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Heiko Borchert

Maritime Security at Risk

Trends, Future Threat Vectors, and Capability Requirements

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Sandfire AG • Bruchmattstrasse 12 • CH-6003 Lucerne
T +41 41 312 07 40 • F +41 41 312 07 44 • www.sandfire.ch • info@sandfire.ch

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Overview

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Author

Dr Heiko Borchert is Owner and Managing Director of Sandfire, a strategic security and defense consulting boutique. Since 1997 he has been working for public and private sector clients across Europe on issues like security foresight, maritime security, energy and resource supply security, critical infrastructure protection, and defense industrial strategies. Dr Borchert is affiliated with the Hague Center for Strategic Studies (HCSS) and is member of the Advisory Board of the Foreign and Security Policy Journal (Zeitschrift für Aussen- und Sicherheitspolitik, ZfAS). In 2014 he joined Wise Pen International as Associate Partner.

Dr Borchert is a conference speaker and lectures regularly at different security/defense academies across Europe and beyond. He studied international relations, business administration, economics, and law at the University of St. Gallen (Switzerland), where he also received his PhD. He has published widely in his areas of work and is co-editor of a series of books on the theory and practice of the Comprehensive Approach.

Summary

Globalization is based on the free flow of resources, goods, capital, information and people. These flows are organized within and along different domains such as the sea, air, space, and cyberspace. Together, these so called global commons form the bedrock of the current politico-economic system.

Freedom and stability of the global commons is one of the most important public goods. But different trends indicate that this very freedom is at risk. As a consequence, access to, maneuverability within, and use of the global maritime domain is increasingly contested. The risks entailed with this development follow from different trends that are closely intertwined. In order to understand the complex interplay of these different trends, the paper (1) provides an analytical approach to conceptualize the maritime domain as a transport route, a resource, habitat and an area for power and stability projection, (2) proposes a definition of maritime security, (3) addresses different trends in each of the aforementioned four categories that influence maritime security, and (4) provides food for thought on future capabilities required to provide maritime security.

In doing so, the paper will expand on three basic premises: First, in a globalized world connectedness is key to provide stability and prosperity. But maritime security risks endanger connectedness and are thus very likely to cause ripple effects that affect many different policy fields – in particular economic policy and development aid. It is thus very important to provide for interagency mechanisms to make sure that policy agendas driven by different stakeholders can be coordinated and harmonized. Second, activities in the maritime domain very much depend on stability and good order in other global commons, in particular the cyber domain and the space domain. However, inter-domain interdependencies are hardly understood so far. This will be analyzed with reference to the growing concern of maritime cyber insecurity. Finally, addressing today's and tomorrow's maritime security challenges will require close public-private interaction. This reinforces the importance of the Comprehensive Approach for the maritime community and underlines the need for a common understanding of definitions, principles, processes, and instruments to help advance public-private security cooperation in the maritime domain.

Introduction

Prosperity and economic globalization build on the unrestricted exchange of resources, goods, capital, information, and the mobility of people. The respective interactions create flows that connect different locations of production and consumption. Prosperity thus requires connectivity. Connectivity, in turn, depends on the availability of different means of transportation and the linkage of various domains. Domains such as the sea, airspace, space, and cyberspace are generally referred to as the Global Commons, i.e. domains to which state and non-state actors have legal access.[1] Access to, maneuverability within, and use of the Global Commons can be restricted or enlarged depending on the ability and the willingness of these actors to exert influence on the Global Commons. By influencing the Global Commons in this way, state and non-state actors also influence the process of connectivity and thus global prosperity. Right now the international community is in a transition stage that is characterized by the fact that different actors try to shape the Global Commons based on their very specific interest and ambitions. This has far-reaching consequences for global prosperity and stability.

Competition with regard to the governing principles of the Global Commons is not a new phenomenon. Today, however, the contest goes hand in hand with tectonic shifts in the global ideological, political, and economic order. As a consequence, the current maritime order becomes increasingly fragile as the following examples illustrate:

- Containers have become the epitome of economic globalization. Containers drive economic trade as they are based on standardization. Standardization is a prerequisite for tightly knit supply chains. As a consequence of the swift advancement of containerized trade maritime trade regions are growing together. This provides obvious advantages as supply routes are shortened and transport time is reduced. But the same trend also creates additional vulnerabilities. The more maritime trade regions depend on each other, the more instability in one region is likely to affect neighboring regions. In addition, the same container that is used to transport goods between destinations can also be misused for illegal activities such as smuggling, human trafficking, illicit weapons transfers, or breaching international embargos. Containerized seaborne trade is thus inherently Janus-faced.
- Global competition for energy and mineral resources is growing as the world demand for these resources steadily increases. Exploiting energy and mineral resources creates revenues. Rent seeking actors that want to keep these revenue streams open thus reinforce competition for resource access and exploitation. Growing pressure on resource fields is affecting the maritime domain as offshore resources are becoming increasingly important. This provides many countries with an incentive to redesign current international borders such as the scope of Exclusive Economic Zones (EEZ). Outward projection of EEZ and different activities aimed at restricting travel through international waters serve as a new source of maritime conflict.[2] Together with land-based in-

1 Paraphrasing and expanding the definition provided by Susan J. Buck quoted in: Redden/Hughes, Global Commons and Domain Interrelationships, p. 1.

2 "Excessive EEZ claims are the major source of instability in the international law of the sea". See: Kraska, Maritime Power and the Law of the Sea, p. 13. This is reflected, among others, in China's use of artificial islands to claim sovereignty over disputed waters. See: Hardy, "China building island in South China Sea", p. 5; Hardy/Atkinson/Hurley, "Beijing goes all out with major island building project in Spratlys", p. 17

stabilities these trends create increasing dangers for fragile regions and thus put the current maritime order at risk.

- As new maritime powers emerge, the group of actors with distinct maritime interests becomes bigger. This trend may be welcome if more actors find common ground to join forces to provide for the stability of the global maritime domains. But the same trend can also fuel additional uncertainty if maritime interests collide and the disciplining effect current maritime powers have had on the existing maritime order wanes.[3]

These examples and the following thoughts make it amply clear that nothing less than a paradigm change in global maritime governance is needed: Security and stability of the maritime domain must be organized along global supply chain, thus cutting across existing legal regimes that grew out of a territorial understanding of sovereignty. Like ashore, there are stable maritime zones with functioning governance approaches, followed by maritime zones of instability, and maritime regions of disorder where actors deliberately ignore and break international rules, norms, and principles. The resulting normative patchwork and the porous governance framework endanger overall maritime stability. This is a fundamental problem for the international community in the 21st century. Unlike in the past, the aforementioned developments imply uncertainty in terms of who is going to set the rules, norms, and principles to govern the maritime domain and who will do what to verify and enforce compliance with a normative framework that is in flux.

Against this background this papers argues that maritime security is at risk. The paper starts from a comprehensive definition of maritime security that will be developed in the next section. Maritime security will be understood as a continuum of different tasks that need to be tackled in a closely integrated multi-stakeholder approach crossing well established defense and civilian as well as public and private divides. Most importantly, maritime security is closely intertwined with the security and stability of other operating domains. Instability in these domains, for example in cyberspace, has a fundamental impact on maritime security. In addition, the paper proposes a three-layered framework to think about maritime security. Physics or the "law of nature" constitutes the foundational level of maritime security. The operational level looks at how actors use the maritime domain in particular as a transport route, a resource, habitat, and an area for power and stability projection. Finally, the normative level consists of the basic rules, norms, and principles that shape the use of the maritime domain. Section three which includes the main thrust of the paper is focusing on the operational level by highlighting different long-term trends that influence the use of the global maritime domain and are likely to increase maritime instability in the future. Section four will provide food for thought on future capability requirements to provide maritime security. The final section summarizes the main arguments and concludes with a brief outlook on what academic research could contribute towards maritime security.

3 Holslag, "Crowded, Connected, and Contested. Security and Peace in the Eurasian Sea and What It Means for Europe," p. 15.

Maritime Security: Scope and Working Definition

The maritime domain is a complex environment. How we interpret the maritime domain very much determines its conceptualization.[4] In order to cut through complexity, this section starts with an ideal-type framework that helps understand what needs to be taken into account when addressing maritime security. The framework also illustrates the interdisciplinary nature of maritime security and thus underlines the need to reach well beyond social science in order to understand how the maritime domain will evolve in the future. The framework builds on three layers (Figure 1) that interact with each other:[5]

- **Foundational level**
  The "physics" of the maritime domain provide the ultimate foundation of the framework. As a natural rather than a technical or human-made domain, the "laws of nature" influence the maritime domain. It is important to remind readers that human mankind's understanding of the world ocean is still rather limited. For example, we still know very little about marine resources, although our dependence on them is rapidly increasing.[6] Our ignorance becomes more and more critical as climate change is about to affect the global maritime domain – with far-reaching consequences for human mankind.

- **Operational level**
  Human use of the maritime domain depends on its physical specifics (foundational level) and is shaped by the rules, norms, and principles that have been put in place to govern activities in this domain (normative level). Very generically, the maritime domain serves as a transport corridor, provides marine resources, is seen as a living environment (habitat) and is used to project power and stability.[7] What sets the maritime domain apart from the remaining Global Commons is the confluence of trends and activities in each of the four aforementioned use cases. This becomes most obvious when looking at the littorals. The littorals will play a key role in the 21st century, because almost all trends shaping human living in the future come together in a narrow strip along the world's coastal lines. The littorals are key to connecting global supply chains, they are magnets for people that strive to improve their standard of living and thus nurture rapid urbanization, and they harbor promising offshore resources. Stability in the littorals will thus become of paramount importance for pan-regional stability and global security.[8]

4 For more on this, see: Steinberg, The Social Construction of the Ocean.
5 As Philip Steinberg observed: "Human actions shape the physical landscape, just as the landscape enables and limits human action and social formation." See: Steinberg, The Social Construction of the Ocean, p. 22.
6 See for example: Rohstoffe aus dem Meer – Chancen und Risiken.
7 For similar concepts, see: Till, Seapower. A Guide for the Twenty-First Century, pp. 286-306; Steinberg, The Social Construction of the Ocean, pp. 11-38. Steinberg broadens traditional concepts of the ocean as a space used by society to develop a theory of territorial political economy that views the ocean as a social space. Among others, he argues that ocean-space is "not a formless void *between* societies but rather a unique and specifically constructed space *within* societies" (p. 23, emphasis by Steinberg).
8 "The presence of ever-larger cities in this zone [= the littorals, HB], with increasing population density, more intensive land usage, heavier ground movement, and busier air and sea traffic, makes an already complex system even denser and more complicated. For this reason, operation in littoral zones are very different from their continental (entirely lands-based) or maritime (purely sea-air) operations," Kilcullen, Out of the Mountains, p. 31.

