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TRANSFORMING ITALIAN PORTS INTO INNOVATION HUBS

A strategic advantage for the European Union and a way to bolster security in the Mediterranean Sea

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“Secondo alcuni autorevoli testi di tecnica aeronautica,
il calabrone non può volare a causa della forma e del peso del proprio corpo,
in rapporto alla superficie alare.
Ma il calabrone non lo sa e perciò continua a volare.”

I. Sikorskij.

EXTENDED ABSTRACT

Questa tesi nasce con l'obiettivo di dimostrare che trasformare i porti italiani in poli di sviluppo e innovazione è una questione di interesse securitario quantomeno europeo. La rotta transoceanica più breve per trasportare la merce prodotta in Cina fino all'Europa e agli Stati Uniti passa proprio per il Mar Mediterraneo, detto anche Medio Oceano e frontiera sud dell'Unione Europea. L'Italia, trovandosi al centro del suddetto mare, presenta un vantaggio strategico sul controllo delle rotte transoceaniche che transitano per esso e sulla possibilità di attingere le sue risorse. Tale vantaggio strategico, potrebbe essere sfruttato a beneficio di tutti i paesi che compongono l'Unione Europea, senonché, questo potenziale viene inibito da numerosi fattori tra cui l'arretratezza del sistema portuale italiano. Pertanto, rinnovare i porti del Bel Paese, diventa una priorità comunitaria in chiave energetica, ambientale, logistica e informatica, soprattutto alla luce degli sconvolgimenti globali occorsi negli ultimi anni, che hanno portato ad una maggiore richiesta di sicurezza a livello internazionale. L'Italia è veramente pronta ad assumere il ruolo di portale d'accesso delle risorse del Mediterraneo all'Unione? Questa tesi mira a verificarne l'effettiva possibilità, analizzando lo status quo di quelli che sono i requisiti per un' integrata rete logistica europea dell'energia e delle telecomunicazioni. Non si può, infatti, parlare di portale d'accesso europeo o di polo di sviluppo senza che snodi cruciali come i porti siano dotati di infrastrutture adeguate a finalizzare tale obiettivo.

Quello della sicurezza internazionale è tema centrale all'interno della tesi. A seguito di shock sistemici che hanno avuto luogo tra il 2008 e il 2023 (Crisi finanziaria, guerra commerciale tra Stati Uniti e Cina, Primavera Araba, Pandemia da Covid 19, Guerra in Ucraina e, in misura minore, il blocco del Canale di Suez) il dibattito politico odierno ferve intorno alle seguenti tematiche: indipendenza dal gas russo, accorciamento delle filiere produttive e commerciali, sicurezza degli approvvigionamenti e delle telecomunicazioni, sicurezza ambientale. Le minacce a queste realtà, possono essere gestite attraverso il mare, su cui l'Italia possiede, come già detto, un vantaggio strategico. Se l'Italia si candida a diventare un portale d'accesso (o come si legge sulle notizie di oggi un *gateway*) per il trasferimento delle risorse del mare al resto d'Europa attraverso la terraferma, dovrà rivedere il proprio modo di affrontare le minacce provenienti dal nuovo paradigma delle relazioni internazionali, ovvero la competizione continua Questo comporterà la necessità di fortificare le proprie infrastrutture critiche, tra cui i propri porti, allo scopo di renderle più resilienti alle nuove minacce (soprattutto, nel caso dei porti, da quelle provenienti dal mare).

Il capitolo uno tratta, per l'appunto, dell'importanza del mare e della portualità, sia nel mondo globalizzato che conoscevamo prima del 2020, che nel mondo più regionalizzato che sembra profilarsi a seguito della Pandemia da Covid 19. Dopo aver introdotto il tema dell'importanza del mare, il capitolo prosegue con una panoramica sulla dimensione commerciale, digitale ed ecologica dei porti. Un paragrafo, inoltre, viene dedicato alla governance internazionale e al quadro legislativo internazionale dei sistemi portuali.

Il primo paragrafo illustra l'importanza del mare come dimensione fondamentale per il commercio e quindi per l'evoluzione delle società che popolano il pianeta Terra. È proprio attraverso il mare e i suoi porti (cittadelle addette al trasferimento delle risorse dal mare alla terraferma) che oggi viene trasportato il 90% dei beni e questo permette il prosperare delle società. Il mare è infatti il tessuto connettivo della Terra, capace di mettere in comunicazione isole terrestri (che altrimenti rimarrebbero separate) attraverso linee di comunicazione marittima percorribili via nave. A questo punto viene utilizzata la teoria dei quattro Mediterranei di Fioravanzo per dimostrare che l'Italia, trovandosi al centro del Mediterraneo Latino, possiede un vantaggio strategico per il controllo del mare. Avere il controllo del mare significa avere il controllo sulle rotte commerciali che transitano per esso e avere il controllo sulle risorse naturali che da esso possono derivare. Proprio per questo motivo, il mare è anche il luogo dove si incontrano (e si scontrano) gli interessi degli stati che vi si affacciano; è stato, perciò, necessario regolamentare l'azione degli stati sul mare attraverso la Convenzione delle Nazioni Unite sul Diritto del Mare (UNCLOS) ratificata a Montego Bay nel 1982. Dall'analisi della Convenzione emerge la possibilità per gli stati di ricorrere all'utilizzo di un istituto chiamato Zona Economica Esclusiva: parte del mare antistante il mare territoriale di uno Stato dove esso può esercitare i propri diritti di esplorazione e sfruttamento delle risorse del mare, del sottosuolo, dei venti e delle correnti. L'Italia per anni ha scelto di non adottare quest'istituto per non suscitare conflitti con gli altri stati rivieraschi rimanendo però penalizzata nell'estrazione delle risorse del Mediterraneo. Solo con il decreto n.91 del 14 luglio 2022 l'Italia ha finalmente adottato la propria ZEE, abbracciando la possibilità di sfruttare al meglio il proprio vantaggio geo-strategico.

Il secondo paragrafo invece, analizza la dimensione commerciale dei porti nel mondo globalizzato e regionalizzato. All'inizio viene descritto l'andamento della globalizzazione dall'età moderna ad oggi, sottolineandone il carattere non-lineare e multi sfaccettato. Quello che emerge da questa analisi è che con l'arrivo della turbo-globalizzazione negli anni 90, gli shock sistemici che hanno perturbato l'ordine mondiale si sono moltiplicati, producendo effetti sempre più disarmanti. Particolare attenzione viene data agli shock sistemici occorsi dal 2020 in poi, mettendo in luce come questi abbiano dato un grosso impulso ad un trend già iniziato in precedenza: quello del re-shoring. Nonostante questo fenomeno sia in crescita, secondo dati di Eurofond, non è possibile parlare di una de-globalizzazione, in quanto (secondo la maggior parte delle previsioni) il fenomeno riguarderà soltanto catene del valore che producono materiali critici. Tuttavia, quello che si evince dall'analisi degli ultimi trend, è che il mondo sia in procinto di assistere ad una fase di ri-globalizzazione del commercio chiamata "riglobalizzazione selettiva", in cui gli stati sceglieranno di riportare i loro stabilimenti produttivi presso paesi confinanti, condividenti gli stessi valori e con rischio politico vicino allo zero. Ci si aspetta che l'accorciamento delle filiere da parte delle aziende produca un tipo di scenario globale "regionalizzato" e caratterizzato da commercio di prossimità. Se le previsioni dovessero corrispondere a realtà, l'Italia potrebbe ancora una volta godere di un vantaggio strategico nella navigazione a corto raggio per il Mediterraneo attraverso i progetti Autostrade del Mare e Short Sea Shipping. Infine, il

porto viene descritto nel suo funzionamento di base come piattaforma capace di coinvolgere un insieme variegato di portatori di interesse e dove settore pubblico e privato si intersecano. Il modello di collaborazione pubblico-privata che ha preso più piede fra i porti europei è quello del "landlord" in cui lo stato rimane possessore e gestore del porto, ma fornisce (attraverso contratti di concessione di medio o lungo termine) alle aziende private la possibilità di adoperare il terminal per le proprie operazioni. Le aziende private che operano nei terminal vengono definite "aziende terminaliste" e di solito possiedono un portfolio di terminal in diversi porti del mondo. Ogni terminal è equipaggiato per un certo tipo di attività commerciale specifica che può variare dalle rinfuse, ai passeggeri ai container, alle attività estrattive ed energetiche. Ciò che emerge da questa tesi è che questo sistema dà la possibilità alle aziende straniere di insinuarsi nei terminal portuali di un altro stato sfruttandone gli asset e questo può rappresentare una minaccia alla sicurezza nazionale e internazionale. Tuttavia in Italia la governance dei porti rimane appannaggio delle Autorità di Sistema Portuale, ufficio della pubblica amministrazione che ha la funzione di coordinare le aree, le funzioni e i servizi del porto, gestire le concessioni e di coordinare le attività del porto con gli interessi delle comunità locali, regionali nazionali coinvolgendo tutti i portatori di interesse e facendo rispettare la legge nazionale. L'autorità di Sistema Portuale ha, inoltre il compito di sviluppare le politiche del porto in materia di connessione e infrastrutture, di pianificare lo sviluppo del porto, di regolare gli investimenti per progetti di interesse nazionale, e di rappresentare il porto nei forum internazionali. Il governo Italiano è a capo di 15 Autorità di Sistema Portuale, ognuna delle quali raggruppa diversi porti.

Il paragrafo tre tratta della governance internazionale dei porti. Essendo i porti luogo d'incontro di catene del valore originate in diversi paesi, questi diventano soggetti di legge internazionale. Sia l'Unione Europea che l'ONU hanno, dunque, dei quadri internazionali a cui ogni porto si deve adeguare. Dalla ricerca inerente è emerso che l'International Maritime Organization delle Nazioni Unite ha prodotto tre convenzioni internazionali che regolano la sicurezza della vita in mare, la prevenzione dell'inquinamento delle navi e alcuni standard e certificazioni per i navigatori. ILO, WCO e ISO sono altre organizzazioni internazionali che hanno competenza in materia di porti, ma quella che più di tutti concerne l'Italia è naturalmente l'Unione Europea. Dall'UE emerge un quadro piuttosto disomogeneo: siccome l'iniziale CTP non includeva politiche comuni per il mare, solo negli anni 90, con l'allargamento ad est dell'UE e l'affermarsi dell'intermodalità si è arrivati a capire la necessità di integrare la CTP con politiche marittime. Nonostante tutto, ancor'oggi l'UE non ha una chiara e omogenea programmazione comune degli spazi commerciali marittimi. La tanto auspicata European Port Policy si limita ad alcune politiche sconnesse tra cui il Port Package, SSS, MoS all'integrazione della TEN-T con una rete di porti. Tuttavia esiste una piattaforma denominata ESPO che raduna le voci di tutti gli stati membri europei e che cerca di avanzare una proposta di armonizzazione del commercio marittimo e delle politiche di sostenibilità nei porti. Un altro quadro legislativo internazionale a cui i porti si devono adeguare è quello delle infrastrutture critiche. Quella delle CI è una disciplina a carattere di protezione della sicurezza nazionale, nata negli Stati Uniti a seguito dell'attacco alla sede

dell'Organizzazione Internazionale del Commercio l'11 settembre del 2001. In quell'occasione gli Stati Uniti promulgarono una serie di atti volti a definire ed enumerare le infrastrutture vitali per il paese, la cui distruzione avrebbe un impatto sulla salute pubblica o sulla sicurezza del paese. La designazione di queste infrastrutture è volta a destinare loro particolare protezione da parte dello stato. La disciplina ha raggiunto anche l'Unione Europea, che prevede un proprio quadro per la protezione delle infrastrutture critiche. Dalle ricerche dell'autrice è emerso che la designazione di tali infrastrutture è classificata, tuttavia è stato comprovato che i porti rispondono a tutti i requisiti per essere designati come tali. Sulla base di alcune assunzioni fatte da O.Merk in un report dell'OECD del 2010, l'autrice ritiene opportuno considerare i porti (italiani e non) come infrastrutture critiche per tutto il resto della presente tesi e ritenerli, di conseguenza, da adattarsi al quadro legislativo dell'EPCIP.

Il paragrafo quattro ha come oggetto la dimensione digitale dei porti. Dall'analisi di quest'argomento è emerso che i porti sono hub digitali per due motivi: da un lato essi sono luoghi di partenza per le navi che operano la posa dei cavi sottomarini in fibra ottica, indispensabili per la comunicazione digitale fra paesi in quanto il 97% dei dati mondiali scambiati via internet non è trasmessa via satellite ma bensì via cavo. Questi cavi, sono stati essi stessi definiti infrastrutture critiche proprio perché senza il loro funzionamento verrebbe meno la possibilità di effettuare delle operazioni vitali per gli stati tra cui transazioni economiche di un certo rilievo. Data la loro importanza e la complessità di definire un quadro giuridico adeguato, i cavi sottomarini sono preda perfetta per diverse minacce e per questo necessitano di un'adeguata protezione. In secondo luogo, i porti sono definiti hub digitali anche perché vista l'alta quantità di attori in gioco, essi rappresentano un ecosistema digitalmente prolifico: un'immensa quantità di dati viene scambiata tra i vari attori del porto attraverso diverse piattaforme che hanno bisogno di essere connesse in maniera agile per velocizzare il lavoro frenetico degli operatori dello stesso e dei suoi portatori di interesse. Alla luce del fatto che i porti sono ambienti fertili anche per lo sviluppo di tecnologie di intelligenza artificiale e IoT, questa grande quantità di dati necessita di servizi internet sempre più complessi. Questo rende i porti particolarmente interessanti per le aziende di telecomunicazioni che vedono aumentare il numero di occasioni di collaborazione con l'ambiente portuale. Inoltre, macchinari e utensili del porto saranno sempre più smart e questo rende il porto un polo di interesse anche per aziende che operano nei settori dell'automazione e dell'intelligenza artificiale e che intendono avviare in esso attività di ricerca e sviluppo di nuove tecnologie.

L'ultimo paragrafo del primo capitolo analizza la dimensione ambientale dei porti. L'autrice ripercorre la storia dell'industrializzazione dei porti sottolineandone la natura non più di punti nevralgici per l'interscambio logistico all'interno delle catene del valore, ma di cluster industriali dove le materie prime in arrivo dalle navi commerciali vengono stoccate, trasformate e ridistribuite. Questo aspetto dei porti li rende tra le infrastrutture più inquinanti del mondo e la causa di molti problemi ambientali. Durante l'analisi viene

rilevato che le attività portuali hanno un impatto considerevole sull'acqua, sulla terra, sulla biodiversità e producono molti materiali di scarto, anche se il peggior impatto è quello prodotto sull'aria attraverso le emissioni di gas serra. Molti porti per ovviare a questo problema danno vita ad iniziative di economia circolare o si rivolgono alla produzione di energie rinnovabili: tutte queste manovre rientrano nella cosiddetta decarbonizzazione dei porti. Le energie rinnovabili più quotate da applicare nei porti sono l'eolico off-shore, l'idrogeno (il quale necessita ancora di molta ricerca prima di poter essere sviluppato, soprattutto quello che proviene da fonti rinnovabili), l' energia prodotta dal moto ondoso e il gas naturale liquefatto come energia di transizione.

Il secondo capitolo prende in considerazione i porti italiani come frontiera sud e portale d'accesso all'Unione Europea per merci, energia, cavi sottomarini. Da questa prospettiva si discerne la necessità di proteggere i porti da potenziali minacce di nuova generazione. Il primo paragrafo indaga il paradigma moderno delle relazioni internazionali, ovvero la condizione di competizione continua in cui sembra versare il mondo post Guerra Fredda. Dall'analisi di questa condizione emerge che al girono d'oggi gli stati hanno la tendenza a non scontrarsi più direttamente attraverso guerre convenzionali, ma al contrario, a ricorrere a mezzi di competizione sempre più indiretta e sofisticata. Questi mezzi assumono diverse sembianze e siccome spesso sono riconducibili al principio della negabilità plausibile, solitamente fanno parte di una zona grigia che si trova prima della soglia dell'uso della violenza. Come ben dimostra l'episodio inerente ai gasdotti Nord Stream 1 e 2 avvenuto l'estate scorsa, questo tipo di attacchi non convenzionali è facilmente riproducibile nel mondo marino e applicabile alle infrastrutture critiche ad esso connesse, motivo per cui i porti si rivelano un target plausibile. Il ventaglio di attività che rientrano nel regime della competizione continua, della zona grigia e delle guerre ibride è vasto e può comprendere guerre per procura, attività di disinformazione, operazioni nello spazio, sabotaggi di vario tipo, attacchi cibernetici e coercizione politica ed economica. Come esempio emblematico di leva economica riguardante i porti, l'autrice ha scelto di analizzare il caso del porto del Pireo che, insieme alla Belt and Road Initiative, nasconde dietro la faccia della cooperazione l'insidia dell'estorsione economica. Per quanto non si possa parlare di zona grigia vera e propria (in quanto manca l'elemento di coercizione delle autorità greche da parte delle autorità cinesi), l'acquisto del porto greco da parte del Celeste Impero rappresenta una minaccia sufficiente per suscitare timore presso l'Unione Europea e la NATO. Si dà il caso, infatti, che già negli anni 80 Pechino minacciò il governo neerlandese di spostare i propri traffici portuali da Rotterdam ad Anversa se il governo avesse venduto sottomarini a Taiwan. Constatato che con la compravendita del Pireo, i cinesi hanno salvato la Grecia dal collasso economico, niente vieta loro di utilizzare la medesima leva economica usata nei Paesi Bassi, motivo per cui le cancellerie occidentali si preoccupano affinché ulteriori porti europei non cadano in mano orientale. A seguito dell'analisi della vicenda, l'autrice conduce un breve raffronto con il tentativo cinese di entrare nei porti italiani di Genova, Trieste e Taranto, giungendo alla conclusione che, almeno per ora, l'ipotesi che si verifichi un Pireo in Italia è alquanto remota e improbabile.

Il paragrafo successivo tratta dell'importanza di proteggere ciberneticamente i porti. Se nel capitolo uno si è parlato dell'importanza di proteggere fisicamente i cavi sottomarini per evitare possibili interruzioni della comunicazione, in questo capitolo vengono trattate le minacce virtuali appartenenti al mondo informatico che possono produrre interruzioni o alterazioni dei servizi portuali. Dopo un breve excursus sugli attori, sulle motivazioni e i possibili scenari che riguardano gli attacchi cibernetici nei porti, questi vengono divisi in attacchi agli asset portuali e attacchi ai sistemi di navigazione. Questi ultimi non sono meno importanti in quanto un attacco cyber ai sistemi di bordo rischia di avere riverberi sia sui porti che su altri sistemi interconnessi della medesima compagnia di navigazione. Essendo i porti ambienti cyber-fisici (dove, cioè, il mondo dell'automazione e delle infrastrutture fisiche si mescola con il mondo informatico dell'Internet of Things e dell'intelligenza artificiale) è importante che siano dotati di sistemi per la difesa informatica delle proprie infrastrutture virtuali, poiché un attacco a queste ultime potrebbe determinare un'interruzione anche dei servizi fisici del porto.

Infine, il capitolo tre vuole essere un'analisi dello stato dell'arte dei porti italiani. I porti presi in considerazione sono solo alcuni (scelti a campione per essere, a parere dell'autrice, quelli più interessanti e dinamici) della rete "core" della TEN-T in Italia: La Spezia, Genova, Livorno, Ravenna, Venezia, Trieste, Gioia Tauro e Taranto. L'analisi viene effettuata attraverso i Piani Operativi Triennali dei porti per il periodo 2020-2023 (in alcuni casi 2022-2024), e attraverso i Documenti di Pianificazione Energetica e Ambientale inerenti allo stesso periodo. Entrambi i documenti vengono analizzati in coppia per ogni porto scelto; di entrambi i documenti l'autrice ha scelto di analizzare alcuni elementi che ha ritenuto più indicativi per il fine ultimo di questa tesi:

- La connettività dei porti al resto del sistema logistico regionale, nazionale e internazionale in quanto elemento chiave per trasmettere le risorse in arrivo dal mare al resto dell'UE e verificare quanto i porti italiani si stiano adeguando al framework previsto dalla TEN-T.
- L'impronta di carbonio prodotta come indice dell'inquinamento di un porto. La dotazione di infrastrutture per le energie rinnovabili e GNL per avere la misura di quanto effettivamente i porti italiani si stiano preparando a diventare poli di produzione e importazione di energia per l'UE.
- La transizione digitale nei porti, per verificare che tutti i portatori di interesse del cluster portuale stiano comunicando sempre di più in maniera digitale in modo da uniformarsi a quanto previsto dalla normativa EPCIP (CIWIN) per la protezione dei dati concernenti le infrastrutture critiche.

Dall'analisi comparata della connettività emerge che quasi tutti i porti analizzati presentano carenze nelle politiche di connessione di ultimo miglio e desiderano potenziare le loro linee ferroviarie. La quasi totalità dei porti analizzata dichiara di voler usare i fondi in arrivo dal PNRR per migliorare le connessioni con le ZLS e ZES nei pressi delle proprie aree e di voler potenziare le connessioni ferroviarie. Ulteriore desiderio comune che viene espresso nei piani operativi triennali è quello di migliorare, attraverso i fondi in arrivo, le

connessioni con i corridoi logistici TEN-T. Tuttavia esistono grosse differenze di connettività tra i vari porti, per esempio il porto di La Spezia risulta essere molto più dinamico e connesso al resto della rete TEN-T rispetto a quello di Livorno che presenta ancora notevoli difficoltà a svincolarsi dagli ingorghi e a connettersi con i corridoi europei. Un punto di vista interessante è quello del porto di Ravenna, che sottolinea la necessità di migliorare la connettività delle vie fluviali interne.

Dall'analisi dell'impronta di carbonio risulta che i porti analizzati utilizzano più o meno gli stessi parametri (spazi comuni del porto, spazi dell'Autorità di Sistema Portuale, terminal marittimi passeggeri, commerciali e industraili, servizi di mobilità all'interno del porto, veicoli aziendali, navi commerciali ormeggiate all'interno del porto, in transito e in manovra, trasporto merce dal porto all'inland ecc..). Ogni porto analizzato tiene quanto possibile sotto controllo la propria carbon footprint. Ciò che è più interessante riguarda l'analisi delle energie rinnovabili: nonostante tutti i porti dichiarino di volersi sviluppare nel campo del GNL in conformità con il regolamento UE EU 1315/2013, ci sono diversi porti che puntano di più ad altri tipi di energie, come Genova e Livorno che fanno dell'idrogeno il loro pilastro.

Dall'analisi comparata della digitalizzazione dei porti si può notare che l'argomento è trattato in maniera molto scarna e secondaria rispetto ad altre tematiche. La quasi totalità dei porti italiani è impegnata nello snellire e digitalizzare le procedure burocratiche delle PA attraverso l'utilizzo di un'unica piattaforma digitale. Un'altra tematica molto importante che emerge è quella di sveltire le procedure doganali e logistiche e di collegare i Port Community Systems con la Piattaforma Logistica Nazionale. Il tema dell'automazione nei porti è meno toccato nei documenti analizzati: solo raramente si fa accenno all'utilizzo di tecnologie blockchain, a droni per la sorveglianza e alla digitalizzazione dei varchi di accesso al porto. Al contrario, diversi porti rilevano la scarsa preparazione dei propri operatori in materia di utilizzo di piattaforme digitali e avvertono la necessità di dedicare parte dei fondi in arrivo alla formazione digitale del proprio personale. Il tema della cybersecurity e della protezione delle infrastrutture digitali dei porti da eventuali minacce virtuali non è quasi mai toccato nei documenti analizzati.

Gli ultimi due paragrafi del terzo capitolo costituiscono la chiusa della tesi e approfondiscono il tema politico dell'Italia come hub e gateway energetico d'Europa. Il governo italiano negli ultimi anni ha stabilito un indirizzo politico-energetico di lungo termine e ha effettuato un numero di visite istituzionali all'estero senza precedenti. Quest'indirizzo politico si sviluppa su tre direttrici: rafforzare la dorsale adriatica per prepararsi a ricevere il gas in arrivo dal Mediterraneo Orientale, dotarsi di capacità necessarie per produrre energia rinnovabile per tutto il paese (puntando in particolare sullo sviluppo di 12 valli dell'idrogeno), e rafforzare i rapporti diplomatici con i paesi del Nord Africa per importare energia. L'ultimo punto è di particolare importanza per questa tesi, in quanto migliori relazioni con l'altra sponda del Mediterraneo permetterebbero all'Italia di fare da ponte per l'importazione di energia dall'Africa verso il Nord Europa. L'offensiva diplomatica condotta dal governo in Nord Africa prende il nome di "Piano Mattei" e prevede

accordi che non si limitano al gas ma variano dalla posa di cavi per l'energia elettrica, pipelines per il trasporto dell'idrogeno e la cattura e lo stoccaggio di Co2 sotto i fondali marini. È previsto che l'incremento della cooperazione tra Italia e i paesi del Nord Africa porti investimenti e sviluppo in entrambi i paesi dando origine ad un nuovo tipo di dialogo a tutto tondo che vede i porti italiani come protagonisti, capaci di radunare attorno a sé portatori di interesse di tutti i settori coinvolti (energia, telecomunicazioni, cyber, logistica, commercio, difesa e ambiente). Per questo, basandosi sulla normativa offerta dalla Convenzione di Vienna sulle Relazioni Consolari del 1963, l'autrice auspica che i porti italiani vengano utilizzati non solo come forum o polo di innovazione e di sviluppo ma addirittura come sede consolare, in maniera tale che il corpo diplomatico possa assumere il ruolo di catalizzatore e regolatore di questo nuovo dialogo Mediterraneo.

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INTRODUCTION

This thesis was born out of the idea of investigating whether Italian ports really have the capacity and the means to play the role of Southern gateways to Europe. In order to play this important role, ports will have to produce and import energy and be logistically and digitally connected to the rest of Europe. At the same time, ports will also have to be ready to face threats and vulnerabilities stemming from the above-mentioned fields.

The author will explore this aspect conducting a qualitative analysis of primary sources deriving from national and international law such as ports' three-year operational plans and energetic and environmental policy papers, but also international conventions and regulations deriving from EU law and UN law. Reports by international think tanks, scientific articles, local and national press will be analysed as well. Finally, official websites of ports ad international institutions will be consulted as well as social networks, youtube and blog posts. The whole work has been produced in collaboration with the Italian Institute of Military Maritime Studies of Venice.

The work is divided in three chapters. Chapter number one provides an overview of three port dimensions that are considered from the author to be the backbone of a supposed European Southern gateway and hub: the commercial dimension, the digital dimension and the environmental dimension. In addition to that, the chapter aims at providing the reader with the general competences that are needed in order to understand the topic: the importance of the maritime dimension in globalization, the new political trends leading to a regionalized scenario and ports' role in the new scene, ports' structure, stakeholder and governance, the international multilevel governance of ports, the international framework to which ports' have to comply, ports' nature of critical infrastructure and their commercial, digital and environmental dimension. In paragraph number one "Sea as world's connective tissue: the importance of the maritime dimension in globalization" the author explains that sea is fundamental for its intrinsic property of connecting lands and societies through trade and shipping. Today's globalization owes its existence to the maritime dimension. In the maritime dimension particular importance is held by peninsulas located in the Mediterranean Seas, and this is why Italy holds a geographical and strategic advantage with respect to other European countries. In paragraph two the author deepens the commercial dimension of ports in the light of the recent economic and political phenomena that are seemingly leading to a regionalization of global trade. The reader will need this overview of the shifting pattern of global trade in order to understand why, if the forecasts are to come true, Italy ought to play a key role in the Mediterranean Sea in the incoming years. Finally, the same paragraph offers an overview on the internal functioning and the organizational structure of ports. In particular, ports are described as a platform where private and public interests meet and where several stakeholders develop their activities. Given their multifaceted nature, ports are subject to national and international governance that is described in paragraph three: hereby, the author pictures

the national division in 15 Port Authorities, the European Port Policy, the IMO system of conventions, and the many associations that represent ports' interests at a national and global level and the framework for critical infrastructures to which ports will also have to comply. The discipline of critical infrastructures was born in the US in the aftermath of the terrorist attacks of 9/11 and afterwards enlarged to the European Union that established its own framework to which European CIs (among which we can find ports) have to stick. This framework also obliges CIs to comply and to integrate to a cybernetic information network. Paragraph four concerns the digital dimension of ports. Here, ports are described in their nature of digital hubs: on one hand they are home to vessels which pull submarine internet cables, on the other hand they are digitally rich ecosystems that enable companies working in the telecommunication and AI sectors to invest in these areas looking for new working and development opportunities. The last paragraph deals with the environmental dimension of ports, showcasing them as polluting industrial clusters rather than mere logistic nodes in the GVC. In this paragraph ports are illustrated as source and catalysts of pollution and climate change; this is why national and international administrations invited them to comply to frameworks promoting their decarbonization and green energies' production and utilization. Many ports resort to industrial ecology, circular economy initiatives and mitigation measures and they are also preparing for the production and implementation of renewable energies, while adaptation measures still seem to be of more difficult application.

If Italian ports want to become proper Southern gateways to Europe, they will have to comply to international frameworks (hence applying the necessary reforms) and will also have to be prepared and equipped to face new generation threats. Chapter two thus consists in an overview of new generation threats deriving from the new paradigm in international relations that Southern European citadels will have to face. Hereby the author describes the condition of perpetual competition that characterises our contemporary world. In a world arena with these characteristics, states tend to avoid conventional wars and resort to other means of competition that stand before the use of violence threshold and are more likely to be filed under geopolitical competition, hybrid wars or grey zones. These types of attacks have the characteristic of being plausibly deniable by the perpetrator (thus being particularly difficult to address) and often hit critical infrastructures, this is why ports must be aware of these new generation attacks. Some of them involve the cybernetic sphere, as in the case of cyber-attacks to port assets and navigation systems, some of them involve the economic leverage, as the case of the port of the Piraeus, described in paragraph two. Paragraph three showcases a range of potential cyber-threats to which ports might be subject. If Italian ports are preparing to become innovation hubs, they cannot ignore these new types of threats.

Chapter three consists in analysis of the state of the art of Italian ports regarding the three dimensions already anticipated in chapter one (logistic, environmental and digital). In order to comply to national and international frameworks, Port System Authorities are in charge of writing strategy papers that deal with

every aspect of them. Documents thus analysed in chapter three are the three-year operational plans (POTs) and the Energetic and Environmental Documents of Port Authorities (DEASPs). Among all the topics touched inside these policy papers, the author decided to focus on the analysis of those aspects that most of all are needed in order to understand if Italian ports have the capability to become innovation hubs and gateways to Europe: logistic connectivity of ports to the rest of the TEN-T network (in order to ensure supply availability and GVCs' resilience), digitalization of ports in order to improve stakeholders' communication and transmission of confidential data, carbon footprint measurement and production and implementation of renewable energies inside port areas, in order to improve ports' impact on ecology and states' energetic independence. The analysis will be conducted on main Italian ports connected to the TEN-T corridors: La Spezia, Genova, Livorno, Ravenna, Venezia, Trieste, Taranto and Gioia Tauro. The last two paragraphs of the work consist in its final accomplishment: in paragraph nine the author describes the political guidelines of the latest years that are trying to transform Italian ports into European energetic gateways and energetic hubs and explains the difference between the two concepts. In the light of the investments and growth that this project is expected to bring and the high number of sectors and stakeholders involved, the author, in paragraph ten, invites authorities to inaugurate a new type of dialogue with the Southern and Eastern rim of the Mediterranean, that sees consular relations as a coordinating element among all of these actors.

CHAPTER I: PORTS' ROLE IN THE WORLD
SEA AS WORLD'S CONNECTIVE TISSUE: THE IMPORTANCE OF THE MARITIME DIMENSION IN GLOBALIZATION

Society evolves with trade and transport modes. The paradigm of trade and transport is changing

From the dawn of times, evolution of societies always took place alongside with the evolution of trade and transport modes. The reason is that commerce, and inherently transport, represent key sectors for the developing of economic, political and social relations of societies and the moulding of countries. While trade and transports evolve, people and territory evolve with it, even though not at the same speed. While for developed countries transports and infrastructures represent a means to consolidate their territory, for less developed countries these are a means to achieve development and participate in first world countries' activities. In the history of transportation, several phases can be acknowledged, starting from the mercantile age until globalization[1]. Today, after a set of external shocks and a period of perpetual crisis, a new shift in logistics and trade is taking place, that might be called re-globalization[2] or archipelago-globalization[3]. The international debate revolves around the terms "de-globalization[4]" or "slowbalization[5]", but since globalization hasn't always followed a straight forward path, the term that would rather be used in this thesis will be "re-globalization" as per Mr. Ottaviano. Nowadays the future of transportation is at stake, will globalization as we know it survive or will it change shape? And if so, how radically? Will the new paradigm be able to respond to the new needs of society and enhance citizens security? The following two paragraphs will try to answer these questions by showcasing the importance of the sea in trade and states' interest protection.

Trade and transport find their ultimate form in the maritime dimension. The importance of sea in global shipping from the origin to globalization

While the above questions remain open, this analysis is hereby focused on the value of the maritime dimension, which is often underestimated and sometimes even forgotten. Instead, sea represents, a key element for the protection of states' interests and the development of trade, as trade and shipping find their ultimate form in the maritime dimension.

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[1] P. Sellari, *Geopolitica dei trasporti,* Laterza e figli, 2013.
[2] G. Ottaviano, *Riglobalizzazione: dall'interdipendenza tra Paesi a nuove coalizioni economiche,* Egea, 2022.
[3] M. Deaglio, G. S. Frankel, P. G. Monateri, A. Caffarena, *Dopo l'Iraq: Ottavo rapporto sull'economia globale e l'Italia,* Guerini e Associati, 2003.
[4] V.V.A.A., *Slowing down or changing track? Understanding the dynamics of 'Slowbalisation'*, European Parliament, 2020.
[5] Ibidem.

Seas have the property to connect lands and peoples that otherwise wouldn't have got in touch in passed ages, and thus would likely have never developed trade among each other. The maritime dimension is fundamental for trade, because it acts as a "connecting tissue" among individuals, cultures, states, producers. As it will be analysed in the following lines, 80% of world goods are shipped by sea[6] and shipping companies develop their main traffic on sea routs called Sea Lines Of Communication (SLOCs).

To acknowledge the importance of the sea in global shipping, a step back to the Modern Age will be taken. According to the stage-based theory of A. Vallega[7], several stages in the development of sea trade can be distinguished: a mercantile stage (from Modern Age to the Industrial Revolution of 1750), a paleo-industrial stage (from 1760 to 1870), an industrial stage (from 1870 to 1920), a neo-industrial stage (from 1920 to 1970) and a trans-industrial stage (from 1970 to nowadays).

The features of the mercantile stage consist in the shifting of the fulcrum of trade from the Mediterranean Sea, with Spain and Portugal exercising their dominion in the world arena with their India Companies, to the North Sea where Great Britain exercised its dominion trading with the Americas and Africa[8]. At this stage, ports and port cities become the fulcrum of trade activities among states. The paleo-industrial stage is characterized by the supremacy of Great Britain with its role in defending the resources coming from its colonies and by the primacy of manufacturing. The Atlantic becomes the centre of world trade and lines of communication between Great Britain and North America become the first "motorways of the sea"[9]. Ports, which were formerly degraded and rundown, start to change their features by implementing, alongside to traditional activities, warehousing and financial activities. Railways start to become important in order to spread on land the resources stocked in ports.

The industrial phase starts with great technological innovations, including those in the energy sector[10]. Industries start to use oil and electricity instead of coal, which induces the creation of new sea lines specialized in oil supply and delivery.

During the subsequent trans-industrial phase, ports start to become the perfect milieu for the concentration of petrochemical transformation, metallurgical and thermo-electric factories, giving birth to what will subsequently be called the Maritime Industrial Development Area (MIDAs)[11]. Ports in this phase thus become big energetic hubs. Naval Gigantism and the stretching of sea lines are the main characteristics of this phase.

Approaching the 60s, Malcolm McLean spreads the idea of standardizing cargos with the aim of speeding up their loading and unloading while shifting from one mode of transport to another. His invention is called

[6] UNCTAD, Review on Maritime Transport 2022, https://unctad.org/publication/review-maritime-transport-2022 last accessed on February 15th, 2023.
[7] A. Vallega, *Trasporto mercantile e società industriale gli spostamenti del cuore oceanico del mondo*, 1997
[8] P. Sellari, *Geopolitica dei trasporti,* Laterza e figli, 2013, pgg.22-24.
[9] Ibidem pgg.4-24.
[10] Ibidem pgg. 4-24.
[11] Ibidem pgg. 4-24.

"container" and it has conquered the seas during the age of globalization. In 1965 container vessels for the first time float across transatlantic routes and from that year on 70% of world cargos are shipped through containers[12]. This consents shipping prices to be cheaper and causes companies to delocalize their activities giving birth to multinational enterprises and internationalization of GVCs. In this period ports undergo a structural and functional transformation: the necessity for big spaces dedicated to stockpiling pushes ports to abandon urban areas. In the meantime, containerized traffic becomes more and more popular while the route starting from the Pacific Ocean, crossing the straits of Malacca and Bab-el Mandeb, the Mediterranean Sea reaching the Atlantic Ocean becomes the most travelled path carrying out 30% of world traded goods[13]. Asian navigation companies start ruling unmatched the shipping sector. These shipping companies, with their nautical strategies, manage to improve the development of several port areas even outside their home country, determining a sensible shift towards success[14].

Today ports compete in order to attract stopovers of major shipping companies thus representing crucial nodes in the international GVC logistic mode shift. The development of intermodal corridors, the overlapping of port hinterlands and the global harmonization of port governance are all elements that during globalization boost port competition[15].

Finally, the trans-industrial stage is also known as the age of transhipment. The research for cheaper prices obliges shipowners to make their ships travel with the maximum capacity loaded and to make few stopovers. This is how feeder services developed: minor ships coming from and going to regional ports reach the transcontinental vessel in order to tranship containers to a minor destination. The majority of the ports in the world is characterized by transhipment services rather than being outposts of greater sea line shipping companies. This system is also called hub-spoke[16]. In the Mediterranean Sea some 50% of ports are destined to transhipment, while in Northern Europe they only make the 30%. Hub ports do not produce the value (in terms of money) that traditional ports actually do[17]. Containerization and transhipment also lead to the dissociation between port and cities and to the increasing decline of state power on port control.

The main problem of today in the development of ports and their hinterland is that inter-modality renderes ports intermediate spots in the logistic chain, binding together the different modes of transports. This made them extremely vulnerable to the switching strategies of shipping companies and industries reorganizing the shipping of their products. Ports' planning has thus become extremely hard and susceptible to uncertainty [18].

[12] Ibidem.
[13] Ibidem.
[14] Ibidem.
[15] Ibidem.
[16] Ibidem.
[17] Ibidem.
[18] Ibidem.

