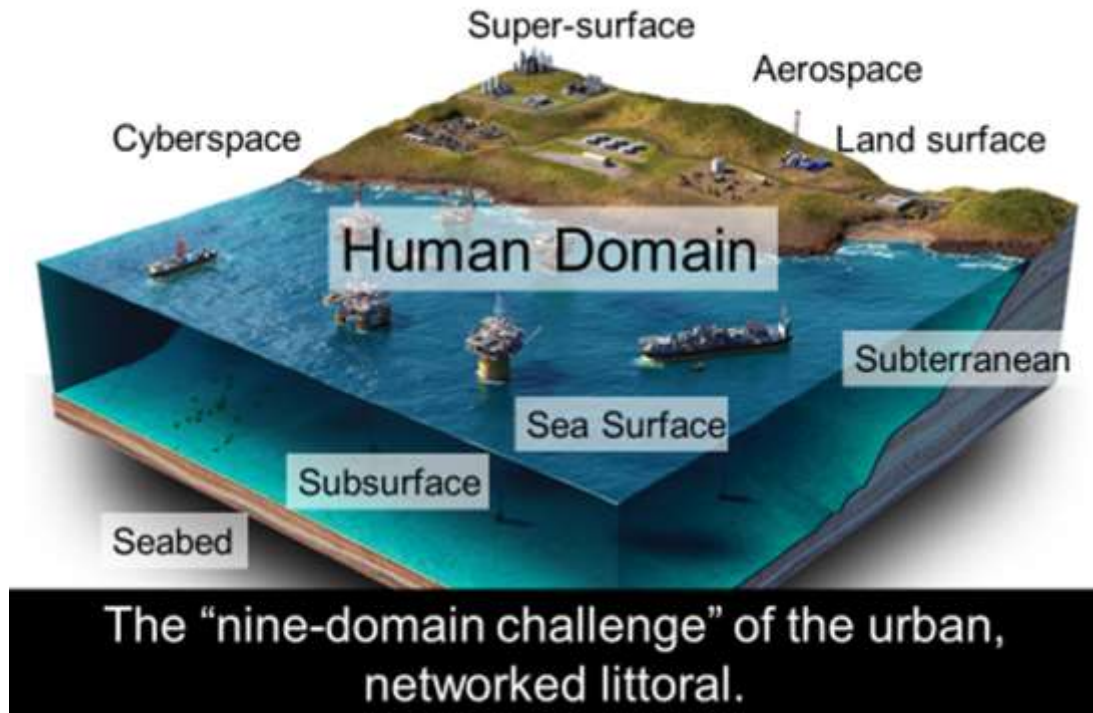
¹⁰ The seas beyond territorial waters and outside the Exclusive Economic Zone (EEZ) are free from the sovereignty of all States. In the EEZ states have only limited sovereign rights that in general do not interfere in freedom of navigation. Warships can operate in all the world's oceans right up to the edge of the territorial sea unfettered by coastal State control.

¹¹ AJP 3.1, Allied Joint Maritime Operations, 2016.

¹² In accordance with COE CSW MoU, 03 October 2008.

¹³ Kilcullen, David, The Conduct of future operations in the urban littoral and its implications for NATO, Research paper for Allied Command Transformation Urbanisation Project, 2015.

distinctive and can significantly complicate operations in an urban littoral environment. These natural challenges have an even greater and less predictable impact in confined and shallow waters. Researchers suggest that a “nine-domain challenge” must be faced when conducting urban, networked littoral operations.



Source: David Kilcullen; Presentation at the Maritime Urbanisation Community of Interest Workshop in Hampton Roads, February 2015

This is the basic impetus behind this paper, which will also discuss the anticipated importance of these domains and challenges NATO will face while conducting maritime operations.¹⁴

¹⁴ Using the structure outlined by Borchert, Heiko, Maritime Security at Risk: Trends, Future Threat Vectors, and Capability Requirements, Lucerne, July 2014.

2. Maritime Commodities and Information Flow

2.1. International Seaborne Trade

The ocean is the highway for international trade, with 90 per cent being seaborne¹⁵. While predicting the future is challenging, current assessments forecast that the world of 2030 will be almost unrecognisable owed to the rise of emerging countries, new consumer classes and unprecedented resource demand.¹⁶ The majority of studies looking into the future conclude that four global drivers will also affect the commercial shipping sector: demography, economy, resources and the environment.

From these four drivers, the economy has the largest measurable impact on the commercial sector. National economics is a reflection of a country's productivity and technology level, which in turn is reflected in the extent of urbanisation and industrialisation. The rise in the standard of living increases the middle classes and generates demands for resources, consumer goods and services. Continued urbanisation trends leads to cities with much denser populations, and requires the infrastructure to connect them. This generates an increasing demand for raw material such as iron ore, which may not be available locally. Bulk carriers are required to ship raw materials such as coal and iron ore across the oceans from producing to consuming countries. In the meantime industrialisation requires electricity to power industrial growth. This generates demands for fossil resources such as coal, crude oil, liquefied natural gas and oil products which are carried by tankers. As countries develop their industrial capacity, they increasingly export manufactured goods to consumers around the world. This generates demand for even more container capacities to carry manufactured goods from production centers to consumers around the globe.

In January 2014, the world fleet reached a total of 1.75 billion deadweight tonnage (DWT).¹⁷ Bulk carriers account for 42.9 per cent of the total tonnage, followed by oil tankers (28.5 %) and container ships (12.8 %)¹⁸. Interruption of maritime flows can easily cause problems in the impacted urban area, the whole region/ hinterland as well as anywhere in the global supply chain. Current research suggests that 20-30 per cent of incoming goods are supporting the port city, while the rest is distributed and transported further on by land. For this study we assume that there will be significant effects on the impacted urban population if maritime transportation flows are interrupted. The future trends in terms of cargo type providing a basis for predicting commodity flows are listed in the Annex.

¹⁵ IMO, IMO and the Environment – IMO's response to current environmental challenges, 2011.

¹⁶ Lloyd's Register, QinetiQ and University of Strathclyde, Global Marine Trends 2030, 2013, p. 10.

¹⁷ DWT is the sum of the weights of cargo, fuel, fresh water, ballast water, provisions, passengers, and crew which a ship can safely carry. It does not include the weight of the ship.

¹⁸ UNCTAD, Review of Maritime Transport, Geneva, 2015.