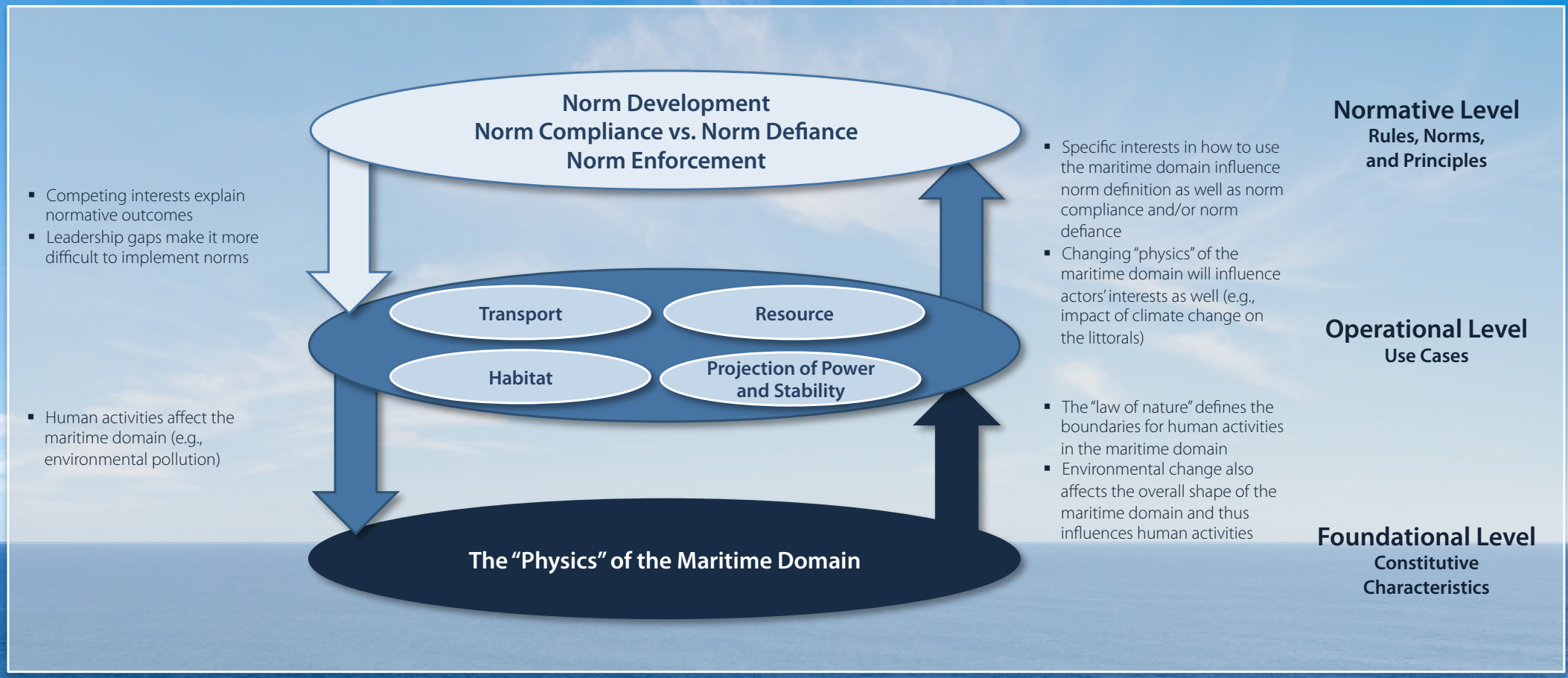

Figure 1: How to think about the maritime domain

- **Normative level**
  The normative level comprises all rules, norms, and principles relevant for activities in the maritime domain. When it comes to maritime security, the key challenge stems from the fact that existing normative foundations are dispersed across many different regimes. In addition, most of the rules, norms, and principles that could be applied to maritime security are subject to interpretation. This is where the current power play between developed and emerging powers comes in and creates additional uncertainty. The consequences are uncomfortable. First, norm definition and norm development are contested as will be shown below. We can expect this contest to grow even fiercer in the future as economic influence is shifting to some of the leading emerging powers. Second, norm enforcement becomes more difficult because there is a growing lack of consensus on how to go after actors that defy current well-established norms. And there is also disagreement on how to sanction norm defiance. When looking at naval capabilities as one dedicated instrument of power that can be used to sanction non-compliance, the simultaneity of shrinking naval power in the "West" and increasing naval power in emerging countries makes things even more difficult than they already are.
  Norms, rules, and principles guiding seaborne activities result from negotiation processes. The three-layered framework makes it clear that the normative level, where norms are negotiated, cannot be separated from the remaining two levels. Normative and material resources as well as institutional frameworks are three aspects that need to be taken into account when considering norm development. In addition, it can be speculated, that the impact of climate change on the maritime domain in general and coastal nations[9] in particular will further increase the complexity of these negotiations. Based on the traditional two-level game theory, recent studies suggest that the domestic impact of climate change affects governments' behavior at the international level.[10] This needs to be kept in mind in particular with regard to future rules, norms, and principles for deep-sea mining and to solve existing territorial disputes at sea.[11]

The proposed framework illustrates why maritime security is a multi-faceted concept that awaits universal definition (Box 1).[12] The complexity of maritime security is a direct consequence of the broad scope of tasks that has come to form the core of so called maritime security operations. From a theoretical point of view, the term "maritime security" is thus similar to the concept of "comprehensive security": Both are defining a very broad subject thus running the risk of being hollowed out. From a practitioner's perspective, the vagueness of the concept can be very useful as it provides multiple opportunities to establish cooperation among different actors.

However, the biggest risk of vagueness lies in the willingness of most observers to readily "reduce to the max" what is hard to un-

9 Here, reference to nations only is just a matter of simplifying the argument. Omission of non-state actors should not be interpreted as if they were irrelevant. Rather certain types of non-state actors that will be discussed later on already create substantial problems to ensure maritime stability, because they follow radical approaches to achieve their goals. If these actors start to engage in norm engineering, things will become even more difficult.

10 Paskal, Global Warring, pp. 237-249; Moran, Climate Change and National Security; Mazo, Climate Conflict.

11 Climate change in the form of raising sea levels can affect existing borderlines and thus either aggravate or solve unresolved maritime territorial disputes. Paskal, Global Warring, pp. 227-229.

12 Thayer, "Efforts to Ensure Maritime Security," p. 2.

derstand.[13] The current debate thus tends to suggest that maritime security primarily deals with unlawful acts such as combatting piracy, smuggling and trafficking only. But nothing could be worse than this, because it obfuscates the big picture. This paper thus suggests a very broad understanding of maritime security based on three building blocks:

Maritime security

- *refers to all relevant activities that support the early identification, mitigation, management of and recovery from intentional, unlawful acts and hazardous incidents*
- *threatening the stability and good order of the maritime domain*
- *thereby limiting or preventing access to, freedom of action within, and use of the maritime domain.*

Whereas maritime insecurity is a condition, its antonym, maritime security, is not just the opposite condition. Because the maritime domain is inherently fragile, maritime security implies a degree of proactive activity. That's why this broad definition of maritime security comes with several implications that are of relevance for the future conceptualization of the subject:

13 See also Geoffrey Till's observation: „In some ways (...) the biggest threat to the maritime future is an insidious one of ignorance and neglect amongst the general population and some parts of government." Till, Seapower. p. 309.

- Maritime security is "the combination of preventative and responsive measures to protect the maritime domain against threats and intentional unlawful acts."

  Wise Pens International, Report to the EDA on Future Maritime Operations Requirements and Planned Capabilities, p. 80.

- Maritime security "means the protection of a state's land and maritime territory, infrastructure, economy, environment and society from certain harmful acts occurring at sea."

  Klein, Maritime Security and the Law of the Sea, p. 11.

- Maritime security is the "advancement and protection of the UK's national interests, at home and abroad, through the active management of risks and opportunities in and from the maritime domain, in order to strengthen and extend the UK's prosperity, security and resilience and to help shape a stable world."

  The UK National Strategy for Maritime Security, p. 9.

- Maritime security is understood as a state of affairs of the global maritime domain, in which international law and national law are enforced, freedom of navigation is guaranteed and citizens, infrastructure, transport, the environment and marine resources are protected.

  European Union Maritime Security Strategy, p. 3.

- "Maritime security includes a collection of tasks that are derived from agreed-upon international law. Maritime security operations (MSO) are those operations conducted to assist in establishing the conditions for security and protection of sovereignty in the maritime domain. (…) The creation and maintenance of security at sea are essential to mitigating threats short of war. Countering these irregular and transnational threats protects the homeland, enhances global stability, and secures freedom of navigation for the benefit of all nations.

  Naval Warfare. Naval Doctrine Publication 1, p. 30.

Box 1: Maritime security – exemplary definitions

Figure 2: Maritime security tasks
Source: Adapted from Krause, "NATO Operations and Their Contribution to Maritime Security Challenges," p. 11.

- First of all, *maritime security is a process* leading to a desired – yet to be defined – outcome. Understanding maritime security as a process is closely related to the concept of supply chain security. Each supply activity (e.g., energy supply, resource supply, supply of means of transportation) connects the zones of origin with zones of transit and final destinations. In doing so, transport corridors and means of transportation play a key role. Maritime security should be conceptualized along these supply chains that cross existing regulatory regimes and cut across existing responsibilities of public and private actors.
- Second, a process-based definition of maritime security opens the door to bring together a *broad spectrum of different tasks* (Figure 2). This suggests that maritime security requires an interagency process to coordinate and harmonize different policy areas. Tasks relevant for maritime security encompass, inter alia, economic policy (e.g., tariffs and trade, general framework for maritime trade), industrial, science, and research policy (e.g., marine science and technology, shipbuilding), development policy (e.g., integrated coastal zone management) as well as security and defense policy (e.g., law and order at sea, search and rescue, coastal surveillance, military operations). A holistic framework to bring together these different policy strands is missing in most countries around the world.
- Third, the broad scope of maritime security tasks suggests that a federated approach to coordinate many different actors is indispensible. Therefore maritime security requires a *holistic approach to public-private stakeholder management.* For maritime security to work in practice, an institutional framework needs to be established that allows for smooth cooperation of public and private actors. This highlights the importance of common vocabulary, close exchange of information as well as joint training and education to mention but of few of the key enablers for public-private interaction.
- Fourth, *maritime challenges are inherently international.* Unilateral approaches to maritime security tend to produce displacement effects. If one country is more effective at dealing with let's say organized crime, pirates, or tackling marine pollution, it will literally push the respective problem next door. The resulting beggar my neighbor effect is not only expensive and ineffective, it also hinders cooperation. But currently international cooperation on maritime issues is nowhere near the level where it should be to live up to the global nature of the challenges.
- Finally, there is a very *close interconnection between the maritime domain and other key domains,* in particular cyberspace and space. The current debate on maritime security tends to focus on land-based threats and instabilities that threaten the maritime domain. These are important, but they are by far not the only origins of maritime risks. Space-based assets such as navigation, surveillance, and communication satellites have become integral parts of contemporary maritime operations. The same is true for seamless connectivity that enables interaction among different units operating independently at great distance. Degraded information environments, by contrast, would seriously affect current operations in the maritime domain. Thinking holistically about the inter-domain relations that affect maritime security is a consequence of the growing digitization of these domains. However, concepts currently in place to provide guidance to maritime operations hardly address the trend toward technological convergence and the damage that can be created by exploiting the respective vulnerabilities.