Sea connects lands. Assessing a geographical advantage through sea

As previously touched upon, seas also have the property of connecting lands which would otherwise remain unlinked. According to Aymeric Chauprade[19], the world can be divided in three macro-islands: the Americas, the Eurasian-African block (including Australasia) and the Antartic. Oceans separate these three major islands[20]. All of these islands are connected internally and to outer oceans by internal seas, which acquire major importance in the light of their function of letting oceans penetrate the macro-islands. Internal seas also connect lands to the international oceanic routes system.

In his work *Basi navali nel mondo* (1936), the Italian Admiral Giuseppe Fioravanzo acknowledges the importance of internal seas by elaborating the theory of the "Four Mediterraneans[21]" according to which, the macro-islands identified by Chauprade are separated by the following four internal seas: the "Latin Mediterranean Sea" (the one that the Roman Empire called Mare Nostrum but including the Red Sea and the Black Sea), the "American Mediterranean Sea" located between the Gulf of Mexico and the Caribbean Sea, the "Australasian Mediterranean Sea" that separates the Indian from the Pacific Ocean, and the "Japanese Mediterranean Sea" extending from Formosa to the Kamchatkan peninsula[22]. The four Mediterranean Seas have some features in common: first of all, they have common dimension, surface and bathygraphy. Moreover, they are seas between oceans characterised by two basins divided by an island or a peninsula in the middle. According to Fioravanzo's theory, who governs these central peninsulas or islands has a strategic advantage in controlling the seas[23]. To be located at the center of the Mediterraneans, gives states the opportunity to project their power strategically over both sides of the Sea, exercising a deeper control on local waters and on shipping routes crossing oceans. At the same time, the state that wields control over the straits of these Mediterraneans wields the keys for the access to several strategic commercial routes.

Having control of the seas means to have control on trade

But what is the purpose of controlling the Mediterranean Seas and projecting states' power amidst them? A state might want to control internal seas because, since "the sea is a means of communication, exchange and trade, who controls the seas controls trade[24]", which is the primary interest of a state, essential for its survival. For a state, in order to have trade one should have "a consistent and competitive merchant fleet, a

[19] M. Marconi, P. Sellari, *Geopolitica e Spazi Marittimi,* edizioni Nuova Cultura, 2021
[20] Ibidem.
[21] Ibidem, pg. 217.
[22] Ibidem.
[23] Ibidem.
[24] F. Zampieri, *Elementi di Strategia Marittima*, edizioni Nuova Cultura, 2020.

dense port network capable of receiving and distributing what it trades, a credit system higher than the competitors', a maritime insurance system and a military naval fleet protecting the state's commercial interests and a well-established information-control system[25]". According to the literature on the topic, the control on the seas is exercised throughout two intertwining factors: the naval power of a state (military fleet, bases and supports such as shipyards, warehouses, nautical schools, etc.) and the maritime cluster (industrial activities necessary to make the nautical sector run). In 1989 Admiral Flamigni gathered all the theories on sea power elaborated by Admiral Thayer Mahan, Giamberardino and their succeeders and described sea control through maritime power as a multiplication of factors:

> "[States] tend to control the sea through the means of Maritime Power, which is made by naval power, the merchant navy and the capability of the entire State. It goes without saying that when we talk about the merchant navy, we intend to include all the economic, financial and commercial structure which stands at the very heart of maritime traffic. […] naval power consists in the fleet multiplied the bases […] if bases are zero, naval power is null, independently from the conditions of the fleet. The value of the bases depends, obviously, on their security and location inherently to the geostrategic situation of the war they fall into. The two branches of the maritime power are, in other words, naval power on one hand and the merchant navy with its commercial and industrial structure on the other hand, they are intimately bounded one another because the second allows the maintenance of the first[26]".

Therefore, it is plain that the sea is the place where the military and the commercial sphere intertwine and integrate. In order to pursue and protect states' interests and earnings, hence trade, a state must have control of the portion of sea where it is conducting its interests. One cannot have control of the sea without a military fleet protecting his exchanges, and, at the same time, one cannot have fleets (neither military nor commercial) without an industrial-maritime cluster producing ships. According to Zampieri, this concept might be better explained through the use of the German language, where the two components of the Maritime Power can be distinguished in *seemacht* (=power expressed through sea) and *seegeltung* (=interests pursued through sea)[27]. In last analysis, the Italian Navy gives a quite complete definition of Maritime Power containing all the elements aforementioned (i.e., the importance of sea control, the need for a projection of power capable of influencing events on sea and from the sea, and the intertwining of political, economic, and military sphere[28]):

> "Systemic ability of a State to grow and prosper, protecting and developing its own interests throughout synergic action of military, diplomatic, economic information and, nonetheless, cultural and industrial components pertaining to the maritime domain[29]".

[25] Ibidem, pg. 111.
[26] Ibidem, pg.116.
[27] Ibidem, pg.117.
[28] Ibidem.
[29] Ibidem, pg.119.

Having control of the seas means to have control on their resources. The legal framework for the control of the seas.

In synthesis, control of the seas and control on trade are two interconnected concepts. A state, in order to have the possibility to tackle its security issues, also needs to exercise sovereignty on the seas where it has interests. Only with the exercise of sovereignty over a stretch of sea can a state better prevent crises, tackle threats and have control on its resources. Territoriality of waters is regulated by the United Nation Convention on the Law of the Sea (UNCLOS), ratified at Montego Bay in 1982. This Convention gives the basic definitions of the various maritime zones: territorial sea, contiguous zone, high seas, continental shelf, exclusive economic zone.

The definition of territorial sea appears as following: "The sovereignty of a coastal State extends, beyond its land territory and internal waters and, in the case of an archipelagic State, its archipelagic waters, to an adjacent belt of sea, described as the territorial sea[30]". Concerning its delimitation the UNCLOS says: "Every State has the right to establish the breadth of its territorial sea up to a limit not exceeding 12 nautical miles, measured from baselines determined in accordance with this Convention.[31]". "The outer limit of the territorial sea is the line every point of which is at a distance from the nearest point of the baseline equal to the breadth of the territorial sea.[32]".

The contiguous zone is defined in art. 33:

> "In a zone contiguous to its territorial sea, described as the contiguous zone, the coastal State may exercise the control necessary to:
>
> (a) prevent infringement of its customs, fiscal, immigration or sanitary laws and regulations within its territory or territorial sea;
>
> (b) punish infringement of the above laws and regulations committed within its territory or territorial sea.[33]"

The contiguous zone is delimited in Art. 33, comma 2: "The contiguous zone may not extend beyond 24 nautical miles from the baselines from which the breadth of the territorial sea is measured[34]".

In Part VII the definition of High Seas is depicted and in art.86 possible conducts in this stretch of sea are described:

> "1. The high seas are open to all States, whether coastal or land-locked. Freedom of the high seas is exercised under the conditions laid down by this Convention and by other rules of international law. It comprises, inter alia, both for coastal and land-locked States:
>
> (a) freedom of navigation;
>
> (b) freedom of overflight;

[30] UNCLOS, Part 2, art. 2.1.
[31] Ibidem, Part 2, art. 3.
[32] Ibidem, Part 2, art. 4.
[33] Ibidem, Part 2, art. 33.1.
[34] Ibidem, Part. 2, art. 33.2.

(c) freedom to lay submarine cables and pipelines, subject to Part VI;

(d) freedom to construct artificial islands and other installations permitted under international law, subject to Part VI;

(e) freedom of fishing, subject to the conditions laid down in section 2;

(f) freedom of scientific research, subject to Parts VI and XIII.

2. These freedoms shall be exercised by all States with due regard for the interests of other States in their exercise of the freedom of the high seas, and also with due regard for the rights under this Convention with respect to activities in the Area[35]".

The definition of Continental shelf is given in part VI, art. 76.1:

"The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea throughout the natural prolongation of its land territory to the outer edge of the continental margin, or to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured, where the outer edge of the continental margin does not extend up to that distance.[36]".

Rights of exploration and exploitation inside this part of sea are described in part VI, art. 77:

"1. The coastal State exercises over the continental shelf sovereign rights for the purpose of exploring it and exploiting its natural resources.

2. The rights referred to in paragraph 1 are exclusive in the sense that if the coastal State does not explore the continental shelf or exploit its natural resources, no one may undertake these activities without the express consent of the coastal State.

3. The rights of the coastal State over the continental shelf do not depend on occupation, effective or notional, or on any express proclamation.

4. The natural resources referred to in this Part consist of the mineral and other non-living resources of the seabed and subsoil together with living organisms belonging to sedentary species, that is to say, organisms which, at the harvestable stage, either are immobile on or under the seabed or are unable to move except in constant physical contact with the seabed or the subsoil.[37]".

The most modern and interesting tool given by this Convention is the introduction of the Exclusive Economic Zone (EEZ). UNCLOS art. 55 defines the EEZ as following: "The exclusive economic zone is an area beyond and adjacent to the territorial sea, subject to the specific legal regime established in this Part, under which the rights and jurisdiction of the coastal State and the rights and freedoms of other States are governed by the relevant provisions of this Convention.[38]"

Art. 56, in turn, describes rights and powers of a state inside the EEZ as following:

"1. In the exclusive economic zone, the coastal State has:

(a) sovereign rights for the purpose of exploring and exploiting, conserving and managing the natural resources, whether living or non-living, of the waters super-jacent to the seabed and of the seabed and its subsoil, and with regard to other activities for the economic exploitation and exploration of the zone, such as the production of energy from the water, currents and winds;

[35] Ibidem, Part 7, art. 86.
[36] Ibidem, Part 7, art. 76.1.
[37] Ibidem, Part 6, art. 77.
[38] Ibidem, Part 5, art. 55.

(b) jurisdiction as provided for in the relevant provisions of this Convention with regard to:

(i) the establishment and use of artificial islands, installations and structures;

(ii) marine scientific research;

(iii) the protection and preservation of the marine environment;

(c) other rights and duties provided for in this Convention.

2. In exercising its rights and performing its duties under this Convention in the exclusive economic zone, the coastal State shall have due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of this Convention.

3. The rights set out in this article with respect to the seabed and subsoil shall be exercised in accordance with Part VI.[39]"

Finally, art. 57 describes the breadth of the EEZ: "The exclusive economic zone shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.[40]"

Even though the breadth of the EEZ and the one of the Continental Shelf are the same, the two entities must not be confused. While the Continental Shelf always exists, proclaiming an EEZ is not mandatory, but gives a state the power to exercise many more rights and a stronger control on the resources of the sea.

The institution of an EEZ is often a controversial issue, since it is seen from many governments as a violation of the principle of the freedom of seas and often implies disputes among bordering states. Its repeated proclamation from several coastal states led to a very small percentage of free waters in the Mediterranean Sea (close to 29%[41]) and left Italy without its own EEZ. Only in 2021 with the law n.91 of July 14th did the Italian government establish his own Exclusive Economic Zone.

As underlined by the definitions above, the establishment of this institution is very important for the control, extraction and exploitation of resources coming from the sea, and without it the Italian government wouldn't be able to exploit at best its geographical and nautical competitive advantage (Italy thus holds the 12th merchant fleet in the world, the 4th in Europe, the 1st ferry boat fleet in the world and the 3rd fishing fleet in Europe[42]). If Italy finds itself unable to exercise control on its seas and to draw resources from it, many assets will remain untouched and the whole European region will lose the opportunity to benefit from them.

[39] Ibidem, Part. 5 art.56.
[40] Ibidem, Part 5 art.57.
[41] G. De Giorgi, "Importanza strategica degli assetti marittimi italiani nell'area mediterranea", *Gnosis* n.1, January 2016, https://gnosis.aisi.gov.it/Gnosis/Rivista46.nsf/servnavig/10 .
[42] Ibidem.

THE COMMERCIAL DIMENSION OF PORTS IN A CHANGING WORLD: RESHORING, NEARSHORING AND "FRIENDSHORING" ARE LIKELY TO RESHAPE GLOBAL TRADE

The shifting paradigm of globalization

As aforementioned, evolution of society goes together with the evolution of transport and communication, and transport and communication, in their turn, are functional to trade. At this point, according to the law of syllogism, one can deduct that evolution of society goes hand in hand with the evolution of trade.

Nowadays, we tend to associate trade with globalization, even though this assumption is not quite suitable. First of all, globalization is a multifaceted concept that entails several aspects that don't regard merely trade. For instance, the use of internet is a landmark aspect of globalization that stands aside from trade. Nevertheless, it is true that international trade remains the most impactful and evident form of globalization. Either than that, globalization hasn't become as it is today out of the blue. Today's globalization is the result of a non-linear process that witnessed highs and lows and proceeded at different pace in different stages.

Scholars tend to associate the beginning of globalization with the Modern Age and the European travels by sea around the world. If we consider globalization as an economic process and we take into account the latest 150 years, we can ascertain that it passed through at least three stages: the first one (1870-1918) regards the invention of the telegraph and the opening of the Suez Canal, consequently determining the expansion of maritime trade. WWI caused a drastic stop to globalization: it took over 40 years to go back to the growth levels existing before the war[43].

The second phase (1945-1980) concerns the Bretton Woods system, the rise of the Fordist model and multinational companies, the consolidation of world-wide capitalism and consumerism.

The last phase (1980-2000) consists in what it is usually called "turbo-capitalism": this period is characterised by the widespread use of information technologies, the imposition of the post-Fordist model, the emergence of Global Value Chains and the explosion of global finance and Foreign Direct Investments. This is where people starts to use the model of the network and where the centre of trading activities moves to Asia. Here, environment became a global problem[44].

From this brief excursus one can understand that globalization had a non-linear development. The real question is: what will happen next? What will the next phase of globalization be? Is a new phase of globalization rising or is globalization sinking? What will the future of the maritime dimension be like? What will the new pattern of trade be and how will it reshape the geographies and politics of the future? Will the new pattern be more profitable for citizens?

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[43] W.E. Murray, J. Overton, *Geographies of Globalization*, New York, Routledge, 2015.
[44] Ibidem.

Major shocks that perturbated globalization and consequences on the short-term

Several shocks disrupted turbo-capitalism from the early 2000 onwards. Global trade that nurtured delocalization of enterprises worldwide in search for lower costs of manpower and enriched shipping companies coming from India and China offering services worldwide at extremely low rates is not sustainable anymore.

The 2008 financial crisis demonstrated how in a global financial network every country can be affected by other's actions. The US-China tariff war demonstrated that a shift to protectionist policies from the US, has effects both on international trade and on those states that are not even involved in the tariff war thus undermining the stability of the international system and showcasing the fragility of multilateralism[45]. The real damage stemming from this situation is the uncertainty on the rules of the game of international trade: do international agreements still have value? The Trump administration admittedly renounced to its role of warrant of the international system, withdrawing from many international conventions and putting protectionist interests of its own country first, generating in the international community great distrust[46]. Only with the election of President Biden could America have a sigh of relief. Even though, the change in presidency didn't really change the features of Sino-American relations (tariffs are still standing where they are, damaging both sides of the trade-war and countries having to do with them through their supply chains[47]).

But the latest shocks are the ones that more rapidly and stronger than ever demonstrated how fragile our global system is. The Covid-19 Pandemic, Russia's war of aggression on Ukraine, and, marginally, the overthrow of the vessel Ever Given in the Suez Canal, drastically stopped the functioning of our global supply chains putting the lives of every citizen in the world at risk. With these shocks and the breaking of our GVCs our industrial, economic, energetic, health, and food security failed to stand, reason why national security strikes back at the centre of the political debate. In particular, the Pandemic has taught us that completely depending on faraway countries such as China (that has very different political approaches from the western liberal countries) for the production of critical goods and for its shipping it's not convenient from a national security perspective, since the shutdown of Chinese producing and shipping centres during the lockdown periods hindered world supply of goods critical for survival.

According to a report of PwC of 2021, the Covid-19 pandemic, starting in Wuhan, (China) paralyzed the major manufacturing and distribution hub in the world, producing a ripple effect in the supply of finished

[45] G. Ottaviano, *Riglobalizzazione: dall'interdipendenza tra Paesi a nuove coalizioni economiche*, Egea, 2022, pgg.63-82
[46] Ibidem.
[47] Ibidem, pg.95, 96.

and semi-finished products to all the countries around the world that depend on China for trade[48]. Countries who depended extensively from China for critical goods such as India, experienced delays in the supply, production and distribution of products.

The implementation of the lockdown system brought to export restrictions that, together with the increasing demand worldwide of certain goods such as personal proactive equipment (PPE), led many countries to find themselves in lack of critical goods.

This is why many countries, such as France, are thinking of producing critical items closer to home and in many cases, due to shortages of essential ones such as drugs, protective gears, and ventilators, the World Trade Organization allowed some temporary export restrictions and, at the same time, protectionist policies for domestic consumption of certain goods were allowed as well[49]. Lockdowns starting from March 2020 spread across 90 countries and led to a partial shut-down of the transport sector. The shipping industry was the one majorly affected by the lockdowns and according to WTO forecasts, world trade fell by 13% at the end of 2020[50].

Impact on the logistic sector resulted in a major slowdown on supply chains that reverberates until nowadays. Distribution companies had to, on one hand, increase their delivery charges to compensate the drop off in the volume of activities (increase in prices fell on enterprises and consumers), and, on the other hand, airlines and shipping companies have had to lay off workforce due to high operating costs and low turnover[51].

Due to high prices of service and lack of personnel, shipping companies found themselves in the impossibility to offer their services. This huge block on global supply chains led governments of developed economies to increase their call to businesses to carefully re-think their supply chains at least for essential items and address processes that will ensure resilience in case of further disruptions of GVCs[52].

Even though it is not comparable (for impact and time extension) to the other shocks cited above and down below, the Suez Canal Blockage of 2021 is worth mentioning, since it exacerbated the pressure already created on supply chains by the pandemic and demonstrated that marine incidents are of utmost importance to supply chain risk management. It also showed how global trade is dependent on container industries, megaships and continuous maritime shipping[53].

[48] I. Falvo, "Impact of COVID-19 on the supply chain industry*", PwC COVID 19 Content Hub*, (2021), pg.2.

[49] Ibidem, pg.3.
[50] Ibidem, pg.3.
[51] Ibidem, pg.5.
[52] Ibidem, pg.4.
[53] O. Özkanlısoy, E. Akkartal, "The Effect of Suez Canal Blockage on Supply Chains", *Dokuz Eylül Üniversitesi Denizcilik Fakültesi Dergisi*, (2022), pg. 68.

When, on March 23, 2021 the Ever Given (big container vessel of Japanese ownership) got stuck in the Suez Canal, it generated a bottleneck of 160 ships[54] carrying goods for industries all over the world. Nowadays, 90% of global trade develops by maritime transport and 12% passes through the Suez Canal[55].

When the accident took place, freight carriers were advised to change their routes by passing through Cape of Good Hope (which took up to 7 additional days) or to ship their freight through rail which took from 16 to 18 days longer. Critical goods were sent from China through Kazakhstan and Russia to European hubs, but still this resulted in increased lead times and shipping costs, increase in oil prices and risks of theft in ports, which were, in the end, reflected on customers.

The Suez Canal risked closing and this would have been reflected mainly on European markets, which are the main benefiters from the Suez Canal route. Fortunately, the Canal didn't close and on March, 29th the Ever Given was freed, even though still 400 ships were waiting in line to pass through the Canal. Oil and gas and basic industrial components transported on ships were victims of this situation as well. This huge bottleneck rendered impossible for shipping agencies to find availability of containers and ships, which resulted in an additional increase in costs of shipping both for industries and final users[56].

The effects of the blockage reflect up to the time of writing, but they wouldn't have been so disruptive if the pandemic wouldn't have already damaged the logistic sector.

Russia's war on Ukraine only worsened supply availability and further undermined European and global economic security. According to a 2022 OECD report, the Russian invasion of Ukraine, the ensuing economic sanctions and Russia's retaliation have furtherly damaged global economy by producing price hikes and shortages in oil, gas, certain agricultural products, and some raw materials indispensable for manufacturing such as aluminium, nickel, palladium and vanadium while potash, essential for fertilizer production has also been affected[57]. This has disrupted plenty industrial applications and severely hindered the green transition which results in further threats to economic and energetic security of the EU.
Furthermore, Russian forces have conquered several coastal cities in the South of Ukraine, enlarging their access to the Black Sea and setting a naval blockade that prevents global freight ships from reaching Ukrainian ports in order to get their supplies. The most important material lacking because of this situation is wheat. Its lack is threatening food security of those countries who completely (or almost completely) depend upon the import from Ukraine, such as India and many African countries. This situation gave rise to the well-known agreement for the grain shipping corridor. Another problem that concerns shipping in this

[54] Ibidem, pg. 61.
[55] Ibidem, pg.53.
[56] J. Lee, E. Wong, *Suez "*Canal blockage: an analysis of legal impact, risks and liabilities to the global supply chain*", MATEC Web of Conferences 339*, (2021).

[57] E. Moisè, "The supply of critical raw materials endangered by Russia's war on Ukraine*", OECD Policy Responses: Ukraine tackling the policy challenges*, (2022) pg.2.

area is that Turkey raised of five times the price for freight ships to enter the Bosphorus and Dardanelles, making it very costly for any maritime shipping agent to enter the area and get supplies from coastal cities[58].

To sum up, on the short-term one can firmly state that the latest external shocks result in a disruption of maritime trade and in perturbation of port activities. This has proved to have significant backlash on global trade stability and citizens' security.

Reshoring is increasing, but there is no de-globalization. Long-term consequences of systemic shocks

As a consequence of the turmoil generated by latest external shocks, citizens' request for more security in procurement of goods and enterprises' quest for survival translated into a general distrust towards globalization. Many enterprises started to bring their production facilities closer to home with the aim of ensuring safer supplies while shortening their GVCs. Is a general de-globalization in favour of national security taking place? The answer is probably not, at least in the sense that citizens will hardly stop using the internet and reshoring of companies will not be overall but will regard only certain critical items.

Still, after 2008, shortening of GVCs has become a growing trend which can be filed under several phenomena called reshoring, backshoring, nearshoring and "friendshoring". Backshoring means for companies to disinvest abroad in order to bring their facilities in their home country. Nearshoring means for companies to disinvest abroad where they formerly had facilities to bring them in countries closer to home with which they have better connections. Friendshoring is a word proposed in 2022 by the US Secretary of Treasury Janet Yellen, which means for companies to move their manufacturing to countries with which they have shared values and hold a positive relationship but also where the political risk is low. Friendshoring is a concept that mixes geopolitics with economics, suggesting that moving a business away from authoritarian countries allows businessowners to access the global market mitigating the risk. Reshoring is a very general term which entails all the abovementioned ones. Eurofond Research Report shows that between 2015 and 2018 reshoring was a growing trend, with Italy being one of the most active characters in this sense[59].

While short-term consequences of global shocks are easily-predictable, long-term consequences are more blurred. It must be noted that, even though these phenomena exist and are getting more frequent, up to now they are still marginal inside the landscape of global trade, where far-shoring and delocalization still hold the upper hand. This is why it is difficult to say with certainty what the future will look like and what

[58] Limes, "*L'Africa contesa da Russia, Cina e Turchia: Caoslandia è preda*", https://www.youtube.com/watch?v=B-IRB7REl4E accessed on 15.02.2023 .

[59] V.V.A.A., "Reshoring in Europe: Overview 2015–2018", Eurofond, Publications Office of the European Union, (2019).

will the long-term consequences of these shocks be. Still, it must be underlined that with shocks happening more and more often, reshoring is increasing. Whether these phenomena will grow enough to influence the shape of global trade it is hard to say and only time will reveal it.

Re-globalization: trade might change pattern while multilateralism is very likely to continue existing. If the pattern of trade changes shape, Italy might gain a strategic advantage thanks to the projects Motorways of the Sea and Short Sea Shipping

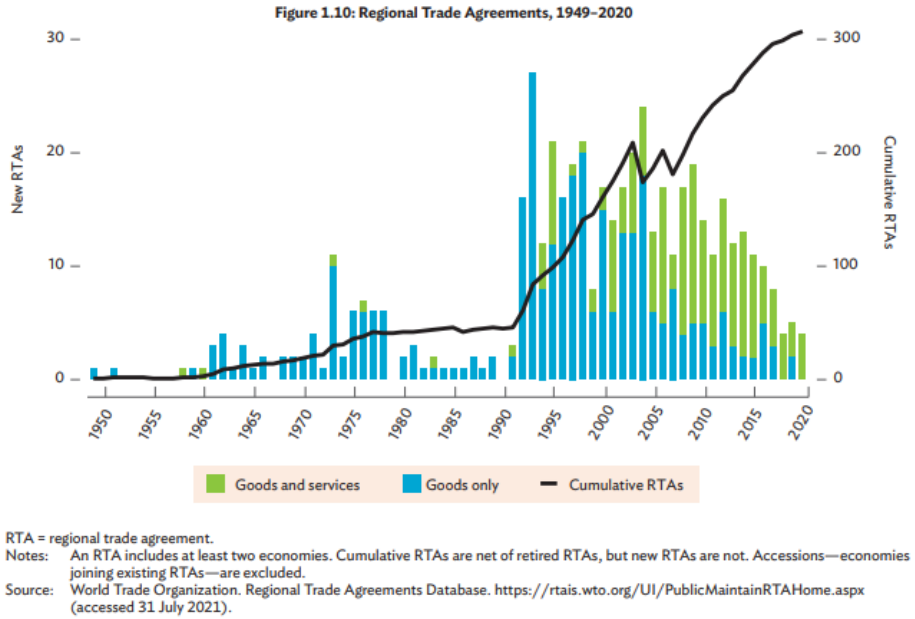
As previously touched upon, the increasing trend of reshoring companies doesn't imply de-globalization. Ottaviano states that, from a political point of view, on one hand economic integration prevailing up to before 2020 led to political disintegration[60] (globalization leads to the flourishing of plenty smaller states with similar features) but on the other hand, it is also true that limited exchange in the defence sector limits political disintegration in few blocks: countries pertaining to US liberal world and countries concerning the autocratic sphere of Russia and China[61]. This scenario takes place because no state wants to trade in weapons with states considered enemies or hostile, and when the danger of a military attack becomes more concrete, as in the case of the war on Ukraine, the need for a stronger security inside countries grows, making far-reaching exchanges less easy and economic integration undesirable, since no state would like to depend economically on a country that could become an aggressor and perpetuate reprisals[62]. Still, globalization of trade pushes states belonging to the same group to compact one another, and this is why states belonging to the "same block" are likely to trade among each other much more than they would do with countries of the "other block". In addition to that, even though multilateralism has been undermined, collective action still offers better solutions to those problems that are global in nature and couldn't be addressed by single states such as global warming, pandemics and fight against poverty[63].

For these reasons globalization is likely to continue existing, but will probably change its pattern to some new form that Ottaviano calls "selective re-globalization[64]" or according to Deaglio "archipelago globalization[65]" where friendshoring and nearshoring will take the upper hand and agreements will be more frequently taken among neighbouring governments that share similar values, have low political risk, or that are located in closer shores, in order to avoid supply shortages of goods.

To sum up, political, economic and industrial institutions are working to change the actual world ordere, with the aim of answering to a request for more security stemmed from the latest shocks. Even though

[60] G. Ottaviano, *Riglobalizzazione: dall'interdipendenza tra Paesi a nuove coalizioni economiche*, Egea, 2022.
[61] Ibidem.
[62] Ibidem.
[63] Ibidem, pg.100-104.
[64] Ibidem.
[65] M. Deaglio, G. S. Frankel, P. G. Monateri, A. Caffarena, Dopo l'Iraq: Ottavo rapporto sull'economia globale e l'Italia, Guerini e Associati, 2003.

reshoring is still a minor trend, not sufficient to define a change in the globalization pattern itself, the political debate still revolves around the concept of a "regionalized" scenario, where globalization will still exist, but will be organized in regional blocks. This system will likely be more resilient to external shocks. Only time will tell whether this new scenario will be able to satisfy the desire of citizens for more security. As a proof that a shift towards a regionalized globalisation is taking place, World Trade Organization reports that from 2020 onward more than 300 Regional Trade Agreements[66] (RTAs) have been concluded.



1.Source: WTO, *Global Value Chain Development Report 2021*, WTO, 2022

If this change in the paradigm of trade and alliances will take place, it will probably have a strong impact on the global organization of maritime routes, that will be redesigned according to the new regional agreements taken by governments. What will the future of seaborne trade be, is still uncertain and will be determined by the newly regionalized blocks. What is sure, concerning the situation in the European region, is that if maritime routes will take a regional character, Italy once again has the possibility of gaining a pivotal position thanks to its location in the centre of the Mediterranean Sea. In this sense there are a couple of projects that are worth mentioning: Motorways of the Sea and Short Sea Shipping.

As we will see in the next chapter, since its birth, the EU has never stopped revising the TEN-T networks with the aim of creating an inter-modal and eco-friendly system of transports. In the latest years, the EU has integrated in the network a series of ports of strategic importance in the name of a tighter cohesion of the communitarian territory with third parties[67]. The project *Short Sea Shipping* (SSS) was borne with this

[66] WTO, *Global Value Chain Development Report 2021*, WTO, 2022.
[67] A. Buonfanti, "Lo shipping e la portualità nel Mediterraneo: opportunità e sfide per l'Italia", *Rivista di economia e politica dei trasporti, n° 3, articolo 1,* 2013.

purpose, and covers today a role of key importance for the Union in implementing inter-modality. In particular, SSS is expected to[68]:

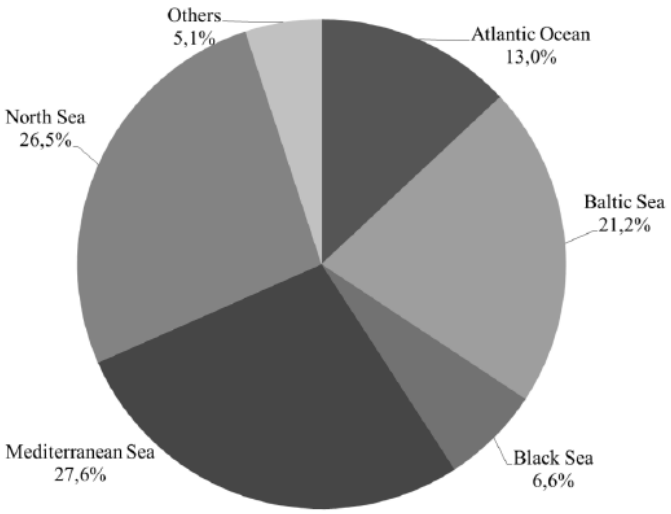
- Enhance economic and social cohesion among MSs
- Concentrate freight traffic on maritime routes rather than on terrestrial ones
- Reduce road congestion and related externalities[69]

The backbone of SSS is represented by the program *Motorways of the Sea* (MoS), that aims at moving a significant share of traffic from road to shortsea maritime routes through the increase in the use of Ro-Ro, Lo-Lo and Ro-Pax vessels in European seas. MoS is aimed at[70]:

- Activating a dense network of transnational, reliable and frequent maritime links with neighbouring countries at scheduled time.
- Realizing special port infrastructures (logistic platforms, terminals and so on) dedicated to the development of inter-modal maritime transport services for frequent high-volume vessels[71].

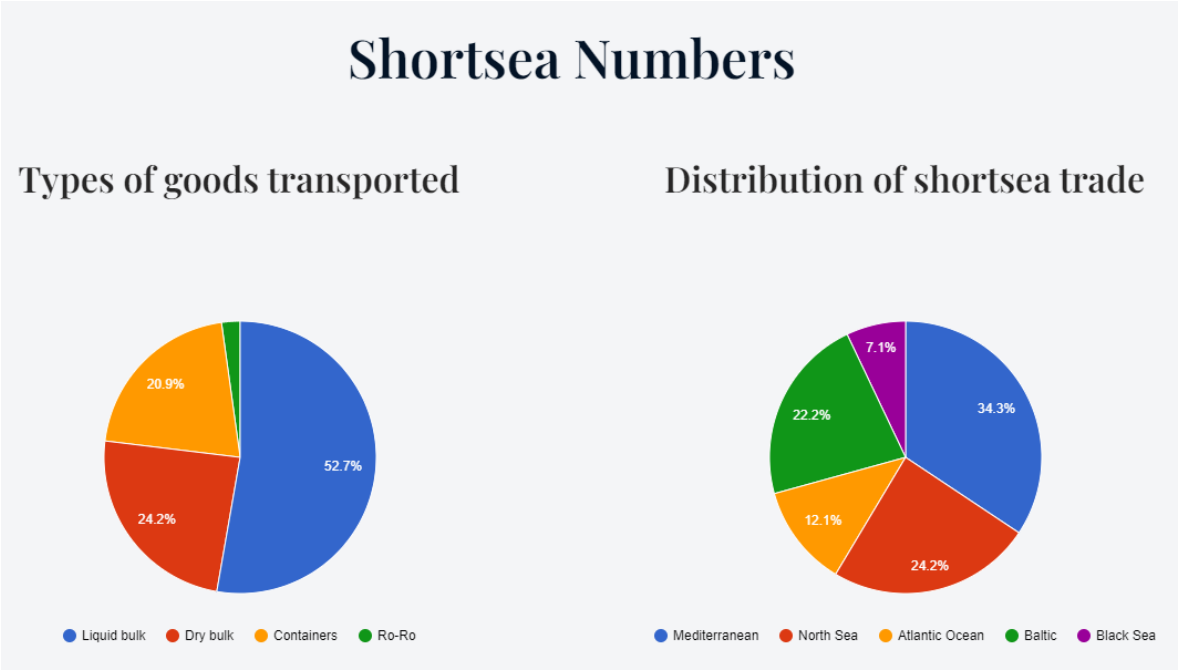
Already in 2013, Anna Buonfanti of SRM wrote of these two projects:

> "*Motorways of the Sea* and *Short Sea Shipping* are a strategic resource for Europe and for Italy. Hence, if correctly integrated, [these two projects] can reduce environmental impact produced by freight traffic and allow to reach new emerging markets from which a strong economic growth is expected. In the last decade shortsea maritime transport in the framework of the *Southern Range* witnessed a very positive stage, marked by a consistent increase in handled goods and people, and a significant increase in the number of new routes. Statistics from Eurostat, 2013 confirm this trend: in 2011, with around 1,7 bn tonns, SSS amounted to 60% of EU-27 overall maritime freight transport; even though this share is variable according to the country. Predominance of *Shortsea* on other modes ("deep sea shipping") is particularly marked in Italy (76,1%). The country's geographical position accounts for such predominance[72]".



2. "Destination of UE-27 SSS freights" Source: Eurostat, 2013

[68] Ibidem.
[69] Ibidem.
[70] Ibidem.
[71] Ibidem.
[72] Ibidem.



3.Short Sea Shipping in 2023. Source: European Shortsea Network

If one compares the data of 2013 in picture 2 with the data of 2023 in picture 3, it is evident that the share of SSS practiced through the Mediterranean Sea has grown. This means that the change in the paradigm of globalization illustrated in this chapter hasn't altered at all the value of the sea. Instead, data seem to show that the Mediterranean Sea is increasingly playing a key role in the economic growth of the Union. It goes without saying, that the country located at the centre of the Mediterranean Sea will be the first to benefit from the empowerment of these two programs, overall with Italy being at the Presidency of the European Shortsea-shipping Network from January 2022[73]. In short, SSS is expected to continue growing, generating even more wealth coming from the sea and the MENA countries, that are expected to become Italy's new strong commercial partners.

Sea is a fundamental dimension, but human activities take place in at least three other dimensions, hence, ports need to have well-structured hinterlands and need to be well connected to other nodes of transport.

Up to now the importance of the maritime dimension has been underlined, but nowadays, individuals and enterprises develop their activities and pursue their interests throughout at least three other domains: land, air and cyberspace. This means that, resources coming from trade by sea, need to be consequently shifted to other modes of transport and information concerning their shipping needs to be protected in the cyber domain. This can happen only if ports (which can be seen as the critical infrastructures, or citadels,

[73] Naples Shipping Week, "Shortsea Shipping: challenges and opportunities towards 2027", Video Youtube, 09/29/2022, https://www.youtube.com/watch?v=DLQufaqt3-8 .

responsible for transferring to land resources coming from the sea) are equipped with adequate cyber-protection infrastructures and have a very well-structured hinterland adequately connected to railways, highways and airports in order to allow the continuing of the logistic chain on other modes of transport. Inter-modality, as a matter of fact, nowadays represents the most common way in which enterprises supply their goods, hence, a port with no connection to other logistic infrastructures would be quite futile for the purposes of global trade. With the implementation of intermodal platforms, instead, ports become critical nodes in the GVCs for the exchange of goods among countries via different modes of transport.

According to K. Kuhn "In medieval times, a port was a shore-based town whose main activity was trade. A port was meant to dispatch cargos between land and sea. It had a harbour and could be recognised by characteristic infrastructures, including dockyards, warehouses and customs houses[74]." This definition proves that the concept of port developed together with the concept of trade. Moving forward from the medieval times, ports attracted other forms of industrial infrastructures either than commercial ones, such as banks, agencies, and markets. These, in turn, attracted more extensive services, and the town hosting the port expanded. Towns developed around ports, became geographical centres for markets and services and gradually evolved into cities, many of which today are major urban spaces with a high concentration of civilians[75].

While port cities expanded, so did the scope of their trade. In modern times, states started to import and export their necessities through commercial ports and those cores that before were isolated or limited in trade gradually became part of a complex, interconnected transport network. According to the network theory, today ports are important to the degree that they are interconnected to and interdependent on other ports of other states, attributing to the logistic and shipping sector a fundamental role. In other words, ports are important for their transportation system. Having ports of major cities connected one another in different states shapes the modern international port system.

Having ports well connected to other infrastructural nodes is very important for the distribution of resources coming from the sea. Without ports' connections distributing resources would be impossible, and without having the possibility of distributing resources to the other parts of the country or abroad, it is useless to have a geographical competitive advantage in being located at the centre of the Mediterranean Sea.

In other words, Italy will be able to exploit its geographical competitive advantage only if it has a dense infrastructural network capable of linking its ports to the rest of the country and to the rest of the European region.

[74] K. Kuhn, "Maritime ports and cybersecurity", *IET*, *Coventry University*, (2021).
[75] Ibidem.

Ports' structure, functioning and stakeholders. Ports as private-public cooperation platforms.

In order to understand how a port works, it is important to take a closer look to its basic components. The main pillar of ports' structure is the terminal. A port terminal can be defined as a dock equipped with the necessary tools for loading, unloading and stockpiling of goods while the ship is at rest. Those tools are cranes and lifts that can be mechanical or automated[76].

Structures for production and processing of goods are usually located close to the dock or in the port hinterland but are not part of the terminal itself[77]. In case of cruise ships, terminals can also be used for the onboarding and disembarkation of passengers. Since ports are composed of several terminals with different equipment needed for the handling of different cargos, ports can be defined as multifunctional entities.