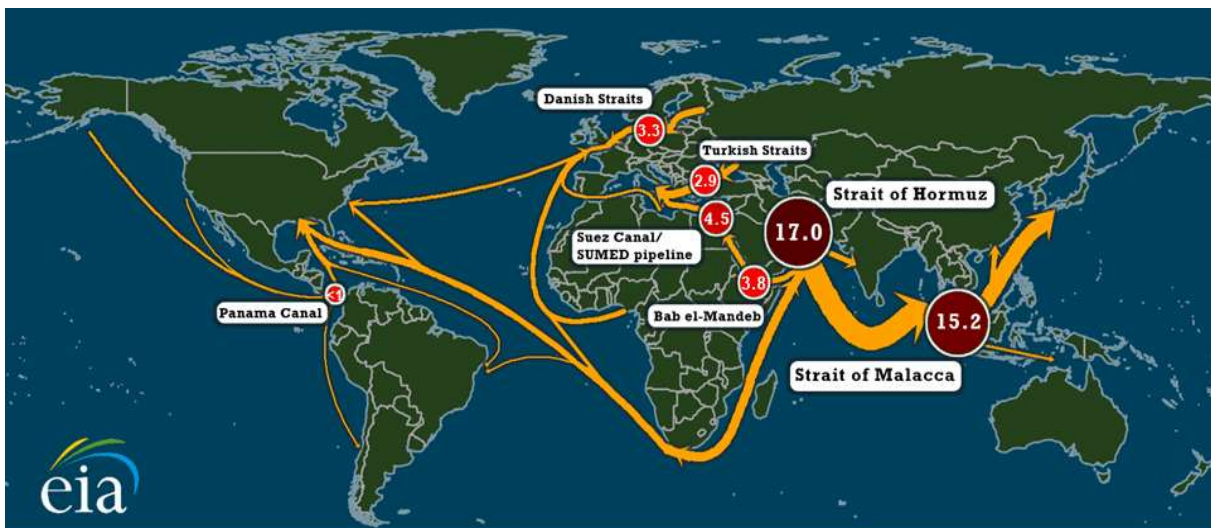
2.2. Maritime Passages and Chokepoints

Maritime Straits and Chokepoints naturally present many challenges. They refer to locations that limit the capacity of circulation and cannot be easily bypassed.¹⁹

Chokepoints tend to be narrow and often also shallow, impairing navigation and imposing capacity limits on ships.²⁰

Many chokepoints are located in politically unstable regions, increasing the risk of compromising their access and use, such as with piracy. However a closure of a chokepoint is a rare instance that so far only took place in situations of war as one proponent prevented another to access and use that seaway (e.g. Gibraltar and Suez during World War II). A closure of a maritime chokepoint in the current global economy, even if temporary, would have significant economic consequences.²¹

There are approximately 200 of such locations, but only a few of them are of strategic importance, as shown at the map below. These chokepoints are the geographical Achilles heels of the global (maritime) trade. They can be mined, physically blocked by sunken ships, or interdicted by naval forces or land based systems. They also leave vessels vulnerable to acts of piracy, terrorist attacks, or shipping accidents that could lead to disastrous oil spills and political unrest developing into hostilities or even armed conflicts.



All estimates in million barrels per day. Includes crude oil and petroleum products. Based on 2013 data.

Source: U.S. Energy Information Administration analysis, based on Lloyd's List Intelligence, Panama Canal Authority, Eastern Bloc Research, Suez Canal Authority, and UNCTAD, using EIA conversion factors

¹⁹ Rodrigue, Jean-Paul, *The Geography of Transport System*, Third Edition, New York, 2013.

²⁰ op. cit.

²¹ op. cit.

2.3. Inland Waterways

Inland waterways connect regions with international sea routes and are important links to the global supply chain with growing economic relevance in the future. Some of these waterways are adjacent to urban areas, either as natural or modified/ canalised rivers, or as artificially constructed canals.

Accessibility and the usage of inland waterways might be hampered by barrages, dams or other manmade and natural obstacles. Military engagements are even more challenging in those coastal areas due to rapid and unpredictable developments. The asymmetric threat is high and easily concealed by everyday activities in the area. Inland waterways might be the only available access to a city from the sea.

2.4. Sea Ports

Many important cities in the world owe their origin and their prosperity to their sea port. Harbours and maritime trade are important drivers of urbanisation. More than half of the world's population will live in a littoral area in 2035 and they will heavily depend on the exchange of goods through ports. Ports are to be regarded as key infrastructure in any urban centric environment.²²

Port infrastructure is the fundamental basis for any transshipment activity and thus facilitates convergence between land and maritime transport systems. Access to industrial complexes and markets influence growth and importance of a harbour. This requires efficient inland distribution ways, such as river, rail and road transportation. The land access to ports located in densely populated areas is facing increasing congestion. Many ports are constrained by urban and environmental pressures which did not exist when the existing facilities were developed.

Ports are becoming increasingly regional in their dynamics, which represents a new development from their traditional local function and as a part of a nation's industrial complex. About 4,600 commercial ports are in operation worldwide, but less than 100 are of global significance. These primary ports are gateways of continental distribution systems and thus are to be regarded as a kind of chokepoints in their own.

Ports and related shipping activities are difficult to secure. Ports are typically large and dispersed over hundreds of acres of land and water. They can simultaneously accommodate ship, truck and rail traffic, petroleum products/ liquid offload, storage or piping, container handling and the movement of freight & cargo (solid or liquid). Any delay snarls all operations.²³ Inevitably, security measures would create some delays that generally falls by the wayside in the interest of time management or convenience mostly with negative influence on the economic efficiency.

²² NATO ACT study paper, The significance of harbours for the flow of commodities and its inherent risks and vulnerabilities related to urban areas, Norfolk, October 2015.

²³ U.S. GAO, Maritime Security: Enhancements Made, But Implementation and Sustainability Remain Key Challenges, Washington DC, 2005.

Advances in logistics and efficiency are often a direct result or accompany technologic innovations. Automation and digitalisation of cargo handling has improved the performance of modern ports significantly. Unmanned systems will increasingly help to load and unload vessels. However, the overall trend in robotics and the introduction of autonomous systems increases not just the performance, but also the inherent vulnerabilities. Automation has significantly reduced the number of crews needed. Some argue the benefits and improved safety standards, but others see growing risks due to cyber-attacks or the proliferation of dual use technology that any adversary could exploit.²⁴

But not just hacking, also social engineering can hamper or shut down a terminal and even worse a whole port.²⁵ Social engineering also presents vulnerabilities such as the disclose confidential documents, or alteration manifests and container numbers, just to name a few. A minor cyber-attack could result in millions of dollars of loss respectively third-party liabilities. The most recent report on port infrastructure cyber security risks, issued by the US Government Accountability Office (GAO) in June 2014, confirms the risks and assesses that the threat has grown in significance, whilst the maritime industry failed to make cyber security a priority.²⁶

Given the interconnectivity of maritime commerce and the paramount need to keep ports operating with speed and efficiency, a cyber-attack on just one single major port would send a significant negative ripple throughout the entire economy. With the ability to create significant impacts with little effort, maritime commerce presents a fruitful target for both non-state and state actors. Threats of cyber-attacks can range from rival companies, through individuals or groups such as terrorist organisations advancing a political or environmental agenda, or states imposing hybrid means to avoid any obvious use of force or military hardware.