Maritime Security Challenges

The Maritime Environment as a Means of Transport and Transport Corridor

National and international sea lanes are important carriers of international trade.[14] Changes in international trade patterns directly affect seaborne traffic. In this regard the following long-term developments are of importance:

- **Resource trade**
  The shipment of energy resources and mineral resources such as iron ore is dominating seaborne trade by volume. Shifting resource demand patterns resulting from different supply requirements around the globe are affecting seaborne trade and will thus also influence future interests in safe and secure sea lanes. Already today, countries in the Asia-Pacific region are the biggest consumers of oil and gas from the Persian Gulf. In 2011, China received over 50% and India got more than two-thirds of its oil imports from Gulf oil suppliers.[15] A similar shift away from resource-driven trade between developed and emerging countries to growing resource trade among developing countries can be witnessed in iron ore shipping, the leading dry bulk. Iron ore shipping increasingly connects Australia and Brazil as the main exporters with China as the key importer.[16] From a strategic perspective, the long-term question thus is whether changes in resource demand will drive the Asia-Pacific region, the United States, and Europe apart or bring them together to find common solutions for the safety and security of the world's key maritime trade corridors.

- **Maritime transport hubs and transport connections**
  There is a close interplay between maritime trade patterns and the global distribution of shipbuilding and port capacities. Countries in the Asia-Pacific region dominate in both sectors. In 2011, China, South Korea, and Japan accounted for over 90% of the global shipbuilding capacities. Together these three countries also had more than 80% of the future shipbuilding orders by volume in their order books.[17] In addition, these three countries also show a growing interest in ships that can be used to travel new transport corridors likely to open up in the Arctic. There, however, it is still Russia that operates the world's largest fleet of icebreakers, including nuclear-powered icebreakers. This is an asset that is missing from the arsenal in the United States, Canada, China, Norway, or Denmark, which all claim access to the North Pole.[18]

14 There is a worrying trend of operating under cheap foreign flags. This trend can be witnessed in global shipping, but also in the energy industry where offshore platforms can be registered under foreign flags as well. This development results from increasing cost pressure on ship and platform owners and operators. Registration under cheap flags creates obvious safety and security challenges. This, in turn, affects national and international security policy as well. If more nations operate their commercial fleets under foreign flags, what is the role of national navies in protecting merchant fleets and who shoulders the respective burden?

15 China. Country Briefing; India. Country Briefing.

16 Review of World Maritime Trade 2013, p. 19.

17 Review of Maritime Transport 2013, p. 58; Jahresbericht 2012: Fakten und Zahlen zur maritimen Abhängigkeit der Bundesrepublik Deutschland, p. 50.

18 The World Icebreaker and Icebreaking Supply Vessel Fleet.

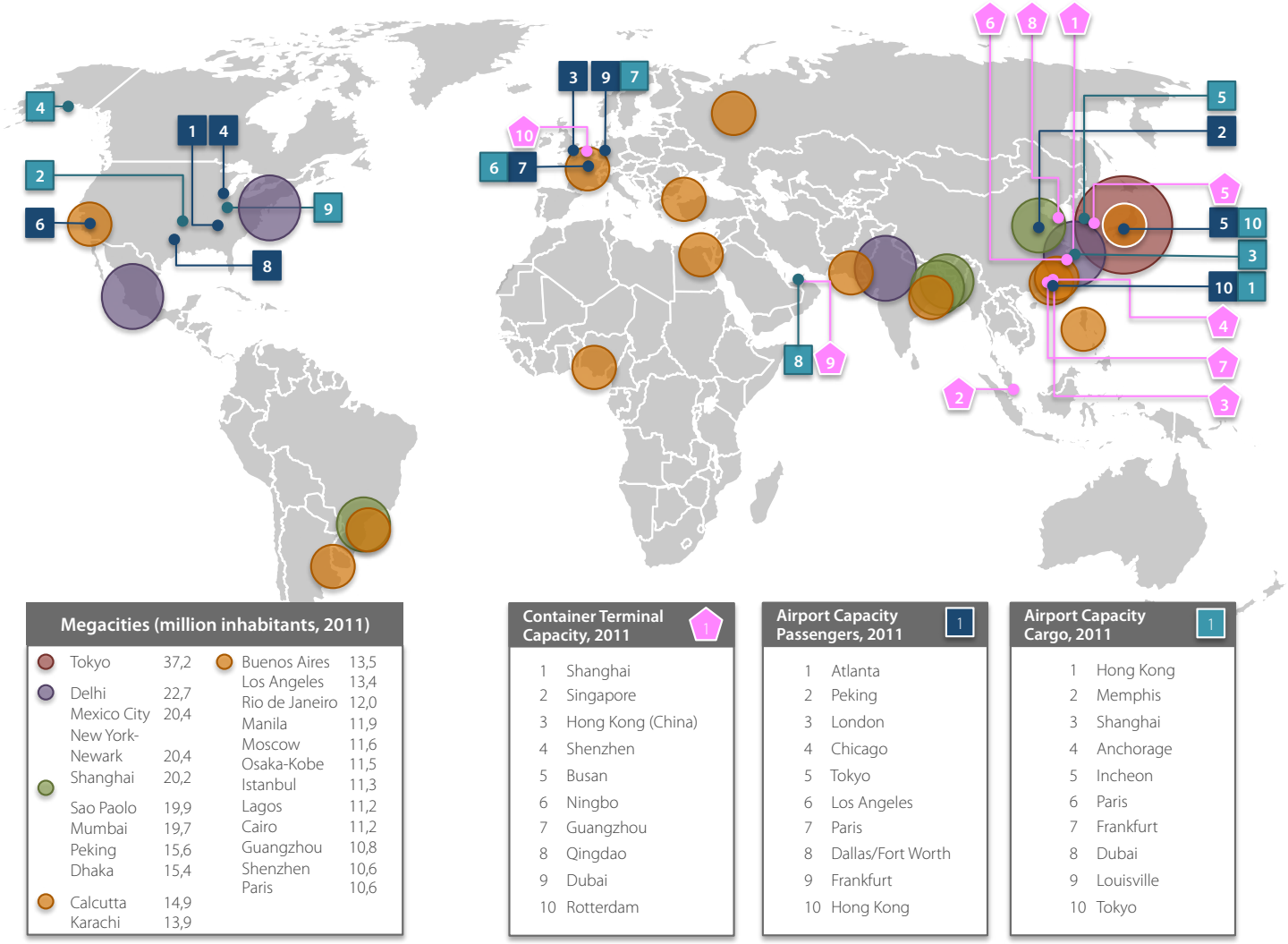

Figure 3: Megacities and world transport infrastructure

Sources: Own compilation based on The World Urbanization Prospects, p. 7, Review of Maritime Transport 2013, p. 91, <http://www.aci.aero/Data-Centre/Annual-Traffic-Data/Passengers/2011-final> (Access 3 July 2014).

The Asia-Pacific region is also the center of gravity of global maritime transport (Figure 3). Of the world's 20 busiest container terminals by capacity 14 can be found in the Asia-Pacific region, and among the world's 10 busiest container terminals, only two (Dubai and Rotterdam) are not located in this region.[19] Whereas countries from the transatlantic community and Southeast Asia share ranks among the top 10 of the world's best-connected countries, China, Hong Kong, and Singapore lead the list. In 2010 twice as many ships called at ports in China than at ports in the Netherlands or Germany, Europe's best-connected countries.[20]

These developments point towards a global maritime freight transportation system in which Asian markets play the key role. As Jean-Paul Rodrigue[21] pointed out, the emergence of Brazil, India, and China as economic power engines could lead to a new maritime connection in the Southern Hemisphere directly linking the respective markets. Russia, in turn, could benefit from the opening of the northern passage across the Arctic, as this route is expected to cut transport distances significantly, in particular for shipments between Northern Europe and Asia.[22]

The strategic significance of these developments is straightforward: For centuries, economic actors have used their economic clout to set the norms, rules, and principles relevant for global trade. As a consequence it will be important to see how the increasing role of Asia-Pacific countries is going to affect seaborne trade standards. In light of this, the following example can be interpreted as an early warning indicator. As noted above, China leads on global shipbuilding capacities. Shipbuilding is closely allied to steel production which in turn depends on access to iron ore. In early 2012, China started to keep iron ore ships from Brazil out of its ports. Among others, China argued that iron ore ships of Vale, one of the world's top three iron ore producer and transporter, do not comply with China's safety regulation.[23] However, the fact that China is the world's biggest producer of iron ore ships opens up another way of looking at the problem. Whereas China has a strategic interest in expanding upstream the global iron ore supply chain from being an importer to make inroads into preceding stages of the supply chain, Brazil as a key producer and transporter is interested in downstream control from source to end markets. It is thus very likely that we will see an increasing number of trade conflicts originating in different perceptions on how to best drive a nation's competitive edge across global supply chains – as witnessed most recently by China's decision to block the alliance between A.P. Moeller-Maersk, Mediterranean Shipping Co. and CMA CGM.[24]

- **Sea lanes, chokepoints, and inland waterways**

  Sea lanes, the essential roads of maritime trade, are another crucial element of the seaborne trade infrastructure. Two aspects are important. First of all, discussions almost always focus on the vulnerability of choke points (Figure 4). Rivalries between different states to block key choke points, such as the Strait of Hormuz or the Strait of Malacca, affect not only maritime trade but also affect international commodity prices. In addition, critical passages such as the Strait of Bosporus raise the specter of large-scale incidents at the heart of a megacities that would cause ma-

19 Review of Maritime Transport 2013, p. 43.
20 "Trends in liner shipping connectivity," pp. 5-6.
21 Rodrigue, "Maritime Transportation: Drivers for the Shipping and Port Industries."
22 Christensen, Are the northern sea routes really the shorter?
23 Hook/Wright, "China blocks Vale's large iron ore carriers."
24 Jasper/Tan, "China Blocks European Shipping Pact, Sending Maersk Down."

jor casualties and significant environmental damage. As global demand for energy and mineral resources is likely to grow in the future, key choke points will continue to remain geostrategic hot spots, because capabilities to control or disrupt the control of these chokepoints can be used as political currency. As a consequence, the readiness to invest in alternative transport routes that help circumvent some of these chokepoints is increasing. This is illustrated, among others, by China's and Russia's involvement to finance and construct a future Nicaragua Canal as an alternative to the Panama Canal, Beijing's cooperation with Tel Aviv to establish a rail route as an alternative to the Suez Canal, and her interest in the Northern Sea Route.[25]

In addition to chokepoints, inland waterways are becoming increasingly important. Inland waterways make an essential contribution to prosperity in well-developed economic regions. In contrast, Brazil uses only around one-fourth of its navigable inland waterways for economic purposes but wants to double their share of the overall transportation mix by 2025.[26] This raises several questions with regard to the multiple use of inland waterways for transport and hydropower generation and to the use of vessel traffic management systems for inland waterways. Brazil's example makes it clear that increasing reliance on inland waterways to advance economic prosperity will also prompt additional maritime safety and security needs. Inland waterways connect regions in the hinterland with international sea lanes and are thus a vital link in the global maritime supply chain. But if surveillance and control of these inland waterways wane, as is the case in the Niger Delta, for example, the respective nations will be deprived of an important instrument to generate local prosperity. For this reason, the international community should pay more attention to security concepts for inland waterways in developing countries.