Each terminal is equipped with highly "commodity-specific" technology which can handle one type or a limited range of commodities at the time (for instance, an oil terminal will handle only crude oil bulk[78]). Cargos are usually divided in three types: general cargo, bulk cargo and passengers. Among the different types of terminals, one can find: the break-bulk terminal (goods usually carried in bags, boxes or pallets that need a combination of open storage and warehouse), the dry bulk one (commodities that are not packed such as coal, iron ore or wheat), the liquid bulk (petroleum products), the containers' (break-bulk standard unit that dominates port landscapes because all kind of goods can be shipped in them), the Ro-Ros (handles vehicles and requires ramps), and passengers' one (requires no particular equipment)[79].

In this framework, port terminals are usually "leased to terminal operators through concessions involving a bidding process to capture the terminal asset[80]". Terminal operators are private companies that have an international portfolio and are also called "terminal holdings". They can exploit port terminals throughout different types of agreement with the state: sales, concessions, leases, management contracts, service contracts or equipment leases. In this way, one can imagine the port as a forum where public-private partnership takes place[81].

This is the result of several waves of reforms in ports, which until the 1980s were of public ownership. This model differed in the different regions of the globe (Northern Europe and the US had municipally-owned ports, while Italy and France had state-owned ports) but they all crashed with the same problem: the looming explosion of global trade. Public ownership of ports crashed with the private shipping industry. Services in ports were too limited and institutional entry barriers were too high. Containerization of transports underlined the deficiency in the offered services and imposed time and performance

[76] Spiegato, "Che cos'è un terminal marittimo?" 2023, https://spiegato.com/che-cose-un-terminal-marittimo .
[77] Ibidem.
[78] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy", *Routledge*, (2022), pp. 181-185
[79] Ibidem.
[80] Ibidem, p.201.
[81] Ibidem, pg.186.

requirements on intermodal supply chains[82]. This led to gradual and hybrid forms of privatization of ports, assuming different shapes all over the world.

In some areas, ports have been completely privatized and have witnessed greater competition and higher productiveness, in other areas of the world the public sector still has a form of hold on ports better described by the formula "Public Ownership – Private Operations[83]".

Private-public cooperation is the model that took more hold globally with different nuances, models of port ownership can be described in 5 types tracked by the IMF[84]:

- Public service ports: infrastructures and all services are in the hands of the port authority. Inefficiencies have been underlined.[85].

- Tool ports: Similar to the model of public service port, except for cargo operations which are of private domain, but use port authority terminal equipment[86].

- Landlord ports: most popular management model. Infrastructures (terminals) are owned by port authorities but leased to private companies through long-term concession agreements: private companies develop their business but pay a rent for the terminal lease to the state. Private companies can hire their workers, build and modify their superstructure (warehouses, buildings, offices, freight stations and so on). This model is popular in Europe and the Americas[87].

- Corporatized ports: port authority is a majority shareholder, but port has been almost completely privatized[88].

- Private service ports: the outcome of complete privatization of port facilities[89].

Among these models, the landlord one is the most popular around the world and the one used in Italy. Port authority awards terminals to private companies throughout a system of concessions. Thanks to concessions the port authority can also grant the supply of nautical services. Concessions can be obtained through direct appointment of the government, private negotiations with the companies competing for a

[82] Ibidem, pg.185 .
[83] Ibidem pg. 201.
[84] Ibidem, pg.296.
[85] Ibidem, pg.196.
[86] Ibidem.
[87] Ibidem.
[88] Ibidem.
[89] Ibidem.

terminal or through bidding process. The bidding process consists in a pre-bidding, awarding and post-bidding phase[90]. Extent of concessions might differ according to the activity developed in the terminal, to its availability and to the type of traffic. Port authorities usually develop a master plan detailing the development of the port, the investments they want to make in the area, the use of the terminals and receive a fee in exchange.

To sum up, ports involve a lot of different stakeholders and decision-makers such as such as the port authority, terminal operators, rail operators, trucking companies, logistics providers, and port-cities. Putting together all of these actors calls the need for a governance approach. But who is in charge of establishing the governance in ports?

In the landlord model, the port authority is the branch of the public sector in charge establishing and putting into practice governance principles. Port authorities are usually responsible for growth and competitiveness of a port cluster by governing the port area, managing port activities, handling hinterland connections and collecting real estate revenue. Port authorities have extensive administrative powers to implement policies, laws and regulations and have the responsibility of facing environmental issues, transforming the port in a sustainable entity[91].

In their role of coordinating port areas, port authorities play different roles: they act as landlords, regulators and operators[92]. As landlords, they manage port assets, jurisdiction and concession of infrastructure. As regulators, they plan frameworks, fees and services and also enforce national port-related regulations. As operators they provide nautical services to ships. Substantially, aims of port authorities are the following: contributing to local, regional, and national economic growth, promoting sustainability, creating employment by facilitating trade, maximizing the added value of the port, generating income and profits, and integrating ports with their foreland and hinterland[93]. Finally, seaports are critical to a state because they allow trade and the movement of goods and people, thus representing a matter of public interest.

"Ports are multifaceted economic arenas that create economic, social, and environmental value at microeconomic (individual firms), meso (sectoral), and macro (economies) levels and are contributors to economic prosperity[94]", this is why their development and exploitation is subject to public policies and can be part of a political agenda of both national and international relevance. Functions of a port can be schematised as per the below illustration:

[90] Ibidem, pgg.201-210.
[91] E. Tijan, M. Jovic, A. Panjako, D. Zgaljic, "The Role of Port Authority in Port Governance and Port Community System Implementation*",* MDPI, (2021) pg.14.
[92] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy"*, Routledge*, (2022) pg. 302.
[93] Ibidem.
[94] Ibidem, p.461.

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4.Source: Nautipedia

KEY:
1) CALATA PAITA: multipurpose area managed by private companies Speter, Rolcim and Mazzi Magazzini
2) CALATA MALASPINA: multipurpose area managed by private company Speter
3) MOLO GARIBALDI: multipurpose area managed by private companies Speter, Monfer, Silos Granari della Sicilia and Sepor
4) CALATA ARTOM: multipurpose area managed by companies La Spezia Container Terminal (Contship Italia group) and Speter
5) MOLO FORNELLI: Lo-Lo container terminal managed by La Spezia Container Terminal (Contship Italia group)
6) TERMINAL ANGELO RAVANO: Lo-Lo container terminal managed by La Spezia Container Terminal (Contship Italia group)
7) TERMINAL DEL GOLFO: Lo-Lo & Ro-Ro container terminal managed by Tarros Group
8) TERMINAL ENEL: coal and bunker fuel managed by the company Eni Production
9) PANIGAGLIA TERMINAL (not on the map but located not far from the military area): regasification terminal managed by the company GNL Italia (ENI Group)[95]

THE INTERNATIONAL MULTILEVEL GOVERNANCE OF PORTS. INTERNATIONAL FRAMEWORKS REGULATING AND HARMONIZING PORTS' ACTIVITIES

Ports are governed both at national and international level. At a national level, the public administration has to ensure that all port activities are aimed at serving the public interest. National, city and regional authorities are held responsible for this. Among the tasks that a port has to fulfil for a national government there are: contribution to local, regional and national economy, social cohesion, minimization of externalities, supply, uninterrupted availability and provision of reliable services to ships, passengers, cargos, users of the port and general public without discrimination[96].

Therein, governments are in charge of planning port policies concerning the following topics: definition of port system and related maritime hinterland and infrastructure connections, definition of the role of the public sector in port governance, designing of laws and regulations for ports and monitoring their

[95] Nautipedia https://nautipedia.it/index.php/MAPPA_DEL_PORTO_DI_LA_SPEZIA accessed on 25.03.2023.
[96] Ibidem, p.460.

implementation, rueling the representation of the port in international forums, negotiations and agreements, regulating investment and financial affairs, with potential support for investments in projects of national importance[97]. Governments thus have an important role in port planning and developing activities such as designating port zones and establishing port priorities, defining property rights for port land and authorizing and executing planned infrastructures[98].

In this framework, national governments are allowed to implement reforms and issue official policy papers to change the nature of ports. Policies with which governments are usually concerned are: industrial policies (location of major industries), customs and immigration processes, safety requirements and minimum conditions for workers, environmental and aesthetic factors, security and prevention of unlawful acts, energy strategies and free ports also have to manage free trade zones with distribution and warehouses[99].

According to the Italian Decree n. 169/2016, Italian ports are divided under the jurisdiction of 15 Port System Authorities, each governing a cluster of ports headed by a major one. For example, in the Port System Authority of the Northern Tyrrhenian Sea (whose cluster is composed by the ports of Livorno, Piombino, Capraia, Portoferraio, Rio Marina and Cavo), Livorno hosts the headquarters of the PSA and is the head of the cluster. Heads of clusters are chosen for their dimension and strategic importance, in order to become the backbone of the Trans-European Network of Transports (TEN-T) that will be taken into exam in the next chapter.

On top of national governments, ports are also subject to supranational institutions that harmonize ports' policies and develop initiatives to shape organization, development and management of ports. This multilevel governance has been established because of the peculiar character of ports, naturally devoted to connecting countries by implementing international trade through supply chains.

Italian ports are therefore subject to Italian law, to European law and to United Nations' law.

The United Nations has a dedicated agency called International Maritime Organization (IMO) that since 1948 develops initiatives, guidelines and regulations in order to enforce the following treaties: The International Convention for the Safety of Life at Sea (1974), the International Convention for the Prevention of Pollution from Ships (1973), the International Convention on Standards of Training, Certification, and Watchkeeping for Seafarers (1995). IMO's objectives are to "set standards for safety and security of vessels and ship/port interface, protect the environment from shipping activities, establish global provision for search and rescue, ensure that all seafarers are adequately trained and competent, define liability and ensure compensation is available when accidents happen[100]".

[97] Ibidem.
[98] Ibidem.
[99] Ibidem, pg.465.
[100] Ibidem, pg.467.

The IMO also promotes facilitation of maritime traffic, sets environmental standards and guarantees energy efficiency of this sector. The organization's measures cover every aspect of the shipping sector such as ship design and equipment, manning, construction, operation and disposal. It promotes sustainable shipping, maritime training and education, technology and innovation and the development of maritime infrastructure. The organization works actively to implement the 2030 UN agenda and throughout its activity supports UN's Sustainable Development Goals such as clean water and sanitation, affordable and clean energy, industry innovation and infrastructure, climate action, sustainable cities and communities[101].

Other international organizations concerning ports are the ILO, active in enhancing port labour standards, the WCO whose mission is to improve effectiveness in custom procedures, the UN's Container Control Program and the International Standard Organization (ISO)[102].

The supranational organization of main concern for Italian ports is the European Union.

While a common framework for transports has always existed since the integration of the European Union, hints of a common framework for maritime logistics were lately and hardly achieved.

With the Treaty of Rome, in 1957, a Common Transport Policy has been established and considered vital to the project of a Common Market, but no modes of transport have been directly indicated and since air and sea ways of transport were apparently excluded, this framework was welcomed as a "disappointing performance[103]". Only the first enlargements of the ECSC underlined the importance of including maritime ways of transport in the CTP, the EC thus set up a Community Port Working Group in order to study the institutional management and framework of European ports, with the aim of improving ports' competitiveness. Nevertheless, the Commission found out that ports have a very complex and different organization all around Europe and that it wasn't worth an extension of the CTP, thus a policy of "non-intervention" was fixed until the late 1980s[104]. Only in those years, with the enlargement of the ECSC in other countries on the Mediterranean Sea, trade by seaways started to increase its volume of affairs and Member States understood that, due to its international character and its powerful revenue generation potential, maritime transport was crucial for national economies.

Member states started to self-manage such mode of transportation and didn't push the EC and EP for an integration of maritime policies, even though, CTP was experiencing great success in the areas of rail, road and inland waterways transport.

This success led to the 1990s affirmation of the intermodal transport: institutions understood that competitiveness of European markets in the transport sector is key to the affirmation of the single market.

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[101] International Maritime Organization, last accessed on 12/03/2023, https://www.imo.org/en/MediaCentre/HotTopics/Pages/SustainableDevelopmentGoals.aspx accessed on 20.11.2022.

[102] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy", *Routledge*, (2022) pg. 467.

[103] C. Chlomoudis, A.A. Pallis, "The EU port policy in a historical perspective", *European Research Studies Journal,* (2005), pg. 4.

[104] Ibidem.

Its coming of age with the Treaty of Maastricht led to liberalisation of intra-EU markets and to the removal of borders making the integration of the contents of CTP with maritime transport unavoidable[105].

Interconnection of local networks and ports as part of the new intermodal transport system were finally included in the new European Union Agenda which started working on new projects called TEN-T network, Shortsea Shipping (SSS) and Port Package.

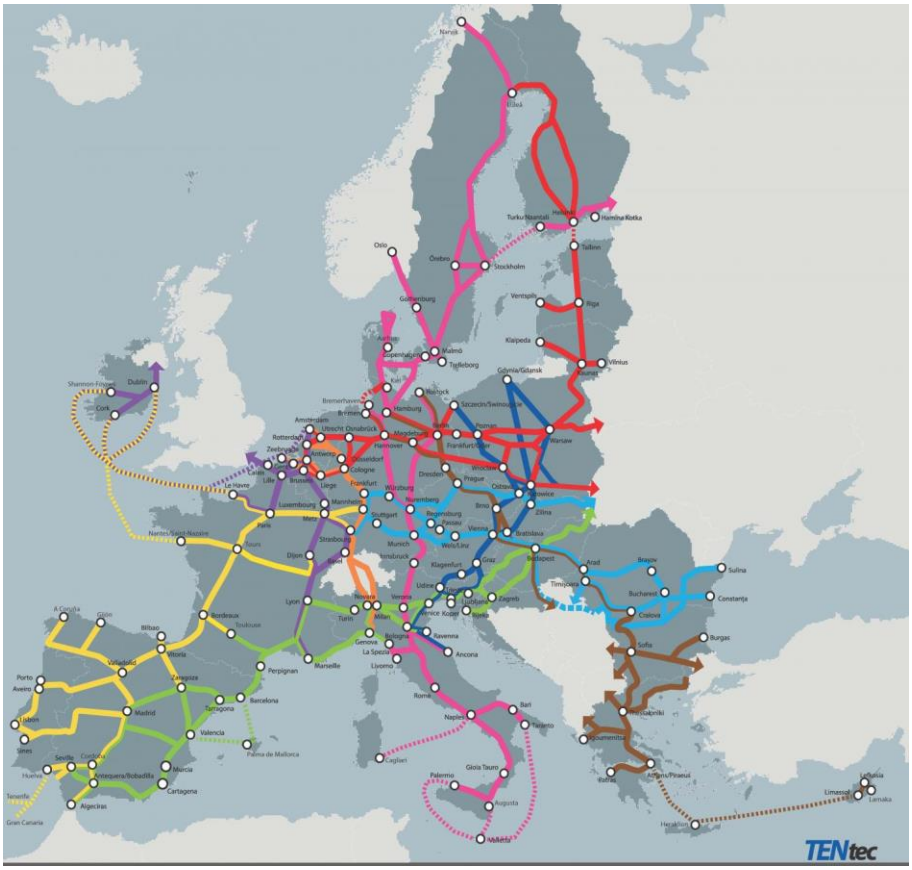
In the 1990s the EC Port Working Group became the European Sea Ports Organization, a new platform for port stakeholders to make their voices be heard in the EU institutions. Albeit only in 2001, topics such as harmonization of maritime shipping and sustainable development are finally addressed at a European level. Even though a common and long-term European Port Policy desired by some (and neglected by others) hasn't been achieved yet, the European framework concerning transport and port issues did make a big step forward and what has been achieved nowadays can be summarised by the following handful of regulations:

"European Port Policy":

- **Transport policy and seaports:** Supply chain policies, integrated maritime policy, single European transport area, service in the internal market[106].
- **Connections with the hinterland:** Motorways of the Sea, Shortsea Shipping, Trans-European Networks, Inland navigation, Intermodal transport, Transport of dangerous goods[107].
- **Safety in seas and seaports:** Port state control, Vessel and port facility security, Supply chain security[108]
- **Ports and the environment:** Environmental charging, Marine strategy framework, Maritime special planning, Regulation on waste carriage, Port reception facilities, Renewable energy, Decarbonisation[109].

The most important footprints set by this handful of norms concern ECOPORTS, the first sustainability report presented at a European level, the Short Sea Shipping and Motorways of the Sea projects, and the TEN-T network which has been revised with the aim of including ports. International connection of the multimodal transport network should look approximately as indicated below:

[105] Ibidem.
[106] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy"*, Routledge*, (2022), pg.471.
[107] Ibidem.
[108] Ibidem.
[109] Ibidem.



Source: European Commission, Mobility and Transport

The TEN-T network is based on a system of corridors and entails two levels of network: a core one, linking the most strategic nodes to be completed by 2030, and a comprehensive one, that shall involve all European regions and shall be completed by 2050. TEN-T network supports the European policy on decarbonization of transports[110].

Given the multilevel governance of ports, stakeholders have established associations representing their interests both at national and international level. These associations exercise lobbying power in national and international forums. In the case of Italy, (among many others) two main national stakeholders' associations are worth mentioning: Assoporti and Confitarma. For what concerns the international level, Italian ports' stakeholders take part in several associations seeking to shape the content of port-related public policies in the UN, EU and other international forums. The two main ones are the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA) and the International Association of Ports and Harbours (IAPH), while ESPO, the one aforementioned, is especially dedicated to the EU.

IALA is a non-profit international association with technical aims. It was founded in 1957 by bringing together manufacturers, consultants, authorities, scientific and training institutes that wanted to share

[110]Rete Ferroviaria Italiana: Gruppo Ferrovie dello Stato, "Corridoi TEN-T: l'asse portante della Trans European Network of Transports", last accessed on 05/26/2023 https://www.rfi.it/it/rete/in-europa/corridoi-ten-t.html .

their experiences. It aims at harmonizing marine aids to navigation worldwide and reducing incidents in marine traffic. IALA issues recommendations, standards and guidelines and represents a stakeholder in the port sector.

The International Association of Ports and Harbours is another association born in Japan. IAPH represents over 160 ports, 120 port-related businesses, 87 countries and the 60% of the world container traffic[111]. IAPH is engaged in lobbying activities for port authorities and operators representing their interests in international forums organized by the IMO, the World Customs Organization, the International Standards Organization, the World Economic Forum and others. It also works together with UN bodies such as the UN Conference on Trade and Development (UNCTAD), UN Environmental Program (UNEP) and the UN Global Compact. The main pillars of the association are climate and energy, data collaboration, risk and resilience[112].

Finally, the European Sea Ports Organization is an EU specialized agency born in 1993 out of the ashes of a working group on ports established by the EC. It gathers representatives of the port authorities of Europe's major ports and represents their interests to the European institutions. The most important works of the organization are the regulation EcoPorts of 1996 and the participation in the debate around the EC's ports package of 2001. The organization's role consists in assisting the European institutions in understanding the needs of port authorities and to engage in a continuous dialogue with European stakeholders of the maritime sector supporting its members in implementing European policies. The aims of the association are to influence decision-makers and public policy-makers in the EU ensuring that the voices of European ports are heard, to promote free and fair competition in the port sector, to promote highest possible safety standards, to be proactive in environmental protection and to deliver economic efficiency[113].

Critical infrastructure protection: a discipline born in the US

Another international framework to which Italian ports' have to comply is the one of Critical Infrastructures. Critical infrastructures are first defined by the government of the US (Department of Homeland Security) in the Patriot Act of 2001, which regulates security issues in the aftermath of the terrorist attacks to the Twin Towers of 09/11/2001. In this document, critical infrastructures are defined as "systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters[114]." This act, together with the National Infrastructure Protection Plan is

[111] International Association of Ports and Harbours, last accessed on 11/20/2022, https://www.iaphworldports.org/about-iaph/ .
[112] Ibidem.
[113] European Sea Ports Association, last accessed on 11/20/2022, https://www.espo.be/organisation .
[114] United States' Public Law 107–56 107th Congress, Uniting and strengthening America by providing appropriate tools required to intercept and obstruct terrorism (USA Patriot Act) act of 2001, 2001, https://www.congress.gov/107/plaws/publ56/PLAW-107publ56.pdf .

considered foundational to the DHS. The National Infrastructure Protection Plan (NIPP) consists in a list of all the critical infrastructures of the US and also establishes the way in which CI are identified, created and protected[115]. Another milestone document in the definition of critical infrastructure protection is the Presidential Policy Directive 21 (PPD-21) of 2013, that gathers critical infrastructures in sectors, each headed by a Specific Sector Agency which has the duty of structuring and managing its sector.

Actually, the first federal definition of critical infrastructure was born in 1996 under the Clinton Administration with Order 13010 and later evolved over time. Order 13010 also established a Commission with the aim of "assess[ing] the scope and nature of the vulnerabilities of, and threats to, critical infrastructures recommending a comprehensive national policy and implementation strategy for protecting critical infrastructures from physical and cyber threats and assuring their continued operation[116]". This document also establishes eight sectors (or categories) in order to organize national critical infrastructures and improve their management. Therefore, sectors group infrastructures that are similar on form and function, for instance, emergency services are in one sector, while dams are in another one, museums and icons in another and ports in another one. The quantity of sectors and subsectors grew until today, reaching the number of 16. DHS has the power to change the sector to which one CI is assigned[117]. In this respect, the US Election Assistance Commission writes:

> "The Department of Homeland Security groups critical infrastructure into sectors to help focus the department's efforts, better direct resources, and organize its efforts. These critical infrastructure sectors are groupings of critical infrastructure based on commonality in function and form. So, infrastructure entities that perform similar functions and are structured in similar manners are designated as part of the same sector. For example, museums are considered critical infrastructure, as are sports arenas. Since both of these venues perform a similar function, hosting large groups of people in public spaces, and are structured in a similar manner, using buildings as gathering places for the groups of people, they both fall into the same sector – commercial facilities. You can see how this helps DHS channel its efforts. Entities that perform similar functions and are structured in similar ways will probably have overlapping needs. These overlapping needs are not necessarily the same as those of entities that are not similar in form and function. Since DHS primarily provides information through the CI framework, sorting infrastructure into sectors helps DHS know which entities need which information. Sector designations allow the department to share that information with specific groupings rather than assessing each individual entity independently every time they want to distribute information. A list of all of the sectors and their SSAs is below:[118]"

[115] US election assistance commission, "A New Home Base for Critical Infrastructure Information", 05/11/2017 https://www.eac.gov/new-home-base-critical-infrastructure-information .
[116] US Election Assistence Commission, "CI Scoop: History of Critical Infrastructure Designation", 05/17/2017, https://www.eac.gov/ci-scoop-history-critical-infrastructure-designation .
[117] Ibidem.
[118] US Election Assistence Commission, "CI Scoop: What are sectors and sub-sectors?", Blog Spot, 05/26/2017, https://www.eac.gov/ci-scoop-what-are-sectors-and-sub-sectors .

Sector/Subsector	SSA
Chemical	Department of Homeland Security (DHS)
Commercial Facilities	Department of Homeland Security (DHS)
Communications	Department of Homeland Security (DHS)
Critical Manufacturing	Department of Homeland Security (DHS)
Dams	Department of Homeland Security (DHS)
Defense Industrial Base	Department of Defense (DOD)
Emergency Services	Department of Homeland Security (DHS)
Energy	Department of Energy (DOE)
Financial Services	Department of the Treasury
Food and Agriculture	Department of Agriculture (USDA)
Government Facilities	Department of Homeland Security (DHS)
Elections (subsector)	Department of Homeland Security (DHS)
Education Facilities (subsector)	Department of Homeland Security (DHS)
National Monuments (subsector)	Department of Homeland Security (DHS)
Healthcare and Public Health	Department of Health and Human Services (HHS)
Information Technology	Department of Homeland Security (DHS)
Nuclear Reactors, Materials, and Waste	Department of Homeland Security (DHS)
Transportation Systems	Department of Homeland Security (DHS)
Water and Wastewater Systems	Environmental Protection Agency (EPA)

6.Source: US Election Assistance Commission, "CI Scoop: What are sectors and sub-sectors?"

Since CIs are vital to the existence of a country and, as per definition, having them damaged would have a debilitating impact on national security, they also become platforms where sensible data is gathered and exchanged among private entities, CI operators and the government. This is why there are two other very important offices that operate together with SSAs: Information Sharing and Analysis Centers (ISAC) and Information Sharing and Analysis Operations (ISAOs). Both offices analyze, filter and disseminate useful intelligence information concerning critical infrastructures and create alerts against potential threats[119]. The difference between the two agencies stands in the fact that the former is mainly made out of CIs owners and operators that "provide 24/7 threat warning and incident reporting capabilities and have the ability to reach and share information within their sectors, between sectors, and among government and private sector stakeholders[120]" while the latter consists in an external office. More precisely, the US Election Assistance Commission discribes it as:

> "any formal or informal entity or collaboration created or employed by public or private sector organizations, for purposes of: (a) Gathering and analyzing Critical Infrastructure information in order to better understand security problems and interdependencies related to critical infrastructure and protected systems, so as to ensure the availability, integrity, and reliability thereof; (b) Communicating or disclosing Critical Infrastructure information to help prevent, detect, mitigate, or recover from the effects of an interference, compromise, or an incapacitation problem related to Critical Infrastructure or protected systems; and (c) Voluntarily disseminating Critical Infrastructure information to its

[119] US Election Assistence Commission, "Wading Through Critical Infrastructure's Alphabet Soup", Blog Spot, 07/10/2017, https://www.eac.gov/wading-through-critical-infrastructures-alphabet-soup .
[120] Presidential Decision Directive 63, 1998 in US Election Assistance Commission's Starting Point.

members, State, local, and Federal Governments, or any other entities that may be of assistance in carrying out the purposes specified in subparagraphs (a) and (b)[121]".

For the purpose of intelligence information exchange among CI operators and local and national governments two requirements must be respected: confidentiality and a safe exchange of data through the use of internet and telecommunication lines. This is why cybersecurity becomes a key issue in granting CI security.

The European Program for Critical Infrastructure Protection

Following the pathway indicated by the United States on the necessity of spreading CIP policies in order to prevent terrorist attacks in the western world, the European Union established a program for the protection of its own critical infrastructures. As the result of long consultations of the European Council, in 2004 the Directive EU COM(2006) 786 took shape, establishing the European Program for Critical Infrastructure Protection (EPCIP) and the European Critical Infrastructure Warning Information Network (CIWIN)[122] . The creation of the latter program underlines the importance of information sharing in this field.

The Directive invites all Member States of the EU to adopt EPCIP in their national legislations. The Directive recognizes the threat of terrorism as primary and thus, its overall purpose is to enhance the protection of critical infrastructures in the Union. The used approach invites MSs to keep track of all hazards concerning a critical infrastructure yet focusing on the ones in which the given CI is more vulnerable.

The framework of EPCIP is structured in the following way[123]:

- **Identification of European Critical Infrastructures:** ECIs are identified as those CIs that wield highest importance for the Community and whose disruption or annihilation would affect two or more MS, or a single Member State if the CI finds itself on the soil of another Member State. This implies transboundary effects resulting from interdependencies among interconnected infrastructures across different states[124].
- **Measures to facilitate the implementation of EPCIP (Action Plan, CIWIN, CIP expert groups, CIP information sharing processes and identification of interdependencies):** The Action Plan is meant to set out the results to be achieved alongside with its deadlines. CIWIN is meant to provide a platform for the exchange of best practices an rapid alerts in total security while complementing existing networks. Expert groups may be set up where specific expertise is needed by the Commission. CIP expert groups shall facilitate public-private dialogue regarding critical infrastructure protection. They

[121] Presidential Policy Directive 21 in "Starting Point: US Election System as Critical Infrastructure".
[122] European Union, European Program for Critical Infrastructure Protection, last accessed on 05.13.2022, https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0786:FIN:EN:PDF .
[123] Ibidem.
[124] Ibidem.

shall also, on an advisory basis, facilitate exchanges of views on related CIP issues. During the information sharing process, stakeholders will take appropriate measures to protect the security of critical infrastructures and protected systems, interdependency studies and vulnerabilities of CIs, threat and risks assessments. This information is sensitive and must not be publicly disclosed or be used other than for the purpose of protecting CIs. MSs are in charge of providing adequate security vetting for any personnel handling classified information of their nationality. This is expected to enhance research and development, stakeholder dialogue, identification of interdependencies, awareness of CI issues, understanding about interdependencies, threats, vulnerabilities, security incidents, countermeasures and best practices for the protection of CIs[125].

- **Support to MS' National Critical Infrastructures (NCIs):** each Member State is in charge of establishing a National CIP Programme. Aims of the programmes shall be addressed by MSs concerning the protection of NCIs within their territory. Issues that should be tackled are the following: identification and designation of National Critical Infrastructures according to its own national criteria. CIP Programmes shall be based on the common list of CI sectors established for ECIs. In identifying NCIs the following criterias will have to be taken into consideration: public effect, psycological effect, scope, environmental effect, severity, political effect, public health consequences. Responsibility for protecting NCIs falls on the NCI operators and owners and on the MSs. When requested, the Commission will support the Member States in these efforts[126].
- **Contingency Planning:** In order to minimize potential effects of destruction or disruption of CIs, contingency plans play a key role.
- **External dimension**
- **Financial measures and funding opportunities**

To sum up, The European Union on one hand finds out ECIs and establishes a common framework, on the other hand it asks MSs to establish its own NCIs and to assume responsibility for them. On many occasions both the American and European frameworks underlined the need for keeping CIs, and information concerning, them strictly classified, but, the webpage of the Italian Ministry of the Interior reports that (according to the Green Book adopted in Brussels on Novermber 17th, 2005[127]) communication systems, maritime and oceanic transports, energetic networks, plants ad pipelines, systems for the production, stockpiling and transport of dangerous substances are all to be considered critical infrastructures[128]. This website also reports that the list of CIs is still open and "susceptible to implementation". Taking into consideration all of these assumptions, it is logical to suppose that ports (as well as the internet cables used

[125] Ibidem.
[126] Ibidem.
[127] Italian Ministry of the Interior, Approfondimento: le infrastrutture critiche , lasta accessed on 05/26/2023 https://www1.interno.gov.it/mininterno/export/sites/default/it/sezioni/sala_stampa/notizie/protezione_civile/0867_2008_02_14_app_infrastrutture_critiche.html .
[128] Ibidem.

to transmit classified information concerning them and the industrial clusters located in their hinterlands) are to be considered critical infrastructures as well, and they are thus subject to the National Critical Infrastructure Program and to the EPCIP. In this regard, Merk writes:

> "Introduced in many OECD states around the world during the period of 2001-2010, CIP policies seek to integrate a range of sector-specific security initiatives into one unified national (or even supra-national, in the case of the EU) protection strategy. To the difference of 'public utilities' denoted through reference to concrete objects (bridges, roads, dams, pipelines, etc.), 'critical infrastructure' tends to be defined in the negative, which is to say, in terms of the material and immaterial systems without which society and the economy could not function. In nearly every CIP policy—from the EU's European Programme for Critical Infrastructure Protection, to Australia's Critical Infrastructure Resilience Strategy, Germany's Nationale Plan zum Schutz Kritischer Infrastrukturen and the United States' National Infrastructure Protection Plan—ports are included as a vital part of a broader infrastructure sector, variously referred to as the 'maritime transport system', 'freight and logistics', the 'shipping and postal sector', and so on. Such policies have generally focused on the trans-sectoral and trans-jurisdictional interdependencies between infrastructural systems. In the EU, for example, critical infrastructures such as energy grids and rail-based freight networks span multiple countries: failure in one sector or in one national jurisdiction can 'cascade' into others. Canada's CIP policy has pointed to ports as a site in which infrastructure failures could cascade or be amplified, due to sectoral interdependencies such as intermodal transfers to road networks, or the concentration in the port of petrochemical facilities that service the energy needs of the economy. Given the preeminent economic role of maritime ports in facilitating the import and export activities upon which the economic health of many nations depends, port actors are increasingly included in the formulation, implementation and review of such policies. […] The creation of 'information sharing networks' is increasingly being used as an instrument for the implementation of risk governance frameworks in ports and beyond, especially in countries that have formulated so-called CIP policies (the U.S., the EU, and Australia have all created such networks). Networks for sharing information on threats and disruptions between private and public actors at multiple scales are seen as a crucial platform for coordinating the many different interests that must be brought together in order to increase risk governance capacities in and around port infrastructure. These networks also promote planning for adverse events across sectors, involving increasing cooperation between port authorities, national security agencies, and private operators, in order to put in place response strategies and contingency plans[129]".

THE DIGITAL DIMENSION OF PORTS

Being ports CIs, they are subject to the EU Directive "(EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 concerning measures for a high common level of security of network and information systems across the Union[130]" adopted by all MS in 2018. This directive defines CIs as "Operators of Essential Services [that is to say] subjects that provide a service that is essential to the maintenance of critical economic and/or social activities […] this service depends on the network and from informative services on which an incident might have significant effects related to the supply of the service itself[131]". This means that CIs, among which ports, are created to provide essential services to the nation and largely rely on digital systems, that is to say that ports access to the internet must be always guaranteed in order to ensure the regular process of critical data sharing with the institutions. In order to guarantee them a continuous and

[129] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010
[130] G. Mosca, "La protezione cyber delle infrastrutture critiche", Istituto per gli Studi di Politica Internazionale, 11/08/2019 https://www.ispionline.it/it/pubblicazione/la-protezione-cyber-delle-infrastrutture-critiche-24113 .
[131] Ibidem.

safe internet access several aspects must be taken into account: where weak, ports' digitalization must be improved, and port assets and underwater cables must be protected against potential damage. Harm to any of these infrastructures can be considered a threat to national security.

First of all, it is of utmost importance to consider the underwater and international dimension of internet cables consenting the exchange of data throughout the internet. Nearly the total amount of data in the world is exchanged via submarine cables, even though it is often wrongfully thought to travel via satellite[132]. Data is exchanged in binary code through light impulses along fiber optic cables which are pulled by special vessels on the seabed[133]. Impulses can be sent back and forth in both directions and this allows countries on opposite rims of the ocean to be digitally connected. Fiber optic cables have the diameter of a garden hose, so, in order not to be damaged by fishery activities, animal attacks, anchorage of vessels or incidents of any other kind, they have to be coated with special resistant and waterproof materials such as Kevlar and others, be buried under the seabed sand or protected with special concrete covers[134]. In order to avoid as much as possible incidents deriving from human activities many states have declared a Cable Protection Zone (CPZ) where vessels are forbidden to fish or to anchor. Still, it is hard to avoid cable damaging by natural incidents or shark attacks[135]. In the high seas, where fishery or anchorage do not take place, cables are simply laid on the seabed without any coverage, and this renders their position even more delicate and their protection even more needed.

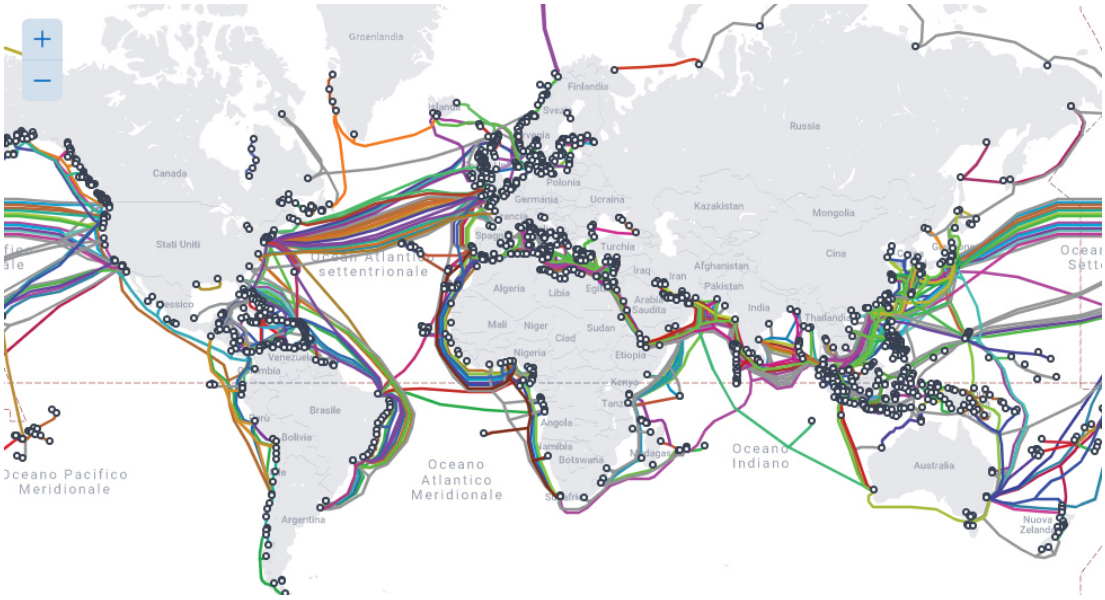
On the importance of the submarine global cable network, Alessandro Gili of the Italian Institute of International Politics Studies, writes:

> "The network of submarine infrastructures is critical and its functioning crucial for international economy and states' security. Few data is needed in order to comprehend its fundamental importance: 97% of global internet traffic passes through these cables and thanks to them financial transactions of around 10 trillion dollars per day are realized. Up to today, on the seabed there are around 450 submarine cables for a total of 1,2 million kms. Importance of such cables is expected to rise thanks to the high demand of data, cloud services, and new generation networks such as 5G and 6G, as well as the Internet of Things. Hence, submarine cables are today the key infrastructure for the digital era, as well as an indispensable component of global governance and global digital security. Yet, internet cables do not fall into the scope of a shared international regulation, neither are they attributable to a single state's responsibility. Property of these cables is often shared among several enterprises and institutions of different states exercising different jurisdiction. Nevertheless, their structure is connected to a wider environment intertwined to other types of infrastructures such as data centres and technical and technological data[136]".

[132] Geopop, "Internet ed elettricità viaggiano in fondo all'oceano lungo i cavi sottomarini", Video Youtube, 09/15/2021, https://www.geopop.it/video/cavi-sottomarini-dove-passa-la-fibra-ottica-dei-nostri-dati-altro-che-satelliti/ .
[133] Ibidem.
[134] Geopop, "La posa dei cavi sottomarini in fondo agli oceani e la manutenzione", Video Youtube, 09/17/2021, https://www.geopop.it/video/la-posa-dei-cavi-sottomarini-in-fondo-agli-oceani-e-la-manutenzione/ .
[135] Ibidem.
[136] A. Gili, "Cavi: interessi di Stato in gioco", Istituto di Studi di Politica Internazionale, 20/21/2022, https://www.ispionline.it/it/pubblicazione/cavi-interessi-di-stato-gioco-36487 .

In short, the difficulty in having a regulatory approach to internet submarine cables, stands in two facts: first, their length stretches along international waters and national waters of different states, reason why harmonizing law of cables is a real challenge, and second, their ownership falls in the hands of a consortium of enterprises of different nationalities.