With regards to military operations, a port might be the only useable access point to a city or resupply hub for own forces. As more than 90 per cent of all military cargo enters an area of operation via a seaport of disembarkation, these logistic hubs are of key importance for strategic mobility and operational access in general, but all the more in an urban scenario.²⁷

²⁴ World Economic Forum, The Global risks Report 2016, 11th Edition

²⁵ Social engineering is a commonly used term when employees or vendors are used to conduct data breaches.

²⁶ U.S. GAO, Maritime Critical Infrastructure Protection, Washington DC, 2014.

²⁷ op. cit.

2.5. Digital Sea Lanes

The maritime domain hosts one of the most important, but often ignored infrastructure: undersea communication lanes.²⁸ These cables connect the globe, whether it be of private, economic, political or any other nature. Most of the intercontinental digital traffic is handled via undersea cables.

Starting in 1988, a massive 10-year build-out replaced the vast majority of copper network cables with long-haul fibre optic cables. Today virtually all of the undersea long-haul communications lanes are optical fibre handling more than 95 per cent of IP voice and data traffic and 100 per cent of international Internet traffic between the continents.²⁹

The underwater cable network is a critical component to global commerce, and it is still growing. According to a comprehensive market research report by Global Industry Analysts, cumulative global installation of submarine optical fibre cable is projected to reach two million kilometres by 2018³⁰. The longest submarine cable is the Southeast Asia–Middle East–Western Europe (SEA-ME-WE 3) system stretching 39,000 kilometres from Northern, Germany, to Keoje, South Korea. The system connects 33 different countries with 39 landing points.

One of the biggest challenges facing the submarine optical fibre network is that many parts are vulnerable to disruptions in service due to lack of redundancy. Technical faults happen less frequently than in terrestrial networks, but take much more time to repair. In fact, the transatlantic cables require dozens of repairs each year, but the United States and Europe have ample redundancy, so a single cable failure is hardly noticeable to the public. However, cuts to cables in bottleneck areas like the Suez Canal (for cables connecting Europe to the Middle East, Asia and East Africa) can slow down or even completely disrupt the service for weeks.

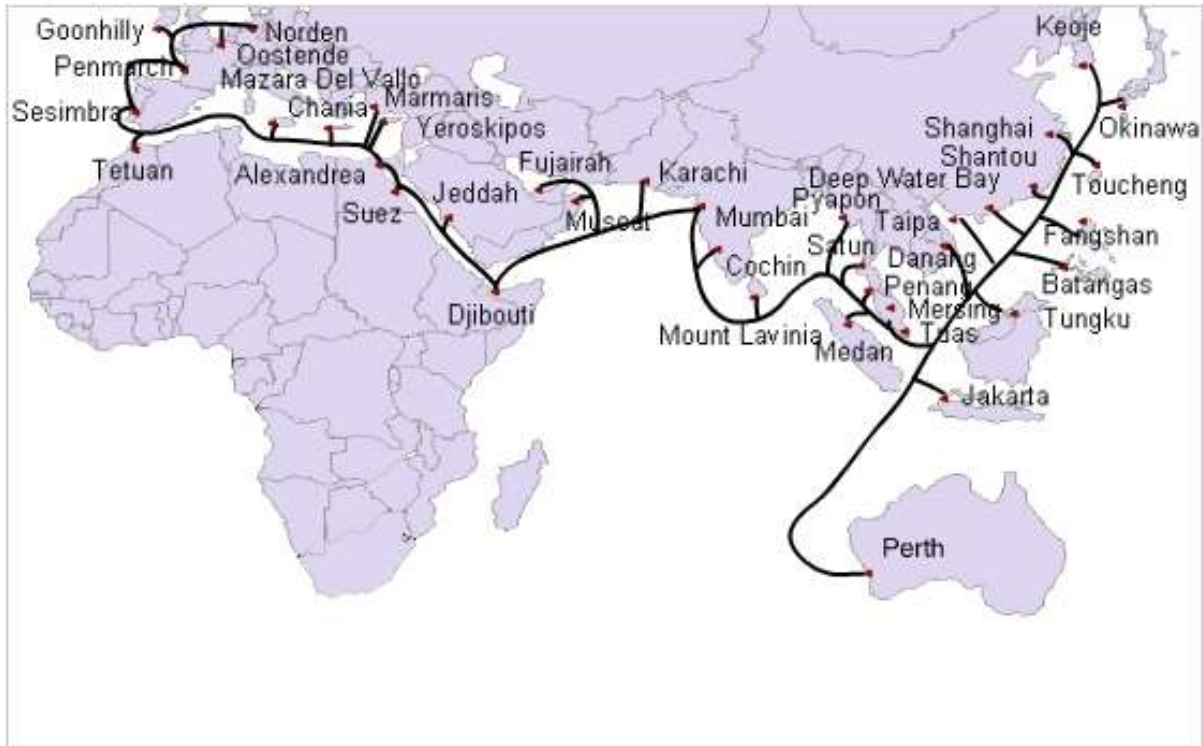
The most common threat to submarine cables are shipping and fishing activities. Roughly 70 per cent of cable damage from anchor-dropping and trawling occurs in water less than 200 meters depth.³¹ Maps depicting most of the cable routes are easily accessible to the public. A lot of information about global cable routes is available on the Internet, making it easy to discern weak spots. With this detailed information and along with the increasingly eased access to sophisticated equipment, state and non-state actors could target cables by using underwater vehicles equipped with high-resolution sonar and explosive ordnances or mechanical cutting devices. Also, natural disasters such as mudslides and typhoons are posing dangers to undersea fibre.

²⁸ Borchert, Heiko, *Maritime Security at Risk: Trends, Future Threat Vectors, and Capability Requirements*, Lucerne, July 2014.

²⁹ David W Brown, *10 Facts About the Internet's Undersea Cables*, November 2015

³⁰ Global Industry Analysts, Inc.: *The Global Submarine Optical Fiber Cables Market (Trends, Drivers & Projections)*, March 2015

³¹ Karl Frederick Rausher, Keynote address at the *"Global Summit on Reliability of Global Undersea Communications Cable Infrastructure (ROGUCCI) conference*, The Report, Issue 1, rev 1, (2010 IEEE Communications Society)



SEA-ME-WE-3 Cable System Configuration

Source: sea-me-we-3 website

In fact there are not only physical threats to underwater communication lanes. The U.S. State Department listed the world's cable landing sites as among the most critical of infrastructures for the United States.³² By gaining access to terminals located within cable landing sites, or control to systems managing the fiber-optic wavelengths themselves, a hacker could acquire control over portions of international data and voice traffic and, potentially, the power to disrupt or degrade vital parts of the cyber infrastructure.