- **Digital sea lanes**

  The global maritime domain is home to one of the world's most important but most often overlooked infrastructures: undersea communication cables. Undersea communication cables are absolutely vital, because they handle almost all of the world's intercontinental digital traffic. Today, the global undersea cable network spans around 1.25 million kilometers. Between 1987 and 2012 almost $57 billion have been invested to establish the network, and new projects worth $28bn are in the pipeline to expand this vital digital infrastructure.[27] With global bandwidth demand on the rise, undersea communication cables will grow in importance. Vulnerability of these cables at the transition from deep water to the landing points is a major concern, since most of these landing points are located in areas with heavy maritime traffic. In addition to natural hazards (e.g., earthquakes), technical failures, and interruptions caused by negligence (e.g., anchors), undersea cables have also become the object of theft and eavesdropping. In addition, undersea cable repair ships are possible targets for pirates.[28]

25 "A man, a plan – and little else", pp. 43-44; Blank, "Nicaragua: Moscow's 'Second Front'"; Levitt, "Israel-China Alliance Moves Forward With $2 Billion 'Red-Med' Freight Rail Link Alternative to Suez Canal", Jakobson/Peng, China's Arctic Aspirations.

26 Passos, "Logistic Infrastructure Scenario in Brazil."

27 Submarine Telecoms Industry Report, pp. 18-21.

28 Rauscher, Proceedings of the Reliability of Global Undersea Cable Communications Infrastructure; Submarine cables and the oceans: connecting the world; MacAskill et. al., "GCHQ taps fibre-optic cables for secret access to world's communications".

- **Technology development**
  Finally, maritime technologies play an important role in all of the four maritime use cases addressed in this paper, but play a particularly relevant role when it comes to maritime transport. Technologies that help advance logistics efficiency will become even more important in the future, since competition between harbors is intensifying. Several options are feasible. Advanced use of information and communication technology could help drive the digitization of global logistics, thus making it easier to track and trace goods. Materials technology in combination with energy management and propulsion techniques is of increasing importance for shipbuilders, because innovation in these fields can help reduce energy consumption and CO_2 emission by cargo ships. In addition, it could be considered whether the use of automatic and unmanned systems[29] could help improve operations in congested coastal zones and harbors. For example, unmanned systems could be used for commercial logistics seabasing, thereby providing an opportunity to load and unload cargo vessels without the need to enter densely populated ports. Automatic or semi-automatic platforms could also provide offshore refueling stations, thus reducing the need for ships to travel through dangerous waters. And thought should be given to the idea of using unmanned maritime cargo systems along pre-configured routes to speed up short-distance maritime transport and to boost trade along coastal hubs.
  In addition to transport, safety and security requirements will be important drivers for marine technologies. The spectrum is very broad. Surveillance and reconnaissance, for example, are important to monitor what is going on in important maritime regions. Wide area monitoring and the challenges of new operating domains such as the Arctic will pose specific demands. The growth in underwater activities goes hand in hand with additional surveillance and reconnaissance tasks, for example, in order to monitor deep-sea mining in view of possible environmental risks and potentially illicit activities. All of these tasks will drive sensor technology requirements as well as the design of different platforms that can be fully networked in order to provide for the seamless exchange of information and communication. This will also significantly increase bandwidth requirements and the demand for tools and techniques to analyze the exploding amount of data that will be generated by an extremely sensor-rich environment. This, in turn, puts a premium on cyber security. In addition, we are about to see a dramatic increase in the use of unmanned platforms as a consequence of growing commercial and scientific activities (e.g., dredging, pipeline and sub sea cable construction, touch down point monitoring, hydrography) as well as specific security and defense needs (e.g., anti-mine warfare, anti-submarine warfare, delivery of underwater effects, monitoring of underwater offshore infrastructure).

29 For a general introduction, see: "20,000 colleagues under the sea", pp. 72-73; Guidance for Developing Maritime Unmanned Systems Capability.

The Maritime Environment as a Resource

The global maritime domain becomes ever more valuable as a provider of many different resources. Access to these resources and access to the maritime transport routes needed to bring these resources to consumer markets will be one of the key trends shaping countries' maritime interests and their preferences to build up maritime capabilities needed to protect their interests.

Figure 4 gives an overview of some of the most important marine resource areas and puts them in context with other security-relevant issues, such as fragile governance structures and the scope of pirate activities. Against this background, the following facts and trends are worth considering:

- **Fish stock**
  Fish continues to be a major source of protein in the diet for large parts of the world population. The world supply of fish and aquaculture has grown steadily, reaching 145 million tons in 2009 after roughly 130 million tons in 2000. From 1998 to 2008, the value of exported fish and fishery products doubled from around $51 billion to around $102 billion. This development is underpinned by significant efficiency increases in the global fishing and aquaculture industry. As a consequence the production volume of farmed fish (measured in tons) is now bigger than the production of beef.[30]
  But global fish stock is in danger. Today, slightly more than 60% of the world's fish stock is fully fished, whereas only around 10% is underexploited or moderately exploited. The remaining 30% are "fished at a biologically unsustainable level."[31] Climate change is creating additional problems. Extreme weather conditions could affect the distribution of fish, habitat size, and productivity, thus worsening fishermen's perspectives. Illicit fishing aggravates these problems even further. This increases the dangers of maritime disputes, as news reports about illegal fishing activities off the coast of Libya in early June 2011 showed.[32]

- **Offshore energy and mineral resources**
  Given the world's growing hunger for fossil energy resources, offshore resources are becoming more and more important. Estimates assume that offshore production accounts for around 37% of today's global oil production and approximately 28% of the global gas production.[33] In the European Economic Area, for example, around 90% of the region's oil and 60% of its gas production originates from offshore.[34] But whereas Europe's offshore fossil reserves are in decline, new reserves are found in other regions of the world. Over the past couple of years the most significant offshore oil fields were discovered in Brazil and West Africa. Important offshore gas fields were discovered in Mozambique, Tanzania, Australia, in the Caspian Sea, and in the Eastern Mediterranean.[35] Estimates assume that the Arctic Sea could harbor around 90 million barrels of oil (about the same as the proven reserves of the United Arab Emirates) and around 1,700 trillion cubic feet of natural gas (about the same as the proven reserves of Russia). Approximately 84% of these reserves are offshore.[36]

30 "Different Scales: The price of fish", p. 57.
31 The State of World Fisheries and Aquaculture, p. 7.
32 "Hot Pursuit of Tuna Seiner Along Qaddafi's Line of Death."
33 Rohstoffe aus dem Meer, p. 17.
34 Facing the challenge of the safety of offshore oil and gas activities, p. 2
35 Rohstoffe aus dem Meer, p. 19. See also: World Energy Outlook 2013, pp. 462-464; World Energy Outlook 2012, pp. 118-119.
36 O'Rourke, Changes in the Arctic, p. 20.

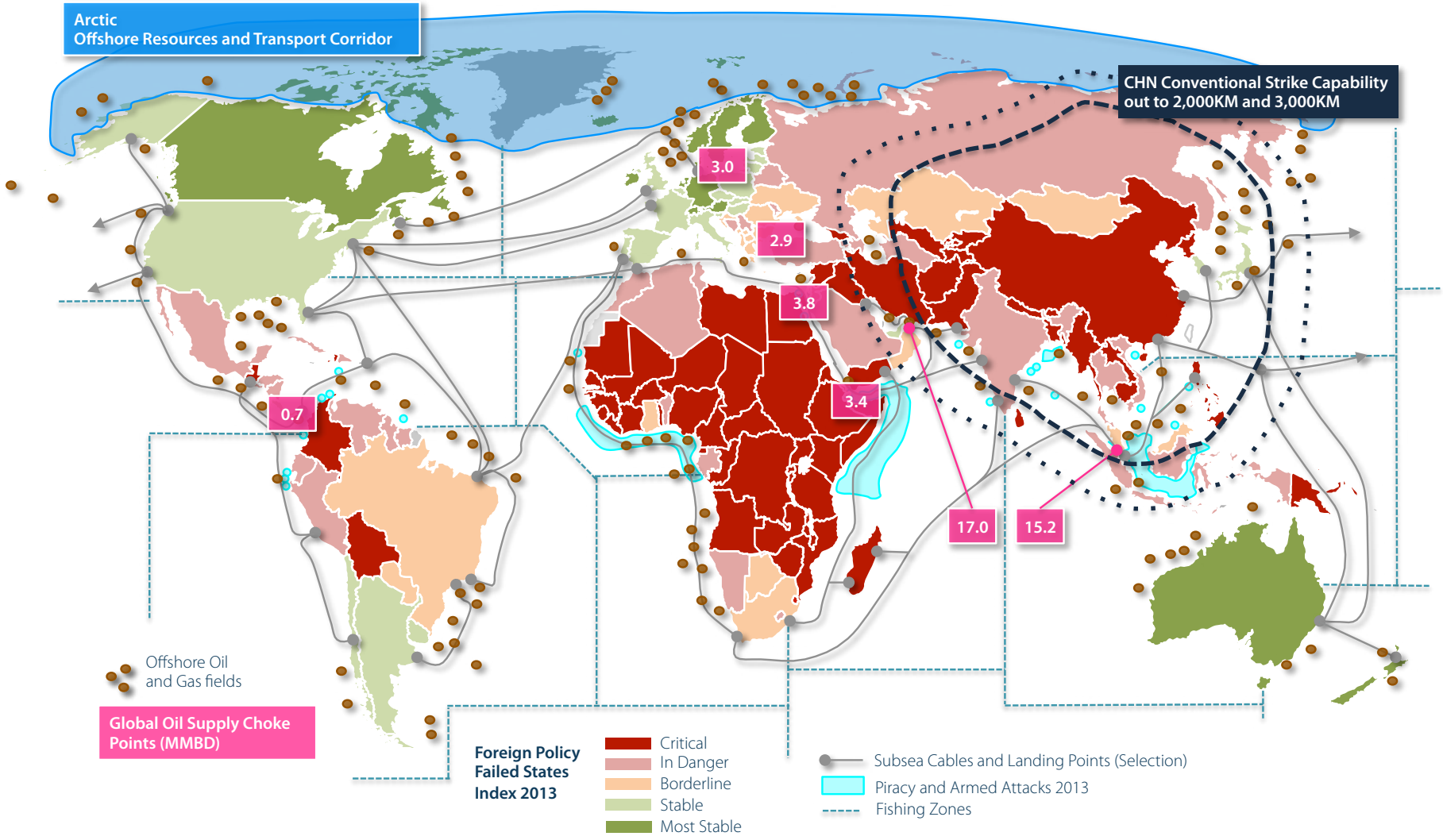

Figure 4: Key maritime hot spots

Sources: Zierul, Der Kampf um die Tiefsee, p. 14-15; World Oil Transit Chokepoints; Global Submarine Cable Map; Military and Security Developments Involving the People's Republic of China 2014, p. 85; <http://www.fao.org/fishery/area/search/en>; <http://www.foreignpolicy.com/failedstates>, <http://www.icc-ccs.org> (Access 3 July 2014).