In fact, when cables are being pulled, their ownership falls under the production industry, but as soon as they are finished, property is sold to telecommunication companies that sells internet subscriptions to the end users[137]. Nevertheless, it is also true that big tech companies (such as Google, Amazon, Meta, Huawei Marine and others) play an increasing role in this sector and own today the 66% of underwater cables: for instance, the Dunant cable that became operational in spring 2021, is entirely developed and exploited by Google[138]. China and USA remain the biggest players in the world arena for the telecommunication sector.



7. Source: Submarine cable map

The fact that cables imply so much international participation makes it hard for states to control them, but at the same time it makes them easy prey for actors willing to sabotage them. For what concerns threats related to internet cables Gili writes:

> "Threats to such infrastructures are multiple and spread from physical distruction from a rival actor in order to damage some states' security or economy (as probably happened to the North Stream2), attempts of espionnage […], installation of viruses *backdoor* in communication centers of departure or landing of cables […]. In order to improve the security of submarine cables there are three approaches: a normative one, that ensures shared rules for the pulling, maintenance and surveillance of submarine cables. The military one, that employs ships and submarines for the correct working of submarine infrastructures and patrols to avoid the espionage threat. Lastly, the redundance approach: suggesting that every country

[137] Geopop, "Chi possiede i cavi sottomarini della rete internet globale?" Video Youtube, 09/19/2021, https://www.geopop.it/video/la-geopolitica-dei-cavi-sottomarini-e-la-sfida-tra-stati-in-fondo-agli-oceani/ .
[138] A. Gili, "Cavi: interessi di Stato in gioco", Istituto di Studi di Politica Internazionale, 20/21/2022, https://www.ispionline.it/it/pubblicazione/cavi-interessi-di-stato-gioco-36487 .

> outwardly makes links with more than one submarine cable, with the aim of limiting economic and strategic negative impact in case of malfunctioning or desruption of cables[139]".

Since submarine cables are CIs themselves, NATO asked its MSs to provide for their surveillance, even though this task is particularly challenging given that for the majority of their path cables stretch through international waters. Nevertheless, after the incident to the North Stream 2, NATO MSs deployed their means to patrol these infrastructures. The Italian Navy for instance enhanced protection of infrastructures connecting Italy to the North of Africa. NATO also declared that: "any attack from a foreign power towards critical infrastructures of MSs shall be considered an attack towards members of the Alliance under article 5 [of the Atlantic Charter][140]". By the way, according to the principle of *plausible deniability of responsibility* that will be better explained in the next chapter, individuating a responsible for these types of attack might be very difficult. It must be remembered that cables are owned by private international consortia, thus demonstrating an attack to a single member state and finding the sponsorship for the attack might reveal very hard, overall if, as in the case of the North Stream 2, the facts take place in international waters[141]. In a climate of rising tensions between the Russian Federation and the Western world, it is important to increase protection and surveillance of physical infrastructures that grant strategic communication and economic transaction among allied countries[142]. Even though the activation of article 5 configures as the most remote scenario (CIs must be hit in national waters of a MS for it to happen), it is also true that Russia and China have invested a lot in underwater technologies. In particular, Russia invested in underwater drones for attacks and deterrence, "hunter killer" submarines, built with robotic arms built with the purpose of cutting submarine cables, and "Losharik" submarines for espionage, built with the purpose of hiding under the seabed[143]. In addition to that, the Russian government doesn't hide its intentions to extend its presence in the wider Mediterranean[144]. At the time of writing, the Chief of Staff of the Italian Defence Giuseppe Cavo Dragone and the Chief of the Naval Staff, Admiral Credendino assert that the Russian army is assuming an aggressive temper in the Mediterranean[145] and that Italy should be prepared to face the next battles on CIs in the underwater domain, which is gradually assuming importance and should be added to the defence domains alongside with the other more traditional ones (land, air, sea, space and cyberspace).

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[139] Ibidem.
[140] Ibidem.
[141] Ibidem.
[142] Ibidem.
[143] V.V.A.A., "Putin «potrebbe bloccare internet in Europa» tagliando i cavi sottomarini. L'allerta degli analisti: «Blackout devastante»", Il Messaggero, 09/29/2022, https://www.ilmessaggero.it/mondo/putin_bloccare_internet_blackout_cavi_sottomarini_attacco_nato_infrastrutture_cosa_succede_baltico-6958168.html?refresh_ce .
[144] V.V.A.A., Распоряжение стратегию развития морской деятельности Российской Федераций до 2030 года, *Government of the Russian Federation*, (2019).
[145] G. Carrer, "Mosca minaccia il Mediterraneo anche sott'acqua. Parola di Cavo Dragone", Formiche!, 05/30/2023, https://formiche.net/2023/05/cavo-dragone-russia-underwater-iai/ .

In order to answer to the need for more protection on these infrastructures and to the need to invest in the underwater domain, the Italian government is working on the construction of a national pole for underwater research and innovation in the port of La Spezia[146], that already hosts NATO's Center for Maritime Research and Experimentation (CMRE)[147]. In an interview the Undersecretary of State at the Ministry of the Defence Matteo Perego di Cremnago explains that the main aim of the national pole for the underwater domain will regard the enhancement of military deterrence means used to patrol and protect strategic corridors for energetic supply, pipelines and underwater ridge for the transmission of data traffic. Preserving underwater links in the Mediterranean in quality of NCIs will be a priority[148]. In order to respond to the increasing demand of protection of NCIs, it will be important to keep technological sovereignty as well. With this purpose, it will be important to invest in technological development in the military field with the attempt of foreseeing in which direction the market will develop[149]. Up to now a very important issue to deal with, concerns hybrid threats (in the cybernetic, cognitive and space domains) and the development of means capable of acting without altitude limits. Unmanned systems will also play an increasing crucial role in the future scenario[150]. Lastly, the national pole for the underwater domain wishes to work in synergy and coordination with national industries of the defence and high-tech sectors, research centers, universities and the academic world in order to be always up to date with the latest technological innovations[151].

In this framework, thanks to the aim of protecting digital and underwater states' capacities, ports become hubs for technological development, innovation and collaboration between the academic world, private high-tech companies and the defence sector. Ports are also home to special vessels for underwater cable pulling. If prevention and surveillance become key words in the new international scenario, they have to go hand in hand with innovation and technological cooperation among countries.

As an example of international cooperation in the field, in 2021 Italy, together with other 24 MSs, signed the Declaration on European Data Gateways with which:

> "The Member States and the Commission will align their efforts to support the entry points for international internet traffic in Europe, or the European Data Gateways. Improving infrastructure that links Europe with these regions will allow Europe to offer more data services. At the same time, Europe's partners can benefit from secure data processing thanks to the EU's strong data protection standards. […] In order to improve international connectivity, Member States and the Commission commit to: strengthen international partnerships for connectivity, offer EU data storage and processing services to partners

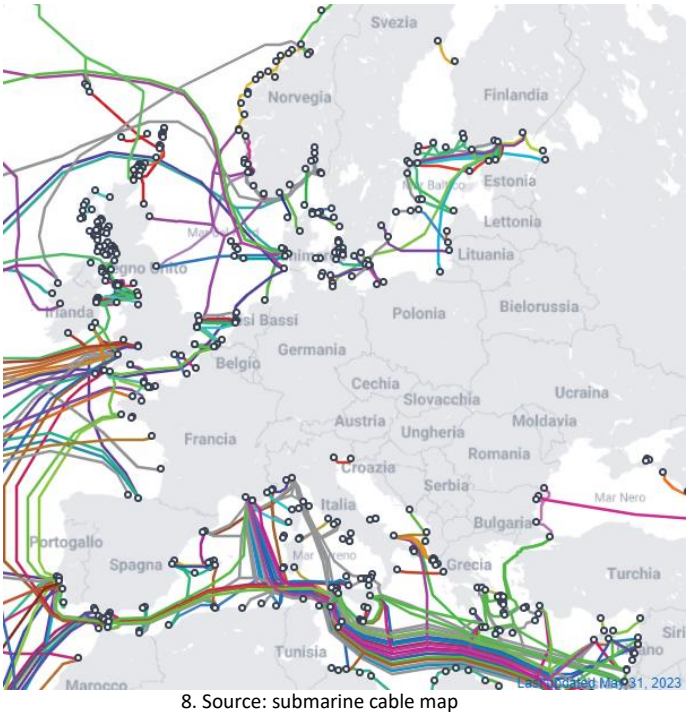
[146] G. Carrer, "Cosa farà il Polo nazionale della subacquea. Parla il sottosegretario Perego", Formiche!, 12/23/2022, https://formiche.net/2022/12/perego-polo-nazionale-della-subacquea/ .
[147] Center for Maritime Research and Experimentation, last accessed on 05/26/2023, https://www.cmre.nato.int/ .
[148] G. Carrer, "Cosa farà il Polo nazionale della subacquea. Parla il sottosegretario Perego", Formiche!, 12/23/2022, https://formiche.net/2022/12/perego-polo-nazionale-della-subacquea/ .
[149] Ibidem.
[150] Ibidem.
[151] Ibidem.

outside of Europe, improve submarine cable networks, establish satellite connectivity ensure safe and secure connectivity networks[152]".

In addition to that, the EC underlines:

"Submarine cables are essential in order to sustain the exponential increase in internet traffic. For one, internet traffic across the Atlantic is doubling every two years. New, secure submarine cable infrastructures can serve growing data flows of Africa, Asia, and Latin America. Member States and the Commission will improve the managing of different communication networks and infrastructure, while ensuring to strengthen cybersecurity[153]".

According to this framework, Italy has gained greater influence in the submarine worldwide network in latest years. Thanks to the pulling of the cables Unitirreno, Jio (landing in Savona), BlueMed and 2Africa (landing in Genova) Italy acquired interconnectivity to faraway countries while enhancing redundancy and resiliency in the telecommunication sector. Italy's strategic location in the Mediterranean, at the crossroads of Europe, Africa, and Asia, makes it an important transit point for network traffic flowing between these regions, rendering Italy more competitive with Marseille, which is the current most trafficked data hub in the Mediterranean.



8. Source: submarine cable map

As clearly envisaged by the map, up to today Italy is the country with the major number of port-cities working as Digital Gateways to Europe after the UK, Norway and Sweden. Among the Southern European countries it is the first one for number of data gateways to Europe. Particular importance must be attributed to the new cable 2Africa and the institution of its new data center GN1 (collaboration between the American Equinix and the Italian Vodafone) in Genova: this cable is the longest ever realized (45.000 km) and will

[152] European Commission: Shaping Europe's Digital Future, last accessed on 06/01/2023, https://digital-strategy.ec.europa.eu/en/news/digital-day-2021-europe-reinforce-internet-connectivity-global-partners .
[153] Ibidem.

connect 46 cities across Europe, Asia and Africa[154]. The new Italian-American data center will allow the companies to increase the number of partners and reach new markets, while creating stronger connectivity in Europe. The direct connection to the new flagship Equinix data centre in Milan will allow direct connection to port digital ecosystems and more internet capacity for the implementation of new services such as clouds, computing and videos. Secure and resilient internet access to future 5G and 6G technology will be guaranteed to all the populations connected by this cable, estimated to be millions of people[155]. Hence, 2Africa represents a historic opportunity for the Italian economy and for the development of the economies distributed along the cable line, since these internet services are likely to enhance and speed up processes in trade, they would guarantee a:

> "privileged access to new markets giving a competitive advantage to any Italian company in terms of export accelerating the digital development of Europe. At the moment, Marseille is the major European data hub for traffic of data. A lot of internet research ends up in France increasing standby time. Realizing more digital hubs [such as GN1] in Italy would generate workplaces. Enterprises need qualified specialists to work in these strategic nodes of connectivity[156]".

In a recent interview to the Italian newspaper *Corriere della Sera*, Emmanuel Becker, Manager Director of Equinix, underlined the need for Italy to equip itself with *digital ports,* i.e., landing points for fiber optic submarine cables and places where they can be connected to the national network. According to his view, our country might transform itself in the "European Singapore, a platform for the transit of data even to the Middle East, India and Africa[157]". Genova, in this sense, occupies a strategic point in the map of global submarine network.

Since ports are recognized as platforms where multiple stakeholders exchange a great amount and variety of information, they are seen from the telecommunication industry as an ecologically fertile ground. Ports are clusters of information where data is heterogeneously transmitted through different platforms.

> "Data in the maritime domain is growing at an unprecedented rate, e.g., terabytes of oceanographic data are collected every month as well as petabytes of data are already publicly available. Big data from different sources such as sensors, buoys, vessels, and satellites could potentially feed a large number of interesting applications regarding environmental protection, security, shipping routes optimization or cargo handling. Although many projects are trying to develop data management platforms in various application domains, not many of them have addressed integration in port environments with the possibility of including cognitive services and extending their platform to whole transportation routes around Europe[158]".

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[154] C. Barbieri, Inaugurato l'hub digitale di Equinix e Vodafone a Genova, che collega Africa, Europa e Medio Oriente", Comune di Genova, 05/23/2022, https://smart.comune.genova.it/comunicati-stampa-articoli/inaugurato-l%E2%80%99hub-digitale-di-equinix-e-vodafone-genova-che-collega-africa .

[155] Ibidem.

[156] F. Savelli, "Genova diventa «porto digitale»: un cavo sottomarino per Vodafone (con gli americani di Equinix)", Corriere della Sera, 03/03/2021, https://www.corriere.it/economia/aziende/21_marzo_03/genova-diventa-porto-digitale-cavo-sottomarino-vodafone-con-americani-equinix-9938a426-7bff-11eb-bc48-454efd4893c8.shtml .

[157] Ibidem.

[158] Christos Gizelis, Theodoros Mavroeidakos, Achilleas Marinakis, Antonis Litke, Vrettos Moulos. Towards a Smart Port: The Role of the Telecom Industry. 16th IFIP International Conference on Artificial Intelligence Applications and Innovations (AIAI), Jun 2020, Neos Marmaras, Greece. pp.128-139.

This implies challenges and opportunities for the AI and telecommunication sectors that may optimize, improve and speed up the process of data sharing among ports, stakeholders and institutions. Infact, these sectors aim at becoming pivotal players in the transformation of seaports into *Digital* or *Smart Ports* of the future:

> "Transformation is not only today's trend but also a reality. Ports could not be excluded from that change. A transformation process has been initiated in order to change their operational structure and the services they offer. Artificial Intelligent and Data oriented services push the services' landscape beyond the traditional ones that are currently used. As a result, new opportunities are risen for Telecommunications/Information and Communication Technology (ICT) providers at ports. These opportunities are the steppingstone towards the transformation of ports for the future. Smart and Cognitive Ports is the newest trend and, like the Smart Cities, is a creation of a new emerging data market. It is a term that expands the traditional stakeholders' ecosystem with limitless opportunities for new entries. A multi-actor and very diverse ecosystem is created with many opportunities for market expansion, revenue increase, new services, especially data-driven ones such as Internet of Things (IoT) and AI-based services. This rapid growing ecosystem with many actors and many roles creates the need for new and dynamic Business Models to fulfil the also rising needs. This opportunity was early identified by European Union in 2014 and a special chapter was included within the Smart Cities one. Ports are considered a special case of a Smart Community, then they have to meet the same requirements that are asked for a Smart City, adapted to the port situation[159]".

In chapter three the situation concerning the digital transition in Italian ports will be analysed in order to understand if Italian ports are ready to play the role of smart hubs and digital gateways of the European Union.

THE ENVIRONMENTAL DIMENSION OF PORTS

Ports' impact on the environment: an ecologic threat concerning the international system

Ports are among the most polluting structures created by humankind. Their twofold nature of industrial clusters on one side, and of connection elements among value chains on the other, makes them a place of concentration for pollutants, having impact on port cities and on population living on the waterfront in first place.

Still, pollution of air and sea knows no governmental boundaries, and gives birth to health problems also for people living away from the coastline, reason why it represents an international problem that must be tackled by collective action and on a twofold basis concerning the logistic chain on one hand, and the industrial cluster of ports on the other.

As touched upon previously, historically, ports expanded up to the degree that they attracted a wide range of activities concerning the energetic and chemical sectors and also other industries that needed a close relationship with the sea or stockpiling services close to the ships through which determined goods are transported. This is why environmental impact related to port activity is of a wide variety and concerns

[159] "The Role of the Telecom Industry in Smart Seaports", Data Ports, Blog Spot, https://dataports-project.eu/the-role-of-the-telecom-industry-in-smart-seaports/ .

both sea and ports' hinterland. While areas of concern stretch from water quality, noise, waste, soil to biodiversity, air emissions remain of primary concern, being them the main catalyst of climate change.

Climate change with everything that it entails (increasing temperature, tide rise and so on) represents the most challenging ecologic threat of the century and is thus faced by a growing number of policies and agreements, the most commonly known are the Paris Agreement and the European Green Deal.

While the Paris Agreement aims at limiting the increase of the average global temperature beneath 2°C compared to pre-industrial levels, the Green Deal aims at making Europe climate-neutral by developing an economy with net-zero gas emissions by 2050[160]. The more policies against climate change are elaborated, the more compelling it becomes to decarbonize ports.

Industrialization of ports and contemporary environmental problems

Traditionally, in many port-cities, industrial development and port development have walked together. Industrialization of port-cities grew spontaneously until in 1950s a wave of planned industrialization took place[161]. As O. Merk reports:

> "These policies were in most cases driven by national states supporting national champions as a means of developing economically disadvantaged areas, by restructuring industries and creating new growth poles. The fundamental reasons for their development lie within the sphere of maritime transport, namely the development of very large bulk carriers, which have dramatically reduced the costs of long-distance ocean transport (Vigarié, 1981). This heavy industrial development in coastal areas, frequently referred to as Maritime Industrial Development Areas (MIDAs), was very land intensive with requirements for sites of at least 2000 hectares. Major MIDA projects in Europe, US and Japan, all took place in the late 1950s[162]".

The first ports to apply this model were the ones of the Northern Range, building in their inlands' huge complexes and facilities for oil, chemical, shipbuilding, iron and steel stockpiling and transformation. Dunkirk, Le Havre, Weser and Livorno followed after.

Population in port-cities started to increase pressure to diversify economic activity and limit pollution, hence obtaining a revision of port development projects and thus a change in the shape of ports. New port-related projects included a shift towards light industries, more spaces devoted to warehousing and commercial activities. A blatant example of this transformation is the port of Gioia Tauro, that witnessed a shift towards a container transhipment port after a failed attempt of industrial development. MIDA projects

[160] European Commission, Climate Action: 2050 long-term strategy, 2020, https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en#:~:text=The%20EU%20aims%20to%20be,net%2Dzero%20greenhouse%20gas%20emissions .

[161] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010

[162] Ibidem.

gave birth to special economic zones and special logistic zones, often located in the nearness of port-cities, providing them with exceptional financial and logistic regimes in order to attract industrial development[163]. The result of this reform in port-planning project has given birth to a series of mixed outcomes. In many cases new port-planning has led to an increase in population, in more employment and economic growth, increasing the industrial potential of nations and successfully restructuring post-war economies.

On the other hand, in some cases, MIDAs industrial development fell in the hands of multinational companies that had poor knowledge of the land they were operating in and whose strategies were not aligned to the economic tissue of cities and regions. This left port industrial clusters without connections to the rest of the region. Lack of economic linkages among the co-siting industries and among industries and the region left many ports with a dependency on the only industrial sector that had been developed in the area, this is why many ports are specialized in few industrial sectors at the detriment of commercial activities, while, on the contrary, other ports are only commercial stopovers with a good urban and logistic connection but have poor industrial clusters. Ports having an industrial character sometimes tried to develop container terminals but not always successfully. Such one-sided port-related development leads ports to the accumulation of specific assets for a determined sector of the economy and this leads to economic vulnerability of the port in times of global industrial restructuring[164]. According to Merk:

> "Ongoing outsourcing of heavy industries from developed economies to emerging economies has led to the closure of many industrial plants on port sites and the need for industrial reconversion. Although there is increasing talk of near-sourcing, indicating a reorientation of industrial activity closer to consumer markets instead of low wage regions, there are few empirical data that seem to underpin this trend. With this perspective of looming industrial rationalisation, many ports and port-cities are assessing new industrial opportunities that could build on existing assets and infrastructure to be developed. These opportunities include industrial ecology and renewable energy.".

In other words, industrialization of ports turned out to be not only ecologically disadvantageous but economically inconvenient as well, because over-specialization of port clusters might lead to the isolation of the port when local or global economy undergoes substantial changes. This is why many ports turned to industrial ecology and renewable energies as a solution for problems such as local economic development, competitiveness of port clusters, optimization of processes, pollution prevention and waste management[165].

[163] Ibidem pg..95-99
[164] Ibidem.
[165] Ibidem.

Contemporary environmental problems fuelled by ports' industrialization: air pollution and carbon emissions

Air emissions produced in port cities derive around half from the industrial cluster and half from the shipping industry.

According to an OECD report of 2021, carbon dioxide emissions coming from vessels was estimated to be 3.3% of global emissions on 2007 while, worldwide, oxides of nitrogen from shipping accounted for about 10% to 15% of the global anthropogenic[166].

According to the same OECD report:

> "Air emissions can be divided into two groups: Common Air Contaminants (CACs) and Greenhouse Gases (GHGs). Each of these groups is gathering diverse gases. Main CACs are: Oxides of nitrogen (NOx), oxides of sulphur (SOx), particulate matter (PM), among others. GHGs are gases present in the earth's atmosphere that reduce the loss of heat into space3. Main GHG gases are: Carbon dioxide (CO2), Methane (CH4) and Nitrous Oxide (N2O)[167]."

While Common Air Contaminants have effects only on local air quality, Green House Gasses are responsible for climate change and have a global impact, since these gasses trap heat inside Earth's atmosphere by blocking long-wave energy normally bounced back into space.

Both types of pollutants are subject to monitoring and object of discussion of public policies, this is why many ports publish sustainability reports presenting the results of their monitoring. The problem with this monitoring system is that, since there is no mandatory top-down approach involving political institutions, every port is responsible for writing down its own GHG inventory, selecting its own air contaminants and using different indexes, hence making ports contaminants' inventories incomparable one to another. For example, while the port of Antwerp measures sulphur dioxide, nitrogen dioxide and particulate matter, Vancouver takes into account other gasses such as carbon monoxide, volatile organic compounds and ammonia. This renders impossible making a comparison of air pollutants among ports.

Water pollution

Information on emissions of pollutants in waters by port clusters and shipping is rather scarce, if compared to the information we have on air pollutants.

Among the sources of water pollution deriving from the shipping industry there are oil spills, transfer of harmful aquatic organisms, pollution from slop, leaching of antifouling paints and dredging.

Oil spills can derive from normal activities such as loading and unloading of tankers and removal of bilge water as well as from leakages, accidents and illegal dumping practices. Some estimate that regular marine transportation account for the 70% of the oil entering sea[168].

[166] Ibidem.
[167] Ibidem pg.30.
[168] Ibidem pg.33.

According to IMO, about 10 billion tonnes of ballast water is transferred each year, through which microscopic dormant and toxic aquatic organisms such as pathogens and bacteria, are discharged into open sea waters[169].

Another source of water pollution comes from slop, which stands for the residual of all chemical products contained in tanks and used for washing operations including antifouling paints, which are used to coat the lower part of the ships in order to prevent sea organisms to attach to the hull of the ship and thus slowing it down. These paints are often illegally discharged at sea.

Finally, dredging can contaminate sediments and surrounding waters, even though it is essential for port access.

In an attempt to harmonize water pollution measurement, the EU established a European Water Framework Directive that includes 3 priorities (prevent and reduce pollution, promote sustainable water use, protect and improve the aquatic environment and mitigate the effects of floods and droughts[170]) and establishes 8 contaminants to be monitored.

Impact on soil and waste production

The only impact ships have on soil regards their terrestrial activities in port areas. Main sources of soil pollution come from the following activities: discharge of oil on the soil, spill of chemicals during the demolition of ships, emissions of SO_2, NO_x causing acid rain that leads to soil acidification[171].

Still, the main impact a port has on land, is represented by erosion. The presence of a port modifies the natural coastal sediment transport, hence causing degradation of natural resources and damaging local biodiversity.

Waste produced by ports, ships and port clusters represent a significant share of land and water pollution. Port waste basically comes from oil terminals and fuel deposits that produce toxic sludges.

Waste from ships derives mainly from dredging operations and from tourist activities of cruise ships: even though they represent only 1% of the global fleet, they are responsible for 25% of all waste reversed in water, consisting of glass, tin, plastic, paper, cardboard, steel cans, kitchen grease, kitchen waste and food waste[172]. In particular, plastics are the major source of waste, as plastics released from vessels makes up almost 80% of all garbage found on shorelines and on the sea floor in the Mediterranean Sea.

Waste represents a challenge for port authorities, which are in charge of collecting it and treating it[173].

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[169] Ibidem.

[170] European Parliament, Factsheets on the European Union: water protection and management, 2022, https://www.europarl.europa.eu/factsheets/en/sheet/74/water-protection-and-management#:~:text=It%20aims%20to%20prevent%20and,effects%20of%20floods%20and%20droughts .

[171] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010

[172] Ibidem.

[173] Ibidem.

Impact on biodiversity

For what concerns the disruption of the balance of ecosystems, the main threat concerns the aforementioned introduction of non-indigenous marine spices throughout the transfer of ballast water. When alien spices enter into conflict with local spices environment undergoes sever changes and this might disrupt local ecologic equilibrium, but natural environment, flora and fauna are also damaged by dredging activities, noises that can disturb and confound animals and sulphur nitrogen compounds emitted from ships oxidising the atmosphere and contributing to the acidification of the marine environment[174].

Industrial ecology as a solution for environmental pollution and port competitiveness. The governance of industrial ecology

As touched upon before, in order to better face pollution and competitiveness problems, port clusters engage in industrial ecology. While ports of North America engage in these types of policies mainly for environmental reasons, European ports do it mainly for economic development and competitiveness of port-cities. In particular, ports of the Northern Range exploit industrial ecology in order to attract businesses. For instance, the Rotterdam OCAP project is worth mentioning: residual Co2 from Shell Pernis plants is transferred to horticultural businesses through disused pipelines[175]. For "industrial ecology" or "circular economy" it is hereby meant a "systematic management of material and energy flows using waste from one process as an input to another process where this cascading of materials or energy is achieved through collaborative relationships between normally unrelated industries, often referred to as industrial symbiosis [176]". Port industrial ecology is usually implemented in the sectors of energy, petrochemicals, chemicals, waste, construction materials, agri-food, metallurgy and maritime industry. Ports have a great potential for these types of experiments, precisely because of their wide industrial estates dedicated to MIDAs and industrial clusters. Ports have the power to influence industries co-siting in their inlands throughout their master plans, their zoning regulations, and by giving industries access to waterways, railway and inland connections. Ports might serve as facilitators in giving co-siting industries support for exchanges and utility sharing, but also by giving them concessions for port land sites at industrial estate purposes through special incentives, and port terminals concessions. These possibilities given by ports would allow industries more room to organise synergies via co-siting and utility sharing. All of these practices above cited might be used by ports to push for circular economy and ecologic projects. As for many Asian ports, approach to industrial ecology is often top down driven, and thus based on national strategies (i.e. the Circular Economy Law in China, the Green Growth strategy in South Korea, the

[174] Ibidem.
[175] Ibidem.
[176] Ibidem pg.97.

Recycling Ports plan in Japan and the Eco-town program still in Japan[177]). Again, ports represent a platform where different interests meet: national and international law and governance, private corporations, shipping industries and in this case, university and the academic world as well. Knowledge institutes and universities may play the role of important facilitators in the process of implementing industrial ecology projects by delivering technical expertise. know-how and innovation to fresh workers of the industrial cluster, preparing new workforce and facilitating exchange of information and best practices among the industries working in the cluster; Potential collaboration among the academic world, research and ports may play a crucial role in the years to come. Where drivers coming from national law, political institutions, port authorities and innovation industries are absent, weak or not clear, industrial ecology projects hardly take place.

Measuring ports' level of pollution. Mitigation and adaptation measures are crucial to preserve Italian and European strategic advantage. Decarbonizing ports as a mitigation measure

Measuring environmental health status is fundamental for ports, since they are particularly vulnerable to climate change impacts. Being them located in coastal zones, these critical infrastructures are susceptible to rising sea levels, strong winds, storms and floods. As Merk writes:

> "In its Fourth Assessment Report, published in 2007, the IPCC estimated that the global average sea level would rise from 18 to 59 cm by the last decade of the 21st century (EPA 2008). Assuming a sea level rise of half a metre by 2050, Lenton et al. (2009) estimated that the value of exposed assets in 136 port megacities may be as high as US$ 28 trillion[178]."

No matter this situation, many ports today don't have comprehensive plans for adaptation and mitigation strategies, even though many institutions (among which the United Nations' Framework Convention on Climate Change) push for the need to urgently take adaptive measures[179].

This reluctance probably depends on the discrepancy between port authorities planning and the time span of climate change impact: decision makers are more likely to act on situations that are already tangible or easily foreseeable. In addition to that, taking adaptation measures often comes together with the building of resources-intensive working groups and committees.

According to the EU's ports' climate performance report of February 2022, Italy is on top of the chart for emissions from ship activities at port and holds the third place for country ranking of maritime supply chain emissions[180]. If above-mentioned IPCC's data is correct, Italy in 2100 should look approximately as following:

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[177] Ibidem pg.98.

[178] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010.

[179] Ibidem.

[180]Transport & Environment, "EU Ports' Climate Performance An analysis of maritime supply chain and at berth emissions", February 2022, https://www.transportenvironment.org/wp-content/uploads/2022/02/2202_Port_Rankings_briefing-1.pdf .

9. Source: Ormeggi Online

This map demonstrates that for a country located in the centre of the Mediterranean Sea such as Italy it is extremely important to measure the effects of emissions in ports and take both mitigation and adaptive measures against climate change and tide rise. This might also entail moving ports towards other locations.

Taking mitigation and adaptation measures concerning Italian ports is thus key for maintaining Italian and European strategic advantage in the Mediterranean Sea. As per Fioravanzo's theory of the Four Mediterranean Seas, if Italy floods due to climate change, Europe risks losing its strategic peninsula amidst the Latin Mediterranean Sea also called the "sea amidst the oceans" or the sea in the middle of global SLOCs.

Adaptation measures are particularly important in order to guarantee the continuous operability of the port in case of natural disasters, disruption of logistic systems and loss of competitiveness[181]. Hence, empowering adaptation measures will be a key factor for shipping companies in the future while choosing ports for their stopovers. Italian ports will have to be ready to face not only the canonical sea level rise but also the *storm surge* phenomenon: a mix of low pressure, wind and waves that might determine a further sea level rise of over 1m[182]. According to a report of the Italian Ministry of Sustainable Mobility the Italian administration recognizes the following difficulties in taking adaptation measures[183]:

> "Even though attention to the topic of CC impact on ports is rapidly growing, port adaptation policies are still at an early stage. Difficulties in such approach embrace three areas:

[181] V.V.A.A. "Cambiamenti climatici, infrastrutture e mobilità", Report of the Commission on Climate Change, Infrastructures and Sustainable Mobility, 2021, pgg.194-199

[182] Ibidem.

[183] Ibidem.

a) *Adaptation is highly context-specific*: this means that a general model doesn't exist and that the few literature on the sector is based on case studies and experiences which are very different from one another.
b) Inconsistency between time span necessary for investments and time span necessary for climate events. This doesn't foster investments in adaptation measures because benefits coming from the investments will be appreciated a lot of time after concessions' expiry.
c) Answers to CC require innovation processes in the planning field being able to overcome the fragmentation of processes that is actually characteristic of territorial governance of coastal areas[184]".

Overcoming these obstacles is a major concern of the NRRP that dedicates € 1.47 bn to an action aimed at making ports more resilient against climate change inside the mission concerning infrastructures for sustainable mobility, more specifically while tackling the issue of intermodal and integrated logistics)[185]. In particular, actions of the NRRP are aimed at enhancing maritime accessibility by powering breakewaters, platforms and docks, and adapting infrastructures to the increasing dimension of ships. A key role will be played by digitalization: IoT technologies, sensors, digital twin projects will allow to improve forecasting and handling of port operability thanks to the possibility of forecasting and representing natural phenomena with greater precision[186]. By the way, another challenge in planning adaptation policies consists in avoiding over-engineering and finding new innovative solutions capable of mingling regulations and technology with nature-based green solutions such as realization of barriers with new eco-friendly materials and re-naturalization of coastal areas that better reflect the different landscapes of Italian port realities.

While planning adaptation policies several points must be taken into account[187]:

- Stakeholder involvement
- Coordination with decision-making political guidelines
- Adoption of approaches targeted for different climate risks
- Risk assessment must take into account time and space constraints
- Risk assessment plans must always be updated
- Adaptation plans might entail the construction of new expensive infrastructures
- Adaptation plans should come with the formation of think tanks capable of analysing data on a multidisciplinary approach

The same report of the Italian Ministry proposes the following adaptation measures[188]:

[184] Ibidem.
[185] Ibidem.
[186] Ibidem.
[187] Ibidem.
[188] Ibidem.

Cambiamenti climatici	Impatti sul porto	Misure di Adattamento
Aumento del livello del mare	Onde che possono danneggiare le facilities del porto	Costruzione di nuove barriere frangiflutti e/o potenziamento di quelle esistenti
	Allagamento delle infrastrutture di trasporto	Accrescere l'elevazione della posizione del porto
		Migliorare la resilienza all'allagamento delle infrastrutture esistenti
	Erosione costale nei pressi del porto	Azioni di protezione costale e programmi di accrescimento delle spiagge
	Deposizioni e sedimentazioni nei canali di accesso al porto	Incremento/espansione azioni di dragaggio
	Accessi di terra (strade/ferrovie) al terminal del porto interrotto per allagamenti	Diversificazione e miglioramento della qualità degli accessi al porto
Intensità e frequenza crescente dello storm-surge	Sospensione delle attività del porto per forti venti	Sviluppo di contingency-plan e strategie per fermo e ripresa efficienti delle attività
	Danneggiamento delle infrastrutture e delle navi ormeggiate	Costruzione di nuove barriere frangiflutti e/o potenziamento di quelle esistenti

10. Source: Cambiamenti climatici, infrastrutture e mobilità

Mitigation policies consist in, on one hand, mitigation of ports impact on the environment, on the other hand, risks mitigation related to climate change and environmental security. For this reason, risk management guidelines and security plans are being elaborated, many of which fall under the critical infrastructure protection program.

For what concerns mitigation on water impact, the main international regulation regarding discharges from vessels and their proximity to land is Annex IV of the MARPOL Convention 1973/8. The Convention regulates limits on discharge through three different mandates: protecting aquatic habitats, spices and drinking water zones. Then, the International Convention on the Control of Harmful Anti-Fouling Systems on Ships of 2008 creates a mechanism that ensures that determined compounds are not used in anti-fouling treatments. Lastly, in 2000 a regulation within MARPOL was adopted to regulate reception facilities of ports. The aim of this regulation was to reduce illegal port discharges by promoting a better availability of waste reception services[189]. With the directives on ship discharge starting to become more stringent both at EU and international level, strong reception facilities can be considered assets for the attractiveness of a port. In order to handle wastewater from ships, some ports collaborated with local authorities.

Concerning solid waste disposal, its management in ports:

> "Involves the collection, transport, processing or disposal, planning and monitoring of unneeded bi-material products generated through port activity. The reception and management of solid waste in ports is often best undertaken through coordination with the municipal authorities or local subcontractors. In some ports, this leads to innovative collaborations that make use of the particular specialisation of the port."

Mitigation measures taken in this field up to now regard the single ports.

[189] Ibidem.

For what concerns mitigation of ports impact on air emissions, initiatives are embedded in international regulations. The main ones are: 1987 Montréal Protocol, the 1997 Kyoto Protocol and the sixth Annex of the MARPOL Convention of the IMO on "Regulations for the Prevention of Air Pollution from Ships" (main source of air pollution in Italian ports), which was first adopted in 1997 and entered into force in 2005. This convention plays a pivotal role in regulating the emissions of the shipping sector globally. Thanks to this Convention in 2005 emission caps entered into force. Annex VI of the MARPOL convention, amended in 2011, introduces two indexes to regulate and monitor the energy efficiency of ships: the Energy Efficiency Design Index and the Ship Energy Efficiency Management Plan. The former is for new ships and sets stringent criteria for shipbuilding and measures Co2 emissions per capacity mile, while the second index is for existing ships and benchmarks operable ships bringing operators to review ship performance. Nevertheless, MARPOL measures are considered not to be enough in order to reduce carbon emissions[190]. Many port authorities nowadays employ incentive schemes in order to foster reduction of emissions and to punish "dirty" ships[191].
Adaptation is a topic rarely touched upon in ports' political debate, but would rather entail the physical displacement of the port to another location.
Up to now, the most effective way of ensuring mitigation measures and compliance to international regulations remains investment in clean on-port technology. Since shipping companies must comply with increasingly stringent regulations on the types of fuel they can use, ports that offer green services become more attractive. Among the most pushed clean technology initiatives those that are worth mentioning are LNG systems (in the short run) and cold ironing, also known as Shore Connection, On Shore Power Supply, and Alternative Maritime Power Supply[192]. Cold ironing consists in:

> "Providing shore power to ships that come into their quays, instead of using their diesel-fuelled auxiliary engines, these ships use power generated by the local grid, which significantly diminishes diesel- and other fuel-derived emissions while in port. Shore power not only requires an on-shore power connection, but also ships that are able to connect to this power source. For this reason, shore power is most feasible for point-to-point connections, such as ferries. Increasingly though, issues of compatibility are being resolved, and other ship types are connected to shore power in ports.[193]"

In addition to providing clean fuel and energy services for the shipping sector, ports are increasingly investing in cleaner, low-emission technology to drive their own operations[194].
In order to shift away from diesel engines, many ports have upgraded their cargo-handling technologies and their spaces with renewable energies. This implies the implementation of clean energy power plants in port clusters (or offshore) or the purchase of power from companies that deal with renewable energy production. For instance, the port of Houston signed a deal in 2006 with Direct Energy. The deal foresees a

[190] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010.
[191] Ibidem.
[192] Ibidem.
[193] Ibidem pg. 120.
[194] Ibidem.

purchase of a share of electricity generated abroad through wind power amounting to the 5% of the port's energy. Still, ports' consumption of renewable energy remains marginal as many of them are still too expensive or unreliable[195]. In Australia, for example, the company Oceanlinx build a huge wave-energy system in Port Kembla that was supposed to create energy for around 500 houses but broke free of its moorings during a storm in 2010 and has been rusting in a channel for a long time, hence it is largely considered a failure. This is only a tiny example that demonstrates how renewable energies still need to undergo a lot of experimentation and are subject to unpredictable events. Investments in renewable energies today require strong commitments from governments, industries and policy makers both from an ethical, risk and financial point of view[196].

Decarbonization of ports through renewable energies. Clean energies are an answer to eco-threats and state energetic independence

As an answer to increasingly stringent requests of decarbonization from institutions, many ports and logistic operators turned to renewable energies for their long-term strategies. Many ports have a vision of a 20-50-year timeframe and try to encourage policy alignment with industries and governments.