³² Clayton, Mark, WikiLeaks List of "Critical" sites: Is it a "Menu for Terrorists"?, The Christian Science Monitor, 2010.

3. Marine Resources

With the expected population growth, energy demand is forecasted to increase by as much as 40 per cent by the year 2030.³³ In China alone, oil consumption is expected to increase three-fold over the same time period. In addition, the food requirements necessary to meet the increased demand should be met by developing technology and will use the ocean as an important source for nutrition.

3.1. Offshore Energy, Mineral Exploration and Exploitation

Most of the world's oil and gas reserves rest beneath the sea floor; the maritime domain is therefore a vital area for the world's offshore exploration and exploitation.

Security has always been one of the priorities of the energy industry, especially the oil and gas sectors. Oil facilities are an important part of a country's critical infrastructure. Reports by intelligence agencies in a number of countries have clearly identified the oil & gas industry as a potential target for terrorist attacks. The attacks against oil facilities in Iraq, particularly oil and gas pipelines, have been extensively adopted as a war tactic. In the last few years an average of 300 terrorist attacks per annum have taken place against oil targets (facilities and personnel).³⁴

The oil and gas industry is susceptible to these risks for a number of reasons. First, the physical and chemical properties of the materials handled and stored have the inherent potential to cause damage to ecosystems and populations that are close to the facilities, creating enormous media impact on top of the economic and human devastation. Secondly, the strategic and global nature of the oil & gas industry means that any disruption in its operations has serious consequences on the world economy. Finally, large oil companies are often based in major centres of power and influence.

The risk of attacks against oil and gas infrastructure varies according to the segment of the value chain involved: exploration and production, treatment, refining, pipeline transport, sea transport, distribution and marketing. Currently, the biggest threat to critical infrastructures comes from "asymmetrical conflicts" that use unconventional tactics of attack. An oil companies' corporate security departments increasingly have to face "unconventional enemies": nationally or internationally operating terrorists, activists, pressure groups, fanatics for specific causes, disaffected employees and computer hackers (either organized or opportunistic). These opponents may use different methods of attack at various levels of intensity most likely in a complex and coordinated plan aimed at exploiting any vulnerability, to include physical, cyber (IT), organisational, environmental, and even human.

³³ Lloyd's Register, QinetiQ and University of Strathclyde, Global Marine Trends 2030, 2013, p. 112.

³⁴ Thales Group Article, Protection of Critical Infrastructures in the Oil and Gas Industry, 29.07.2010

In addition to traditional oil and gas production there has been significant development of offshore wind farms in coastal areas in order to meet renewable energy demands. Substantial research is underway on how to harness energy from waves, tidal currents and ocean currents, as a source of energy. The requirement for a more environmentally friendly energy production, such as those listed above, might create navigational obstacles and challenges for future maritime operations in coastal and urban areas.

It cannot be ruled out that small offshore nuclear plants installed on the seabed, or the use of ships as floating nuclear power plants, will be solutions to an increased energy demand in rapidly urbanised areas. Both Russia and China have already developed plans for such installations, and the Massachusetts Institute of Technology has designed a nuclear power plant that could be easily deployed to regions with "limited indigenous resources and coastal populations in need of power"³⁵. Energy sources like this would be obvious targets and have inherent energy security and environmental aspects that can not be ignored.

Steady and reliable delivery of energy to urban areas will be of vital importance to maintain stability and order. Global competition for both energy and resources has driven a desire for changes to international borders, and their associated Exclusive Economic Zones (EEZ). At the Pacific 2015 Maritime Conference, Admiral Scott Swift, Commander U.S. Pacific Fleet, stated that "some nations view freedom of the seas as up for grabs, as something that can be taken down and redefined by domestic law or by reinterpreting international law. Some nations continue to impose warnings and restrictions on freedom of the seas in their exclusive economic zones and claim territorial water rights that are inconsistent with UNCLOS. This trend is particularly egregious in contested waters."

In situations with a lack of regional or national abilities to fulfil this role there might be the necessity for NATO to develop capabilities to protect vulnerable and critical energy security nodes in a coastal and urban environment. With the potential for a significant increase of installations for energy production in the coastal urban environment, NATO needs to be aware of the potential operational obstacles in such an environment.

3.2. Fisheries and Aquaculture

The expected population growth will lead to an increased need for food. It is likely that fish supplies from capture fisheries will not be able to meet this growing global demand for aquatic food.³⁶ Therefore the UN Food and Agriculture Organization (FAO) expects a huge increase in coastal food production based on fish farming and farming of aquatic plants.

In an urban area a significant growth of marine food production might lead to a challenge regarding the use of coastal space for maritime enterprises. Fisheries are vulnerable and important income areas which have to be taken into account not just with regard to resource exploitation, but also while conducting military operations. Impacts on fisheries, both regular fishing and fish farming, and other forms of aquaculture, in particular in an urban area, may have significant impact on the stability situation within it.

³⁵ Nancy W. Stauffer, A new look for nuclear power, MIT Energy Initiative, 24.06.2015

³⁶ Fisheries and Aquaculture Technical Paper 500/1, World aquaculture 2010, Rome 2011

Ongoing research is looking into spatial management of the coastal areas. An example is the EU sponsored 'AquaSpace 2020' project. The central goal of this project is to provide increased space of high water quality for aquaculture by adopting the Ecosystem Approach to Aquaculture (EAA) and Marine Spatial Planning (MSP) and so to deliver food security and increased employment opportunities through economic growth. The project aims at working in collaboration with the aquaculture industry, other stakeholders, coastal managers as well as planners in the European Economic Area and beyond to produce a range of tools that will enable effective implementation of EAA and MSP to support the aquaculture sector.

Even though NATO is not to be regarded as a stakeholder within the framework of this project, it still remains important to understand that there will be a crowded coastal arena where fisheries and aquaculture could spatially occupy a substantial part of the coastal areas close to an urban area.

4. Coastal Habitat

Presently, around 80 per cent of the world's population lives in coastal regions. As populations grow, cities will also grow. Especially in the developing world, urbanisation has been accompanied by increasing inequalities, growth of informal employment, expanding slums and informal settlements.³⁷ Nowadays large numbers of people are living in environmental high risk areas such as creeks, river and canal beds, marshes, and even at sea on floating platforms, depending on the sea-level. Coastal slums constrain sea approaches to cities, and choke waterways with refuse and small boat traffic.

In slum areas there is often a huge proportion of the population are migrants from neighbouring countries, seeking for work and a better life for their families. The local population and the government often do not welcome them, forcing them to live in enclaves. This can create challenges leading to or aggravating a crisis, triggering city turmoil and other violent destabilising behaviour. If a natural disaster hits a coastline, the vulnerable slum-areas will be most affected.