Energy resource-related claims by different countries also collide over access to the Spratly Islands and gas reserves in the Eastern Mediterranean. The latter is a particular case, because exploiting the gas fields off the coast of Israel and Lebanon has not only prompted rival claims by the two respective countries but also by Hezbollah.[37] Whether competing resource interests lead to violent conflicts depends on many different factors. Among others, the overall economic value of the respective resources, past conflict resolution track records of the actors involved, political ambition vis-à-vis the maritime space in question, the existence of unresolved maritime disputes, and the importance local policy-makers attach to the maritime space play a premier role.[38]

Seabed mineral resources such as manganese nodules are catching governments' and miners' attention as well. Many of the known mineral seabed deposits are attractive because the amount of metals that could be exploited far exceeds known deposits onshore. Manganese nodules in the Clarion Clipperton[39] zone in the Pacific promise to provide around five billion tons of manganese, around ten times the volume that could be gained from existing onshore deposits. Similarly, estimates assume that seabed methane hydrate deposits could provide around ten times the methane volume stored in conventional gas deposits.[40] However, experts fear that very large seabed areas are likely to be affected due to seabed mining, thus causing environmental damage.[41]

In addition to conflicting claims, technical aspects of offshore activities need to be taken into account. Whereas Deepwater Horizon was operating oil drills at around 1,500 meters below the waterline in the Gulf of Mexico, Petrobras will have to drill down 7,000 meters to exploit huge oil fields off the Brazilian coast.[42] This obviously raises questions with regard to the safety of the technical installations used for these challenging operations. Additional energy-related offshore activities relevant for maritime security include plans for small offshore nuclear power plants that could be installed on the seabed, the construction of gigantic offshore wind parks that can cause problems for radars and submarines, the use of ships as mobile nuclear power plants, and floating nuclear plants.[43]

The Maritime Environment as Habitat

Already today, around 70% of the world's population lives in coastal regions. Given current projections of future population growth, this concentration is very likely to grow, thus increasing the pressure on the littorals. This is likely to affect maritime stability and thus also maritime security in many different ways:

37 Ratner, Israel's Offshore Natural Gas Discoveries Enhance its Economic and Energy Outlook.
38 Manicom, Bridging Troubled Waters, pp. 5-7, 27-37; Emmers, Geopolitics and Maritime Territorial Disputes in East Asia, pp. 8-21.
39 For more on the zone, see: < http://www.isa.org.jm/en/scientific/exploration> (Access 3 July 2014).
40 Rohstoffe aus dem Meer, pp. 96-119, here p. 96.
41 Ibid., pp. 54-93, here p. 93.
42 "Petrobras verweigert mehr Sicherheit. Brasilianischer Ölkonzern hält seine Standards bei Tiefseebohrungen für ausreichend," p. 7.
43 "Deep sea fission"; "Cassidian improves performance of air traffic control radars in eliminating wind turbine interference"; "'Lighthouse' for Submarines"; Rietz, "Offshore-Kernkraft für Sibirien. Ein schwimmendes Kernkraftwerk soll ab 2016 der Exportschlager der russischen Nuklearindustrie werden", p. 56; Sandhana, "Floating nuclear plants could prove tsunami-proof".

- **Demographics**

  Demographic development has an ambivalent effect on the maritime domain. The world population is projected to rise from around 7 billion right now to over 9 billion in 2050, with the most significant increases taking place in Asia and Africa. This will put an extra burden on rapidly evolving megacities. Most of them can be found along the world's busiest coastal zones (Figure 4). Megacities are attractive hubs of economic prosperity, and they provide access to global maritime supply chains. But they are also at risk due to the inflow of people, inadequate infrastructures, and activities by violent non-state actors, such as gangs and organized crime. As a consequence, fragile megacities mixed with state-level insecurity across the world's most important coastal zones are very likely to become the next big security issue for which the international community should prepare.[44]

  In Europe, by contrast, demographic change might come with different consequences for maritime business. Since Europe's population is shrinking and growing older, there might be a shortage of seafarers and qualified officers. This, in turn, could affect compliance with existing environmental, safety, and security regulations on board ship and perhaps also in busy harbors.[45] In addition, increases in social spending due to demographic changes will cause public spending shifts, most likely to the detriment of maritime capabilities.

- **Spatial planning**

  Another aspect, which is closely related with demographic change, is spatial planning. Land-based growth opportunities for megacities are limited. As a result, megacities could expand offshore. There are many examples of large cities establishing artificial land zones into the littorals to create more space for transportation infrastructure, such as airports. Going one step further, the Japanese construction company Shimizu envisions "Green Floats," which are urban villages built on floating platforms that could provide a new home for up to 50,000 people per platform. Several platforms could be tied together to create floating cities at sea. Green Floats could also provide an option for island states threatened by the risk of rising sea levels.[46] But how to determine maritime sovereignty rights when populated islands become mobile? Which laws apply on floating city-states in particular if they cross territorial waters of other countries? Can floating city-states be interpreted as ships or platforms under existing maritime conventions? How to best protect and defend floating city-states? These are but a few questions likely to arise should floating islands one day become reality.[47]

- **Climate change and rising sea levels**

  Climate change has been identified as a threat multiplier that is likely to contribute to instability in different regions of the world.[48] As argued in section 0, we can expect that the impact of climate change on domestic stability will have an influence on

44 For more on this, see in particular: Kilcullen, Out of the Mountains.
45 OPTIMAR: Benchmarking strategic options for European shipping and for the European maritime transport system in the horizon 2008-2018, pp. 199-200.
46 "Green Float: The Environmental Island."
47 For more on this, see, <http://www.seasteading.org/law-and-policy/> (Access 3 July 2014).
48 National Security and the Threat of Climate Change.

the international behavior of states. What matters most in terms of future maritime security requirements is the impact of climate change on sea levels. Although there are still significant uncertainties in projections of sea level rise, the Intergovernmental Panel on Climate Change concluded that "sea level rise is one of the longest-term consequences" of climate change.[49] Many coastal areas are vulnerable to rising sea levels, but it has been estimated that "75% of all people living in areas vulnerable to sea level rises are in Asia, with the poorer nations most at risk."[50] Refugee flows and internal displacement of people might be the consequences, which will increase the burden on megacities described above.[51] In addition, rising sea levels will impact the economy, as there are key infrastructure components in coastal zones. For example, China's most important terminals for the supply of liquefied natural gas (LNG) are on the east coast. Approximately 95% of Nigeria's export earnings are from supplying oil and gas. These sales account for around 65% of the Nigerian government's revenues. And in the United States, the Louisiana Offshore Oil Port receives 13% of the country's oil imports and is connected to 50% of the country's refining capacities.[52]

- **Pollution**
  Finally, pollution of the ocean is getting worse. There are several risks, including the release of sewage and wastes, chemical pollutants, spillover effects from exploiting fossil energy resources, and the uptake of plastics by fauna.[53] Overall, research findings suggest that the "resilience of the ocean to climate change impacts is severely compromised by the other stressors from human activities, including fisheries, pollution and habitat destruction."[54] Maritime security with a focus on maritime surveillance should therefore incorporate initiatives to advance ecosystem-based management of marine and coastal areas.[55]

49 Workshop Report on the Intergovernmental Panel on Climate Change Workshop on Sea Level Rise and Ice Sheet Instabilities, p. 1.
50 The State of Asian Cities 2010/11, p. 184.
51 It is worth mentioning that so far there is a protection gap for refugees, as the Geneva Conventions do not cover cross-order displacement as a consequence of climate change and/or natural disaster. The multinational Nansen Initiative is working towards closing the gap. See: <http://www.nanseninitiative.org> (Access 3 July 2014).
52 "Louisiana Offshore Oil Port: History"; China. Country Briefing; Nigeria. Country Briefing.

The Maritime Environment as a Domain for Power and Stability Projection

Power and stability projection and the use of the maritime domain are strongly intertwined. Future trends suggest that traditional ways of projecting maritime power are at risk. This will have fundamental implications for maritime security. In addition to excessive EEZ claims, the following challenges should be addressed:

- **Strategic maritime capabilities**
  More and more regional powers are increasing investments in strategic maritime capabilities. Among others, strategic capabilities strengthen an actor's freedom of manoeuver and expand its reach. Strategic capabilities increasingly include so called anti-access and area denial capabilities (A2AD) geared towards denying adversarial forces the freedom of action and inhibiting their ability to project power into maritime zones of interest (section 0)

53 Implementing the Global State of the Oceans Report, pp. 16-17.
54 Rogers/Lafolley, International Earth system expert workshop on ocean stresses and impacts, p. 6.
55 Taking Steps toward Marine and Coastal Ecosystem-Based Management.

China and India are the two most obvious examples. Both are putting an emphasis on expanding their submarine fleets and investing in aircraft carriers. Both nations have also greatly expanded naval areas of operations, among others, by conducting simultaneous naval operations in the Mediterranean and in the Indian Ocean. China has in addition put a focus on A2AD capabilities such as C4ISR,[56] space-based assets, cyber capabilities, underwater surveillance networks, and information warfare, thus significantly expanding the country's ability to deny an opponent freedom of maneuver.[57]

Other countries are following this pattern. Australia's 2009 and 2013 defense white papers foresee a "more potent" Navy able to conduct undersea warfare, anti-submarine warfare, and surface maritime warfare. The country will significantly increase its submarine fleet by 2030 and is interested in unmanned underwater systems.[58] Brazil's 2008 national defense strategy is illuminating, as it explicitly tasks the country's navy to protect oil platforms and naval and oil facilities and to respond to threats against sea lanes. Brazil also wants to establish a powerful submarine fleet and is even considering the purchase of nuclear-powered submarines to protect offshore oil fields.[59] In contrast, many European countries are cutting back their naval assets due to budgetary problems.

- **Technology transfer and technology proliferation**

  These investment priorities must be interpreted in light of the increasing danger of technology proliferation, in particular with regard to A2AD capabilities. Ready-to-use containerized A2AD weapon systems such as Club K missiles[60] that can be operated from maritime vessels further aggravate this risk because they provide state and non-state actors the ability to expand their naval zone of influence. In addition, technology transfer is proving to be increasingly ambivalent. Almost all of the aspiring development countries have made technology transfer a prerequisite for market access. As a consequence, defense suppliers' export prospects depend on their willingness to share technologies. This, however, is problematic, if technology transfer to end users cannot be controlled, and thus opens the door for technology proliferation to other countries and non-state actors.

  This is a worrisome trend for stability in general. The controversy over the delivery of Russian weapons systems to Syria in summer/autumn 2013 was a case in point. Among others, the international community has considered these weapons a potential risk for plans to establish and enforce an international no-fly zone over Syria. This illustrates the logic of A2AD: Exporting the respective capabilities will create far away "A2AD pockets" that make outside intervention more difficult. This can expand the

56 Command, Control, Computers, Communication, Intelligence, Surveillance, and Reconnaissance.

57 O'Rourke, China Naval Modernization: Implications for U.S. Navy Capabilities; Scott, "Joining the Club. Briefing: Carrier Air Power – China and India," p. 5; Kemp, The East Moves West. India, China, and Asia's Growing Presence in the Middle East; Military and Security Developments Involving the People's Republic of China 2013, pp. 31, 34-35, 38-40; Yoshihara/Holmes, Red Star over the Pacific; Goldstein/Knight, "Wired for Sound in the 'Near Seas'," pp. 56-61.