Clean energy solutions that have been encouraged by institutions regard Liquefied Natural Gas (LNG), Cold Ironing systems, Photovoltaic panels, Offshore Wind Energy, Wave energy and Hydrogen.

LNG and biofuels have been proposed as sustainable options for the short-term while the only real clean fuels for the maritime sector are hydrogen or hydrogen-based e-fuels such as e-ammonia and e-methanol[197]. E-fuels are so called because they are all produced through decarbonized electricity coming from renewable energies such as solar panels, wave or wind energy.

Solar power panels in ports are commonly built on platform roofs of building roofs in order to light-on port facilities, buildings and structures in compliance with energy efficiency policies.

Natural Gas in order to be exploited has to be extracted, refined and transported through gas or methane pipelines to the end users' buildings. Pipelines are used when the gas deposit is at a reasonable distance, otherwise transport by sea is desirable, even though riskier. In order to be transported by vessels, natural gas has to be liquefied (becoming LNG) and stored in special LNG carriers (which are often regasification units itself and are thus called Floating Storage Regasification Units) in order to reduce their volume by 60% and lose their flammability[198]. When LNG carriers reach the port needed, gas requires structures for its transformation back into gaseous state and also structures for its stockpiling and distribution to citizens'

[195] Ibidem p.126.
[196] Ibidem.
[197] Transport & Environment, "EU Ports' Climate Performance An analysis of maritime supply chain and at berth emissions", February 2022, https://www.transportenvironment.org/wp-content/uploads/2022/02/2202_Port_Rankings_briefing-1.pdf .
[198] JAES Company Italia, "Come si trasporta e come funziona un Rigassificatore di gas naturale? Liquefazione – Vaporizzatori", Video Youtube, 04/28/2023, https://www.youtube.com/watch?v=dN6tgvqkN2Y .

houses. Gas storage and transformation units might be offshore (gravity-based) as well as onshore in the nearness of the port[199]. In this particular period of time, LNG is often talked about as a solution for the independence from Russian pipeline gas. In this regard, vessel-transported LNG from other countries surely offers an alternative solution and a key for state energetic independence, but since the real energetic independence will come only when each state will be able to produce its own energy sources, LNG is still seen as transitional energy, valid for the short-term. Nevertheless, Italy (as well as the other states) will have to hurry in equipping their selves with the adequate structure for LNG transformation and distribution. Hence, states will have to buy FSRUs (as Italy did with Snam's Golar Thundra and BW Singapore) and equip ports' hinterlands with gas transformation and chemical treatment plants. It must be specified, that natural gas is not a renewable energy itself, since it comes from fossil fuels and must be extracted through drills, causing huge environmental impact. But, in the latest years, a biologic version of natural gas has taken the upper hand: bio-LNG is produced through the decomposition of organic waste, or through the extraction of methane from compost produced within the farming industry[200]. This is why sometimes LNG is also found among renewable energies. From this point of view, ports of the Northern Range are a perfect example of good practice in the use and distribution of LNG. Up to now Rotterdam is one of the largest importers of LNG provided with an advanced set of liquid bulk refineries used for bio fuels[201]. The port has also invested in the building of carbon capture and storage infrastructure and in the development of a synthesis gas cluster. Apparently, the trend is growing and many other Dutch port-cities have based their own growth strategies on such projects. The port of Groeningen constitutes a striking example, since it has developed the Bioport Eems Delta with the aim of becoming the main importer and transhipper of biomass. For this purpose, it has also developed partnerships with local authorities and industries[202]. The city of Zeeland, in turn, has established a set of policies with the aim of bolstering synergies between the ports and bio-mass activities.

Cold ironing, shore-side electricity or on-shore power supply is a technology that allows ships to "shut down its diesel auxiliary generators while the ship is at berth. The ship, in order to recharge, must plug-in to an on-shore power source that gives continuous electricity power to emergency equipment, refrigeration, cooling, heating, lighting and other equipment[203]." Through the lens of decarbonization, cold ironing is an indispensable process. Ships at berth in ports need to keep their diesel engines running for all the period of their stay (which is often very long) in order to support minor functions such as accommodation facilities and vessel's operations. This produces noise, vibration, particle and air emissions that thanks to cold

[199] Ibidem.
[200] JAES Company Italia, Come si estrae il gas naturale? - Torre Derrick – Metano", Video Youtube, 04/28/2023, https://www.youtube.com/watch?v=xXfc4coeLGI .
[201] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010.
[202] Ibidem.
[203] Circle Group, "European Flagship Action For Cold Ironing in ports - EALING Project", Video Youtube, 04/28/2023, https://www.youtube.com/watch?v=aRgtrB5TySg&t=59s .

ironing would be finally saved[204]. For instance, a mooring cruise in 10 hours produces an amount of Co2 emissions equivalent to 25 cars of average capacity in a year[205]. The other side of the coin is that electrification of ports' infrastructure will require a lot of time and investments. The main challenge of cold ironing consists in the fact that it needs a complex system of electric plants that needs to be connected to the port on one side, and to the docks on the other, in a way that it can allow the recharge of ships in total security. This system will need to be adjusted to the urban network of the adjacent town and to the rest of the nation as well, this implies creating an underground electric station, a frequency converter and a voltage transformer in order to adapt to different types of ships. Nevertheless, fuelling standards will have to be consistent all around the world in order to consent global shipping[206]. Given all of these challenges, it is unlikely that global cold ironing will take shape soon.

On the contrary, in the recent years, overall in European waters, there has been a rapid boom of offshore wind energy and marine energy[207]. Feasibility studies show that these two sources present strong potential to generate economic benefits in a sustainable way[208]. In fact, offshore wind energy represents the essential strategic element for the EU to achieve its goals in the renewable energies' agenda and a key growth sector. This sector is expected to bring employment and high value added to ports. For instance, in 2013, the London Array Project took off. It is supposed to generate enough energy to power half a million homes in England. This project is considered the largest offshore wind farm in the world with its 175 turbines[209]. The European Wind Energy Association (EWEA) has been created on the purpose of putting together manufacturers, suppliers, wind farm developers, financial institutions, research institutes and other stakeholders of one of the most tangled supply chains existing. In order to support such a complicated supply chain several factors are needed: a competitive institutional framework capable of supporting the developing of offshore wind energy market, investments in infrastructure and technology encouraging stakeholders' management, stable policy drivers and technological resources. Ports also acquire different functions on the OWE supply chain when they decide to engage in this type of business. In describing the complex OWE supply chain, Merk writes:

> "Depending on the associated activities and functions, there are mainly two types of ports, namely base ports, also called as major components ports which cover the manufacturing and construction activities, and service ports, which include the operation and maintenance aspects. To be more specific, four main functions can be distinguished for ports to engage in OWE. They are fabrication and installation; operations, maintenance and service; research and development; and lastly, import and export of onshore and offshore wind energy plants and components. Besides the traditional logistics tasks as storage, stowage and transhipment for the components, there are also multifaceted opportunities for ports to benefit from engaging in the business, such as related industry clustering, further development of infrastructure and research facilities. On

[204] Ibidem.
[205] M.C. Cavuoto, "Cold Ironing: cos'è e perché permette di ridurre le emissioni delle navi", Close Up Engineering Magazine, 10/07/2022, https://energycue.it/cold-ironing-perche-ridurre-emissioni-navi/35105/ .
[206] Ibidem.
[207] O. Merk, *The Competitiveness of Global Port-Cities: Synthesis Report,* OECD, 2010.
[208] Ibidem.
[209] Ibidem.

> the other hand, market players in the industry, including OWF developers, component manufacturers and designers, ship-owners, operators and energy providers, are also evaluating ports in terms of their handling capabilities and capacities when making choices on location. Therefore, it is critical for ports to be aware of the requirements for the OWE industry and then strategically position themselves to meet the industry needs.
>
> Whether for a base or a service port, there are some shared preconditions that are extreme important for the ports to be able to meet. For example, the high quality of location factors, meaning the availability for expansion and qualified labour force, and excellent connectivity of the port to its hinterland for logistics transport. Because the fabrication of OWE turbines is often decentralised, meaning that the components are produced in different sites – in many cases in the hinterland, and then transported to the storages areas near the ports. Therefore, not only having sufficient storage space to carry out the pre-assembly or pre-store activities is important, an efficient hinterland connection for transporting the heavy-lift cargo is also imperative, especially for ports that serve as the consolidation ports in this supply chain, such as the Port of Belfast in Northern Ireland (ibid.)[210]."

Ports are also investigating the possibility of widening their energy portfolio. Hence, many ports take into consideration marine wave energy and tidal energy too. Wave energy is created by the movement of a device which can be either berthed to the ocean bed or floating on the surface of the sea, while tidal energy is the generation of power through the exploitation of the amplitude caused by the gravitational forces of the moon[211]. At the moment this kind of industry is at a very early stage and not much developed on the market since tidal turbines and wave devices have very high costs. Worldwide there are still few operations ongoing that concern marine engineering, nevertheless, technological improvement proceeds at very high pace, so production costs are expected to be driven down soon. Marine engineering technologies in order to be effective must be positioned where there are strong currents. By the way, financial investments are worth the price and the risk, since tidal resources produce highly predictable energy. When engaging in these activities, ports also need to be aware of the design and facilities that are required for these power arrays since they often need the deployment of specialized vessels, components and equipment. This technology will need electric grid connections as well. Last but not least, ports need to be aware of the fact that ocean energy development has an impact on marine life and environment that, for a chain reaction, might affect shipping and fishery[212].

Finally, the most reliable of all the renewable energies, is hydrogen. 1kg of hydrogen contains 3 times the energy of 1kg of oil. This characteristic and the fact that water is abundant on Earth, renders hydrogen the most suitable energy for the energetic transition[213].

Unfortunately, sheer hydrogen is not easy to find in nature, it is always bounded to other molecules such as oxygen to make water or carbon dioxide to make oil. The only way to obtain sheer hydrogen in order to use it for logistic purposes is to separate it from other molecules, but this process consumes a lot of energy and is thus very costly. The most common process through which sheer hydrogen is obtained is called

[210] Ibidem.
[211] Ibidem.
[212] Ibidem.
[213] Geopop, "Idrogeno: cos'è e perché è il combustibile ideale per la transizione energetica del futuro", Video Youtube, 04/29/2023, https://www.youtube.com/watch?v=nW5wNe7XWjU .

electrolysis, i.e., the separation of hydrogen and oxygen molecules from water. Machinery for electrolysis is very costly and still hardly applicable in the logistic sector at national or international level at the moment.
In order to facilitate this process, political movements would have to create the adequate environment for the attraction of private investments, making market competitive and allowing prices to go down[214]. In this way hydrogen product would become cheap, convenient, and widespread. Up to now hydrogen is only produced in small special economic zones and parks for innovation and development where governmental investments are made, called hydrogen valleys. Hydrogen valleys often involve ports.
There are three types of hydrogen: if energy consumed for electrolysis comes from green sources, then the result will be green hydrogen. If electricity used to produce hydrogen comes from fossil fuels, we will have grey hydrogen. Finally, hydrogen will be called "blue" if energy used to produce it comes from fossil fuels but Co2 emissions are captured and stocked[215]. Today, grey hydrogen deriving from methane is the most produced even though it is not the best solution. Blue hydrogen represents a good transitional energy while waiting for green hydrogen to be popular, but it needs a lot of space to stock Co2 captures. Unfortunately, green hydrogen is still very expensive and we will have to wait a lot for its development.
While production of hydrogen is still complicated, its transportation might easily be done through regular gas pipelines. Stocking it will be more difficult because it requires underground salt-rock caves that must be emptied in order to host big quantities of hydrogen.
To sum up, it seems like green energies will still require a lot of time to be implemented in the logistic field at national and international level. Nevertheless, governments and enterprises are making big efforts to invest in the green transition and in transitional energies.
It must be remembered that, a good mix of renewable energies is a key factor for each state energetic independence, and state energetic self-reliance assures a reduction of conflict among countries. Hopefully, states will do whatever it takes to reach this outcome as soon as possible, but in the meantime, we will still have to trade energetic resources and rely on transitional energies. In any case, regardless of the type of energy that flows into the port, what matters for the purpose of this work is that the concentration of energy infrastructures in the port area makes the port generator of value for the state on one hand, and vulnerable to new generation threats on the other.

[214] Ibidem.
[215] Ibidem.

CHAPTER II: BOLSTERING EUROPE'S SOUTHERN GATEWAY: ADDRESSING NEW GENERATION THREATS

As touched upon previously, ports are critical infrastructures for a country because they are home to activities which are vital for a country's survival and for the unfolding of citizens' everyday life. Ports are home to key commercial, industrial and energetic activities as well as seat for telecommunication lines. They are also hubs for research and development where collaboration between public and private sector produces innovation in all areas. Last but not least, they are bases necessary to the navy forces for the development of capabilities and the deployment of personnel aiming at protecting states' interests offshore. Being ports so strategic, they are vulnerable and subject to different kinds of threats (both traditional and hybrid), especially in times of breaches of peace and global distress such as the ones we're facing nowadays.

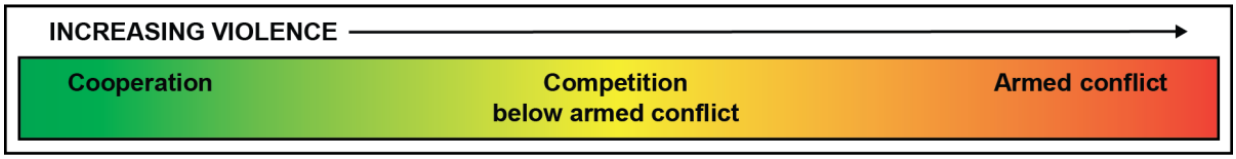
If Italian ports yearn to become proper European Southern gateways and hubs, they thus must be rendered more resilient to new generation threats, since having ports protected means to have communities' interest sheltered. Even though the latest events in Ukraine demonstrate that, unfortunately, conventional wars haven't disappeared from the face of Earth and can take place even close to our western societies, the efforts of the post-war international community to build a world of peace and security have largely had effect by shifting the pattern of war from conventional to unconventional. Since states understood that resorting to war is too costly from a human and economic point of view, they decided to avoid it as much as possible and, after the Cold War a new system of perpetual competition that stands before the violence threshold entered into force. The state of perpetual competition entails traditional economic competition, diplomacy, geopolitics, political warfare and other new forms of competition called hybrid wars and grey zones. These terms, and the reasons why they are particularly important for the maritime domain, will be better clarified in the next chapter.

A NEW PARADIGM IN INTERNATIONAL RELATIONS: THE CONCEPT OF "COMPETITION CONTINUUM". HOW STATES AVOID RESORTING TO CONVENTIONAL WAR: THE DIFFERENCE BETWEEN THE CONCEPTS OF COMPETITION, HYBRID WAR AND GREY ZONE.

The concept of *competition continuum* stems from the military and strategic environment of the United States of America with the aim of theorizing the relationship among cooperation, armed conflict and everything that stands in between the two concepts. According to the Department of the Army of the US:

> "The competition continuum describes an environment of enduring competition characterized by a mixture of cooperation, competition below armed conflict, and armed conflict. The competition continuum creates a distinction between war and other forms of armed conflict because of the scope and scale of land forces involved. While the U.S. Army has not been in an officially declared war since World War II, Army forces fought in several conflicts that rose to the

level of war because of the resources involved. In that same period, Army forces also fought in several armed conflicts below the threshold of war[216]."



11.Source: U.S. Army, *FM 3-94. Armies, Corps, And Division Operations*, July 2021, p. 1-8

Cooperation may involve allies as well as rivals. Competition below armed conflict aims at improving one's strategic condition but must be lived cautiously, paying attention not to fall into forms of escalation that might be counterproductive. Lastly, the condition of conflict entails the use of force in order to maintain or regain a strategic advantage[217].

What has been witnessed in the post-war years is that there are several powers of small and average capacity that are critical to the actual world order (and are thus called *status-seekers),* because of whom cooperation is often undermined and that create an environment of perpetual competition. These powers are usually North Korea, China, Iran and Russia but perpetual competition is also fostered by non-state actors that might take advantage from a shift in the world order and push to opt-out from certain forms of cooperation. Given the behaviour of these actors, that use all the resources they're equipped with (diplomatic, economic, political, industrial, energetic) to empower their strategic level, competition below the violence threshold turns out to become the perpetual state-of-the-art of relations among states[218].

Classical criterions of war and peace must thus be substituted by a new circular paradigm consisting of three phases: competition, conflict and return to competition. Competition might grow exponentially until it reaches the threshold of violence. This threshold marks the step into conflict. Deterrence and negotiations are the means used to avoid armed conflict. Sometimes states pass through a phase of conflict before revising their intentions and going back to a competition below the level of violence and sometimes negotiations block the escalation of conflict. The circle envisaged by the state of competition continuum defines the new pattern of relations among states in the international arena after the Cold War and the crisis of American hegemony[219].

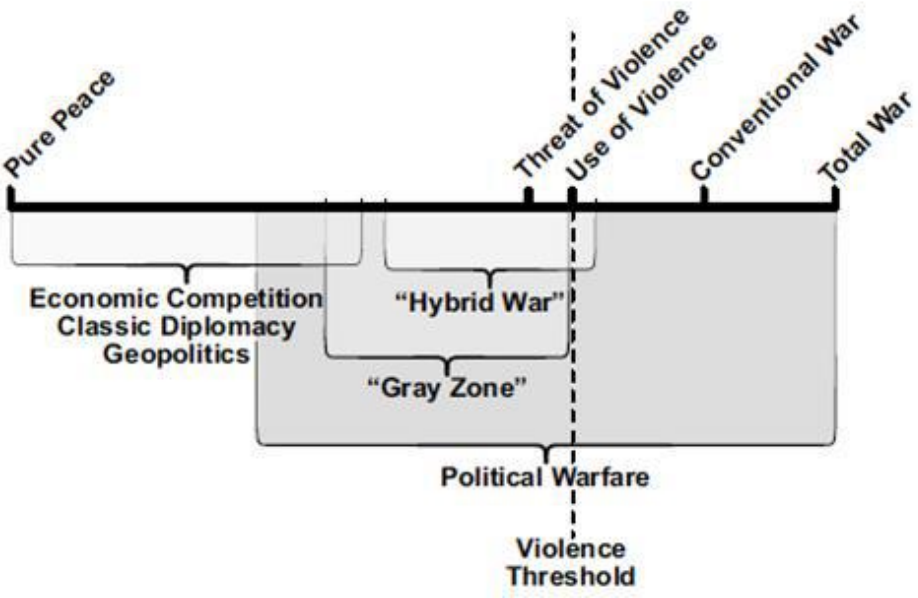
In this framework, Alessandro Colombo describes the paradigm of the global order we're living today as ruled by emergency and uncertainty. American liberal world order has been sensibly undermined already a long time ago from several shocks:

"emergencies concerning the war on Ukraine are only the last in line of a long series of uninterrupted emergencies declared and started many years ago: terrorism emergency named after the terrorist attacks of September 11th, 2001 in the US, and its

[216] U.S. Army, *FM 3-94. Armies, Corps, And Division Operations*, July 2021.
[217] F. Zampieri*, La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.
[218] K. McCoy, "In The Beginning, There Was Competition: The Old Idea Behind The New American Way Of War", Modern War Institute, 04/11/18, https://mwi.usma.edu/beginning-competition-old-idea-behind-new-american-way-war/ .
[219] Ibidem.

repetition in Europe of Madrid 2004 and London 2005, the economic and financial emergency declared after 2007-2008, the European sovereign debt crisis between 2012 and 2015, the new emergency on terrorism after the wave of Daesh attacks between 2015 and 2019 and only few months later, the health crisis concerning the Covid-19 pandemic at the beginning of 2020.[220]"

Since the contemporary international arena is characterized by all of these emergencies, it is more difficult today to understand what is war and what it is not: attacks take place in multiple dominions, time and space constraints are more blurred and declarations of war do not exist anymore. This is why several new terms have appeared in the international scenario in order to describe new phenomena that stand below the formal use of violence but that still, overpass the means of traditional economic competition[221]. In other words, war today has become more *informal*. In order to clarify the new border between competition and war, the US marines trace the following graph:



12.Source: MCDP 1, *Competing*

As touched upon before, pure peace and total wars today are close to inexistent. Conventional wars are hardly found, even though recent events in Ukraine demonstrate that this phenomenon still hasn't been eradicated. What marks the difference between the regimes of competition and war is the dashed line that the marines call "violence threshold". This line determines the use of violence, everything that stands before it consists in competition, everything that comes after it, is war. While economic competition, diplomacy and geopolitics stand well away from the violence threshold, political warfare overpasses the line. The new generation elements introduced in this graph consist in hybrid wars and grey zones. While

[220] A. Colombo, *Il governo mondiale dell'emergenza. Dall'apoteosi della sicurezza all'epidemia dell'insicurezza*, Milano 2022, Raffaello Cortina Editore, p. X .
[221] U.S. Marine Corps, *Competing MCDP 1-4*, 2020, pp. 1-11.

hybrid wars may in some cases transcend the violence threshold, grey zone ends when violence is triggered.

Hybrid wars and attacks in the grey zone are the most popular types of aggression nowadays. They mark the stages before the use of violence (i.e. the stages of competition before conventional war) and are characteristic of modern competition. Most of all, they are of concern of this thesis because they are more likely to take place in the western world overall in ports and other critical infrastructures.

The debate on hybrid wars, grey zones and their collocation in the competition continuum is very topical today and far from being exhausted. These terms today are still blurred and their definition elusive. Therefore, it is difficult to understand how to associate a certain strategy, attack or tactic to hybrid wars, grey zones or other forms of non-violent competition. It also must be noted that *plausible deniability* (or, as it will be explained afterwards, the difficulty in attributing a certain attack to a definite perpetrator) is the first characteristic of grey zone attacks, and this makes it more difficult to trace borders in anything that happens before the violence threshold.

Even though a univocal definition of grey zone doesn't exist, many scholars try to give one. In particular, Hicks and Friend describe actions taking place in the grey zone as:

> "an effort or a series of efforts aimed at advancing one's security objectives at the expenses of a rival, using other means either than the ones associated to governmental routine activities and below the means associated to direct military conflict among rivals. Dedicating itself to a grey zone approach, an actor tries to avoid crossing the line of open conflict[222]".

Therefore, the grey zone includes the main forms of competition and the majority of the actions that do not involve major wars or full-scale combat. Among the activities that belong to the grey zone there are the following: propaganda and disinformation activities, armed forces deployment and military exercises in the nearness of disputed areas, support to state and non-state actors, use of economic sanctions, trade wars, military training and the transfer of equipment to the benefit of allies or proxies, proxy wars, militarization of disputed areas, technological competition, and cyberattacks[223].

While describing the difference between grey zone and hybrid wars Zampieri precises:

> "Often, the grey zone has been identified as hybrid war, or even worse, the concepts have been used as synonyms. It is important to make a distinction between the two concepts, or better, to understand that a good part of the operations used in hybrid warfare make part of the greater ensemble of the operations typical of the grey zone. The difference between the two is that, while the grey zone stops at the violence threshold, hybrid warfare, in its ultimate and most extreme form, overpasses it. So, the dynamic of the operations inside the grey zone is partially different from hybrid warfare: in the grey zone military forces exercise a role of deterrence and military actions are always below the

[222] K. Hicks-A. Hunt Friend (edited by), *By Other Means. Part I: Campaigning in the Gray Zone*, Center for Strategic and International Studies (CSIS), July 2019, Rowman & Littlefield, p. 4.
[223] D. Stoker and C. Whiteside, (2020) «Blurred Lines: Gray-Zone Conflict and Hybrid War—Two Failures of American Strategic Thinking» Naval War College Review: Vol. 73 : No. 1 , Article 4, https://digital-commons.usnwc.edu/nwc-review/vol73/iss1/4 .

> violence threshold, while in hybrid warfare the violence threshold might be overcome entering the war domain, where violence is used in order to reach one's political objectives[224]."

Hybrid wars, in their turn, are better defined by the doctrines of Frank Hoffman, one of the most accredited scholars in the field, and the Russian general Valeriy Gerasimov. Hoffman describes hybrid wars as the convergence of regular and irregular means of war. He gives two definitions. First, hybrid war is a form of war where "an adversary employs simultaneously and in a changeable way, according to the situation, a mix of conventional weapons, irregular tactics, terrorism and criminal actions inside the battlespace, with the aim of achieving his own political objectives[225]". Secondly, Hoffman completed his first definition by saying that:

> "A hybrid war is a form of war based on the employment of conventional capabilities and regular forces, irregular tactics and formations and terrorism capable of developing forms of indiscriminate violence and coercion and forms of criminal disorders. These activities may be conducted by one unit only or by several distinct units with tight strategic, operational and tactic coordination inside the battlespace in a way that they can sort out synergic effects in both the physical and psychological dimension of the conflict[226]".

In order to better understand the features of hybrid wars it is important to add to this definition the contribution given by general Gerasimov while describing non-linear wars. Gerasimov underlines how in the 21st century the distinction between peace and war has become less marked since:

> "Wars are not declared anymore, and once they start, they proceed following an unknown scheme. […] the role of non-military means in order to reach one's political and strategic objectives has grown and, in many cases, it has overcome the role of weapons in terms of power and efficiency. […] frontal operational and strategic confrontation among powers is gradually becoming a memory of the past, while asymmetric actions are increasingly employed […]. Among these actions those that are more commonly used are political, economic and informative measures with other non-military actions in coordination with other actions aimed at destabilizing the population. All of these actions are integrated by military means acting occultly supported by informative measures and special operations[227]."

To sum up, in hybrid warfare, new social spaces (cyber, economic, political and cultural) increasingly gained importance in spite of the traditional battlespace (sea, air, land, outer space). Military power has lost its importance and efficiency giving ground to other less disruptive means used to achieve prefixed strategic purposes (political, economic, informative and humanitarian)[228].

The Arab Spring and to some extent, the war in Ukraine of 2022, represent examples of hybrid wars. During the Arab Spring, the massive use of cell phones, social networks and GPS localization have played a

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[224] F. Zampieri, *La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.
[225] F.G. Hoffman, "Hybrid vs. compound war. The Janus choice: Defining today's multifaceted conflict," *Armed Forces Journal*, October 1, 2009, http://armedforcesjournal.com/hybrid-vs-compound-war/.
[226] Ibidem.
[227] Valery Gerasimov, «The Value of Science Is in the Foresight: New Challenges Demand Rethinking the Forms and Methods of Carrying out Combat Operations», *Voyenno-Promyshlennyy Kurier* (Military-industrial courier), 26 February 2013, riportato in J. Derleth, « Russian New Generation Warfare. Deterring and Winning at the Tactical Level», *Military Review*, September-October 2020, Army University Press.
[228] F. Zampieri, *La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.

key role in the revolution. Access to technology in this case turned out to be a weapon and gave strategic advantage to those who could exploit it. Thanks to the economic support of sponsor-states, belligerent groups have access to sophisticated information technologies. This becomes more evident during the conflict in Ukraine, where Russian separatists in Donbass use cyberattacks to undermine enemies' infrastructures.

War in Ukraine is considered to be many types of war at the same time. It certainly is a multidomain war, since attacks take place in several spheres (cyber, cognitive, drones, and conventional domains, since there is the use of arms and critical infrastructures are triggered), but if the characteristic of hybrid wars is to be different types of war at the time, Ukraine definitely falls into the scope. For instance, in Ukraine, irregular and private subjects fight (on both belligerent sides) alongside with regular forces. Drones and cyberattacks are used massively. Energy is continuously weaponized (supplies are interrupted). But the real turning point in this hybrid war stands in the operations conducted in the human/cognitive domain[229]. Having a strategic advantage in this domain is very important in order to cause a paralysis in the decision-making process, this is why cognitive domain is one of the most important spheres of the grey zone. This domain involves the acquisition, interpretation and comprehension of information, making the human brain the new battlefield. This battlefield is becoming increasingly important with the introduction of new means of communication and people being exposed to a greater plurality of information types. According to Zampieri, war on Ukraine demonstrated that: "who manages to handle information at his own advantage or to dominate the information warfare has an enormous advantage: he will be capable of creating and spreading favourable narratives by conditioning national and international public opinion[230]." Revisionist powers are very likely to use attacks in the cognitive domain, since they acknowledged that democratic western forces are easily vulnerable from this point of view. Disinformation activities in fact, take root better where there is freedom of press and speech rather than places where control on information and censorship make it difficult for information to circulate. This is why Russia and China have developed good manipulation and control on information skills that are easily applicable in hybrid wars[231].

Finally, how is grey zone different from simple competition? Actions taken in the grey zone are very complex, since they require risk management skills and the ability to coordinate different resources. Normally, those who resort to attacks in the grey zone do it with the purpose of rendering the decision-

[229] V. Coralluzzo, «Verso un ritorno delle guerre tradizionali tra grandi potenze?», in A. Colombo-P. Magri (a cura di), Ritorno al futuro. Rapporto ISPI 2023, Milano 2023, Ledizioni LediPublishing.
[230] F. Zampieri, *La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.
[231] Ibidem.

making process more difficult for the adversary[232]. Recent studies have gathered all of the instruments used in the grey zone in seven macro areas[233]:

Macro area	**Instrument**	**Description**
Informative	Information and disinformation operations	Employment of social media and other means of communication together with the traditional ones, with the aim of spreading a state's narrative through propaganda, raising doubts, disinformation and dissent in foreign countries.
Political	Political coercion	Use of coercive measures in order to influence the political situation and the decision-making process inside the target-state.
Economic	Economic coercion	Use of coercive measures in the economic sphere. For instance, illicit financing or energetic blackmail for political purposes or with the aim of causing economic damage to the adversary.
Other	Cybernetic operations	Employment of cybernetic means (*hacking*, viruses, other means to conduct cyber operations) with the aim of provoking physical disruptions, economic or political damage or acts of sabotage.
	Operations in outer space	Disturbing activities or degradation of space capacities of the adversary, acting on hiss pace access systems, or exploitation of it.
Military	Support to proxy	Direct or indirect employment of statal and parastatal groups in order to conduct military

[232] Ibidem.

[233] K. Hicks-A. Hunt Friend (edited by), *By Other Means. Part I,* ecc., cit., p. 7.

		intimidation, assuming control of a territory or part of it in order to achieve specific security and political purposes.
	Provocation by forces controlled by the State	Employment of civil or paramilitary forces with direct links to national military power in terms of both communication and finance, in order to affirm state rights without the formal employment of regular armed forces.

13.Source: re-elaboration of K. Hicks-A. Hunt Friend (edited by), By Other Means. Part I, ecc., cit., p. 7.

These instruments, techniques and actions might be used in several combinations with different levels of intensity, according to the seriousness of the situation. The success of a grey-zone attack depends on the ability of the strategists to combine these elements in an efficient way. The way of combining all of these elements determines the style of each actor. Even when they appear casual or unclear, nothing is ever as it seems in grey zone strategy: the complex design at the base of these attacks is the main characteristic of the grey zone and it is always related to a particular objective, and this is also why these attacks are so difficultly attributable to a particular actor.

By the way, grey zone and hybrid attacks have utmost importance in the maritime domain. Here, operations pertaining to the grey zone take place in narrow seas, choke points and archipelagic areas[234].

These are the areas where states struggle to project their sea power, reason why they are more vulnerable to grey zone attacks. The Baltic Sea, where 15% of global shipping takes place including oil and gas shipped from Russia to Europe, and the Black Sea, home to very important underwater pipelines, are suitable candidates for grey zone attacks[235]. At the same time, the Strait of Hormuz that witnesses the transition of 25% of global oil thus representing a vital choke point, is another perfect milieu for grey zone attacks coming from revisionist powers. Being the Mediterranean Sea a semi-closed sea (entering in the macro category of the narrow seas) and the Suez Canal another very important choke point, one might consequently suppose that they are as suitable for grey zone attacks as the Black Sea and Hormuz are. This is why it is necessary to make Italian ports resilient and ready to face hybrid and grey zone attacks. Having ports ready for these attacks means better protecting states' strategic assets located offshore such as telecommunication lines, commercial vessels, pipelines and energetic sites (as well as renewable energy plants offshore, oil vessels, LNG vessels etc).

[234] NATO, Allied Joint Publications (AJP) 3.1, Allied Joint Maritime Operations, April 2004.

[235] C. Callaghan – R. Schroeder – W. Porter, «Mapping Gray Maritime Networks for Hybrid Warfare», *Center for International Maritime Security*, July 1, 2020.

It must be remembered that navigation systems, surveillance systems and on-board equipment are all dependent from information technologies that might be hacked. Hacked ships moor into ports and this is why ports must be ready for cyberattacks both against their structures and incoming vessels. A cyberattack might disrupt computerized systems for traffic management in ports, giving access to vessels carrying unidentified personnel or weapons, but it also might cause environmental damage[236]. Just to name a few examples, in 2017 a virus hit several terminals of the Maersk company disrupting services of the industry all around the world[237]. The year before around one hundred South Korean fishing boats suffered sabotage of their GPS signal from North Korea which denied its responsibility[238].

A very important concept that must be underlined when talking about grey zone attacks is the one of the *plausible deniability of responsibility*[239]. As seen in the table above, grey zone measures are extremely complex because they require the combination of multiple elements in different domains and their coordination and management is thus very sophisticated. Since they are so complex in nature, grey zone attacks are very difficult to intercept and localizing the head and the mind of the attack might be close to impossible. Paternity of these types of attacks often remain of very difficult attribution. Actually, since paternity of these attacks can be very easily denied or contradicted, mischiefs often are left without the identification of a concrete perpetrator for years or forever. This is what makes grey zone attacks particularly insidious.

A blatant example of the principle of plausible deniability concerns the case of the attack to the pipeline North Stream 1 and 2 that took place in 2022[240]. Energetic pipelines and underwater infrastructures for digital communications or for energy exchange are the perfect trigger for grey zone attacks. To sabotage these pipelines, 100 tons of TNT have been used that might be put into place by vessels, aircrafts, remotely operated vehicles, scuba divers or probes used for the maintenance of pipelines. In cases like this one, it is very hard to determine who is responsible for the attack and whether it is a state or non-state actor[241]. Ownership of these crimes is always easily deniable and damage to underwater infrastructures is not always made on purpose: every year more than a hundred damage is done to cables because of wrong mooring operations or fishery accidents. Nevertheless, it is also true that Russia developed exceptional

[236] F. Zampieri*, La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.
[237] J. Saul, «Global shipping feels fallout from Maersk cyber attack», Reuters, June 29, 2017, https://www.reuters.com/article/us-cyber-attack-maersk-idUSKBN19K2LE .
[238] Reuters Staff, «South Korea says fishing vessels turn back after North disrupts GPS signals», *Reuters*, April 1, 2016, https://www.reuters.com/article/northkorea-southkorea-gps-idUSL3N1741IT .
[239] C. Hawken, «Q-Boats and Chaos: Hybrid War on the High Seas», *RealClear Defense,* December 7, 2017, https://www.realcleardefense.com/articles/2017/12/07/q-boats_and_chaos_hybrid_war_on_the_high_seas_112748.html .
[240] S. Vakulenko, Shock and Awe: Who Attacked the North Stream Pipelines?, 30.09.2022, Carnegie Endowment for International Peace, https://carnegieendowment.org/politika/88062 .
[241] Ibidem.

skills in damaging such infrastructures and in 2014 it was able to divide Crimea from the rest of Ukraine cutting its cables off[242]. On the other hand, in 2007 Vietnam lost 90% of its connections due to a damage of underwater cables and in 2017 the cable connecting UK and US underwent the same damage[243]. In both cases, up to today, no instigator has been found.

Other examples of grey zone threats might be *lawfare* and military initiatives. Lawfare consists in fighting upon the interpretation of legal agreements among states[244]. For instance, claims on stretches of sea and disputes over the EEZ are examples of lawfare. China and the US have different views on the interpretation of UNCLOS regarding stretches of the South China Sea[245].

Military initiatives instead, foresee the use of military power exercises as a threat to another state. Naval exercises, maritime incidents in disputed stretches of sea, aggressive patrolling or militarization of choke points represent intimidating acts that states can take in the grey zone to put pressure on other states without reaching the violence threshold[246].

THE USE OF FOREIGN DIRECT INVESTMENTS AS A GEOPOLITICAL AND GREY ZONE ISSUE. THE THREAT OF THE BELT AND ROAD INITIATIVE. A COMPARISON BETWEEN TRIESTE, TARANTO AND THE PIRAEUS.

Theo Notteboom in his "Port Economics, Management and Policy" acknowledges that "ports are political and economic tools[247]" and that "geopolitics has a controversial role in ports economic development and strategic planning. […] The relationship between ports and their localities remains a challenge involving various facets of port–city interactions. [248]" Furthermore, Notteboom explains:

> "Ports have been linked with geopolitical considerations as they are platforms that project commercial activities and military power. Many ports are bases supporting national navies and, as such, strategic interests. […] From the second half of the twentieth century, commercial considerations prevailed in geopolitics. With port authorities adopting the landlord model, this opened the door for private terminal operators to set up a portfolio of privately operated terminals. The nature of the investments in terminal operations, such as the scale of foreign direct investments, the critical infrastructure nature of ports, and sovereign funds in the list of companies that operate port terminals, provide a geopolitical dimension in port development that did not exist before reforms. While, in the majority of cases, private terminal

[242] Kabanenko, «Russian 'Hybrid War' Tactics at Sea: Targeting Underwater Communications Cables», Jamestown Foundation, Eurasia Daily Monitor, January 23, 2018, https://jamestown.org/program/russian-hybrid-war-tactics-sea-targeting-underwater-communications-cables/ .
[243] R.R. David, «Submarine Cables: Risks and Security Threats», Energy Industry Review, March 25, 2022, https://energyindustryreview.com/analysis/submarine-cables-risks-and-security-threats/ .
[244] O.F. Kittrie, *Lawfare. Law as a weapon of war*, Oxford 2016, Oxford University Press, p. 21.
[245] P. Tacujan, «Chinese Lawfare in the South China Sea. A Threat to Global Interdependence and Regional Stability», Journal of Political Risk, Vol. 10, No. 7, July 2022.
[246] F. Zampieri, *La dimensione marittima della Grey Zone*, Roma, Società Italiana delle Organizzazioni Internazionali, 2023.
[247] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy", *Routledge*, (2022), pg. XXV.
[248] Ibidem.

> operators are aligned with the national geopolitics of the ports they are involved with, there are occasions when this alignment of foreign direct investments can be subject to contention."