Poverty and informal structures, along with poor governance may create conditions where people are forced to earn money by illicit activities, ranging from piracy to waterborne trafficking. Such areas of generally low situational awareness with limited or non-existent government and security presence enable and encourage non-state-actors to "nest" in and conduct their 'business' untroubled.³⁸

³⁷ Based on a conservative estimate the slum population in low and middle-income countries is likely to double within less than 30 years. By 2035 close to 1.7 billion of the expected 3.93 billion urban dwellers will be living in slums (UN-HABITAT, *Slums of the World: "The Face of Urban Poverty in the New Millennium"*, Nairobi, 2003).

³⁸ Kilcullen, David, *Out of the Mountains: The Coming Age of the Urban Guerilla*, London, 2013.

In maritime terms another aspect feeds in: The “seamless city,” a peri-urban space around a city that merges into “bands of urbanized terrain that extend hundreds of miles in coastal areas, cross national borders, and house many millions of people.”³⁹ Consequently, access from the sea, besides ports and rivers, will be hampered or may be even impossible.

The phenomenon of “internal secession” may occur at a city, district or street level creating an urban environment where privately owned sectors, government-controlled areas and territory with the poorer population creating no-go areas come together.⁴⁰ One of the related concerns might evolve from gated communities protected by private security companies, being another relevant armed actor in an urban environment.

In ungoverned areas with poor hygienic conditions diseases will pose a major threat to the population as well as any civilian or military assistance force. Along with the extensive movement of goods and people in a city, a dangerous epidemic can easily impact or even stop military operations.⁴¹

Another trend is the increase of artificial infrastructure and (is)lands, built on rivers and in the sea. This growing trend is triggered by the overcrowding of cities and confined space. Safety, prestige, and accessibility may be additional reasons why this alternative has become increasingly popular. Maritime platforms for recreational use might be seen in growing numbers and could create additional obstacles for military operations.

5. Environmental Change and the Maritime Domain

Although there are still significant uncertainties in the projections of environmental changes, there is a common view that coastal cities are particularly vulnerable to the long-term effects of global warming. The sea-level rise, flooding, air pollution or severe storms are just some examples of the effects of global warming. Even if environmental changes do not increase the severity of such events, their impact would still be significant as a larger number of people will be affected.

The impact of rising sea-levels will vary from place-to-place depending on topography, geology, natural land movements and any human activity affecting the water level or sediment availability. In taking these anticipated risks into account, coastal cities should be assessed in terms of the consequential potential dangers.

Humanitarian Assistance and Disaster Relief Operations may not be the core tasks of military forces, but are likely to be increasingly required and requested in response to on-going environmental changes.

³⁹ Kilcullen, David, The Conduct of future operations in the urban littoral and its implications for NATO, Research paper for Allied Command Transformation Urbanisation Project, 2015

⁴⁰ Kilcullen, David, Climate and Geographical Implications for Future Urban Operations, research paper for Allied Command Transformation Urbanisation Project, 2015.

⁴¹ United Nations Development Group, Socio-Economic Impact of Ebola Virus Disease in West African Countries, February 2015.

6. Power, Influence and Control

6.1. Impacts on future maritime operations in an Urban Area

Future trends suggest that the maritime domain will experience significant changes when it comes to power projection and sea control. In a situation where regional powers are notably increasing their maritime capabilities, and the competition for the resources intensifies, some of these states may seek to limit the freedom of the high seas by extending their jurisdictions and introducing control regimes.⁴² Operationalisation of the NATO Alliance Maritime Strategy (AMS) has been under consideration for some time.⁴³ A priority is to ensure that NATO will maintain its role as a predominant actor in the maritime domain. However, this ambition is challenged by a decreasing number of platforms in NATO navies⁴⁴ and the diametrical trend of increasing numbers in navies on the other.⁴⁵

The new paradigm is connectivity and being able to use global networks to disseminate and receive ideologies, weapons, drugs, revenues, and technical expertise while overcoming geographical isolation. This is affecting traditional power projection in a significant way.

The recent US naval strategy highlights: "...the proliferation of technologies that allow potential adversaries to threaten naval and air forces at greater ranges complicates our access to some maritime regions (Anti Access: A2), as well as our ability to maneuver within those regions (Area Denial: AD), including the littoral and landward access ... the free flow of goods and services can be impeded by state or non-state actors ...".⁴⁶

The implication is that maritime operations in an urban area will most likely not be conducted in permissive deployment and entry conditions. As the possible hostile environment can consist of elements representing conventional, irregular and hybrid threats, operations aiming to dominate an urban littoral battle space are both complex and risky.⁴⁷ A presentation from the US Naval Postgraduate School referred to the technologies as "the littoral niche player challenge" and listed the following weapons and weapon-systems as threats to naval forces conducting littoral operations:

- weapons of mass destruction (chemical, biological, radiological, nuclear),
- ultra-quiet diesel submarines,
- sophisticated sea-mines,
- anti-ship cruise missiles (shore-, ship- and air-launched),
- swarming small boats,

⁴² Borchert, Heiko, *Maritime Security at Risk: Trends, Future Threat Vectors, and Capability Requirements*, Lucerne, July 2014, p. 29-32.

⁴³ Yonah Alexander and Richard Prosen, *NATO from Regional to Global Security Provider*, US 2015

⁴⁴ Advanced navies: USA, UK, European, Brazil, Canada, Australia; Emerging navies: China, Republic of Korea, Japan, Singapore, Malaysia, Thailand, Vietnam. (*Global Marine Trend 2030*, p.99).

⁴⁵ Lloyd's Register, QinetiQ and University of Strathclyde, *Global Marine Trends 2030*, 2013.

⁴⁶ United States, *A Cooperative Strategy for 21st Century Seapower*, March 2015.

⁴⁷ Jasper and Moreland, *Future Anti-Access and Area Denial Challenges Posed by Urban Centers to 2035*, research paper for NATO ACT Urbanisation Project, Monterey, 2015.

- unmanned vehicles⁴⁸,
- advanced surface-to-air missiles (fixed and mobile),
- land-attack cruise missiles,
- theater ballistic missiles,
- decentralised integrated air-defense-systems,
- commercial C4ISR systems for communication, navigation and imaging

With the potential existence of such threats NATO maritime forces might be limited or hindered in their approach from sea. Therefore, NATO forces must have the capabilities to counter A2 threats in the first step and find appropriate access points to project power ashore. Nonetheless, maneuvering remains to be a challenge and available AD weapons and systems will make it more difficult for large, traditionally static forces to operate in geographically restricted areas. Commercial satellite systems and space imaging, the proliferation of advanced surveillance and data systems and integrated communications technologies will lead to ever more transparency of military operations, while an irregular opponent can work offline using a combination of traditional communication means as they choose. In addition, capabilities for invasion, occupation and defeat of a nation or a city, that may be still a goal in contemporary operating inventories, are less likely to meet regularly desired political end states in the future.