58 Defending Australia in the Asia Pacific Century: Force 2030, pp. 70-74; Defence White Paper 2013, p. 82.

59 National Strategy of Defense. Peace and Security for Brazil, pp. 20-22; "Brazil to protect oil fields with nuclear sub: minister."

60 <http://www.concern-agat.com/products/defense-products/81-concern-agat/189-club-k> (Access 3 July 2014).

zone of interest of one group of actors while at the same time limiting options for other actors. Allied forces of Western origin will need to consider this trend as part of their own force planning, because it suggests that intervention will become much more risk-prone. As a consequence, technological superiority and operational dominance can no longer be taken for granted. This will set future scenarios apart from interventions à la Iraq or Afghanistan where intervening forces enjoyed almost unrestricted air superiority.

- **Inter-domain relations**
  Additionally, thinking across all relevant domains to advance maritime security is indispensible, because "intradomain military operations are increasingly dependent on interdomain dependencies."[61] For example, naval operations depend on space-based assets and access to cyberspace. Space-based assets are needed for all sorts of communication and data exchange and for navigation; access to cyberspace is indispensable to make sure that these exchanges are safe, secure, and reliable. In the future, maritime stakeholders must prepare for deliberate action by state and non-state actors to disrupt important lines of communication; hide, spoof, and reroute digital traffic; or take out vital maritime communication infrastructure.
  These risks are becoming more important, because the need for the smooth exchange of information and communication among maritime stakeholders will increase in the future. This is a consequence of the growing need to coordinate an expanding number of maritime stakeholders (multi-stakeholder approach). In addition, the growing demand for unmanned platform goes hand in hand with new requirements to properly integrate these platforms into existing C4ISR value chains. Information security, in turn, is at the heart of C4ISR. But in a fully networked environment information security must cut seamlessly across different military services, civilian agencies, commercial operators, scientific partners, and other actors. Existing information security concepts are far from matching this requirement.

- **Non-state actors**
  Finally, non-state actors also have an interest in using the maritime domain for their own interests. Today, pirates are the most prominent non-state maritime actors. Given data limitations, it is difficult to assess the global costs caused by piracy, but studies assume that annual global costs could range from around $5-16 billion.[62] Organized criminals engaged in illicit activities such as human trafficking and smuggling of heroin, cocaine, firearms, and counterfeit products also make a lot of money by exploiting maritime disorder.[63] The fact that organized crime and piracy come together in certain littoral hotspots has caused concern that terrorists could become involved as well. This could create a situation where all three rely on each other for operational support, funding, and the joint provision of support infrastructures.[64]
  Three additional groups of non-state actors should receive more attention. First, militant animal rights organizations such as Sea Shepherd cause problems for maritime security because they use "tactics that could be considered activism, but bordering on

61 Redden/Hughes, "Global Commons and Domain Interrelationships," p. 2.

62 The Economics of Piracy; Bowden, The Economic Costs of Maritime Piracy.
63 The Globalization of Crime.
64 Murphy, Small Boats, Weak States.

criminality."[65] In addition, the growth of the organization's fleet and its tactical experience to fully leverage it should raise concern about the disruptive potential of this group and similar organizations. Second, the growing maritime capability profile of insurgents causes even greater concern for maritime stability. Organizations like Hezbollah make it amply clear, that A2AD capabilities are no longer the prerogative of nation states. Rather, Hezbollah's capabilities include, inter alia, a mobile and digital land line communication network of its own, naval commandos that could attack offshore infrastructure, missile systems with increasing range, and the ability to hack into communication networks used to operate unmanned aerial vehicles.[66] As a consequence the presence of non-state actors in the maritime domain will make operations in contested and congested littorals even more challenging and will generate additional capability requirements. Finally, there are the private maritime security companies that are growing in importance, but remain ambivalent. Due to many nations' lack of effective law enforcement at sea, they provide the "last line of defense" for maritime stability. However, their specific supply needs create new security problems as recent incidents with armory ships in the Arabian Gulf have shown.[67]

65 Rawley/Berube, "The Non-State Navy: Sea Shepherd as a Case Study for 21st Century Maritime Non-State Actors", p. 2; "Sea Shepherds' Expanding Fleet and the Militarization of Maritime Eco-activism."

66 Borchert, „Leviathan in der Levante. Bausteine der maritimen Konflikteskalation im östlichen Mittelmeer", p. 305.

67 Berube/Cullen, Maritime Private Security. Market responses to piracy, terrorism and waterborne security risks in the 21st century; Badam, "UAE coastguard detains floating weapons arsenal off Fujairah."

Fields of Action

The above review of long-term challenges affecting the maritime domain made it clear that maritime security covers a very broad spectrum of issues. As a consequence, the scope of maritime security should be defined broadly as well in order make it big enough for many different stakeholders to play a role. The following sections present food for thought on five pressing issues:

- First of all, maritime situational awareness and maritime situational understanding is indispensable for joint action;
- Second, the growing interest of state and non-state actors in A2AD capabilities endangers the freedom of the sea and needs to be addressed head on;
- Third, the lack of cyber security is the Achilles' heel of the maritime community as it as it endangers the effective execution of public and private tasks as well as public-private interaction,
- Fourth, as the importance of offshore resources is growing, the protection of offshore and underwater infrastructure against intentional acts and hazardous incidents becomes more important
- Finally, multi-stakeholder cooperation among the various state and non-state actors operating in the maritime domain fundamentally depends on the comprehensive transformation of maritime security sectors.

These issues are of general importance and should be addressed by nation states and regional organizations before or in parallel to tackling more specific questions. Inaction in these five domains, by contrast, would endanger maritime stability.

Establishing Comprehensive Maritime Situational Awareness and Understanding

How state and non-state actors use the maritime environment very much depends on their respective understanding of this complex operating domain.[68] Situational awareness and situational understanding with regard to the overall framework and the close interplay between what actors do (or fail to do) and how this affects the overall maritime community is a prerequisite for successful cooperation.

In general, situational awareness and situational understanding refer to the gathering, fusion, evaluation/assessment, and distribution of information to support the maritime community's decision-making. Given the characteristics of the maritime environment, information exchange must bridge existing public-private and civil-military divides in order to successfully organize cooperation. A holistic approach to information and knowledge management for the maritime community must not lead to bureaucratic, centralized exercises. Rather the focus should be on fully leveraging technology in a way that helps all stakeholders overcome existing institutional hurdles by establishing a joint information pool, also called a Maritime Situational Picture, This should be interpreted as a ready to use information pool where everyone can tap into and provide information based on his own tasks, responsibilities, and information ac-

68 Until today, sea blindness remains one of the key detriments to successful maritime cooperation. See: Feldt, "Sea Blindness: ein Faktor der Maritimen Sicherheit", pp. 17-21; Maritime Surveillance of CSDP. The Wise Pen Team Final Report to EDA Steering Group (Brussels: EDA, 2010).

cess rights.[69] A Maritime Situational Picture as a specific information management and decision support system fits into a broader context of providing a so-called "Common Information Sharing Environment," an initiative that the European Union has been working on for quite some time.[70]

A Maritime Situational Picture supports the whole spectrum of maritime security tasks. Two objectives are particularly important:

- As argued above maritime security needs to be organized along global supply chains. Supply chain security, in turn, depends on a holistic risk management approach. Risk analysis is of key importance in order to identify vulnerabilities and establish risk mitigation strategies. Risk management across supply chains requires the seamless flow of information between state and non-state actors in order to identify risks, assess likely outcomes, and evaluate countermeasures. In doing so, assessment and mitigation of risks very much depends on every actor's role within the global maritime supply chain.
  This is where the Maritime Situational Picture comes in. As a "one stop information shop" for the maritime community, the Maritime Situational Picture would provide information about the actors involved, their tasks, and their contribution towards providing maritime security. By illuminating roles and responsibilities of all actors involved, the Maritime Situational Picture illustrates joint areas of responsibility, highlights overlapping tasks, and sheds light on possible gray areas no one is tackling.
  This, however, requires actors to overcome existing reluctance to share information for reasons of national security and commercial competition. Rather than continuing the practice of secrecy and heavily classifying information, the maritime community should work towards adopting a rules-based "open source" approach. Rules-based information access means that information is shared depending on a user's overall tasks and responsibilities. Classification, if needed, would become more output and outcome-driven rather than input-oriented.
- Actors' behavior in the maritime environment is another important aspect that can affect maritime security. Among others, the focus is on movement patterns and unlawful activities. Norm compliance, in particular, is relevant for many different activities such as the exploitation of marine and seabed resources, environmental protection and enforcement of international embargos. Tracking actors' behavior in the maritime domain is impossible without a Maritime Situational Picture. But in the maritime domain, transparency is hard to achieve, as different challenges need to be addressed. Many stakeholders consider data on cargo, shipping routes and other activities as confidential and proprietary. Let's take the so-called Long Range Identification and Tracking (LRIT) signals as an example. There are only very few companies that handle LRIT data for merchant shipping. Actors like the U.S. Coast Guard that negotiate access to LRIT data via contracts can improve their Maritime Situational Picture. This, however, prompts counter-reactions. China, Iran, and Russia, for example, have established government authorities to keep con-

69 For more on this, see: European Union Maritime Security Strategy, pp. 11-12; Maritime Surveillance of CSDP, pp. 19-29, 31-32; Feldt/Roell/Thiele, Maritime Security: Perspectives for a Comprehensive Approach, pp. 14-21.

70 For more on this, see: <http://ec.europa.eu/maritimeaffairs/policy/integrated_maritime_surveillance/index_en.htm> (Access 3 July 2014).

trol of sensitive LRIT data.[71] A second category of technical challenges for marine data gathering pertains to the nature of the maritime environment. The growth of underwater activities will prompt future needs to monitor these activities and thus also integrate them into wide area Maritime Situational Pictures. However, underwater sound and signal propagation is challenging due to the physics of the oceans (e.g., signal reflection). Finally, the increasing use of unmanned surface vehicles and unmanned underwater systems will create additional signals emission, collection, and track and trace requirements in order to make sure that Maritime Situational Pictures can display unmanned systems.

Confronting Adversarial A2AD Challenges in the Maritime Domain

Economic globalization rests on the free flow of resources, goods, capital and information and the unrestricted mobility of people. This paradigm is in danger as the freedom of the Global Commons is increasingly contested. More and more state and non-state actors attempt to exert strategic influence by affecting the free flow of economic exchanges according to their own very specific interest. Economic policy favoring protectionism and preferential trade agreements is one instrument to achieve this outcome. In a sense, A2AD is the strategic and military equivalent to economic protectionism because it creates "pockets" of non-intervention.