Once again, ports mix together strategic and commercial interests of a state. This is why, governments have an interest in keeping the management of ports located on their territory in the hands of the state or of companies of the same nationality or that are, at least, in line with the government's objectives. In the landlord model, where Port Authorities are allowed to rent for a long term or even to sale ports' infrastructures (terminals, logistic platforms and so on) this problem seems very vivid and actual. State-owned companies of governments considered not in line with one's political values or geopolitical views might rent for a long time or even buy strategic assets such as port terminals or logistic platforms gaining access to the territory of a potential "political adversary". Notteboom notes that "Foreign direct investments are controversial since their hold on strategic port facilities may imply a loss of sovereignty and go against long-term national interests[249]". This is why FDIs in strategic infrastructures can be seen as a form of competition and sometimes also grey zone measure. In this sense, western administrations are mostly scared by:

> "The rapid increase of Chinese investments in the operation of container terminals and port management through the purchase of majority shares in corporatized port authorities in many different world regions, and the multinational character of the Belt and Road Initiative (BRI). [This has], in most cases, generated discussion, support, or opposition at governmental level, rather than remaining subject to decisions at port level. As operators associated with state interests, such as being state enterprises or part of sovereign wealth funds, move into terminal operations in foreign countries, geopolitical concerns about ports as elements of national sovereignty will continue to rise[250]".

In Europe this fear is bolstered by the case of the nearby port of the Piraeus. Following bilateral agreements, the governments of Greece and China agreed on Chinese involvement in port operations inside the port of Athens. European institutions invited Greece to organize a tender procedure in 2008 in order to secure a fair competition among countries for the ensuring of the task, but no matter the attempt, the Chinese state-owned company COSCO finally gained a 35+5-year container terminal concession paving its way to Southern Europe[251]. Chinese government thus opened itself a window in a country on the edge of bankruptcy, where ground was fertile to reach the control of the port. Chinese leaders conducted regular visits in Athens, advocating the idea that leaving to COSCO the control of the port was "part of the Chinese effort to help Greece overcome its debt crisis[252]". In 2016 an international tender for the Port Authority of the Piraeus and all of the concerning operations was indicted; even though six parties participated it was COSCO to place the final bid, winning the majority share ownership of the port and hence, its actual control. The public port authority has been substituted by a new Chinese

[249] Ibidem, pg.478.
[250] Ibidem, pg. 479.
[251] Ibidem, pg.479.
[252] Ibidem.

office exercising the functions of owner-manager and operator for the whole port. The agreement was endorsed by the Greek Parliament the same year[253].

The results of this FDI in the Piraeus were several and contrasting. While the IMF fostered selling the port authority's shares, ECB and EC favoured concessioning to third parties so that the port authority could keep its effective control on the port. From the workforce point of view, Chinese settling in the port was met with lawsuits and a month-and-a-half strike of workers on the docks. After enlarging over half the coast of the Piraeus, COSCO intended expanding its activities into other domains and inserted inside the port's masterplan real estate projects for the hinterland such as a shopping mall, several hotels, a vehicle terminal, new shipyards either than new terminals for cruises and containers, leaving local enterprises with barely no opportunities[254]. Even though impact on Greek economy remained limited, to Europe's eyes this represented a new challenge towards big shipping companies: meaning that everywhere they settled, market competitiveness for the local tissue was not to be taken for granted anymore. With the enlargement of the port environmental problems also raised: pollution grew both in water and in air, due to the breakneck increase in freight and vehicle traffic generating congestion around the port. But probably the worst problem caused by the Chinese establishment in the port is a social one: workers have seen their salaries been cut as well as their pension contributions[255]. Death on the workplace increased. In spite of all these negative outcomes, it is also true that the port of the Piraeus experienced an increase in container throughput thanks to the additional transhipment traffic, becoming the fourth largest container port in 2020[256], with this meaning that FDIs might represent on one hand a threat from a geopolitical and economic point of view, but also a chance for extraordinary economic growth on the other. In 2009 the port of the Piraeus moved less than 700 thousand TEUs, while in 2020 it moved 5,4 million (over 670% more[257]). The achievement for the next few years is to move over 11 million TEUs, which means more than all of the TEUs moved by Italian ports altogether[258]. In 2019 before the pandemic crisis the PPA issued 149,2 million euros[259].

The exponential growth of the Piraeus as well as the end of the debt crisis in Greece is undeniable, but this happened at the expense of the port workers, of the environment and of the competition for local

[253] Ibidem.
[254] Claudio Paudice, "La privatizzazione del Pireo è stata un affare, ma solo per i cinesi, non per i greci", The Huffington Post, 09/05/2021, https://www.huffingtonpost.it/entry/la-privatizzazione-del-pireo-e-stata-un-affare-solo-per-i-cinesi_it_612d0b95e4b02be25b5ecea8/ .
[255] Futura D'Aprile "Il Pireo (cinese) cresce, ma a farne le spese sono lavoratori e ambiente" 02/28/2023, https://www.editorialedomani.it/politica/mondo/il-pireo-cinese-cresce-ma-a-farne-le-spese-sono-lavoratori-e-ambiente-faocfcpe .
[256] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy", *Routledge*, (2022), pg. 479
[257] Claudio Paudice, "La privatizzazione del Pireo è stata un affare, ma solo per i cinesi, non per i greci", The Huffington Post, 09/05/2021, https://www.huffingtonpost.it/entry/la-privatizzazione-del-pireo-e-stata-un-affare-solo-per-i-cinesi_it_612d0b95e4b02be25b5ecea8/ .
[258] Ibidem.
[259] Ibidem.

enterprises. This pushed the European Commission to rethink its relationship with China, defining in its 2019 Strategic Outlook the oriental government as a "strategic rival[260]" and by equipping itself with new defensive instruments such as Regulation (EU) 2019/452 for foreign direct investment screening in the EU. According to the Huffington Post, Europe might have underestimated the importance of an agreement guaranteeing to a foreign subject control on a strategic infrastructure[261]. Claudio Paudice writes:

> "According to Kas and IIER COSCO investments have had geopolitical investments that haven't been adequately measured up to now and cause a barely concealed discomfort in western partners of Greece. For Clingendael, port investments might make the country that receives them economically dependent from who issues it, hence working as a political [and economic] lever. Just as when, in the 80s, Beijing threatened to move all of its traffics from Rotterdam to Antwerp if the Hague authorized to sell two Dutch submarines to Taiwan. […] The Piraeus represents somewhat the sum of two deadly sins committed by Brussels in the last decade: the rolling out of the red carpet to state-owned enterprises of Beijing without worrying about the damage to the internal market competition, plus having pushed fiscal austerity without reckoning long-term consequences[262]."

This confirms that enhanced presence of revisionist powers in western critical infrastructures might be used as a political and economic lever (i.e., grey zone attack) against western societies. If on one hand boosted economic growth is undoubtedly positive (even though it doesn't come for free), the threat of its removal by an exogenous power that pursues its own interests in foreign territory can pave the way to grey zone actions such as diversion of trade flows, acts of sabotage against foreign infrastructures, sensitive data collection, espionage campaigns etc. This is why being economically dependent on foreign powers is always a risk and western institutions increasingly want to pay attention to these phenomena.

The port of the Piraeus is called by the Chinese establishment "the dragon's head" because it represents the most western outpost of the Belt and Road Initiative. This project, born in 2013 as the "One Belt One Road Initiative" is aimed at finding new markets for Chinese industries and fostering Chinese economic growth, overall of its western provinces in the field of cement, aluminium and steel, "streamlining foreign investments of Chinese companies and enhancing capital convergence and currency integration of the Yuan[263]". China also has the ambition of incrementing its leadership and diplomatic role in the world while preserving its territorial integrity. The BRI is supported by several investment centres such as the China Development Bank, the Asian Infrastructure Development Bank, the Silk Road Fund, the Export-Import Bank of China and so on. The project foresees a land-based belt and a maritime silk road that intertwines in the Italian port of Venice. The land-based belt crosses many countries among which Kazakhstan, Iraq, Syria, Turkey, Bulgaria and reaches Europe through Romania, Czech Republic, and Germany. The maritime silk road begins in Quanzhou, heads south to the Malacca Strait, proceeds to India and Pakistan, passes by East

[260] Ibidem.
[261] Ibidem.
[262] Ibidem.
[263] T. Notteboom, A. Pallis and J.Rodrigue, "Port economics, Management and Policy", *Routledge*, (2022), pg. 481

Africa and crosses the Mediterranean Sea reaching the Piraeus and Venice[264]. The maritime silk road is of particular importance for the Italian government, because it involves several Italian ports: Trieste, because it is close to major Northern Italy cities and it easily connects with Central Europe, Genova, which has an agreement with the China Communications Construction Company and might capture maritime traffic in the western Mediterranean Sea, and Palermo, which might serve as main hub between Europe and Northern Africa[265].

Chinese expansion in Italian ports is welcomed by the establishment with mixed feelings. In 2019 the Italian government signed a Memorandum of Understanding[266] with the Chinese government for the BRI development including several commercial agreements some of which regard the ports of Genova, Trieste and the Chinese state-owned CCCC. These agreements are seen with circumspect by NATO and the European Union which would like to avoid the repetition of the situation in the Piraeus and thus continue to keep an eye on Italian ports. The situation is currently under debate, as in January 2023 the President of the European Council, Charles Michel, NATO Secretary General Jens Stoltenberg, and the President of the European Commission, Ursula von der Leyen, gathered at NATO Headquarters to sign the third Joint Declaration on the cooperation between NATO and the European Union, that, according to the leaders, will concern "the growing geostrategic competition, resilience issues, and the protection of critical infrastructures[267]". Moreover, the Italian government will have to decide before the sundown of the year, whether it has the will to continue cooperating with China on the Belt and Road Initiative or not.

More specifically, NATO sees autocratic regimes wielding power on European critical infrastructures as a threat to its organization, and the EU sees Chinese investments in Trieste and Genova as a way to breakthrough Europe via southern maritime gateways. Western fears amount for the control of Chinese government on logistic routes, gaining a strategic advantage both commercially and politically. The vague statements appointed by China in its agreements and the little room for participation of local enterprises in the project (the BRI is entirely financed by Chinese institutions and left to the management of Chinese enterprises) leads other countries to think that China aims at a complete control of connectivity lines and foreign hubs for strategic reasons[268], framing other countries in the *debt trap*.

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[264] Ibidem.

[265] One Belt One Road Initiative, last accessed on 05/09/2023, https://www.oboreurope.com/en/italy-bri-european-integration/ .

[266] Italy and China, Memorandum of Understanding Between the Government of the Italian Republic and the Government of the People's Republic of China on Cooperation within the Framework of the Silk Road Economic Belt and the 21st Century Maritime Silk Road Initiative, 22 March 2019, https://www.governo.it/sites/governo.it/files/Memorandum_Italia-Cina_EN.pdf .

[267] North Atlantic Treaty Organization, NATO and European Union leadership sign third joint declaration, 01/10/2023, https://www.nato.int/cps/en/natohq/news_210523.htm .

[268] F. Ghiretti, The Belt and Road Initiative in Italy: The Ports of Genoa and Trieste, Istituto Affari Internazionali, Roma, 2021

By taking a closer look to the agreements signed between CCCC and the Port Authorities of the Western Ligurian Sea and of the Eastern Adriatic Sea one may notice that up to today, the destiny of Italian-Chinese partnership in the port sector seems very different from the partnership that took place in the Piraeus. The agreement between Genova and CCCC consisted in the participation of the Italian PSA in a new logistic park in China in order to sell Italian products in an online platform managed by CCCC[269]. Even if the Chinese public demonstrated to be interested in buying Italian products through online platforms, the cost of shipping for Italian enterprises to supply their products so far away barely covered the costs of production, making it difficult for Italian SMEs to capitalize on this type of business. This part of the agreement thus fell into a dead end. On the other hand, the Chinese company was invited to participate in a public bid to construct a new breakwater dam in Genova, where CCCC has interest in settling, given their presence in Vado Ligure. By the way, CCCC positioned itself at the seventh place and has been hence excluded from the tender. This demonstrates that, up to the time of writing, the MoU between China and Genova hasn't produced any effect and hasn't exposed Italy or Europe to any new risk[270].

The agreement between the PSA of the Eastern Adriatic Sea and the Chinese company is quite similar to the one signed between China and Genova: the port of Trieste was supposed to take part in the new logistic parks in Shanghai, Ningbo and Shenzen while selling its products on the web platforms of CCCC. Proposals would have been made from Chinese customers to Italian local enterprises and the PSA would have to mediate the exchange. A pilot project concerning the export of Italian wine was launched, where ten companies had the privilege to showcase their products on the Chinese platform. The project was successful and after a break for the Covid-19 pandemic it definitely took off. Chinese involvement in Italy concerned the renewal of Aquilinia and Servola train stations which were supposed to become intermodal nodes connecting the port of Trieste. CCCC was supposed to build the stations while the PSA together with RFI would manage them and pay a rent to CCCC. By the way, the company gave a negative assessment on the feasibility of the project, stating that there is not enough room to build two intermodal stations and a new project has yet to be presented[271]. In the meantime, the United Stated blacklisted and sanctioned the company, intimidating the Chinese company for its participation in further western port projects. At the end of 2020, the German company Hamburger Hafen und Logistik AG (HHLA) acquired the 50% of the intermodal platform of the port of Trieste, putting to an end all Chinese efforts to work on the project. Finally, US sanctions prevented even collaboration in Slovakia among China and Trieste. Once again, as in Genova, the MoU seems to have produced zero results.

In conclusion, there is no ground for the two agreements to cause international alarm. Not only, were neither Genova nor Trieste trying to sell their PSAs or looking for collaboration directly on their ports, but

[269] Ibidem.
[270] Ibidem.
[271] Ibidem.

also, Chinese presence in Italy is not new: China Merchant Group, CCCC and COSCO have remunerative collaborations in many other Italian cities such as Venice and Ravenna. Nevertheless, the Italian government is always free to use the Golden Power, a legislative tool that allows the public sector to block inbound foreign investments when national security is considered at risk[272]. In 2021 the appointed Prime Minister Mario Draghi already used this tool and during his presidency "Italy [returned] to its dual Atlanticist and European frame while labouring to strengthen multilateralism and the rules-based system[273]". The following Italian government either seems to have intention to renew its agreements with China but rather seems to confirm its alignment to Washington. As Ghiretti writes:

> "If there was a Chinese plan to expand in the Italian and European transport networks, this has been constrained by a growing awareness in Italy and the EU of the need to protect critical infrastructures. Italy's and the EU's rules on public procurement and investment screening limit the possibility of Chinese enterprises investing freely in national strategic assets. The Golden Power mechanism has expanded its reach over the years, and it now covers a number of sectors in which the government can block foreign investments. Its enacting, however, is entirely dependent on governmental decision[274]."

It must be said, that ports in Italy may only be leased and not sold. There is no proof up to now that Chinese companies have the intention to buy the majority of shares of any Italian port. Nowadays it is unlikely to see Italy following the same destiny of the Piraeus, considered that Italian public debt is still not as high as the one Greece. Still, it is not easy to say how situation will evolve after Chinese companies step a first foot inside one's ports. Italian ports' future will also depend on the capacity of Europe to make its logistic sector competitive with the Chinese one. At the same time, consequences of the war in Ukraine must be taken into account. After the war, the division of the globe in two opposite blocks is likely to become more marked, as Russia will probably establish tighter bonds with China, while the Atlantic side is likely to pull even closer to the European Union. In the light of this probable scenario, we can predictably say that Western institutions will hardly let Chinese enterprises penetrate Italian ports, at least with enterprises participated with majority shares by Chinese enterprises.

Another interesting case is represented by the port of Taranto, where in the second half of 2022 an enterprise participated by Italian and Chinese owners manifested its interest in the logistic platform of Taranto. This enterprise (Progetto Internazionale 39 Srl) is participated at 33% by Tommaso Celletti, at 33% by Alfredo Esposito, at 33% by the Chinese Gao Shu'ai and at 1% by the Association for international cultural and economic development. The head of this association is the same Gao Shu'ai. In the end this

[272] Ibidem.
[273] X. Hong, Italy Changes Track: From the Belt and Road to (Re)Alignment with Washington, IAI, Roma, 2021.
[274] F. Ghiretti, The Belt and Road Initiative in Italy: The Ports of Genoa and Trieste, Istituto Affari Internazionali, Roma, 2021.

results in the fact that the Chinese entrepreneur holds a greater share of the company with respect to the other two Italian owners[275]. As reported by the Association itself, its aim is to:

> "Create an intergovernative cooperation aiming at fostering cultural and commercial exchanges among enterprises, in particular in the field of science and technology. [It also aims to] Operate to realize a global platform that can work in the fields of law, politics and rules of the EU and can actively promote Italian and European enterprises within the framework of the construction and development of "One Belt One Road". [It aims at] further promoting the expansion of Italian and European enterprises abroad and to efficiently promote international development and cooperation[276]".

Thereby, the project of Progetto Internazionale 39 for Taranto's logistic platform seems another attempt of the Chinese establishment to put its hands on Italian ports and perpetrate the Belt and Road Initiative Project[277]. It will be up to the Italian government to decide how to act, given that protection of national critical infrastructures (with explicit reference to concession of public assets such as airports and highways) through the clause on the protection of national interests is one of its mail pillars[278]. According to national press, in an effort to maintain harmonious relations with Washington, the Italian government has no doubt on withdrawing from the BRI agreement before 2024[279], the main issue at stake remains when and how to create a cooperation parachute in order not to damage Italian-Chinese relations[280].

CYBER-PROTECTING PORTS, A PRIMARY NECESSITY FOR CRITICAL INFRASTRUCTURES.

Among all the grey zone and hybrid threats, the most common ones are probably cyber-attacks. These kinds of attacks are very important, because they can compromise the whole port system and easily reverberate in all the national and international system. Since ports hold classified and sensitive data concerning key sectors, a damage to the digital or informative system of the port can have huge consequences. Just to picture an example of how much digital data is exchanged in a port, think of the Port Community Systems. These systems are digital platforms used by ports and port authorities to keep track of import and export processes, simplify information flows and aggregate all the stakeholders of the port by making them communicate easily and fast. PCS functions are of a wide array and the arrest of the system would likely determine the arrest of the whole port activities. The description of its PCS given by

[275] N. Capuzzo, "Interessi italiani e cinesi si sono fatti avanti per la Piattaforma logistica di Taranto", Shipping Italy, 11/27/2022, https://www.shippingitaly.it/2022/11/27/interessi-italiani-e-cinesi-si-sono-fatti-avanti-per-la-piattaforma-logistica-di-taranto/ .
[276] Ibidem.
[277] Ibidem
[278] Ibidem.
[279] M. Galluzzo, "Via della Seta, asse con gli Usa. L'Italia ha già scelto di uscire", Corriere della Sera, 05/03/2023 https://www.corriere.it/politica/23_maggio_03/via-seta-asse-gli-usa-l-italia-ha-gia-scelto-uscire-b210ec88-e9e4-11ed-b051-eaed8a84c878.shtml?refresh_ce .
[280] Ibidem.

the port of Genova is emblematic in order to shed light on the importance of digital platforms in ports' environment:

> "E-PORT is a platform that allows IT systems used by the various players of the transport and logistics chain linked to the port of Genoa to integrate and operate between themselves: from Public Administrations (Coast Guard, Customs Agency and Finance Police) to private operators (shipping companies, maritime agents, porter terminals and auto-transporters). Overall, the platform involves 20,000 users and over 1,500 companies, managing more than 15 million import/export documents per year (including customs declarations, cargo documents, bookings, gate in/gate out management, lorry appointments, etc.). By sharing this information, the system simplifies data entry operations, reducing goods transit times – and consequently costs – to a minimum. The Port Community System of the port of Genoa was recently integrated within the National Logistics Platform which, through the integration of systems and procedures searches for the maximum operative efficiency for the entire world of Italian logistics[281]".

In chapter one the disruptive impact of an attack to submarine cables carrying sensitive information has been analysed, now non-physical threats that spread through software in the digital domain will be dealt with. These can endanger the port system thus representing a trouble for national and international security. Right after the submarine cables, other structures that must be protected in order to maintain port security are port assets and navigation systems. When one talks about ports assets, it must be specified that, even though they represent a primary source of data in the digital ecosystem of the port, computers are not the only systems connected to the internet these environments. In terminals, for example, there are a number of infrastructures which are automated, such as cranes or other instruments for cargo handling. Terminal operations often make use of Internet of Things and Artificial Intelligence infrastructures which are as vulnerable to cyberattacks as computers. Their malfunctioning or sabotage might determine a stop in ports' regular activities. K. Kuhn describes some examples of systems that might be hit by a cyberattack in a port:

ICT Systems	Examples
Security	Vehicle access, building access, control gates
Communications	Mobile radio, email, websites for cargo and customs
Business	Terminal Operation System, Container Terminal Management System, office systems, e.g. payroll
Terminal automation	Vessel scheduling software, yard equipment and maintenance, control systems for cranes, Remote monitoring of equipment

14.Source: K. Kuhn, *Maritime ports and cybersecurity*, IET, Coventry University, 2021

Cyberattacks to ports might cause its disruption. This might result in stop or delay of goods flows, (since ports compete for cargos, bottlenecks of ships queuing for berth or re-routing of ships would cause a huge loss of value for a port and a state), congestion, environmental incidents, geopolitical hazard and port

[281] Port Community System, Ports of Genova, last accessed on 06/02/2023, https://www.portsofgenoa.com/en/development-strategies/port-community-system/pcs-genoa-en.html .

community safety[282]. In an effort to avoid these unpleasant results, ports can equip themselves with cybersecurity strategies. Cybersecurity is defined as: "the protection of information systems (hardware, software and associated infrastructure), the data on them, and the services they provide, from unauthorised access, harm or misuse. This includes intentional harm by a system operator or accidental harm as a result of failing to follow security procedures[283]". *Cybersecurity systems* are used to counter *cyberattacks* perpetrated by *actors* that exploit *vulnerabilities* in ports' systems in order to cause their disruption or general disorders at their own advantage. Attackers have various reasons to perpetrate their malicious activities such as the will to make social or political statements, to financial gain and cyber warfare[284]. A *threat* is defined as: "a circumstance or event with the potential to adversely impact organizational operations and assets, individuals, other organizations, or the nation through unauthorized access, destruction, disclosure, modification, or denial of service to an information system[285]". Threat *actors* are responsible for *incidents*. Ports often categorize the techniques, tactics, procedures of threat actors in order to foresee *threat scenarios* that picture how a threat can be orchestrated and which effects it can have on their businesses. The table below summarizes common threat actors in the maritime industry, their motivations, the groups they belong to and their targets[286].

Threat Actor Groups	Motivations	Threat Actors	Targets
Criminals	Economic/ Financial Information advantage Reputation	Individuals Organizations	Assets Individuals Organizations
Espionage	Commercial/ Industrial Intellectual property Competition	Organizations Nations	Governments Individuals Organizations
Hacktivists	Challenge/ Egoism Ideological/ Political/ Social change	Activists Individuals	Governments Individuals Organizations
Insider threats	Financial gain Revenge	Contractors Employees Partners	Physical/ Process/ Technical failures Poor operational design
Terrorists/ War[1]	Political/ Social change Fear Religion/ Ideology	Hackers Individuals Terrorists States	Individuals Infrastructures Organizations Public/ Critical targets Governments/ Military

15. Source: K. Kuhn, Maritime ports and cybersecurity, Scientific article, IET, Coventry University, 2021.

Ports are particularly subject to cyberattacks because they are places where the cybernetic sphere penetrates the physical one, creating what scholars call a *cyber-physical* environment. According to L. Seshia, "A cyber-physical system (CPS) is an integration of computation with physical processes. Embedded

[282] K. Kuhn, *Maritime ports and cybersecurity*, Scientific article, IET, Coventry University, 2021.
[283] Ibidem.
[284] Ibidem.
[285] Ibidem.
[286] Ibidem.

computers and networks monitor and control the physical processes, usually with feedback loops where physical processes affect computations and vice versa[287]". They are "systems of collaborating computational entities which link the surrounding physical and virtual to achieve a global behaviour[288]". Cardenas and Brinkmann add that "CPSs are composed of a set of networked agents interacting with the physical world[289]; these agents include sensors, actuators, control processing units, and communication devices that enable automation[290]". Collbert and Sullivan finally add that "These sectors control Industrial Control Systems (ICSs) through the use of SCADA systems, Distributed Control System (DCS) and IoT, which are based on the nature of individual systems[291]". Lastly, in order to understand how a cyber-physical environment works it is important to make a distinction between ITs/OTs and ICTs. Coolfire gives a good description of the former in the following lines: "IT manages the flow of digital information, while OT deals with machines and physical processes. A traditional juxtaposition would be that of software (IT) vs. hardware (OT). However, this does not stress the interaction of cyber and physical elements. It is not sufficient to understand IT and OT components separately. Rather, CPS is about the intersection of physical and cyber[292]". An example of IT/OT interaction can be made with digital cargo handling systems and the software used for their remote surveillance. Lastly, ICTs are "ICT systems of ports simplify and accelerate processes, and form a foundation for an Intelligent Transport System (ITS). Ports use ICT systems to manage, store and share information, ensuring swift and seamless product/data exchange from the producer to end consumer during the provision of services. Ports use a wide array of ICT systems to perform vital functions, including communications, security, business, and terminal automation[293]". As ports become smarter and the interaction between cyber and physical environment grows, vulnerability of the environment to cyberattacks increases. The more complex the smart environment is, the more the potential damage of a cyberattack can be.

There is a wide array of attacks that can be addressed against port assets. Some of which are viruses, worms, malwares, advanced persistent threats (APTs), backdoor, ransomware and phishing. Viruses can corrupt and delete data on computers. They are computer programs launched by users that can self-replicate and spread to other computers. Also worms can self-replicate but they do not need to attach themselves to any program in order to cause damage. In addition to deleting files they can also inject further malwares. Malwares are malicious software designed to harm networks, computers or servers without the victim being aware of its presence. According to the 2018 Maritime Cyber Security Survey by

[287] Lee E, Seshia S. *Introduction to embedded systems: A cyber-physical systems approach*. Mit Press; 2016.
[288] Monostori L. In: Chatti S, Tolio T, editors. Cyber-Physical Systems. Berlin, Heidelberg: Springer Berlin Heidelberg; 2018. p. 1–8.
[289] Cardenas A., *Cyber-Physical Systems Security Knowledge Area. The Cyber Security Body Of Knowledge*. 2018;1.0.
[290] Brinkmann M, Hahn A., *Testbed architecture for maritime cyber physical systems*. In: 2017 IEEE 15th International Conference on Industrial Informatics, p. 923–928.
[291] Colbert E, Sullivan D, Kott A., *Cyber-Physical War Gaming. Journal of Information Warfare*. 2017; pg. 119–133.
[292] Coolfire. *What Is The Difference Between IT And OT?* 2019.
[293] Fok E. An Introduction to Cybersecurity Issues in Modern Transportation Systems. ITE Journal. 2013;83(7):18–21.

IHS Markit and BIMCO, 77 per cent of cyberattacks in the maritime industry are malware attacks[294]. Spywares, trojan horses, worms and ransomwares are all types of malwares. Ransomware is a lucrative form of malware: it locks computers and force users to pay money in order to have their files back. Phishing is a social engineering technique ("social engineering is a non-technical practice used to manipulate individuals within an organization into breaking security procedures[295]") aimed at inducing the user to disclose confidential information. Backdoors, instead, are not always a cyber-hack: they were initially designed to provide the producer with a way of restoring passwords, but now they are sometimes secretly installed from hackers in order to ensure themselves a way to bypass regular authentication procedures. Finally, APTs are the most sophisticated security threats. They hide in computers for prolonged periods of time and spread to other hosts in order to collect sensitive information or disrupt systems. Threat actors behind this hack are usually organized, well-funded and well-trained tech-experts that aim at specific objectives[296].

Criminal organizations usually hack networks and assets of port operators, shipping lines and port authorities in order to gain information on ports of call, trucker information, sailing schedules, specific containers and cargos on board, information on destination ports where cargo is released and security measures put into place[297]. Two classical examples of cyber-attacks in ports are represented by the one to the Danish Maritime Authority in April 2012 and the one to the port of Antwerp between 2011 and 2013. In the first case, an employee of the Danish Maritime Authority was infected by a virus, hackers were given backdoor access to his computer's files and subsequently the virus spread through all of the Maritime Authority network until it reached Danish governmental institutions, from which the criminals stole sensitive information concerning the merchant navy[298]. The attack was discovered only two years later but, since criminals left no trace, the mischief still remains unattributed (as the majority of grey zone operations). The Danish Intelligent Service reckoned the attack was sponsored by another state and classified the facts under terrorist threat.

For what concerns the port of Antwerp, between 2011 and 2013 a group of hackers accessed to the data of the port via phishing and started to remotely control the movement of containers through legitimate computers. The group then broke into port facilities using logging devices and started to make cargo vanish. When the authorities started to tackle the issue of the missing cargos, they discovered a drug smuggling

[294] Fairplay and BIMCO, *Maritime Cyber Survey 2018*, Fairplay and BIMCO; 2018.
[295] V.V.A.A.,"National Information Assurance (IA) Glossary", Committee on National Security Systems (CNSS), 2015
[296] K. Kuhn, *Maritime ports and cybersecurity*, Scientific article, IET, Coventry University, 2021.
[297] Sen R., Cyber and Information Threats to Seaports and Ships; 2016. p.281–302
[298] "State-sponsored hackers spied on Denmark", https://www.thelocal.dk/20140922/denmark-was-hacked-by-state-sponsored-spies .

operation of over 1000kg of heroin and cocaine. This case, disclosed by Europol in 2013 is remembered as one of the earliest in the field of cyber-physical realm[299].

These two examples of attacks to port assets prove that cyberattacks to ports can have severe implication on the security of a nation. This is why having ports protected with cyber-structures is a matter of national and international security. Attacks to navigation systems are not less important.

All types of industries are equipping themselves with information systems and the nautical sector is not exempted. According to the European NIS (Network and Information Security) Directive, adopted by the Italian government with the Decree D.lgs. n. 65/2018, navigation companies and maritime traffic assistance services are included in the list of Essential Services Operators (OSE) as well as port authorities. As per the above-cited law, these subjects are obliged to report cybersecurity incidents to the CSIRT (Computer Security Incident Response Team)[300]. This means that not only ports, but ships as well, are obliged to protect themselves from cyber entities threatening their on-board systems and reporting incidents to the coast authorities. This is particularly true if we think that on-board systems are increasingly connected to port and coast operations via digital network. Through the internet ships keep contact with the headquarters on land, this means that a cyber attack on land can intrude inside the vessels' data and vice versa. This entails that a cyber risk for international security on-board is also a risk for international security on-land.

Vessels are equipped with several on-board digital systems that might be subject to cyber-threats: administrative and crew welfare systems, passenger management and servicing systems (systems used for the onboarding of passengers that contain their personal data[301]), access control systems, propulsion, machinery and power control systems ("since electronic programs control the physical actions of the ship, they can fall victim of cyber-attacks and threaten ship control, especially when they're connected to remote condition-based monitoring and are integrated with navigational systems[302]"), bridge systems or navigation networks (that interface with onshore servers), cargo loading management systems (integrated with the on-board electronic data systems) and communication systems[303].

In order to protect on-board cyber systems, the IMO elaborated with resolution MSC.428 (98), a series of guidelines including Cyber Risk Management in Safety Management System. Another very important institution that elaborated guidelines on cybersecurity onboard for ships is the BIMCO (Baltic and

[299] Nguyen L., "Collaboration in the Shipping Industry: Innovation and Technology", KNect365; 2018., https://knect365.com/article/pdfs/91705d00-6d9d-4ba3-98a4-9b10c92ad520Shipping2030 report Feb16-2018 .pdf .
[300] M. Valieri, "La cyber security nel settore marittimo: lo scenario, i rischi e le sfide future", Network Digital 360, 04/17/2020, https://www.cybersecurity360.it/soluzioni-aziendali/la-cyber-security-nel-settore-marittimo-lo-scenario-i-rischi-e-le-sfide-future/ .
[301] "Guide to Ships cybersecurity", *Maritime Institute of Technology and Graduate Studies*, Blog Post, https://www.mitags.org/guide-ship-cybersecurity/ .
[302] Ibidem.
[303] Ibidem.

International Maritime Council). These guidelines indicate the most common vulnerabilities for on-board systems i.e., the areas in which ports and companies willing to improve their cybersecurity on vessels should work on:

- "Obsolete operating systems that can no longer be updated
- Missing or outdated anti-malware software that doesn't protect from modern threats
- Lacking security protocols and safeguards, including employee mismanagement of the network and the use of default administrative accounts and simple passwords
- Integrated computer systems that lack safeguards and network segmentation
- Systems that must be connected to a server on land to function correctly, or are always connected to a system on shore that isn't secure
- Lacking access controls for service providers and contractors[304]"

All digital systems employed onboard are critical since they contribute to the regular functioning of the ship, hence, all of them are potentially vulnerable and of major interest for cyber criminals. By the way, the most vulnerable ones are navigation and radar systems, cargo handling and propulsion. Just to name a few:

- "GNSS (Global Navigation Satellite System).
- ECIDIS (Electronic Chart Display and Information System): an electronic cartographic navigation information system that collects and uses AIS messages, data from radars, GPS and other vessel sensors (from a gyrocompass) and compares them with embedded maps. It is used for navigation, automation of certain tasks of the navigator and increasing the navigational safety of navigation. The system usually consists of a workstation (or two for monitoring and for course planning) connected to the ship's sensors and instruments, on which the ECDIS software is installed. Correct operation of the ECDIS system is very important, its compromise can lead to the most unfavourable consequences: injuries and even death of people, environmental pollution and large economic losses. A "frozen" vessel, having lost the ability to navigate correctly, will block a busy canal or gateway for an indefinite period, which, under certain circumstances, will cause huge economic losses. A tanker carrying oil or other chemical products and running aground due to navigation errors is a ready-made scenario for an environmental disaster.
- VDR (Voyage Data Recorder): it Is a flight data recorder, analogue to the "black box" used in aviation. The main tasks are to record important voyage information of the vessel, including both technical and heading data, as well as voice recordings from the captain's bridge, and its preservation in case of an emergency. The data obtained from the device is extremely important in the investigation of incidents, accidents and disasters that occurred at sea. The VDR is analogous to the aircraft's "black box" but it is orange. On February 15, 2012, Marines aboard the Italian private tanker Enrica Lexie, tasked with protecting the vessel from a possible pirate attack, mistakenly opened fire on an Indian fishing vessel and killed two Indian citizens. The tanker's flight recorder lost data from sensors and voice recordings for the period of time when the incident occurred. There were two versions of the reason for what happened: the overwriting of data by the VDR itself and the deliberate destruction of evidence. The loss of data naturally complicated the investigation, which gave rise to a diplomatic conflict between India and Italy and ended only on August 24, 2015. A couple of weeks after the events at Enrica Lexie, on May 1, 2012, a Singaporean freighter Prabhu Daya rammed a fishing boat off the coast of India, in the Kerala region, and fled the scene. As a result of the collision, three fishermen were killed. An interesting detail emerged in the press following the Indian law enforcement investigation: During the arrival of the officials on the Singapore ship, one of the members inserted a USB stick into the VDR; this led to the erasure of all files and voice recordings from him. Later, despite all the efforts of the experts, the data could not be restored. The Enrica Lexie and Prabhu Daya cases clearly reflect that deleting data on the VDR can make it extremely difficult or completely deadlocked an investigation into an incident at sea.

[304] Ibidem.

Moreover, if attackers have the ability to edit data on the recorder and substitute them, there is a high probability of organizing a fraud, which will send the investigation into the wrong direction.

- AIS (Automatic Identification System): It serves to transmit the vessel's identification data (including its cargo), current position and course. It is also used to prevent collisions of ships, monitor their condition and with its help, the owner can monitor his ship. It also provides communication between courts. The device works by transmitting signals in the VHF band between ships, floating repeaters and coastal AIS gateways that are connected to the Internet. All vessels on international voyages, vessels of over 500 gross tonnages, and all passenger liners must be equipped with AIS. The system works on marine search and rescue equipment. […] [A research shows that tampering with AIS systems can produce the following scenarios:] changes in ship data, including its position, course, cargo information, speed and name; creation of "ghost ships", recognized by other ships as a real ship, in any location in the world; sending false weather information to specific vessels to force them to change course to avoid a nonexistent storm; activation of false collision warnings, which can also cause automatic correction of the course; the ability to make an existing vessels "invisible"; creation of non-existent search and rescue helicopters; falsification of EPIRB signals, which activate alarms on nearby ships; the possibility of carrying out a DoS attack on the entire system by initiating an increase in the frequency of transmission of AIS messages. In addition, it is worth noting that the vessel's personnel can turn off their AIS, becoming "invisible" (according to CyberKeel, a fairly common practice for passing dangerous sections of the water area, such as the Gulf of Aden, the "fiefdom" of Somali pirates), and in some cases change the broadcast information manually. Plotting a non-existent warship of country A on AIS maps in the territorial waters of country B could provoke a diplomatic conflict. In addition, an attack by an intruder can also lead to deviating from the course as a result of spoofing messages about a possible collision with it or to "luring" to a certain point in the water area by creating a false signal of an emergency beacon.
- EPIRB (Emergency Position Indicating Radio Beacon): is an emergency radio beacon.
- CTS (Container Tracking System): is a system that allows tracking the movement of containers.
- PMIS (Port Management Information System) or “port call”: is a system that simplifies the communication and interaction of port services, ensuring the handling when entering a port. Thanks to the port management system, the vessel will stand for less time and the port will be able to receive more vessels[305]”.

Finally, Italy can boast worldwide renowned excellence both in the automation and shipbuilding industry. Italy in these sectors boasts a know-how unique in the world and always invests in research and new cross-sectoral technologies. However, cyber risks caught by surprise all actors operating in the maritime world. Navigation systems, propulsion control, cargo handling, control on offshore operations are all elements that must be pulled together and included in one omni-comprehensive cyber security strategy capable of including technologies, processes and the human element. In the cybersecurity field many challenges lie ahead. The operators of the nautical sector would like it to be their supplier of technologies to provide cyber-protections together with the provided product. They would also like the supplier to be able to transmit more awareness of the product to the purchaser[306]. Will Italy be able to combine adequate IT protection structures to its sophisticated OT technologies and develop adequate IT protection instruments for digitally prolific environments such as ports? In order to answer this question in the next chapter the digital dimension of ports will be analysed.

[305] Marine Digital, last accessed on 06/02/2023, https://marine-digital.com/cybersecurity_in_shipping_and_ports .
[306] M. Valieri, “La cyber security nel settore marittimo: lo scenario, i rischi e le sfide future”, Network Digital 360, 04/17/2020, https://www.cybersecurity360.it/soluzioni-aziendali/la-cyber-security-nel-settore-marittimo-lo-scenario-i-rischi-e-le-sfide-future/ .

CHAPTER III: ITALIAN PORTS: AN ANALYSIS OF THE STATE-OF-THE-ART

In order to become innovative gateways to Europe, Italian ports will have to be able to respond to contemporary security challenges and thus undergo several reforms. With the aim of understanding which reforms are necessary, it is essential to go through an analysis of the current situation in Italian ports. Therefore, this chapter deals with the state-of-the-art of the main Italian ports pertaining to the core network of the Trans European Network of Transports: La Spezia, Genova, Livorno, Ravenna, Venezia, Trieste, Gioia Tauro. More specifically, the analysis will concern Port System Authorities with their broader governance initiatives, but particular attention will be paid to the PSA headquarters. The analysis of the status quo will be based on ports' Three-year Operational Plans (POTs) and the Environmental and Energetic Documents of Port Authorities (DEASPs) regarding the years 2020-2023. It must be noted that some of the documents refer to another span of time such as, for instance, 2022-2024.