6.2. Actors in the Maritime Urban-Centric Environment

Strategically located coastal cities, with population concentrations, transportation infrastructure, and above average income levels, have become important points of control for those seeking profit or support for their cause. All research suggests that the most prevalent future threats in this environment will come from non-state armed groups using irregular methods, avoiding direct confrontation, but being able to acquire highly sophisticated weapons. These groups can be very different and categorised by their aims: opposition groups, crime groups, militias, vigilantes and gangs, and also private security.⁴⁹ Since there can be a strong relationship and fusion between these groups it is often very difficult to differentiate them and to identify their purpose and intentions. Those groups and organisations have to be analysed in detail due to the conceivable possibility to destabilise a state and their potential influence on the maritime domain.

All threats to the maritime industry need to be addressed properly. When captured in 2002, Abd al-Rahim al-Nashiri, Al Qaida's chief in the Persian Gulf, had developed a four-pronged strategy to attack Western shipping targets. The strategy included attacking vulnerable vessels at sea, blowing up medium-sized vessels in port and conducting underwater attacks by divers or suicide demolition teams, using limpet mines.⁵⁰ With continued technological development, the ability to conduct terrorist attacks as described will become increasingly easier and become even more relevant.

⁴⁸ Addition by authors

⁴⁹ DCAF Horizon, Working Paper No. 5, Armed Non-State Actors: Current Trends & Future Challenges, 2015.

⁵⁰ Eshel, David, The Threat of Maritime Terrorism,-www.defense-update.com, December2005.

Port authorities will be important actors in any military operation in the urban environment. Some terminals are leased to private entities, so called “Port Holding” companies. Those are also entities with power in the maritime domain.

In addition, the workforce necessary to operate a sea port is of critical importance, in particular if the port lacks automated systems for cargo handling. Due to the kind of work in harbours, the majority of the workforce normally stems from the working class, which might be affected or controlled by non-state actors – be it organized crime or others.⁵¹ Therefore, port actors should be considered highly important players as they dominate central access points to a city.⁵²

Criminal organisations might seek to infiltrate government and commercial business and aim at initiating changes from the inside in order to ease the trafficking of narcotics, arms or humans, relying on the same port facilities that also support legitimate commercial maritime logistics. Although the presence of organised crime alongside legitimate cargo is nothing new, the use of shipping as a method to traffic arms, humans, and illicit drugs is increasing as cargo volumes increase. Along with an expansion of narcotics-, arms- and human-trafficking, comes money laundering and corruption; criminal groups exploit legal transport- and logistic-chains, utilising individuals willing to operate in both legal and illicit domains.

Organised criminal groups have two main uses for ports. First of all, profit-oriented crimes that generate revenue such as the importation of illegal drugs, counterfeit goods (tobacco products, pharmaceutical products, clothes); in addition illegal immigrants and cargo theft are known to be using ports as a major arena for their activities. Secondly, the port, or rather the port organisation, is used as “tactical support” for criminals, facilitating their profit-oriented activities. This involves corruption and to a lesser extent intimidation of industry insiders as well as security and law enforcement personnel. Stolen cars and domestically produced synthetic drugs were cited as the most frequent illegal goods exported through commercial ports.⁵³

⁵¹ As recently shown in Libya, it is the criminal economy rather than state actions that binds the regions of this country together, building more and more networks trading weapons, migrants, drugs and smuggled goods. Criminal non-state-actors in coastal areas use ports and other embarkation points for their business, driven by very local interests. In utilising gaps in law-enforcement and customs/ border control, for example, that only a very small portion of containers are searched, these actors are able to do their business relatively unhindered. With growing resources they can defend their business, especially when they have access to weapons: “Guns are what determines influence in the port now”, as one Libyan official commented. Control of the air- and seaports is considered key to controlling economic activity and therefore also increasing political influence. This goes along with an increasing fusion of crime and government, with consequences for other regions or countries, for example the weapons provided out of Libyan storages for fueling the war in Mali. (see Shaw, Mark and Mangan, Fiona, United States Institute of Peace, Illicit Trafficking and Libya's transition – profit and losses, Washington DC, 2014.)

⁵² Kilcullen, David, Climate and Geographical Implications for Future Urban Operations, Research paper for Allied Command Transformation Urbanisation Project, 2015.

⁵³ Public Safety Canada, Marine Ports and Organised Crime, Organised Crime Research Brief no. 25

A RAND Corporation investigation on Maritime Irregular Warfare revealed that, even if a campaign is primarily maritime or riverine in nature, maritime assets seem to operate in a supporting role.⁵⁴ In maritime-related case studies, a non-state-actor – or a terrorist group – make use of coastlines and ports to bring in goods and weapons they need for their cause. Sealing off vast coastlines is not possible by just employing military means and limited resources.⁵⁵ Any efforts from maritime forces would be an attempt to contain the threats, without striking at the causes or sources of origin. Often non-state-armed groups are a legitimate source of service for the local population. Hezbollah is used as an example to describe a capable force on all points of the delivery and support scale. Such actors cannot be beaten by military means only due to their non-military support system for the population and widespread support from the local population. These factors can not be ignored while dealing with such groups that experience the same conditions in an large scale or limited conflict; providing widespread backhold needs to be dealt with as well.

Another aspect, to consider in regards to Maritime Irregular Warfare, might be the emerging ‘web of criminality’ which may consist of pirates, terrorists, and “ordinary” criminals. This ‘web of criminality’ increases in complexity as these groups may cooperate in illegal activities opportunistically and in an ad hoc manner. While hard evidence is difficult to obtain, there are several aspects that support this thesis.⁵⁶ Unsurprisingly, the world’s key shipping routes and known patterns of illicit activity coincide, revealing the vulnerability of the maritime commerce. For example, global trade routes used by drug traffickers overlap not only with known pirate and terrorist areas of activity, but with the world’s major transit routes for the legitimate trade in energy and commodity flows. Piracy – regardless of where it occurs – imposes economic and human costs on all nations.

The Royal United Service Institute (RUSI) points out that complex competitions between states are occurring less frequently. More typical is the competition between a mix of non-state actors, state sponsored proxies, transnational groupings and ideologically focused affiliates.⁵⁷ Today, and probably even more so in 2035, adversaries will have found an answer to NATO’s military power. State-based militaries and organisations react slowly and in a rather inflexible manner, leaving them two steps behind an innovative and flexible adversary.

⁵⁴ Dunigan, Hoffmann, Chalk, Nichiporuk, DeLuca, Characterizing and Exploiting the Implications of Maritime Irregular Warfare, RAND Corporation, 2012.

⁵⁵ Hansen, Stig Jarle, Piracy in the greater Gulf of Aden: Myths, Misconceptions and Remedies, NIBR Report, Oslo, 2009.