A2AD is about influence in zones of strategic importance. It serves to ensure one's own freedom of action in these zones of strategic importance while at the same time denying adversarial forces freedom of action in the same area of operations.[72] In historic perspective, A2AD has been part of war fighting for ages.[73] However, since the early 1990s military interventions by Western alliances were operating out of technological and operational superiority. But actors that leverage A2AD principles try to undermine superiority, inter alia, by the use of alternative tactics and the deployment of state-of-the art ISR and weapon systems. This is challenging the status quo and is thus of concern for global maritime stability.

It remains to be seen how the transatlantic community is going to respond to growing A2AD challenges. Here again, perceptions and "risk appetite" matter. It is no surprise that the US interprets A2AD as a direct challenge to its own geostrategic ambitions worldwide and thus vigorously tries to counter it. The 2012 Joint Operational Access Concept leaves no doubt that "warfare against highly capable enemies with advanced (A2AD) capabilities [pose] the greatest access challenge of all."[74] From the US perspective, countering adversarial A2AD capabilities is not only a focal point of its own strategic thinking. It will also play an important role in future decisions about political partnerships with other countries and alliances.

There are at least two different types of capabilities to counter A2AD. First of all, there is a need to identify, monitor, and assess an

71 „Nations quietly battle over merchant ship geolocation", p. 8. In the case of Russia, for example, LRIT data is handled by Morsviazsputnik, which has signed an LRIT services agreement with the International Mobile Satellite Organization in 2010. See: "IMSO signs LRIT services agreement relating to the national LRIT data centres of the Russian Federation".

72 In doing so, A2AD is all about "reproducing social hierarchy" by limiting access of people and nations to certain spaces. See: Steinberg, The Social Construction of the Ocean, p. 30.

73 Tangredi, Anti-Access Warfare. Countering A2/AD Strategies, pp. 7-31.

74 Joint Operational Access Concept, p. 3.

adversary's A2AD posture. In addition, there is a need to directly counter adversarial A2AD capabilities by circumventing, neutralizing, and defending against them. Let's look at each of these two options in more detail.

- **Identifying, monitoring and assessing A2AD**
  Identifying, monitoring and assessing A2AD goes hand in hand with the continuous need for situational awareness and situational understanding. Two aspects are important:

  - In addition to operational experience, tactics, and training, A2AD very much depends on adversarial access to technology. This highlights the broader industrial policy context that is relevant to assess A2AD. Technology transfer in return for access to foreign markets and technology proliferation provide a broad range of options for adversaries to build up A2AD capabilities. Countries that want to prevent the flow of relevant technologies thus need to engage in public-private information sharing. Information sharing and joint assessments are important to understand who is acquiring what kind of technologies, how these technologies enable A2AD operations, and how to counter them. Among others, this increases the need to track mergers and acquisitions and the sale of technology-related intellectual property rights. In addition, governments and industry will also have to engage in joint activities to establish technology development roadmaps in order to understand when technology transfer is detrimental to technology superiority.
  - In addition, A2AD in the maritime domain will create new information needs that trigger additional sensor requirements. State and non-state actors will put a premium on concealing specific A2AD assets such as submarines or unmanned underwater vehicles. In view of the respective operating environment, this will create extra demands for new sensors to operate in challenging brown waters with jungle-like vegetation and sand that both affect sound and signal propagation under water. Permanent ice in the Arctic, by contrast, defines completely different requirements. In addition, there will be a growing need to detect, identify, and track objects operating at great depth and to deal with non-cooperative objects. Finally, sensor ubiquity will provide adversaries manifold opportunities for camouflage, concealment, and information degradation, thus underlining the need for information security in a sensor rich environment. All of these requirements raise challenging questions with regard to the future sensor mix (all-purpose vs. specific purpose sensors).

- **Countering adversarial A2AD capabilities**
  Expanding situational awareness and situational understanding as described above is indispensible to directly countering adversarial A2AD capabilities. If and to what extent countries will be willing to do so, depends on their overall level of ambition, their readiness to take risks, and the capabilities already in place. The following ideas thus describe generic options useful to deal with A2AD:

  - Use swarming to establish mixed fleets combining manned and unmanned systems that provide different capabilities and operate in a distributed, highly integrated fashion. This reduces the vulnerability of high value targets and increases the

burden for an adversary to engage many different targets in various operating domains at the same time.[75]

- Operate platforms with multi-purpose sensors and effectors that can be used to accomplish many different tasks at the same time, thereby reducing the need for single-purpose platforms.
- Invest in the exploration of "gradual autonomy", i.e. the ability of platforms to cover a broad range of tasks ranging from automatic to autonomous performance commensurate with overall mission requirements and the respective risk environment.
- Improve energy management in order to expand the operating time of platforms as miniaturization, new sensor requirements, and additional computing power create new on-board power challenges.
- Explore loitering payload delivery vehicles that can be brought into an area of operation well ahead of any specific operations. These pre-deployed assets could be activated just in time upon demand thus significantly reducing preparation time in case of need.[76]
- Beef up protective capabilities against physical and digital risks to enhance the survivability of your own forces and assets. In particular, there will be a growing need to improve the self-protection of unmanned or remotely piloted platforms.

Promoting Maritime Cyber Security

Cyber insecurity is probably the least addressed of all maritime security risks. Several trends make it a key concern for the future. Surveillance, navigation and communication services need to be properly integrated into the overall C4ISR value chain in order to provide maritime situational awareness and maritime situational understanding. Technical malfunction and degraded information environments directly threaten the value of Maritime Situational Pictures. Data used to build Maritime Situational Pictures must be interpreted as high value targets for everyone interested in data theft and data manipulation.[77] The same holds true for digitally wired weapon systems. Data links, command and control systems, and systems used for target identification are potentially vulnerable to outside interference. Navies, coast guards, and other security agencies with maritime tasks thus have a fundamental interest in conducting regular cyber risk and vulnerability analyses. In doing so, they should put a key emphasis on those operations that require real-time communication and real-time data links as adversarial

75 On the logic of swarming to counter A2AD, see in particular: Hendrix, At What Cost a Carrier? Cabral, Eschewing Mass: Dispersed Force Employment as a Counter to Anti-Access/Area Denial Challenges.

76 For more on this, see: The Navy Unmanned Undersea Vehicle (UUV) Masterplan, pp. 46-48. For a more up to date overview of the Navy's use of unmanned systems at sea, see: Unmanned Systems Integrated Roadmap FY2013-2038, pp. 8, 88-90. The US Defense Advanced Research Projects Agency (DARPA) has launched the Upward Falling Payloads program that looks at conceptual and technical specification to realize this idea. See: <http://www.darpa.mil/Our_Work/STO/Programs/Upward_Falling_Payloads_(UFP).aspx > (15 April 2014). However, there are legal barriers for certain types of payloads such as the use of UUV to predeploy ballistic missiles. See: Button, A Survey of Missions for Unmanned Undersea Vehicles, pp. 97-99.

77 To many experts the problems surrounding the flight of Malaysia Air MH370 was a case in point. The fact that the airplane's signals emission had been switched off has made it much more difficult to reconstruct the flight. The same could happen with AIS and LRIT signals in the maritime domain as well. This reinforces the need for solutions that help prevent data manipulation and/or provide redundancy in order to verify signals with multiple systems.

forces could specialize on degrading the information environment relevant for these very particular operations.

Cyber risks do not stop at the commercial sector. Information security has become of paramount importance for the global supply chain and logistics industry. Here, information and communication technology has become key to providing just-in-time services and to avoid the misuse of global supply chains for illicit activities (e.g., smuggling, circumventing international embargos). The maritime logistics industry's digital infrastructure is also a high value target for criminals and data manipulators.[78] When it comes to cyber security regulations for the maritime community, serious gaps exist. The International Ship and Port Facility Security Code (ISPS), the capstone document for the merchant shipping community, mainly focuses on physical aspects of safety and security. Digital risks are not yet covered by the ISPS code.[79] There is thus high time for the international community to address this risk and prevent perpetrators from exploiting the maritime community's "digital hole".

Improving Joint Activities to Protect Offshore and Underwater Infrastructure

The future maritime environment as described above is very likely to affect the risk calculation of offshore and underwater infrastructure operators. Coastal area and offshore infrastructure can create significant environmental damage as witnessed by the explosion and sinking of the oil platform Deepwater Horizon (2010) or the fact that on any single day more than 300 tons of contaminated water flow from the Fukushima reactors into the ocean.[80] Public outrage about such incidents and the likely inability of the companies and public emergency responders to provide swift remedies can undermine trust and confidence. In addition, these incidents create enormous economic damage due to environmental cleaning, loss of production, rebuilding of infrastructure. Perpetrators with an interest in destabilization could feel tempted to produce these kinds of incidents or at least exploit the respective consequences. Already today, offshore oil and gas infrastructure in the Gulf of Guinea is under attack;[81] Hezbollah has threatened attacks against offshore gas infrastructure in the Eastern Mediterranean; and most recently, environmental activist from Greenpeace tried to seize a Russian oil platform.[82]

These incidents raise several questions. First of all, the current regulatory framework to protect offshore oil and gas infrastructure against security threats (e.g., attacks) is underdeveloped. Mikahil Kashubsky[83] recently showed, that all major regulatory frameworks show serious gaps. According to him the UN Convention on the Law of the Sea (UNCLOS) does not "expressly allow coastal states (…) to take enforcement action against foreign ships involved in (…) attacks on or unlawful interferences with offshore petroleum

78 For a general overview that looks at different dimensions oft he transport sector, see: Cybersecurity of Freight Information Systems.
79 Analysis of cyber security aspects in the maritime sector, pp. 14-15.
80 Suga/Okada/Adelman, "Tepco Finds New Leak of Radioactive Water at Fukushima Site."
81 The African Maritime Safety and Security Agency (AMSSA) has launched a project to address these problem. For more on this, see the project outline for the Gulf of Guinea Critical Oil & Gas Infrastructure Task Force: <http://www.marsecreview.com/wp-content/uploads/2013/09/GoG-COGI-TF-2013-operational-doc-1-doc.doc> (Access 3 July 2014).
82 "Greenpeace activists scale Gazprom drilling platform, two arrested in Arctic oil protest."
83 Kashubsky, "Protecting Offshore Oil and Gas Installations: Security Threats and Countervailing Measures."

installations in the EEZ (…)." Furthermore, "mobile offshore installations that are on location engaged in offshore drilling or production are not covered by the 1988 (Suppression of Unlawful Acts) framework which is a major gap." Kashubsky also highlights that the Safety of Life at Sea (SOLAS) convention has no requirement to fit automatic identification systems (AIS), which are mandatory on ships, on offshore petroleum installations.

Second, addressing existing regulatory loopholes against security risks is far from easy, as governance capacities in many of the oil and gas-producing developing countries are dysfunctional at best. This challenges holistic risk management. As a consequence of the Deepwater Horizon incident, the European Commission toughened safety regulation for offshore energy infrastructure. By contrast, Petrobras, Brazil's leading energy company that operates offshore drilling and production platforms in the country's territorial waters, let it be known that there was no reason for additional safety regulation as the company was fit to meet foreseeable technical challenges of drilling 7,000 meters below the waterline (section 0). This creates two contentious issues: On the one hand, ambitious emerging countries might fail to see the need to adapt existing safety and security regulation. On the other hand, local governments might not have the necessary capacity to provide much needed regulatory oversight and enforcement action to verify compliance with existing regulation. This prompts a need for tailored support programs. When providing support for the development of local offshore energy sectors, the international community should increase attention (1) for holistic risk management concepts to address safety and security issues, (2) beef up local state capabilities to provide for the security of offshore installations, and (3) increase local capacities to monitor and enforce compliance with safety and security regulation for offshore energy infrastructure.