Among all of the aspects treated in these documents, particular attention will be paid to features considered as indispensable to make Italian ports become innovative gateways to Europe while making them comply to international frameworks:

- Logistic connectivity of ports to the rest of the region, state and continent according to the rules established in the TEN-T project (reinforcing ports links to the inland and developing inter-modal services will improve GVC resilience. This characteristic is important for future gateways to Europe in the case GVCs are disrupted again as in the case of the Covid 19 pandemic).
- Renewable energy implementation in ports as a long-term solution for environmental threats (pollution and climate change) and for state energetic independence. LNG adoption is considered as a short-term measure, or "transition energy" while waiting for renewable energies to take hold. The analysis of this parameter is important in order to understand if future European gateways will be able to guarantee energy supply to European countries in case of energetic crises and in times of quest for independence from Russian gas resources.
- Digitalization of ports as a means to improve ports' competitiveness in the field of trade and their security in the field of critical information transmission. Analysing this parameter is important in order to prevent potential cyberattacks to ports' information systems or sabotage of submarine cables.

During the following analysis several things must be taken into account. First of all, POTs and DEASPs reflect very different realities, and are the result of the different amounts of resources ports have at their disposal. Ports are also located in extremely diverging geographical contexts. POTs and DEASPs are thus written in different ways, present diverging features and are not always complete in relation to all of what it is wished to be analysed. Secondly, these documents have been elaborated during a period of major slowdown in

economics, hence works programmed in these documents around 2020 have not always been accomplished.

Funds being particularly important to the realization of projects in ports come from the Next Generation EU, and RePower EU. Objectives that the Italian government wants to reach in order to gain these funds are set in the National Recovery and Resilience Plan (NRRP) and those concerning ports are set in Mission n'3: "Infrastructures for sustainable mobility". 31,46 billion euros are predisposed for this mission, while 3,8 billion are dedicated to the modernization of ports, logistics, inter-modality and cold ironing. 630 million euros are destined to ports and Special Economic Zones of Southern Italy with the aim of simplifying governance and making local development and intervention faster and easier. 700 million euros will be destined to the renewal of the Mediterranean fleet with new low-impact ships[307].

It must be noted that carbon footprint and environmental policies are of particular importance to the IMO, while last mile policies, inter-operability of the logistic network digitalization and connectivity are overall of communitarian interest according to the Regulation CE n.1315/2013, and financed through the CEF (Connecting Europe Facility) program.

PORT SYSTEM AUTHORITY OF THE EASTERN LIGURIAN SEA: LA SPEZIA

Connectivity

In its Operational Plan concerning the years 2022-2024 the PSA of the Eastern Ligurian Sea foresees for its ports the rationalization of their functions, bringing order and clarity in stopovers with hosting functions. Commercial and cruise activities will remain at the forefront of La Spezia's port activities. Many enterprises are likely to invest in La Spezia's port since this stopover has strong inter-modal structures and connections. This is why in the next years a lot of resources will be invested in order to obtain more efficient and sustainable railway services with the aim of boosting the logistic corridors to which La Spezia belongs: the Scandinavian and the Southern Corridors. The enhancement of these corridors and the empowerment of inter-modality are only two of the strategic objectives of the EU stated in the Next-Generation EU, TEN-T and NRRP under the mission "infrastructures for sustainable mobility". In particular, according to this mission 200 thousand euros will be destined to works concerning railways, and the PSA of the Eastern Ligurian Sea wants to use it for three projects: the empowerment of the stopover of La Spezia Marittima, the construction of a new tunnel crossing on the railway via Pontremolese and the strengthening of the logistic hub of Santo Stefano di Magra. Finally, the PSA also foresees to access EU financial resources of the Military Mobility Program in order to strengthen railway infrastructures for dual-use mobility.

[307]V.V.A.A.., Piano Operativo Triennale 2022-2024, Autorità di Sistema Portuale del Mar Ligure Orientale, La Spezia, 2022.

The tunnel on the Pontremolese railway in particular, represents a project of utmost importance for the last-mile connection of the TEN-T Scandinavian-Mediterranean Corridor. The strengthening of this route is fundamental for commercial exchanges, since it connects major traffic flows coming from the ports of La Spezia and Marina di Carrara to the commercial activities located in Milano, Padova and Reggio Emilia. Thus, this railway connects the ports of the Eastern Ligurian Sea to the most productive zones of Italy including Toscana and Emilia Romagna, consenting these territories economic growth and making them competitive with Northern Europe[308]. Nevertheless, the empowerment of this railway is important in order to connect these zones to the newly instituted Simplified Logistic Zone[309]. La Spezia is one of Italy's main stopovers for container shipping and a gateway for Italian goods to Northern Europe. The main market which is connected to Europe through this highway is the manufacturing one located in Emilia Romagna, which represents 79% of Italian manufacturing sector[310]. 70% of national volume of import-export has birth in this area[311]. By 2023, the aim is to create a SLZ involving the Pontremolese railway, the logistic hub of Santo Stefano di Magra and the province of Parma, where the major freight terminal for La Spezia's containers is located.

Another project of utmost importance for the following years is the upgrading of the stopover of La Spezia Marittima. La Spezia Marittima is already a stopover for containers, the project for the next years is to create 9 new railroad tracks, a new passenger station, create a new lightning system and dismantle old installations. The aim is also to better connect the station with the logistic hub of Santo Stefano di Magra.

The PSA plans to make Santo Stefano di Magra a stronger logistic platform for inter-modality. Up to today, at Santo Stefano di Magra containers are emptied and filled-in while freights are shifted from railway to highway. There are shuttles at the direct service of the port leading from port buildings to the hinterland and vice versa. Import-export corridors are located at this stopover. The aim of the PSA for the next years is to increment railway infrastructure that connects this stopover to the port of La Spezia in order to shift the 50% of mercantile traffic to railroad, as per port's masterplan[312]. Enhancement of railroad structures in order to move containers from Santo Stefano di Magra to the inland is also foreseen. In the Operational Plan there is also the idea of extending the Core Network of the TEN-T to Santo Stefano di Magra in order to obtain easier access to funds for railway projects' development. Import-export corridors passing through this stopover are the result of an agreement between the PSA with the private companies La Spezia Container Terminal and Terminal del Golfo. Another aim of the PSA is to extend this collaboration with the Italian custom duty agency "Agenzia Dogane e Monopoli" in order to have custom clearance fulfilled for companies at Santo Stefano di Magra. A working group has been established in order to create a

[308] Ibidem.
[309] Ibidem.
[310] Ibidem.
[311] Ibidem.
[312] Ibidem.

governance on the project and better divide the work to do concerning the development of this stopover and its involvement in the TEN-T and in the newly created SLZ[313].

Carbon footprint and renewable energies

As mentioned previously, every port is in charge of creating its own Greenhouse Gas inventory, using the parameters and indexes it retains more suitable for the calculation of its own carbon footprint.

The port of La Spezia took into account the following port functions: PSA and other public entities' buildings, management and maintenance of common spaces in the port, passenger maritime terminals, industrial and commercial maritime terminals, road mobility services inside the port, commercial vessels both navigating and manoeuvring inside the port, vessels at berth inside the port, freight transport on road and railway connecting the port to its inland, shipbuilding industry. As sources of production of GHG, the following have been taken into consideration: fossil fuels for real estate cooling, electric energy exchanged with the net, fossil fuels for operational/road vehicles, fossil fuels for passenger transport, fossil fuels of ships located in the port area, fossil fuels for vehicles of companies located in the port hinterland[314].

The composition of the GHG inventory of La Spezia is limited to carbon dioxide, nitrous oxide and methane. According to UNFCCC, results are published in the national inventory report[315].

Among the interventions proposed inside the DEASP in order to resolve the problem of air emissions, one can find cold ironing and renewable energies. Private companies have proposed several interventions among which installation of photovoltaic panels on warehouses and hangars for the direct solar radiation and production of electric energy and a project concerning energetic efficiency which foresees the substitution of existing floodlights with led technology ones. Wind power energy is, unfortunately, not worth producing in the gulf of La Spezia, since the average speed of the wind would be insufficient to guarantee the continuous and effective functioning of wind-power generating plants. On the contrary, wave-motion energy generation is considered to be well productive in the area. Apparently, the energetic potential developed in the Tyrrhenian Sea corresponds to 3-4 kW/m which is considered an interesting quantity. At this purpose, the authorities of the port of La Spezia are thinking of implementing a project similar to the DIMEMO in the gulf of Naples (Maritime Breakwater for Wave Energy). When the experimental stage will come to an end, feasibility studies will be made on the project in order to implement it in the gulf of La Spezia too[316].

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[313] Ibidem.

[314] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mar Ligure Orientale, porti della Spezia e Marina di Carrara, La Spezia, Autorità di Sistema Portuale del Mar Ligure Orientale, 2020.pgg.51-59

[315] Ibidem.

[316] Ibidem pgg.147-158.

For what concerns LNG, this is highly pushed for as a good solution in order to contain CO2, SOx, NOx emissions produced by maritime traffic.

The PSA underlines the existence of the Directive 2014/94/CE of the European Parliament and Council, which pushes member states to address their national policies at installing the necessary quantity of refuelling points of LNG all along the routes of TEN-T, as in seaports as well as in the inland for road vehicles. As a consequence, ministerial guidelines now push ports, in their turn, to dedicate some space to LNG plants in order to foster the use of this fuel by ships.

Finally, the port of La Spezia has a series of characteristics that must be taken into account: thanks to the projects TEN-T and Motorways of the Sea, maritime traffic is increasing in the latest years, important investments are being made and there is availability of a large quantity of industrial areas ready to host LNG structures. Close to the port, there is also availability of terminals for oil, natural gas, and chemical products handling and warehousing. Moreover, the presence of the regasification plant of Panigaglia in the nearness of the port makes the gulf of La Spezia particularly ready for the reception of infrastructures concerning LNG supply chain[317].

Given the above-mentioned picture of the port, the following outcome is expected in the next years: increase in the bunkering volume after the LNG implementation, increase in the demand for LNG by the Italian Navy located in La Spezia, creation of new services, conversion of Panigaglia regasification plant from source for the methane network to source for refuelling of LNG by ships and other land vehicles. The port of La Spezia is thus awaited to become a supply hub for LNG[318].

Digitalization

The port of La Spezia recognizes digitalization as a priority for its long-term strategy according to the political address given by the Next Generation EU and NRRP's "European Digital Strategy", "New Smart and Sustainable Mobility Strategy", and "Coordinated Plan on Artificial Intelligence"[319]. These frameworks aim at building a European digital Cloud for all the stakeholders, agencies and think tanks working in this sector[320]. The port of La Spezia laments a delay in the definition of a national strategy in AI and stresses the importance of digitalizing three elements involving the port: the public administrations, the supply chains

[317] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mar Ligure Orientale, porti della Spezia e Marina di Carrara, La Spezia, Autorità di Sistema Portuale del Mar Ligure Orientale, 2020.pg.145,146.
[318] Ibidem.
[319] V.V.A.A.., Piano Operativo Triennale 2022-2024, Autorità di Sistema Portuale del Mar Ligure Orientale, La Spezia, 2022.
[320] Ibidem.

involving the port and the logistics of the port system[321]. The digital transition will have to come with growth, sustainability and occupation.

The aim of digitalising PSAs is to free the administration from excessive bureaucracy while simplifying and harmonizing staff processes. This will enhance port's services and organization. The plan for the digitalisation of services sees the tools App IO and SPID as key players to improve interoperability of the services for employees, transparency and citizens' accessibility. The PSA would also like to implement new cloud services according to the guidelines of AgID[322]. The main platform through which port's stakeholders will interact shall be Sportello Unico Amministrativo (SUA) that will act in synergy with all the platforms personally used by the single actors engaged in the port ecosystem. Moreover, for what concerns the digitalisation of logistic services, there is the wish to extend SUA range of action to the SLZs and SEZs by implementing a georeferenced cartographic representation in order to check their availability.

The PSA has already implemented, in agreement with the society Logistica Digitale, the PCS APnet, an innovative tool for the management of import-export procedures. This PCS connects enterprises operating in the port with the port captaincy and the custom clearance agency. The PCS has a platform called "Corridor Management Platform", co-financed by the TEN-T fund, that allows to manage Fast Corridor trains. The PSA wishes to extend the platform services to new communitarian projects such as IRAIL, FENIX, COMODALCE and to integrate the projects URSA MAJOR NEO and the truck module. Particular importance is given to the digitalization of last mile policies concerning the transfer of freight to rail mode and of European Corridors. This will help to improve integrated manoeuvre management, interoperability of RFI operators, better management of rail nodes, and better handling of infrastructural interventions[323].

URSA MAJOR NEO is a project aimed at allowing the shipper to manage his own mission towards the port of La Spezia while receiving real-time updates on his route, availability of parking and containers, traffic, weather conditions, operations that must be done at the terminal and so on. This project aims at improving communication and reducing waiting time at passages. Another project worth mentioning is the Digital Twin, which consists in a digital copy of the port where the port actors will be allowed to play simulations on projects regarding the development of the port system. The port also participates in the projects "Labyrinth" for the implementation of drones in the port area and "SMARTBOL" for the implementation of blockchains technologies on the Bill of Lading. The PSA recognizes that the implementation of 5G and IoT technologies are key for security and interconnection between coast and inland communication[324].

[321] Ibidem.
[322] Ibidem.
[323] Ibidem.
[324] Ibidem.

PORT SYSTEM AUTHORITY OF THE WESTERN LIGURIAN SEA: GENOVA

Connectivity

In their operational plans for 2021-2023, for what concerns infrastructures, the PSA of the Western Ligurian Sea foresees for the port of Genova on one hand, urgent investments in order to restore the traffic situation as it was before the collapse of the Morandi bridge, on the other hand, the implementation of several measures indicated by the European Policy of Transports. More specifically, the port of Genova in the following three years aims at using communitarian funds in order to implement reforms aimed at complying with the TEN-T logistic corridors, improving innovation and complying with the concepts of "smart cities" and "intelligent ports". In order to do this, Genova confirms its participation in European dialogue forums such as the RFC Rhein-Alpine railway corridor from Genova to Rotterdam and the Interregional Alliance for the Rhein-Alpine Corridor EGTC. Through the Association Assoporti and its technical committees, the port of Genova will continue to bring its contribution to ESPO. The consolidated participation of the PSA of the Western Ligurian Sea to all of these platforms makes it possible for its policy-makers to attentively monitor the development on EU port and transport policy and to keep up to date with the current debate concerning issues of major interest for our port system.

From an infrastructural point of view, the PSA of the Western Ligurian Sea has the priority to develop short-range routes, strengthening the links between the port of Genova and the surrounding logistic poles. The empowerment of rails, roads and "last mile" infrastructures will be the top one priority for the next three years and valorisation of free zones, Special Economic Zones and Simplified Logistic Zones will follow suit. More specifically, in Italy's NRRP, more than one billion euros have been destined to projects of the PSA of the Western Ligurian Sea: a new breakwater for the port of Genova, cold ironing infrastructures for the passenger terminals of Genova and Savona, nautical accessibility projects, and last-mile policies[325].

Among the projects listed for the next three years there are new overpass roads, the enhancement of the railway terminal, a new railway-port junction and portals for the auto-detection of data concerning transient containers, which will be transferred automatically to the Port Community System. Finally, the project "E-Bridge" will offer information on infrastructural leakage and a response to congestion due to freight traffic in the hinterland and port area. This project has been set out after the collapse of the Morandi Bridge in 2018 and it is meant to offer a preventive measure to other potential similar situations.

Carbon footprint and renewable energies

The PSA of the Western Ligurian Sea elaborated its carbon footprint on the basis of stationing and manoeuvring ships in the port, port operators and light and heavy vehicles transiting the port.

[325] V.V.A.A.., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mar Ligure Occidentale, Genova, 2021. pgg. 91-95.

As an outcome of the carbon footprint analysis, it turns out that the main cause of Co2 emissions in the port are vessels stationing and manoeuvring in the port, this leads the PSA to take measures against these types of polluters.

In particular, vessels stationing in the port of Genova contribute for the 73% of the overall emissions by stationing vessels[326]. The second important cause of pollution in the area is the activity of the port operators such as logistic and railway services, heavy and light freight vehicles, recreational mooring, mobile handling vehicles, means of transport for support at sea.

Finally, light and heavy vehicles transiting the port are the less contributors to the carbon footprint but their effects are still felt[327].

As stated in the DEASP, the PSA of the Western Ligurian Sea sees LNG and renewable energies as a means for reducing its carbon footprint. The future of shipping stands in vessels using ammonia and hydrogen engines. Therefore, the port of Genova is preparing to exploit energy deriving from solar and wind farms until it will be able to stock energy and to produce hydrogen and ammonia for the fuelling of future vessels[328]. Genova aims at becoming the first port for hydrogen technologies.

The PSA of the Western Ligurian Sea aims at sticking to the goal set by IMO in 2018 consisting in the reduction, before 2030, of half of the emissions of GHG produced by maritime transport with respect to 2008. Decarbonization might be achieved both through the use of green fuels and through the improvement of energetic efficiency[329]. From this point of view, Italy is expected to give an important contribution in the field of green shipping, since it has a lot of potential to develop in wind and solar energy and is thus expected to produce huge quantities of “green hydrogen” and “green ammonia”. In addition to that, since it is forecast that vessels using green fuels are supposed to make more stopovers for their refuelling, Italy might play a pivotal role as energetic hub in decarbonized routes involving the Mediterranean Sea, where resources for energetic production are handled and stocked. The PSA of the Western Ligurian Sea aims at carving out a role as key player when the future world fleet will be fuelled with green energies.

For what concerns the practical implementation of renewable energies in the short-term, the installation of several photovoltaic plants is foreseen, as well as the installation of 16 charging station for vehicles in the inland. Last but not least, since the PSA of the Western Ligurian Sea strongly believes in green hydrogen as key resource for the reduction of emissions, a new plant for the production of hydrogen through electrolysis will be installed. This plant will be used in the beginning for the supply of five service vehicles

[326] Ibidem.
[327] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mar Ligure Occidentale, porti di Genova, Vado Ligure, Prà e Savona, Autorità di Sistema Portuale del Mar Ligure Occidentale, Genova, 2021. pgg.108-110.
[328] Ibidem.
[329] Ibidem.

bought by the PSA but then the use of the plant might be extended to other logistic operators both on land and at sea.

Even if its role will take place far away in the future, the PSA of the Western Ligurian Sea also believes in ammonia as a key resource for the green transition. This is why in 2020 the PSA adhered to the project "Engimmonia" gaining access to EU funds Horizon2020. These funds are meant to be used in experimentation on vessels for their fuelling with ammonia. During the 48 months of duration of the project, stakeholders involved must underline possibilities and weaknesses of the new fuelling system.

Last but not least, in the DEASP GNL is mentioned as well, in consistency with the regulation EU 1315/2013, which implies the installation of supply points for alternative fuels and LNG and cold ironing stations.
The PSA of the Western Ligurian Sea adhered to the project "GNL Facile", co-financed by Italy and France, aiming at helping ports of the two countries to stick to the European regulation and apply LNG supply. Thanks to this project, the port of Genova has been the first in Italy to provide itself with a mobile plant for the supply of LNG which will be able to supply heavy vehicles operating inside the port at first, and small vessels secondly.
Since the government has made available another 800 million euros from a complementary fund to the NRRP for the renewal of the Italian fleet and the bunkering of the LNG, a working group has been set up in order to find out a solution on how to employ these funds in an optimal way. Funds will be surely employed in order to decarbonize the shipping industry, by building supply points of LNG and Bio-LNG with stocking capabilities and new fleets suited for the bunkering from regasification terminals. The working table is also working on the establishment of a unique point of deposit and supply of LNG, for both industries, inland supply chains and marine logistic operators.

Digitalization

The logistic system of the PSA of the Western Ligurian Sea boasts an important, complex and well-working system of informative and technological infrastructures, thanks to the contribution given by all of the operators working in the port. Through several re-engineering processes, the PCS used in the port managed to always keep up to date and to be capable to answer to the growing traffic and to changing conditions of plants and infrastructures. PCS has evolved in a way that aimed at reducing information fragmentation and to enhance coordinated operativity. This has improved logistic and port efficiency during the years while standardizing processes, crating shared databases and harmonizing best practices[330].

The introduction of new IoT technologies paved the way for projects such as e-bridge, automation and revamping of passages to the port. Many gate terminals have been automatized as well as access to port

[330] V.V.A.A.., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mar Ligure Occidentale, Genova, 2021.

areas. Genova's PCS integrates several processes: it fosters automation of gate terminals providing operators with mobile applications for the fulfilment of bureaucratic access to port passages, fosters a safe transition to softwarised documents and to its exchange, and digitalizes the process railway-sea creating new mobile services that help organize the transfer of freight from ship to railway[331]. PCS also allows paperless temporary or daily allowances for import/export procedures to operators crossing international passages, in doing this, PCS also checks the personal data of the operator inside its own database comparing it to previously conducted commercial operations. This tracking system also helps improving security inside the port and all along the logistic chain. In compliance to the project of the Italian custom clearance agency "Special project for digitalization and clearance procedures in national ports" the PSA subscribed a protocol in order to fulfil onboard preclearing operations. This operation, together with gate automation, fast corridors and reducing dwell-time are all measures taken with the aim of relieving the congestion of the port. Last but not least, digitalization of last mile policies is at stake. The PSA of the Western Ligurian Sea fulfilled this task by integrating the PCS with the digital platform for train circulation. Railway pre-clearing operations are also under scrutiny[332].

PORT SYSTEM AUTHORITY OF THE NORTHERN TYRRHENIAN SEA: LIVORNO

Connectivity

In its masterplan the PSA of the Northern Tyrrhenian Sea calls for urgent intervention concerning infrastructures and the revamping of the coastal area. Ports of Livorno and Piombino have been recognized as "areas of complex industrial crisis[333]".

Ports of this area have difficulties in developing their hinterland, so, to be competitive with the ports of Northern Europe, they have to develop synergies with the ports of the Ligurian Sea both in terms of inter-modal and logistic services and in terms of long-distance shipping routes[334].

The ports of Piombino and Livorno are very well connected, instead, with airports and stopovers of short-distance routes such as Sardinia and Corsica, and entertain proactive trade relations with these territories. For the next three years the PSA of the Northern Tyrrhenian Sea wants to confirm this partnership by programming a long-term strategy of logistic and transport policies with the major islands, in order to consolidate its role of Ro-Ro logistic hub. Additionally, the PSA would like to make more agreements in

[331] Ibidem.
[332] Ibidem.
[333] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mar Tirreno Settentrionale, Livorno, 2021.
[334] Ibidem.

order to better connect to the corridor Scan-Med and become a "rail link through the Apennines in order to grant the interoperability of ICT platforms and logistic nodes[335]".

The rail link through the Apennines for the PSA is critical in order to make Livorno become a hub of Ro-Ro traffic and also to make it a container hub for the markets of Central Europe. With this work completed, Livorno could become the third strategic pole for Italy regarding the TEN-T network after Genova and Trieste, and the central pole in the new European Dockyard project.

If the aim of the PSA is to make Livorno the third strategic port of Italy, adjustments on the port hinterland and on the Apennine link will have to be made. This is why the PSA is working on an "iron plan[336]" in order to improve the connectivity of the area. The PSA has also instituted an interregional committee in order to develop coordinated actions for infrastructural and logistic programs that aim at enhancing the competitivity of the region in Europe.

The iron plan foresees the reorganization of railways by creating new rails, enhancing connections with the national railway infrastructure, enhancing last mile connections with the ports of Piombino and Livorno, and also making new rails inside the port itself.

This plan is also aimed at shifting on railroad goods that once were handled only by vehicles, reducing time and costs of freight transports, reducing interruptions on the logistic chain and fostering inter-modal transport.

Other minor works are intended to connect ports to network nodes such as Livorno, Piombino, Pisa and the freight village Vespucci. The aim of these minor projects is to better link production centres with ports and the European network. These works foresee the connection between the port of Livorno and the freight village of Guasticce (where there is a modal shift between rail and road and that is already connected to the Scan-Med corridor through Pisa and Firenze), a link between the freight village Vespucci and the line Pisa-Collesalvetti-Vada (consenting inter-modal shift) that will allow freight vehicles coming from North and South to reach Firenze, Livorno and Piombino bypassing the over trafficked station of Pisa[337]. In all of this, new railroad implementation will play a pivotal role in removing bottlenecks that often originate in the connections port-freight villages-production centres-logistic platforms and the rest of Europe.

Finally, a proposal for a Simplified Logistic Zone has been made involving the port areas of the coast (Piombino, Marina di Carrara, Livorno, Portoferraio), the freight villages of Guasticce, Vespucci, Prato and the airport of Pisa. The aim of this SLZ is to give value to the modal corridors connecting ports and the coast area to the productive centre of the Tuscany region.

[335]V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mar Tirreno Settentrionale, Livorno, 2021. pgg. 71-86.
[336] Ibidem, p.77.
[337] Ibidem.

Carbon footprint and renewable energies

The DEASP of the PSA of the Northern Tyrrhenian Sea doesn't give indications on its ports' carbon footprint but talks about the possibility of reducing its energetic dependence from third parties through the following means: cold ironing, promoting electric mobility and the fuelling of ships through LNG, producing electric energy locally through renewable sources such as wind, solar, and thermic power and improving energetic efficiency[338].

The PSA likes to underline that, in the making of this document, local communities have been involved and the process of decision-making hasn't been top-down.

The main pillar that stands out of this document is the intention of the PSA to make its ports sustainable new generation hubs. The PSA wants to transform its ports from consumers to producers of energy[339].

The PSA states that sustainability will be the principle guiding the transformation of the port in the next years and that decarbonization can be reached discouraging any action in the port that produces carbon and by fostering circular economy, energy efficiency and digitalization of processes. While LNG is well promoted for the implementation in the maritime sector, the PSA of the Northern Tyrrhenian Sea argues that it represents only a partial solution to Co2 emissions. LNG adoption is a valid means for mitigation policies but doesn't target Co2 annulment. LNG represents, thus, a "bridge energy", a temporary measure that it is convenient to adopt only until cleaner energies such as hydrogen are developed[340].

On the contrary, the PSA in its DEASP makes hydrogen its official pillar. It states that the future of logistics and freight transport stands in hydrogen that can be also used in a blended way with LNG. The request for hydrogen has been growing lately and in 2019 it has overpassed 70 thousand tonnes. Hydrogen can be created by fossil fuels, biomass or water. Today hydrogen is mainly employed in industrial processes such as oil refining, ammonia, methanol and iron production. Its price mainly depends on the cost of production of its fuelling cells.

Thanks to the Green New Deal of the European Commission, on the 8th July 2020 hydrogen officially entered the long-term strategy of the EU. Aims of the Union concerning hydrogen are to sustain processes of offer and demand through the Clean Hydrogen Alliance (gathering investors, institutions and industries), sustaining the creation of an open and competitive market and international exchanges of hydrogen, sustaining research and innovation in order to face new challenges given by hydrogen technologies, and

[338] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mar Tirreno Settentrionale, porti di Livorno, Piombino, Capraia Isola, Portoferraio, Rio Marina, Cavo, Autorità di Sistema Portuale del Mar Tirreno Settentrionale, Livorno, 2021.
[339] Ibidem.
[340] Ibidem.

sustaining international integration and cooperation in the field through the International Hydrogen Council.

According to the PSA, Italy might play a privileged role in the market of hydrogen because of its position in the centre of the Mediterranean Sea, its economic tissue made of small and medium enterprises in the sectors of energy, gas and chemicals and its ability in producing excellence in R&D. In particular, the position of the PSA of the Northern Tyrrhenian Sea for its commercial projection, its concessions, existing plants and for its dense network of enterprises might play a key role in making Italy become Europe's hydrogen hub[341].

For this reason, the PSA of the Northern Tyrrhenian Sea created the project "HY.PER" (Hydrogen Project for Energy and Resilience) aimed at developing pilot projects, research, experimentation and structural endeavours in order to integrate potentiality and needs expressed by the port system and the industrial tissues on the Italian territory. This project aims at gathering on a working table local needs, political strategies and industrial implementation in order to help configurate best practices concerning hydrogen.

HY.PER aims at giving answers to the most different requests from the market, expressed from different sectors hoping to push stakeholders to invest in the area of the Northern Tyrrhenian Sea. In exchange the PSA offers: facilities in the oil and gas sector, infrastructures of the ports' hinterland for the production, stocking and distribution of hydrogen in all of its forms, the realization of the project "GNL Power-to-Gas" in the freight station Vespucci di Guasticce in order to integrate hydrogen with LNG and possible industrial conversion in the port of Piombino, where hydrogen can play a key role in steelwork.

Finally, the PSA of the Northern Tyrrhenian Sea aims at becoming a "lab-port" for hydrogen experimentation and aims at pushing demand and the subsequent creation of hydrogen supply chains, but in order to do this, the PSA has very clear ideas in asking for a precise process of policy-making that involves consultation with the stakeholders, an experimental phase, a testing of the stockpiling and distribution system, and a last more operative phase with an implementation plan[342].

Digitalization

The PSA of the Northern Tyrrhenian Sea stresses the importance of digitalizing logistic processes, in particular by attaching ICTs to the National Logistic Platform. This will enhance transit procedures of freight from sea to land but will also improve links North-South and tracking and handling of cargos. Smart logistic chains and e-freight are pillars of the program of the PSA until 2023[343]. The port authority, in fact, supports

[341] Ibidem.
[342] Ibidem.
[343] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mar Tirreno Settentrionale, Livorno, 2021.

the implementation of intelligent devices such as electronic seals and sensors that allow to control freight and its condition in real time, improving trade facilitation. Through this, trade operators will be able to dialogue with their freight independently from the used mode of transport overcoming administrative and bureaucratic barriers. A platform for data exchange via blockchain technologies has already been implemented[344].

More in detail, for the period 2021-2023 the PSA has foreseen to divide the investments concerning the digital transition in the following four spheres:

a) Networks and connectivity: improving connectivity with the Elbe Island and communication systems in general, improving wireless connections and implementing 5G for the main connection of the port[345].
b) Services and applications: supplying acoustic sensors, environmental sensors, air quality sensors, sensors for carbon footprint and marine environment measurement[346].
c) Digital and physical control room: hosting services, second part of the control room, integration on the standard architecture of heterogeneous databases such as national and local platforms but also the port's convergence platform MONICA[347].
d) Innovation quarter: software development services for innovation industries that can bring value added to the port. Delocalization in the hinterland of the Joint-Lab where infrastructures for the technology transfer of logistic and port services are created. Integration of logistic corridors, SLZs and SEZs in the port community system. Smart terminal creation, smart container, e-freight solutions, electronic seals and preclearing operations[348].

The PSA also underlines the importance of digitalization as the basis for its transparency policies and for the implementation of e-government policies (the aim of the PSA is to enhance the use of the platform SUA). In the three-year operational plan particular attention is being paid to the issue of sensors[349]: a lot of them have already been installed in the weather station and many will be distributed for the measurement of sea pollution and noise detection. In Livorno and Piombino several will be installed for the measurement of the wave motion and sea currents and for lighthouse illumination and control. Many of these sensors have already been connected to the platform MONICA, which is used to collect, store and analyse data coming from the sensors. MONICA also creates 3D models with the data collected. The port already uses a PCS called Tuscany Port Community System which wishes to enhance with further feature such as e-freight solutions and synchro-modality functions (smart containers, smart terminals etc) and a connection with the

[344] Ibidem.
[345] Ibidem.
[346] Ibidem.
[347] Ibidem.
[348] Ibidem.
[349] Ibidem.

MONICA platform. Lastly, the port underlines the importance of training. A significant lack of know-how in digital engagement has been detected among the port workers and the PSA is seeking to set up collective training plans in order to enhance the digital skills of the personnel[350].

PORT SYSTEM AUTHORITY OF THE CENTRAL-NORTHERN ADRIATIC SEA: RAVENNA

Connectivity

In its three-year operational plan, the PSA of the Central-Northern Adriatic Sea presents a very pragmatic overview of the works it intends to accomplish in order to improve its connectivity with the European logistic network. Works in several areas of logistics are foreseen such as road transport and railways.

The PSA envisaged a program called "Ravenna Port Hub" that entails the realization of logistic platforms on the right and left side of the Candiano canal at the service of the port of Ravenna, as per port's masterplan. At the moment the authorities are studying a way to connect the right side of the canal to the road SS67 and to the railroad. Town authorities recently approved logistic and urbanization plans for the logistic platforms "San Vitale" and "Trattaroli"[351].

For what concerns road transport, the municipality of Ravenna developed a project called "Piano Urbanistico Attuativo[352]" that foresees the link of the port of Ravenna to the waterway system of the Po Valley for internal navigation. The PSA underlines the importance of internal waterways in this area from several years, but feasibility studies are still in progress. Moreover, the PSA underlines that internal waterways of the venetian-padan area are not competitive because of high port tariffs that are applied equally for maritime ships as well as for canal boats. The PSA insists on the need to enhance infrastructures for ferry boats Ro-Ro and Ro-Pax and to increase fiscal benefits and facilitation for the navigation and transport in internal waterways[353].

Railway investments are also foreseen in the three-year plan as last mile policies. The first investment concerns the enhancement of the railroad track Ferrara-Poggio Rusco-Verona for the realization of a freight route alternative to the node of Bologna which always creates bottlenecks. This pathway has strategic importance for the country, since completing the link road Ferrara-Ravenna/Codigoro and Ferrara-Poggio Rusco will allow freight trains to be addressed from Ravenna directly to the Brennero pass through a pathway with little traffic and interference.

[350] Ibidem.
[351] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale, Ravenna, 2021.
[352] Ibidem.
[353] Ibidem.

Another railroad track that will be strengthened is the one concerning Castel Bolognese-Ravenna, in order to discharge the pressure on the track Ravenna-Bologna, now suffering from the coexistence of trains going at very different speed. By separating rail tracks according to the different speeds the capacity of the new track Castel Bolognese-Ravenna will improve sensibly, avoiding delays and bottlenecks.

Finally, the PSA of the Central Northern Adriatic Sea has the aim of making the port of Ravenna one of the most modern and efficient nodes in Europe. For this, a series of substantial interventions has been put into place that will regard not only port and railway logistics, but will have a huge repercussion on all Emilia Romagna roads, tourism and freight handling as well. Among the new pathways worth mentioning, the new road linking Ravenna-Ferrara-Porto Garibaldi will have huge impact on viability[354].

Carbon footprint and renewable energies

The PSA of the Central-Northern Adriatic Sea elaborated the carbon footprint of the port of Ravenna on the basis of the following parameters: tertiary services taking place inside the port structure or in other support buildings, dock lightning, navigation by shipowners, handling of goods by port enterprises, every activity pursued for the correct working of the basins such as ship towing, mooring and traffic control, water basin clearance, transfer on land of solid and liquid waste of ships, freight transport via train or van inside the port area. All of these activities are gathered under five main categories of attribution of conduct: Port System Authority, main navigation, support navigation, port enterprises, freight transport[355].

The analysis conducted in 2019 led to the result that activities developed by the PSA have negligible incidence (0,7% of total emissions) while 75,3% of impact on air is attributable to shipowners' main navigation in the port. Cargo handling from port enterprises amounts to 15,2% of air emissions while cargo transport gives birth to only 3,7% of total emissions[356].

Main emissions under the responsibility of the PSA consist in the production of electric energy for the docks, external areas service and main buildings. The cause of the high percentage of emissions produced by main navigation stands is due to ships stationing for a long time in ports and having the necessity to keep engines running all the time. Manoeuvres in ports generate a lot of pollution as well.

Support navigation from tug boats towing ships inside and outside the port also contribute to navigation emissions.

[354] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale, Ravenna, 2021.pg.94-104.
[355] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mare Adriatico Centro-Settentrionale, porto di Ravenna, Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale, Ravenna, 2021.pg.21-33.
[356] Ibidem.

Port enterprises are accountable for 15,2% of emissions of GHG due to loading and unloading of cargos on docks. Such operations are made possible through the use of cranes fuelled with gasoline. Conveyer belts and company cars also account for enterprise emissions[357].

Means responsible for freight transport are mainly trucks and trains exiting from the port.

In order to improve general energetic and environmental conditions of the port and rebalance air emissions a series of intervention have been put into place both by private and public entities[358].

Private entities promote interventions concerning renewable energy plants, thermal insulation plants, climatization systems, energetically efficient engines and vehicles, electrification plants for cargo handling.

Public sector, on the other hand, promotes interventions concerning dredging operations at low energetic consumption, cold ironing systems, stockpiling and distribution systems for LNG[359].

For what concerns renewable energy plants, a uniaxial sun tracking system of 19,7 MWP fuelled with green hydrogen is supposed to be installed on the port inland. This project has been submitted to the government in order to receive funds for a total of 100% in the framework of the project Green Ports[360].

Another clean energy project concerns the construction of platform roofs with solar panels and electric charging columns for vehicles in the framework of the projects Sustainable Ports. These platforms will be built in the parking lot of the PSA in order to be used together with the two new electric/hybrid plug-in cars bought by the PSA for their own use inside the port area.

In order to improve the energetic efficiency of the port, cold ironing is also fostered, not only for the cruise terminal and for the implementation of LNG but also in terms of connection with the internal functions of the port. Improvements in sustainability are foreseen since cold ironing allows ships to turn off their engines and recharge through electric systems.

LNG is another great investment for the port of Ravenna. The company “La Petrolifera Italo Rumena s.p.a.” has set up a project for the reception and stocking of LNG in the port of Ravenna that will occupy an area of around 23.000 square meters. Before the installation of the system, docks have been restored and lightning has been finished in 2021[361].

Last project worth mentioning is “Cintura verde” that aims at creating a green belt of gardens for the requalification of the landscape between port and city and at the mitigation of climate-changing emissions. Chosen vegetation is supposed to absorb Co2 emissions produced in the port area thus purifying air and

[357] Ibidem.
[358] Ibidem, pg.34.
[359] Ibidem.
[360] Ibidem.
[361] Ibidem.

creating a humid zone. The project has been submitted to the government in order to be financed with the funds of NRRP[362].

Digitalization

The port of Ravenna distinguishes its approach to digitalization in two categories: on one hand the digitalization of the PSA, on the other hand the digitalization of the port cluster for its innovation and competitiveness. The PSA of the Central-Northern Adriatic Sea first elaborated a plan for digitalization and appointed a chief in charge for the transition in 2021. The transition is expected to be fully accomplished by 2023[363].