⁵⁶ For instance pirates in Somalia are known to have engaged from time to time in gun running on behalf of Al Shabaab. Al Shabaab has been associated with the illegal charcoal and khat trades (most of which is transited by ship). In Nigeria, the Movement for the Emancipation of the Niger Delta (MEND) and the more radical Boko Haram, have been associated not only with piracy and oil theft, but are also believed to be involved in the illegal drug trade transiting through the country as well.

⁵⁷ RUSI Final report ver 1.3., The Utility of Amphibious Forces, 12 Feb 2015.

As commercial shipping companies have a vital interest to keep a port and the flow of goods and services running, they often need to rely on organic security efforts. During the Iraq and Afghanistan wars, Private Security Companies experienced increased demand levels for their services. They provide a vast array of services to include: guarding, protection of persons, escorting humanitarian aid and convoys, training and advising armed forces, operating complex weapon systems and collecting information. As armed non-state-actors can potentially be relevant players with destabilising potential. In April 2015, the G7 Foreign ministers acknowledged the use of Private Maritime Security Companies for sea-going vessels, including armed personnel in order to provide protection against threats. It seems that this is a confession that states are no longer able to support with their navies.⁵⁸

Projected into the year 2035, other commercial organisations should be considered separately and according to their field of expertise as they might have even more power and influence than today. Some may provide services for port reconstruction or parts of sea-basing might be potential partners for NATO, while others could interfere in fields like humanitarian assistance and disaster relief.

In some cases state actors choose a hybrid approach, making use of irregulars or irregular warfare as their preferred instrument and weapon of choice, or using asymmetric methods to minimise their footprint and avoid blame and counter-reaction.⁵⁹ A large scale war primarily employing conventional means and methods is not their preferred option. NATO's future adversary in an urban environment will create and modify their doctrines, tactics and procedures around a clear political and strategic vision. They will transform their limited, but sometimes broad spectrum of means into effective weapons. NATO training and exercises have to take this into account.

⁵⁸ G7 declaration on Maritime Security, Luebeck, April 2015.

⁵⁹ "Hybrid Wars incorporate a range of different modes of warfare, including conventional capabilities, irregular tactics and formations, terrorist acts including indiscriminate violence and coercion, and criminal disorder." cited by Hoffman, Frank, *Conflict in the 21st Century: The rise of hybrid wars*, Arlington, VA, 2007.

7. Conclusions

Coastal zones are of vital relevance for mankind. The vast majority of commodity-flows for cities is transported via the sea. Thus, the importance of maintaining an undisrupted maritime supply chain is essential. The great challenge for NATO will be to continue to sustain a city's ecosystem, while operating together with all other relevant actors in an urban environment.

International maritime routes are forced to pass through specific geographical locations known as chokepoints, limiting the capacity of circulation and not to be easily bypassed, if at all. As global interconnectedness increases, these Achilles heels of global maritime trade and naval passages could be disrupted or closed. NATO must be aware of this possibility and should be able to keep those vital points open and useable.

As inland waterways in numerous geographical areas – to include urban areas – experience increased levels of trade and economic importance, traditional military forces must maintain the ability to operate in these areas across multiple mission areas. The most important challenges will be accessibility, vulnerability from the high ground, and close-quarter engagements and threats. Ports and inland waterways might be the only access from the sea to the city

Sea ports are key hubs for the flow of commodities. With growing populations and increasing supply needs, harbours will maintain a vital function within the global supply chain. Although Ports are very unique, all are inextricably connected to – and dependent on – infrastructure and activities, both on and offshore. The increased automation of ports makes them progressively vulnerable to cyber-attacks. NATO's main challenge is to understand their own role in assisting the other actors in protecting critical infrastructure and defining new joint procedures for this challenging task. Further digital sea lanes and especially their landing points require basic protection.

Steady and reliable delivery of energy to urban areas will be of vital importance to maintain stability and order. Thus there is a requirement to secure the exploration, exploitation, production and transportation of energy in the maritime domain. There might be also a requirement for NATO to develop capabilities to protect vulnerable and critical energy security nodes in a coastal and urban environment. NATO needs to be aware of the potential operational obstacles in an urban environment. The expected rise in aquaculture will contribute to the crowded coastal environment.

In an urban area the coastal zone will be densely populated. Rapid urbanisation results in coastal habitats that include coastal slums. The inequalities among the population, the squalid living conditions, and the absence of governance inside slums are likely to work in favour of non-state actors. These factors impose threats to the security of flows. NATO has to find ways to access these areas even under the threat of diseases, common in spaces like this. For manoeuvre aspects as well as non-military evacuation operations, the growing number of artificial, floating islands and maritime recreational platforms, have to be taken into account. Private Security Companies as key actors related to these installations should be closely assessed and monitored.

Although there are still significant uncertainties in projections of environmental change, there is a common view that coastal cities are particularly vulnerable to the long-term effects of global warming, such as sea-level rise, flooding, air pollution, severe storms and tsunamis. Even if environmental changes do not worsen, the impact of such events would still be significant due to the fact that more people will be affected. NATO could be engaged in urban operations to conduct Humanitarian Aid and Disaster Relief operations. The focus for NATO should be to develop the capacity to collaborate with all involved actors and start to build required relationships already in peacetime.

Operating in the described environment is becoming more and more complex and needs to be trained. To this end, a multi-domain and cross-service training and education centre – both physical and virtual – needs to be considered. Such a training centre must leverage emerging technologies that accurately replicate environmental conditions in order to enable realistic training and doctrinal development for execution under a NATO framework.

This paper describes specific vulnerabilities and challenges in the maritime domain in an urbane centric operational environment. These challenges should be seen as a possibility and starting point for rethinking NATO doctrine, tactics, technics, and procedures, as well as NATO training and exercises in a more comprehensive manner. The characteristics and special qualities inherent to the maritime domain in an urbane centric operational environment call for a more active cooperation with different “non-military” players. Such cooperation is necessary to be effective and relevant in this sphere of stakeholders’ widespread and differing responsibilities.

Based on closer relationships and efficient information exchange with other governmental and non-governmental organisations, a focused comprehensive approach can provide valuable military advice to political decision making and eventually supporting the overarching political strategy and vision for the region concerned.