Third, safety and security concepts for offshore energy infrastructure require close public-private interaction. Enlisting the private sector in the provision of a public good like security is not easy, but in this case, there is a strong business rationale to support government activities. Israel, for example, has adopted a three-layered protection concept that delineates public and private responsibilities with dedicated areas of individual and joint responsibility of the Navy and commercial platform operators.[84] Lessons from this approach could be shared with other countries. In doing so, international organizations could stimulate the transfer of information and experience by providing platforms for public sector and private sector stakeholders to engage in. Bridging gaps between civilian maritime and energy regulatory organizations, the Navies and Coast Guards, infrastructure operators, and private security contractors could provide valuable input to improve operational capacities and address some of the most pressing regulatory security gaps discussed above.

Finally, accidents at sea quickly cause environmental damage across a very wide area. This reinforces the importance of regional approaches towards establishing Maritime Situational Pictures. A joint information pool provides valuable insights into who is going to be affected in order to coordinate countermeasures. In addition, preparedness capacities to deal with environmental accidents at sea could easily lend themselves to pan-regional cooperation. Depend-

84 Opall-Rome, "Israel Seeks Expanded Operating Area. Cabinet Considers Special Funds for Missile Boats, UAVs," p. 20.

ing on the area that would need to be covered, pooling and sharing of scarce assets could be envisaged. This could give a boost to overall pan-regional cooperation and would provide a very welcome opportunity to bring environmental, economic, and security concerns together.

Advancing Maritime Security Sector Reform

This paper has made it clear that maritime security requires a multi-stakeholder approach. Organizing seamless interaction involving public and private actors has been at the heart of the so-called Comprehensive Approach to reform national security sectors. Now it is time to extend the logic of the Comprehensive Approach to the maritime domain. This, however, is easier said than done, because so far the maritime security sector has not received enough attention. This is a problem because without overhauling the maritime dimension of any nation's national security sector, national preparedness will be weakened. Maritime Security Sector Reform (MSSR) is intertwined with the even bigger task of adapting the national security sector as a whole:

> The characteristics of a nation's maritime sector can be seen as a microcosm of that nation. If the national characteristics include a lack of political and/or public consensus over governance, insufficient political competition, capability deficits, or deficient public administration, the maritime sector will likely share these characteristics. By the same token, improvements to maritime governance, law enforcement, and safety may have a positive impact on citizens far beyond the maritime sector (…).[85]

The key purpose of MSSR is to improve the management capacity in a multi-stakeholder environment. Ultimately, MSSR should lead to improved coordination (and even harmonization) of the goals to be achieved and the processes, structures, capabilities, and resources at hand to improve maritime security. This entails defining the tasks state and non-state actors are expected to accomplish, delineating areas of joint and individual responsibility, setting up and institutional framework that enables and support cooperation across existing institutional boundaries, and designating resources for the respective tasks.

85 Maritime Security Sector Reform, p. 1.

Conclusion

Competition for access to, freedom of action within, and use of the global maritime domain is getting tougher. The global maritime environment is becoming much more crowded and cluttered because of the growing presence of state and non-state actors. Technology transfer and technology proliferation enable these actors to express their maritime interest more assertively. Growing demand for different kinds of resources puts offshore resource fields at the forefront. This leads to additional maritime sovereignty claims and increases pressure on unresolved territorial disputes at sea. In parallel more and more actors are trying to broaden their leeway within maritime zones of interest while at the same time preventing others from doing the same. As a consequence the maritime domain is getting more contested than in the past. Toughening contests render the maritime domain narrower thus significantly limiting the strategic significance of safely operating from a distance. In order to ensure one's own interest in the maritime domain continued local, regional, and global presence will again become more important. At the same time different maritime regions are becoming increasingly connected with each other by way of global trade that runs across pan-regional supply chains. As global connectivity increases, trade flourishes and helps distribute prosperity. But vulnerabilities increase as well. Closely knit global supply chain networks transport disturbances from unstable to stable regions. Strategic concepts that consider supply chain interruptions as a means to exert influence on others can heavily backfire as all economies depend on open trade routes and well-oiled maritime supply chains.

Against this background it becomes more than obvious that *ordnungspolitik* for the global maritime domain in the 21st century can no longer remain the by-product of decisions set in other policy areas. Rather there is a need for a comprehensive approach in dealing with all issues related to the maritime domain. As this paper has shown, maritime security is at risk as the result of many different activities. From a security perspective, the current enforcement gap resulting from diverging strategic perspectives of leading European nations, the United States, and emerging powers must be interpreted as the most important problem. This gap is an invitation to every state and non-state actor with a serious interest in disrupting the maritime status quo. At least for the time being, the enforcement gap seems to be systemic thus aggravating the threat to maritime stability inherent on many of the activities described above.

Tackling the enforcement gap is hardly an issue for the academic community. But academic research can play a useful role in other areas that help strengthen maritime security:

- First of all, establishing a broad and comprehensive understanding of maritime security is important in order to overcome the dominant belief that maritime security is synonymous with fighting piracy. Bringing together different academic disciplines in order to establish a maritime security taxonomy could provide a very valuable start for other activities to build on.
- Second, building on multidisciplinarity, academia could bring together scientific experts and practitioners from across the maritime community. Reaching out to many different stakeholders could improve mutual understanding and establish trust. Blending theoretical expertise with real world experience could also help improve academic training and education. In doing so, reaching out to different regions around the globe would be most beneficial to expand cross-cultural knowledge and insights.
- Third, academic research could focus on good practice and worst practice of maritime security regime building. By analyzing the

enablers and obstacles of maritime security cooperation in different politico-institutional frameworks, academic research could provide tangible benefits to the maritime community in general and support MSSR programs in particular.

- Fourth, comparative analyses of existing gaps in the security-relevant regulatory framework for offshore infrastructure could help identify and remedy current shortfalls. These insights could be directly fed into existing security regimes and would thus benefit the global energy industry and local regulatory authorities thereby stimulating local and regional prosperity.
- Finally, academia would be well placed to tackle one of the thorniest issues hindering true maritime security: the lack of coherent governance for the world ocean. The Economist recently argued that a "mishmash of international rules and institutions determines the condition of the watery commons."[86] This is a mild description of the "organized chaos" that is characteristic of today's situation. The main challenge is "atomized" governance, i.e. there is a single regime for almost every issue, but there is a lack of comprehensiveness to provide a holistic approach that encompasses all of these issues. What is even worse, coherent governance is lacking at both national and international levels, thus rendering the global search for sustainable regimes even more complicated. In addition, the current political and economic power shift from industrialized to leading emerging countries affects overall political readiness to tackle this problem at all and questions the legitimacy of existing rules, norms, and principles to govern the use of the global maritime domain. There is thus a wide area for comparative analyses and new proposals on how to provide for global maritime governance during the current transitory stage of world politics.

86 "In deep water. Governing the high seas," p. 48.

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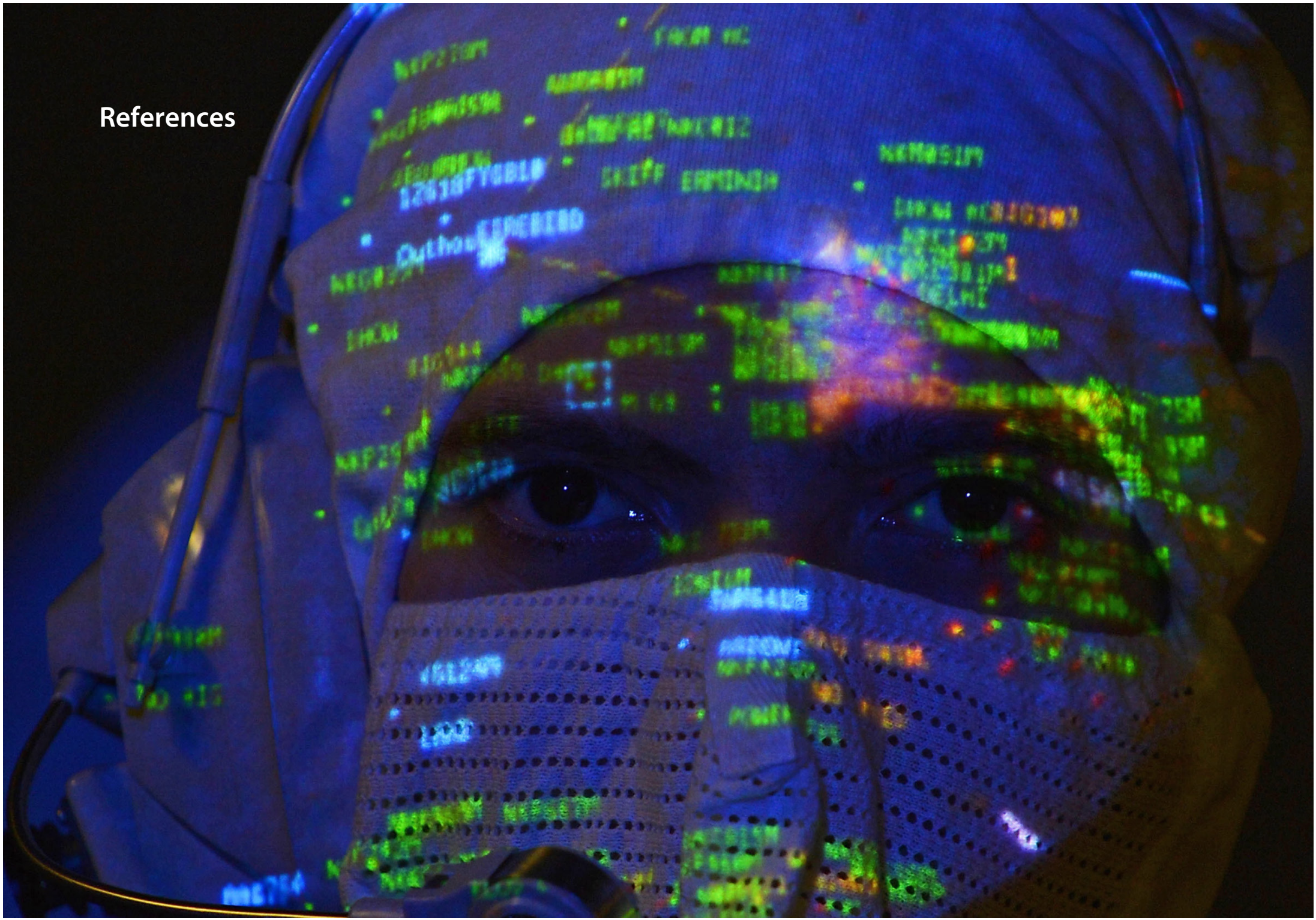

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