Annex

Future Trends in Terms of Cargo Type

a. Crude Oil. The Middle East/ Arabian Gulf will remain dominating the crude oil export in 2035. China and South Asia will significantly increase their crude oil imports by 2035 and join Western Europe as dominant importers. The largest increase in seaborne oil trade will come from the Arabian Gulf, Black Sea, and Latin America to China and other Asian countries.⁶⁰ The rise will be caused by increased transport demand in these emerging regions.

b. Liquefied Natural Gas (LNG). The natural gas import demand will be dominated by Japan, Europe, India and China between 2015 and 2035. LNG export will be dominated by Australia and Qatar. The largest export increases will take place in Australia and Nigeria. East Africa, in particular Mozambique⁶¹, could be a new hotspot in LNG exports due to its recent large offshore discoveries. The major seaborne trade routes of LNG trade in 2030 will be between Australia to Japan; and Australia to China.

c. Coal. Coal will remain one of the major dry-bulk cargoes. About two-thirds of coal transported will be steam coal, used in power stations. One third of coal transported will be coking coal, essential for steel production. Coal import will be dominated by India and China in 2035, while Japan and West European coal import will be small, and their influence on the coal market will wane. Australia will be at the helm of the coal export in 2035.⁶²

d. Iron Ore. Driven by large investments in construction and infrastructure, China currently accounts for over two thirds of the global iron-ore trade. Iron ore import will be driven by demand which is linked to urbanisation and industrialisation. China's continuous iron ore demand will dominate the iron ore seaborne trade for the next 20 years.⁶³

e. Grain. In 2035, grain import will be dominated by Africa, Latin America, Middle East, and Southeast Asia. With regard to grain exports there will be a relatively large increase in the USA and CIS (Commonwealth of Independent States). Grain export will still be dominated by the USA in 2035, accounting for 40 per cent of the world's exports.⁶⁴

f. Containerised trade. In 2035, China will still enjoy her leading role in primary container trades. There are some uncertainties with regard to Latin America. There is a possibility for her to overtake Europe and become second, leaving Europe at the third place followed by Southeast Asia. This relies on the potential and challenges of the industry reforms and transforming Latin America's society into an economy with competitive manufacturing and growing consuming power. The largest container tranship loaded lifts will

⁶⁰ Clarkson Research Services, Shipping Review and Outlook, Spring 2014.

⁶¹ SPTEC Advisory, Mozambique – The Emergence of a Giant in Natural Gas, January 2013.

⁶² Clarkson Research Services, Shipping Review and Outlook, Spring 2014.

⁶³ Clarkson Research Services, Dry Bulk Trade Outlook, June 2014.

⁶⁴ Lloyd's Register, QinetiQ and University of Strathclyde, Global Marine Trends 2030, 2013.

still take place in Southeast Asia in 2035. Europe, the currently second largest transshipment destination around the world will face a much slower growth. Europe's position will be subsequently rivalled by China and the Middle East's remarkable progress by 2035. The greatest growth in container trade will take place between the Far East and the Middle East for the next two decades. The Indian Ocean and Asia Pacific region will be at the centre stage of the global container market. There will be also a significant growth in trades between the Far East and Latin America.⁶⁵

⁶⁵ Partim transshipment volumes, State of the European Port System – market trends and structure update, 08.01.2014

Appendices

A. Acronyms

A2	Anti Access
ACT	Allied Command Transformation
AD	Area Denial
A2/AD	Anti Access/ Area Denial
AJP	Allied Joint Publication
AMS	Allied Maritime Strategy
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, Reconnaissance
CBRN	Chemical, Biological, Radiological and Nuclear
CJOS	Combined Joint Operations from the Sea
COE	Centre of Excellence
CSW	Confined and Shallow Waters
DCAF	Geneva Centre for the Democratic Control of Armed Forces
DWT	Deadweight Tonnage
EAA	Ecosystem Approach to Aquaculture
EEZ	Exclusive Economic Zone
EIA	US Energy Information Administration
ENISA	European Union Agency for Network and Infrastructure Security
FAO	UN Food and Agriculture Organization
G7	Group of Seven (informal block of industrialized democracies:-The United States, Canada, France, Germany, Italy, Japan, and the United Kingdom)
GAO	(United States) Government Accountability Office
LNG	Liquefied Natural Gas
MEND	Movement for the Emancipation of the Niger Delta
MoU	Memorandum of Understanding
MSP	Marine Spatial Planning
NATO	North Atlantic Treaty Organisation
RUSI	Royal United Services Institute
SEA-ME-WE 3	Southeast Asia - Middle East - Western Europe 3 (underwater cable)
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development

B. Bibliography

Publications:

Allied Command Transformation; Study paper: The significance of harbours for the flow of commodities and its inherent risks and vulnerabilities related to urban areas, Norfolk, October 2015

Allied Maritime Strategy, 2011

Borchert, Heiko; Maritime Security at Risk: Trends, Future Threat Vectors and Capability Requirements, Lucerne, July 2014

Caponi, Steven L., Belmont, Kate B.; Maritime Cybersecurity: A Growing, Unanswered Threat, Maritime Executive Magazine, 2014

Clayton, Mark; WikiLeaks List of "Critical" sites: Is it a "Menu for Terrorists"?, The Christian Science Monitor, 2010

Dunigan, Hoffmann, Chalk, Nichiporuk, DeLuca; Characterizing and Exploiting the Implications of Maritime Irregular Warfare, RAND Corporation, 2012

Eshel, David; The Threat of Maritime Terrorism, www.defense-update.com, December 2005.

Fairclough, Graham; Rolling ODD DICE: Operations in the Future Urban Warfare, Oxford/UK, 2015

Hansen, Stig Jarle; Piracy in the greater Gulf of Aden – Myths, Misconceptions and Remedies, NIBR Report, Oslo, 2009

Hoffman, Frank; Conflict in the 21st Century: The rise of hybrid wars, Arlington, VA, 2007

Jasper and Moreland; Future Anti-Access and Area Denial Challenges Posed by Urban Centers to 2035, Research paper for Allied Command Transformation Urbanisation Project, Monterey, 2015

Kilcullen, David; Out of the Mountains - The Coming Age of the Urban Guerrilla, 2013

Kilcullen, David; The Conduct of future operations in the urban littoral and its implications for NATO, Research paper for Allied Command Transformation Urbanisation Project, 2015

Kilcullen, David; Climate and Geographical Implications for Future Urban Operations, Research paper for Allied Command Transformation Urbanisation Project, 2015

Rodrigue, Jean-Paul; The Geography of Transport System, Third Edition, New York, 2013

The Geneva Centre for the Democratic Control of Armed Forces; Working Paper No. 5, Armed Non-State Actors: Current Trends & Future Challenges, 2015

United Nations Convention on the Law of the Sea (UNCLOS), 1982

United Nations; World Urbanisation Prospects: The 2014 Revision, New York, 2014

United Nations Conference on Trade and Development; Review of Maritime Transport, Geneva, 2015

United Nations Development Group; Socio-Economic Impact of Ebola Virus Disease in West African Countries, February 2015

United States; A Cooperative Strategy for 21st Century Seapower, March 2015.

United States Government Accountability Office; Maritime Security: Enhancements Made, But Implementation and Sustainability Remain Key Challenges, Washington DC, 2005

United States Government Accountability Office; Maritime Critical Infrastructure Protection, Washington DC, 2014

Yonah Alexander and Richard Prosen; NATO from Regional to Global Security Provider, Lexington Books, US 2015

NATO Publications:

Allied Joint Publication, (AJP 3.1), 2016