According to the guidelines given by AgID, the PSA is willing to implement the system Pago PA in order to ease payments towards the public administration, to digitalize its cartographic heritage and to supply itself with a GIS tool for geographical individuation, to implement the SUA platform, and to equip itself with drones for port inspection and survey[364]. Drones take part of those high technologies that can arrive in places inaccessible to men, they are thus used to survey particular milieus such as places where incidents took place or seabed as well.

For what concerns digitalization for competitiveness, the PSA would like to exploit digitalization in order to enhance connection between logistic nodes and multi-modal corridors through the national logistic platform, the integrated platform for circulation, the port community system and the port management information system[365]. The PSA also plans to enhance the fiber optic cable infrastructure on the right side of the Candiani canal. Last but not least, two major projects involve the Ursa Major Neo funds and the "project for digitalization of custom clearance in the port of Ravenna". In the framework of the former project, the port of Ravenna aims at automatizing the passage to the ferry terminal, while for the latter project the port aims at introducing web-oriented reforms that can simplify the handling and control of the transient goods. Automatization of port passages, digitalizing custom clearance, port tax payments, and tracking of goods will take place in three phases that will be coordinated thanks to the PCS[366].

[362] Ibidem.
[363] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale del Mare Adriatico Centro-Settentrionale, Ravenna, 2021.
[364] Ibidem.
[365] Ibidem.
[366] Ibidem.

PORT SYSTEM AUTHORITY OF THE NORTHERN ADRIATIC SEA: VENEZIA

Connectivity

The port of Venice is connected to the European network through the Mediterranean and Baltic-Adriatic corridors.

It is served by all modes of transport, even though road and ship remain the most used ones. The road network is well connected to the rest of the region through national highways, consenting a reduced time of freight shipping. Port access is granted through the gateways of Marghera, Venezia Marittima and the stopover for Ro-Ro and Ro-Pax ships in Fusina. Railway manoeuvres mainly take place in Marghera Scalo[367].

Even though the railway system is still hardly exploited, the port of Venice aims at shifting on railway mode around the 50% of its freight traffic. An explosion of railroad traffic is foreseen thanks to the funds of the NRRP that will consent to finish old infrastructural works (among which the opening of the Brennero tunnel that will allow an increase in the use of Trans-Alpine corridors, increasing the flow of freight transport to Central Europe) and begin new ones. Main infrastructural work in progress are the ones reported in the following table:

ID	Description
1	Gotthard Basel Tunnel
2	Ceneri Base Tunnel
3	Semmering Base Tunnel
4	Fehmarnbelt Tunnel
5	Terzo Valico (Giovi pass)
6	Koralm Railway Line
7	Brennero Base Tunnel (including section Fortezza-Ponte Gardena)
8	Verona access
9	Trento & Bolzano bypass
10	Loetschberg Base Tunnel
11	Linz – Wels
12	ABS/NBS Hamburg – Hannover
13	ABS Emmerich-Oberhausen
14	ABS/NBS Nürnberg – Erfurt (Verbesserungen für SGV-Nutzung) + Güterzugtunnel Fürth
15	ABS Uelzen - Stendal - Magdeburg - Halle (Ostkorridor Nord)
16	NBS Stuttgart - Ulm (2030)
17	ABS Stuttgart-Singen-Grenze D/CH (Gäubahn)
18	ABS Grenze NL/D – Kaldenkirchen – Mönchengladbach – Rheydt-Odenkirchen
19	Berlin - Angermünde - Stralsund
20	Angermünde - Grenze D/PL (- Stettin)

16. Source: BCP Rail Freight Study, 2021

Only the works on the Brennero tunnel are supposed to lead to an increase of freight transport demand of 29,8% by 2030 and of 50,9% in 2040[368]. With this increase very likely to take place, an enhancement of rail infrastructures between ports and freight villages will be necessary. The PSA of the Northern Adriatic Sea

[367] V.V.A.A., Piano Operativo Triennale 2022-2024, Autorità di Sistema Portuale del Mare Adriatico Settentrionale, Venezia, 2021.
[368] V.V.A.A., Piano Operativo Triennale 2022-2024, Autorità di Sistema Portuale del Mare Adriatico Settentrionale, Venezia, 2021.pg.20.

also calls upon the creation of new inter-modal terminals in particular within the North of Italy, and the rapid implementation of last mile policies in order to separate urban from port traffic.

In order to maintain its position of core node in the Trans-European Network of Transports in the next years, the port of Venice will have to upgrade its railway terminals and introduce inter-modal functions both for land and sea freight transport[369].

Carbon footprint and renewable energies

In determining its Greenhouse Gas Inventory, the PSA of the Northern Adriatic Sea takes into consideration emissions attributable to ships in service inside the port, ships stationing and manoeuvring in the port, ships navigating outwards[370].

The major source of air emissions comes from freight ships during mooring operations and manoeuvring or navigating inside the port. These two categories represent respectively the 61,5% and the 10,6% of the emissions in the port. Other minor sources of emissions are logistic mobility on land, internal and external to the port (8,9% and 8,5%) and freight and industrial terminals (5,6% and 2,8%).

Maritime passenger terminals, port buildings, inter-modal terminals, PSA offices and mooring ships constitute an irrelevant source of emissions, according to the analysis in the DEASP.

For what concerns the green transition of the port, the PSA of the Northern Adriatic Sea is concerned with several initiatives regarding energetic efficiency, cold ironing, electric mobility, LNG promotion and the construction of the Venice Hydrogen Valley[371]. Thanks to the funds coming from the NRRP (project Green Ports) monitoring emissions will come alongside with a plan for instituting green areas and planting trees. Alongside with NRRP the Italian Ministry for the Ecological Transition published an expression of interest for ports proposing interventions improving energetic efficiency and renewable energies with the aim of reducing Co2 air emissions due to fossil fuels. The budget foreseen for these projects was of maximum €22.000.000 for projects presented by 2021 and the PSA of the Northern Adriatic Sea participated with projects concerning led illumination plants for port buildings, infrastructures for cold ironing and the purchase of 4 full-electric vehicles, one hydrogen-fuelled truck for freight handling and one hydrogen freight ship[372].

The NRRP foresees an investment of 675 M € for cold ironing projects in all of the Italian PSAs. This investment is strategic for the reduction of emissions coming from freight handling. Marghera station is

[369] Ibidem.
[370] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mare Adriatico Settentrionale, porti di Venezia e Chioggia, Autorità di Sistema Portuale del Mare Adriatico Settentrionale, Venezia, 2022.
[371] Ibidem.
[372] Ibidem.

particularly suitable for the implementation of this technology, since it has thermoelectric centrals close to the docks that can guarantee the necessary recharge power. For this purpose, 90M euros of the complementary fund of the NRRP have been assigned to the PSA of the Northern Adriatic Sea for the terminals of Marghera, Fusina and Venezia Marittima.

Another very important project taking place in the port of Venice concerns the Hydrogen Valley. The European Green Deal underlines the importance of ports as potential clusters putting in communication energy, industry, and circular economy. Hence, ports have the potential to become new clean energy hubs for hydrogen and other low carbon emissions energies. The PSA of the Northern Adriatic Sea is thus focused on promoting policies in order to reduce dependence on fossil fuels and foster the use of alternative energies with lower environmental impact, in compliance with the EU Green Deal[373]. On April 15th, 2021 the PSA of the Northern Adriatic Sea and the companies SAPIO srl and Hydrogen Park (composed by ENI, Enel, Confindustria Venezia, Decal and Sapio) subscribed a Memorandum of Understanding with the aim of starting a collaboration for the development of a green hydrogen hub in the area of Porto Marghera. The consortium of companies started working on feasibility studies assessing the potential of the port area and its hinterland, which is a zone of high logistic density. The feasibility study in question aims at finding potential uses of green hydrogen and cold ironing for port and industrial infrastructures and the best solutions for the production, stockpiling and distribution of green hydrogen and for the construction of deposits of green ammonia. Finally, the study aims at finding a proposal for the joint development of a green supply chain of hydrogen destined to be used as a fuel for the TEN-T corridors involving the port of Venice and the ports of the Oriental Mediterranean Sea (EASTMED)[374].

The PSA has the commitment to stick to the "strategic national framework for the supply and transportation of LNG" and to the "work plans" of European interest in the Adriatic-Baltic and Mediterranean corridors for the development of the core TEN-T network. In these frameworks LNG is highly strategic because it is proven that a complete supply and distribution chain could allow to diminish emissions of PM10 by -90% and sulphur dioxide by -95%[375].

The LLC Venice LNG is going to realize the first ever LNG terminal in Porto Marghera. The terminal will consist in a deposit and a barge for transportation and supply of LNG to towing vessels. With an investment of over 140 million euros, the port of Venice will be the first in the Adriatic Sea to complete the logistic chain for LNG supply to vessels. The stockpiling system will have a capacity of 32.000 m^3 and will be fuelled by ships of medium capacity (max 30.000 m). The distribution will take place through vans, barges and

[373] Ibidem.
[374] Ibidem.
[375] Ibidem.

railway mode. This will allow to develop a logistic chain for the deposit and distribution of alternative LNG through maritime transport for both the North Adriatic Sea and the internal waterway system[376].

Digitalization

The framework to which the port of Venice refers to for the implementation of digitalization policies consists in Regulation 2021/1153, Connecting Europe Facility and the NRRP. For these frameworks the general aim is to build, develop, modernize and complete trans-European networks in the logistic, energetic and digital sector, incentivising both private and public investments. Synergies among these sectors are encouraged in order to speed up the decarbonization and digitalization of Europe. For the period 2021-2027 in the digital sector CEF foresees to contribute to the development of a high-capacity network (5G), capable of enhancing resilience and capacity of backbone networks while connecting them with neighbouring territories. Digitalization shall involve public administration too. Great momentum will be given to the digitalization of procedures. PAs will have to follow the "strategic and evolutive model on information technology for PAs", which foresees a budget of 3.000.000 € in order to implement big data, cloud and AI technologies. PAs will also have to improve their digitalization outwards: here SUA will play a pivotal role in slimming down the relations with end users. This new single interface will be used to perform several operations among which: release, renounce or renewal of maritime property concession, temporary occupation of port areas, authorization for new works in ports, subscription to the guide register, authorization for debarkation of junk and so on. Bibliographic and archival material will also be digitalized in order to allow online consultation.

PORT SYSTEM AUTHORITY OF THE EASTERN ADRIATIC SEA: TRIESTE

Connectivity

The port of Trieste covers a role of extreme importance in connecting freight traffic coming from Italy to Central, Eastern and Northern Europe. Among all of the Italian ports Trieste is the first in line for amount of traffic (Eurostat, 2019). This is mainly due to the progressive shift of the economic-manufacturing centre of production towards South-West and the increment in the manufacturing index of the countries pertaining to Central and Eastern Europe[377]. Trieste also offers a free trade zone and a higher seabed with respect to the other Italian ports (up to 18 meters of deepness), with the possibility of mooring new generation ships (up to 25.000 TEU). Today Trieste represents the most important inter-modal gateway to Europe thanks to the strengthening of the "via Adriatica" and of the hinterland of the port that through its inter-modal

[376] Ibidem.
[377] V.V.A.A., Piano Operativo Triennale 2017-2019 Revisione n'3 (2020), Autorità di Sistema Portuale del Mare Adriatico Orientale: Porti di Trieste e Monfalcone, Trieste, 2020.

platforms connects the North of Italy to all Europe. In 2019 the share of the railway connection system amounted to 56% for containers and 23% for the Ro-Ro sector. Trieste has thus reached well in advance the objective set by the EU of shifting the 50% of port freight transport on modes of transport not concerning road by 2050. The inter-modal landscape of Trieste aims at reaching further destinations such as Poland[378].

As a consequence of the pandemics, the port of Trieste elaborated a program for strategic investments in the sectors of industry and logistics at the service of the port area and hinterland. This program is called "Adriagateway" and foresees investments for the green and digital transition on a short-term period lasting from 2020 to 2026. Adriagateway is composed of 57 points (divided in 6 macro-categories) to be implemented in the port system. The program accounts for 2,4 billion euros[379].

Adriagateway plan involves the ports of Trieste and Monfalcone as well as other logistic and inter-modal platforms along the railway tracks connecting the ports to the rest of the region Friuli-Venezia-Giulia (freight village Trieste-Fernetti, free trade zone Bagnoli della Rosandra and the node Cervignano del Friuli). Some public interventions have been individuated in order to be possibly filed by competent authorities in the list of works finance through the NRRP.

The first intervention called "Trieste Rail Port Program" is funded by CEF and aims at creating a new regulatory plan for the railways of Trieste and Campo Marzio, connecting port areas to their hinterlands. The intervention will be realized in collaboration with Rete Ferroviaria Italiana and the Italian Ministry for Infrastructures and Transports. Another intervention regards the programmed maintenance works to the railroads of Monfalcone and Trieste. Maintenance and adjustment work in the railroad link Aquilinia-Wartslig will be needed too, in order to connect the free trade zone FREEeste to the one of the port of Trieste. The two zones aim at guaranteeing the same privileges to freight carriers and economic operators; hence, it is very important to have the two zones well connected. The port of Monfalcone and its docks and railways will have to undergo geometric adjustments, as well as the station Aquilinia and Stazione di Muggia (left in abeyance for years), in order to improve the accessibility to the port and its infrastructures[380].

Finally, a project concerning the railroad link Aquilina-ex Aquila has been submitted for the implementation of a multipurpose marine terminal. At the moment the industrial railroad link is in disuse and its reactivation will give momentum to the area.

[378] Ibidem.
[379] Ibidem.
[380] Ibidem.

A new Operational Centre will be responsible for railway and logistic services in the new Punto Franco Nuovo. From here, routing services, itineraries, port assets and centralized computer services will be controlled from a single operator for manoeuvres. Security adjustments at all levels will follow suit[381].

Carbon footprint and renewable energies

According to art. 5 of the Decree n. 169/2016, the bidding process for the redaction of the DEASP of Monfalcone and Trieste (Project n. 1903) has been kickstarted but it is still ongoing at the time of writing and finalization of the document is postponed at a date yet to be set.

By the way, in an event called "Energetic transition and institutional collaboration in the sector of Blue Economy" organized on May 2023 by the International Propeller Club of the port of Trieste, the commissioner for environmental protection, energy and sustainable development Fabio Scoccimarro asserted that the port of Trieste is going to invest an amount of money coming from both private investments and the NRRP equivalent to 1 billion euros in projects aimed at satisfying the requests of the European Green Deal and of the 2030 UN Agenda on sustainable development and decarbonization[382].

The commissioner stated that the objective of decarbonizing the port has already been achieved through the requalification of the ironwork area of Servola and the closure of the coal power plant of Monfalcone[383]. This important result has been achieved thanks to the precious collaboration that the port has with local universities and scientific research centres. Thanks to its strong collaborations and to the important contribution of the region Friuli Venezia Giulia the port of Trieste aims at achieving carbon neutrality five years in advance with respect to what has been foreseen by the European Green Deal[384]. The port of Trieste puts innovation, technology and sustainability at the forefront of its policies for the next years, aims at investing in hydroelectric energy, biomass and photovoltaic plants and makes of cold ironing its warhorse[385].

On February 2023, the company AcegasApsAmga (Hera group) together with the city authority of Trieste and the PSA presented the project Smart Grid, which is aimed at empowering electric power supply for cold ironing in dock VIII[386]. AcegasApsAmga received a fund of 18 million euros for the implementation of the project in the port, which is supposed to receive electricity coming from renewable energies, recharge vessels and port terminals and support port assets' digitalization[387]. The development of dock VIII and its

[381] Ibidem.
[382] A. Di Giusto, "Porto di Trieste all'avanguardia nella sostenibilità", il Friuli. It, 05/23/2023, https://www.ilfriuli.it/economia/porto-di-trieste-allavanguardia-nella-sostenibilita/ .
[383] Ibidem.
[384] Ibidem.
[385] Ibidem.
[386] V.V.A.A., "Più energia per il porto di Trieste: 18 milioni dal Pnrr", Adria Ports, 02/14/2023, https://www.adriaports.com/it/logistica/energia-porto-trieste-18-milioni-pnrr/ .
[387] Ibidem.

cold ironing are expected to need 160 megawatts of electric energy. The project is expected to start in 2023 and to be finished by 2026. Thanks to the collaboration with the company Terna, requests coming both from the port and the rest of the city have been merged and Smart Grid is going to be able to integrate and satisfy the requests of both the environments.

Integration of the digital sector with the energy one is becoming crucial for the success of the implementation of new projects, since, thanks to the digital twin, authorities and companies were able to confront over the optimization of processes concerning distribution and consumption of the electricity network[388].

For what concerns energy efficiency and the reduction of air emissions by the PSA (that represent around the 33% of the total emissions of the port area), the port is working on several interventions on its own structures: requalification of PSA buildings (Lloyd Tower, Building 60, Building 53, Building "Ex Culp", Building "CSD"), substitution of public illumination lamps with LED technology, modernisation of car parks and, naturally, on-shore power supply implementation. All of these measures are expected to bring a great saving of air emissions with respect to the carbon footprint of the port[389].

Digitalization

The port of Trieste is also active in the digital transition. The PCS of the PSA of the Oriental Adriatic Sea, Sinfomar, has been recently implemented with the Single Windows and with IT systems for automated control[390]. These are tools that are growingly requested for strategic efficiency of logistics in the port area.

From October 2022 Sinfomar has also been implemented with new functions aimed at simplifying and digitalizing bureaucratic practices fostering the possibility of working on one and only port passage[391]. Through a procedure called "Prior notification of arrival" freight carriers reaching the port will be able to reduce bureaucratic practices and time spent in the port area while improving freight trackability[392]. This is likely to make the port of Trieste more attractive and competitive. Carriers not having performed their

[388] Ibidem.
[389] V.V.A.A., Porto di Trieste - Piano d'azione per un porto sostenibile e a basse emissioni di CO2, Interreg-Adrion: European Interregional Developmetn Fund – Instrumnet for Pre-accession, Sustainable Ports in the Adriatic-Ionian Region, Trieste, 10/19/2019.
[390] V.V.A.A., Piano Operativo Triennale 2017-2019 Revisione n'3 (2020), Autorità di Sistema Portuale del Mare Adriatico Orientale: Porti di Trieste e Monfalcone, Trieste, 2020.
[391] L. Zani, "Il porto di Trieste sempre più digitale", Redazioni TGR Friuli Venezia Giulia, 10/29/2022, https://www.rainews.it/tgr/fvg/video/2022/10/il-porto-di-trieste-sempre-pi-digitale-7f1e08aa-5412-4354-a51e-4627a4b4d631.html .
[392] Ibidem.

duties will be addressed to a buffer area where they will be able to fulfil bureaucratic practices on the spot[393].

Another very important project that concerns the digital sphere and sees the total involvement of the PSA is the digital twin of the port of Trieste. The digital twin consists in BIM technology (building information modelling) i.e., a digital informative system where a 3D model is integrated with functional and physical data of the building itself. Here, information concerning the life cycle of the building (from its construction to its dismission or destruction) is shared among all the stakeholders with different levels of access. Applications of the digital twin of the port are several: from communication (showcasing the port in its three dimensions) to the preparing of forecasting models for security reasons, fostering nautical accessibility, management of services and finally planning of the cold ironing network, as aforementioned.

PORT SYSTEM AUTHORITY OF THE SOUTHERN TYRRHENIAN AND IONIAN SEAS: GIOIA TAURO

Connectivity

The port of Gioia Tauro for its works on logistics counts mainly on the incentives granted by the Documento di Economia e Finanza 2021 called Marebonus, Ferrobonus and Sconto Traccia. These incentives are aimed at improving inter-modal logistics between rail, sea and road, enlarging railways, and enhancing logistic nodes. In the next years, the PSA aims at giving particular attention to the links railroad-ship[394]. Connection, security and sustainability are the keywords of this document.

The three-year plan is mainly focused on the importance of instituting a Special Economic Zone surrounding the core port and its hinterland. This core zone shall be interconnected to national ports, freight villages, airports and main productive areas of the region, with the aim of enhancing economic relations with the rest of the nation. The purpose of the SEZ shall be to attract new investors willing to operate on the territory of Gioia Tauro thus offering convenient services like facilitated connections to other logistic nodes and the rest of the world. To this purpose, the PSA of the Central Southern Sea and Straits has foreseen a set of interventions in order to guarantee urbanization to those areas willing to take part in the SEZ that are still not capable of offering primary services[395].

[393] Ibidem.
[394] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale dei Mari Tirreno Meridionale e Ionio: Porti di Gioia Tauro, Corigliano, Crotone, Palmi, Vibo Valentia, Gioia Tauro, 2021.
[395] Ibidem.

For what concerns inter-modality, the port of Gioia Tauro already achieved the objective of reaching full freight mobility and accessibility to Europe by connecting the square behind the docks to the main national freight villages (and thus TEN-T corridors) through a new inter-modal terminal[396].

From the 80s onwards Gioia Tauro confirmed its position as the first container port both in the Mediterranean Sea and along the Suez-Gibraltar SLOC[397]. In the future it aims at consolidating its position in the transhipment sector as well, trend that started in 1995 and in which it has gained a leader position in the Mediterranean Sea in few years. Gioia Tauro today boasts 120 connections of which 60 are in the Mediterranean and Black Sea, and 60 represent international routes in the Americas, Oceania, Northern Europe and South-East Asia. Being a joint towards the outer world, Gioia Tauro's connections with the hinterland and the rest of Europe are extremely important[398].

The port of Gioia Tauro is already connected to the highway A2, part of the TEN-T, and thanks to 5 parallel junctions it is connected to the main cities of the region Calabria: Reggio Calabria, Vibo Valentia, and Lamezia Terme[399]. The Northern part of the Tyrrhenian coast and the Ionic side remain inadequately connected. Railroads connect the port of Gioia Tauro with the Tyrrhenian coastline Battipaglia-Reggio Calabria which is considered part of the core national network. On this railway line there are several important railway nodes: Paola, Lamezia Terme and Villa San Giovanni that connect the port to Sibari, Catanzaro Lido and Messina[400].

Even though through the connection of these nodes the PSA of the Central Sea and Straits reached the objective of complying to the multi-modality of transport given in the definition of the TEN-T network, still last mile policies are to be implemented in order to reach territorial cohesion[401]. The national railroad company RFI failed to apply, in the necessary timeframe, works that were programmed in order to enhance last mile port connections. Once these works will be completed Gioia Tauro will be the main southern gateway for freights coming from the Suez-Gibraltar SLOC connecting them to Italian freight villages and thus European markets. Hence, Gioia Tauro has logistic international relevance[402].

[396] Ibidem.
[397] Ibidem.
[398] Ibidem.
[399] Ibidem.
[400] Ibidem.
[401] Ibidem.
[402] Ibidem.

Carbon footprint and renewable energies

Unfortunately, the drafting of the DEASP of Gioia Tauro is still underway[403]: this means that the targeting of clear objectives for the decarbonization of the port is still ongoing and information on carbon footprint of the port is not available. By the way, in the POT there is information on environmental policy and energetic efficiency. According to the Directive 2014/94/UE of the European Parliament on the realization of infrastructures for alternative fuels, the PSA of the Central Southern Sea and Strait is planning the development of bunkering plants and systems for the supply of LNG. The topic of energetic efficiency has been developed too and several interventions concerning the maintenance of state-owned areas have begun in 2020. Interventions have been programmed for docks, shipyards, internal and port viability[404]. Other information can be found on the sustainability report published in 2021[405]. Here, the PSA recognizes reduction of emissions, safeguard and protection of territory, biodiversity and community as a priority. For this purpose, several programs for the reduction of pollutants and energetic efficiency in the port have been put into place. Buildings, illumination systems and infrastructures will be key subjects. Public illumination in particular has been individuated as in need of adjustment interventions. According to the Sustainability Report, the PSA in 2019 has already achieved the objective of zero emissions of natural gas, while indirect emissions of GHG have been reduced of 19%[406]. In the sustainability report particular importance is given to the preservation of water resources and waste management. Even though the PSA is not in charge of waste management itself, it organized a plan for ship waste collection and management, as a proof that environmental care is a priority of the PSA [407].

Digitalization

Unfortunately, the topic of digitalization inside the three-year operational plan of Gioia Tauro is poorly treated. The few information about it concerns the digitalization of the logistics and the ICT field. Preclearing and fast corridors operations have already been undertaken two years ago. The PSA is also engaged in the development of the European Maritime Single Window Environment that foresees the possibility of integrating the PCS in the PLN. In particular, the PSA aims at "creating an integrated service platform aimed at offering end users and port operators of Gioia Tauro a wide array of information services thus bringing added value to the port[408]". This purpose will be reached through the dialogue with the value

[403] V.V.A.A., *Bilancio di Sostenibilità Ambientale del Sistema Portuale dei Mari Tirreno Meridionale e Ionio,* Autorità di Sistema Portuale dei Mari Tirreno Meridionale e Ionio, Gioia Tauro, 2021.
[404] V.V.A.A., Piano Operativo Triennale 2021-2023, Autorità di Sistema Portuale dei Mari Tirreno Meridionale e Ionio: Porti di Gioia Tauro, Corigliano, Crotone, Palmi, Vibo Valentia, Gioia Tauro, 2021.
[405] V.V.A.A., *Bilancio di Sostenibilità Ambientale del Sistema Portuale dei Mari Tirreno Meridionale e Ionio,* Autorità di Sistema Portuale dei Mari Tirreno Meridionale e Ionio, Gioia Tauro, 2021.
[406] Ibidem.
[407] Ibidem.
[408] Ibidem.

chain operators thanks to the implementation of the platform "Sportello Unico Doganale". The project also foresees the creation of a PCS that shall be empowered in order to work in synergy with the PLN. Moreover, in order to speed up custom clearance procedures, PCS shall be integrated with functions that allow onboard preclearance "at sea" which is already taking place from several years under the authority of the local PSA[409].

PORT SYSTEM AUTHORITY OF THE IONIAN SEA: TARANTO

Connectivity

The PSA of the Ionian Sea in its three-year plan sets goals for the port of Taranto according to 4 sectors: innovation, sustainability, port and territory, physical infrastructure and competitiveness[410].

Connectivity to the rest of the territory and inter-modality are barely touched upon under the objective number 4: physical infrastructure of the port and competitiveness. The chapter opens up with innovations brought up in 2020 such as the new container stopover and the new feeder service. Then, the document focuses on the importance of developing a network based on specialized logistics structures capable of granting the continuity on land of maritime traffic[411]. The importance of connectivity is also linked to the importance of the continuity of the port system to manufacturing activities, and this is why in 2021 a SEZ and a customs' free zone were instituted. These measures are expected to increment the economic growth of the territory. The PSA also established the creation of an Eco-industrial Park that will set the scene for the implementation of administrative procedures necessary for the realization of a logistic platform in the hinterland of the port as well as for the development of an inter-modal network of transport in a logistic area of 75 hectares[412].

From the NRRP the stopover on the Ionian Sea will receive 150 million euros, with which it will accomplish five missions: efficiency and optimization of port services, enhancement of the efficiency of the existing infrastructure and implementation of new strategic infrastructures (logistic platform of the port, buildings for logistics and techno-nautical services, adjustment and enlargement of the docks, reconstruction of decks), investment attraction through the newly instituted SEZ and CFZ, promotion of the maritime cluster of Taranto and valorisation of the port of Taranto in the framework of the TEN-T network[413].

Inherently to this last mission, the PSA states that during 2020-2021 activities connected to Scan-Med corridors underwent a drastic stop because of the covid-19 crisis. Nevertheless, a redefinition of supply

[409] Ibidem
[410] V.V.A.A., Piano Operativo Triennale 2020-2022 (Revisione annuale 2021), Autorità di Sistema Portuale del Mar Ionio: Porto di Taranto, Taranto, 2021.
[411] Ibidem.
[412] Ibidem.
[413] Ibidem.

chains in regional terms is expected to foster shortsea maritime transport for which ports on the Mediterranean Sea hold a leadership position[414].

Carbon footprint and renewable energies

In its GHG inventory the PSA of the Ionian Sea considers: buildings of the PSA and other public entities, Management and maintenance of common parts of the port, maritime passenger terminals, road mobility internal to the port, industrial and commercial maritime terminals, freight vessels at berth or manoeuvring (close to the dock or at sea), inter-modal terminals railway/road and freight villages in the port area, vessels navigating in the port. As sources of GHG the port considers: fossil fuels for air conditioning of properties, for operational and road vehicles, for transport vehicles, for vessels in the port area, electric energy exchanged with the net, imported by the net and for logistics services[415]. According to the outcome of the GHG inventory, industrial and freight terminals constitute the majority of the polluting agents in the port, being transports on land and offshore the 98,51% of the agents producing air emissions in the port area[416].

The three-year plan of the PSA aims at making Taranto a resilient port as well as reaching the achievements of "smart port" and "green port". For this purpose, several public and private actions have been planned under the objective number two of the document: sustainability.

Action number six regards the supply of energy from renewable sources and the development of alternative fuels. The PSA is assessing the possibility of realizing cold ironing systems in docks, Molo Polisettoriale and Pontile Petroli. Supply material for this program has been put in the biannual program purechase and supply of 2022/2023. Moreover, feasibility studies are taking place in order to assess the possibility of making a requalification of the energetic plants of the port in order to install lamps generating light through led and renewable energies.

Action number 7 regards the development of sustainable mobility inside the port area. The port adhered to the project "Green Mobility" according to which it will buy vehicles at low carbon emissions, both electric or hybrid, and also subscribed an agreement with Enel X in order to install fast electric recharge infrastructures in the port area.

Action number 8 concerns the development of circular economy practices. Up to now the port has promoted the monitoring of the level of waste produced inside the port area and several marketing activities aimed at sensibilizing the port community towards the topic.

[414] Ibidem.
[415] V.V.A.A., Documento di pianificazione Energetica e Ambientale del Sistema Portuale (DEASP) del Mar Ionio, porto di Taranto, Autorità di Sistema Portuale del Mar Ionio, Taranto, 2021.
[416] Ibidem.

The PSA of the Ionian Sea is actively engaged in the development of LNG technologies in order to fuel with such energy its vehicles and ships. The PSA recognizes that LNG is an economic and efficient solution capable of granting a sensible reduction of carbon emissions. The PSA aims at complying to the European program Clean Power for Transport by implementing LNG where it can, for this reason is working on the construction of ships fuelled with LNG and the reduction of pollution in the port area. From research of the PSA, it seems that main problems concerning the implementation of LNG stand in its application on land logistics, in the fear of dangerous incidents perceived from the population living in the nearby coast, while the main concerns for operators regard how to fulfil bunkering operations and supply. The Port of Taranto is thus studying four types of bunkering operations: truck-to-ship, ship-to-ship, shore-pipeline-to ship, cryogenic containers[417].

On the other hand, Taranto is a very active port in the field of other renewable energies as well. The PSA of the Ionian Sea is working on an offshore wind farm composed of ten wind generators producing an overall power supply of 30 MW which is considered to be the widest in Italy. The PSA is also working on a solar thermal power plant for the production of hot water for sanitary use and several technologies exploiting wave energy (oscillating water columns, oscillating bodies, overtopping devices and the system Eco Wave Power) which have very limited environmental impact since they don't make use of soil.

Digitalization

For the port of Taranto, the aspect of digitalization makes part of goal number one concerning innovation. The PSA of the Ionian Sea is working to become a Smart Intermodal Port[418]. In order to achieve this goal, fiveì actions have been put into place: 1) realization of "future port innovation hub" 2) digitalization of the PSA 3) Sportello Unico Amministrativo 4) Port Community System 5) Enhancement of the security level of the port, of its industrial area and of the SEZ. Actions 2 and 3 are extremely connected since for the actions of back office concerning the PA a virtual desk relying on a cloud service has been activated, while for the front office procedures the platform "Sportello Unico Amministrativo" is now working. SUA is accessible through SPID and allows payments through Pago PA functions. PA systems and PCS will both work on cloud. For what concerns the PCS a lot of new functions have been upgraded: interoperability with Port Management Information System, with the Port Captaincy, with the terminal operator SCCT, with the informative system of the custom clearance agency and with RFI. For what concerns point number 5 the port is willing to pull fiber optic cables in the port and to equip itself with a mobile means in order to monitor and survey intervention areas and a control room for the checking of material acquired through video cameras.

[417] Ibidem.
[418] V.V.A.A., Piano Operativo Triennale 2020-2022 (Revisione annuale 2021), Autorità di Sistema Portuale del Mar Ionio: Porto di Taranto, Taranto, 2021.

ITALY'S TWOFOLD NATURE OF EUROPEAN ENERGETIC GATEWAY AND ENERGETIC HUB

In the latest years Italy has made a lot of effort to improve its diplomatic relations in order to consolidate its energetic independency and enhance its level of security. Institutional visits, agreements and investments across the Mediterranean Sea have sensibly increased in number[419].

In particular, the Italian government is moving in three strategic directions[420]:

1) It is boosting the Adriatic ridge in order to be ready to receive gas resources coming from the Eastern Mediterranean Sea[421].
2) It is fostering diplomatic relations with the area of North Africa in order to diversify its energy suppliers in the medium-term[422].
3) It is improving its internal capabilities in order to produce renewable energies at home with the long-term idea of being energetically independent[423].

From this point of view, Italy is likely to become both a European gateway for energetic resources coming from North Africa, Cyprus, Azerbaijan and Turkey and an energy hub for renewable energies produced in Italy. In this foreign policy framework, ports become game-changing actors. Italian ports need to be ready to receive and transform all of the resources coming from new routes.

For what concerns strategy number one, a key player will be the project East-Med Poseidon[424]. This project was born in 2017 after the discovery of a big gas reservoir between Israel and Cyprus. If studies on the capacity of the reservoir are correct, the pipeline is expected to supply Europe with 150 billion cubic meters of gas a year (average European gas demand after the war on Ukraine), for 25 years[425]. The pipeline is supposed to exploit the already existing Trans Adriatic Pipeline (TAP) that lands in the region Puglia. Solutions to transport this gas across the Adriatic Sea are at study. In the future, the pipeline is expected to transport hydrogen as well[426].

Regarding strategy number two, a key charachter is represented by the new diplomatic offensive conducted by the Italian government in North Africa called "Piano Mattei". This plan was created in the

[419] Limes, "Italia hub europeo del gas? Il piano Mattei e il Mediterraneo. Un'occasione per il Sud", YouTube Video, 01/31/2023, https://www.youtube.com/watch?v=7ebEdz1iVPE .
[420] F. De Paolo, "Le tre mosse italiane per fare scacco sul gas", Formiche!, 01/26/2023, https://formiche.net/2023/01/gas-eastmed-italia/ .
[421] Ibidem.
[422] Ibidem.
[423] Ibidem.
[424] East-Med Poseidon project, last accessed on 05/15/2023, https://www.edison.it/it/il-progetto-eastmed-poseidon .
[425] Limes: rivista italiana di geopolitica, "L'Italia in un mare di conflitti: Trieste, Giornate del mare 2022", Video Youtube, 09/18/2022, https://www.youtube.com/watch?v=neBuJbucnEE .
[426] Ibidem.

aftermath of the war on Ukraine in order for the Italian government to find alternative gas suppliers from Russia. Piano Mattei sees the involvement of all countries of North Africa in the Italian energy strategy. In compliance with the old Mattei Doctrine, the Italian government shall import energy from North African countries accepting to leave a big share of energy in the countries where it is produced[427]. For this very reason, North African countries prefer to establish agreements with the Italian government rather than with other countries of the Mediterranean Sea and this makes Italy a privileged gateway for North African gas to Europe. For this purpose, in 2022/2023 the Italian government accomplished a first-time-seen series of high-level missions in the MENA region: In Iraq and Lebanon in December, and a series of missions in Turkey, Egypt, Lybia, Algeria, and Tunisia in January[428]. Agreements taken with MENA countries have different nature and span from gas to renewable energies to cable pulling. In Algeria for example, the Italian ENI already works together with Sonatarch, and this makes Algeria Italy's new first gas supplier. Moreover, new pipelines for gas and hydrogen transportation are being built, cables for electric energy are being pulled and a couple of projects for the production of green hydrogen and underwater stockpiling of Co2 are at stake[429]. Tunisia, up to now, together with Algeria and Libya, is one of Italy's major gas suppliers[430]. Libya in its turn, has a lot of unexpressed potential since, a lot of gas reservoirs located in the desert or offshore remain untouched because of the war raging inside the country[431]. Extraction of gas seems now a difficult option and at the same time, existing pipelines such as the Green Stream are not working at full capacity[432]. It must be noted that, after the incident at the North Stream 2, military presence has been incremented around such pipelines in order to enhance surveillance of strategic infrastructures. Nowadays the Italian Navy through the operation *Fondali Sicuri* (in the framework of the *Vigilanza Marittima* operations, where also operations against pollution are conducted) ensures that no unknown object is disposed close to Trans Med, Green Stream and TAP pipelines in order to damage or sabotage them. According to the Italian Minister of Environment and Energetic Security Gilberto Pichetto Fratin, Italy "is bidding to become in few years the energetic hub of the Mediterranean Sea [and] is the only country who can make it, thanks to its strategic geographic position[433]". It must be thus remembered that, if compared to other European countries, Italy finds itself in a central position among several gas-producing

[427] A. Caparello, "Piano Mattei per l'Africa: cos'è e cosa prevede", Wall Street Italia, 04/18/2023, https://www.wallstreetitalia.com/piano-mattei-per-lafrica-cose-e-cosa-prevede/ .
[428] Istituto di Studi di Politica Internazionale, "Italy's diplomatic activism in the Wider Mediterranean", Blog Post, February 2023, https://www.linkedin.com/posts/ispi_medthisweek-activity-7024684098363211776-np6a/?utm_source=share&utm_medium=member_android .
[429] A. Caparello, "Piano Mattei per l'Africa: cos'è e cosa prevede", Wall Street Italia, 04/18/2023, https://www.wallstreetitalia.com/piano-mattei-per-lafrica-cose-e-cosa-prevede/ .
[430] Limes, "Italia hub europeo del gas? Il piano Mattei e il Mediterraneo. Un'occasione per il Sud", YouTube Video, 01/31/2023, https://www.youtube.com/watch?v=7ebEdz1iVPE .
[431] Ibidem.
[432] Ibidem.
[433] F. Di Bisceglie, "Piano Mattei? Italia in sicurezza e… a tutto gas. Parla il ministro Pichetto Fratin", Formiche!, 02/20/2023, https://formiche.net/2023/02/piano-mattei-italia-gas-parla-ministro-pichetto-fratin/?fbclid=PAAaYxnoQh4Fnl3wRA7jffmi3ppxfnyOZuw2Trp2zjZOO1To1x2BlqSSKVBJs .

regions: North Africa, Azerbaijan that exports through Turkey, the Balkans and the Eastern Mediterranean. By the way, a lot of gas extracted in and exported from these countries will be transported via vessel or FSRUs. Hence, in the race for the place of energetic hub of the Mediterranean, the winner will be the country with the best regasification capacity[434]. Since France focuses more on nuclear energy rather than on LNG, Italy's real competitor is represented by Spain, which holds seven new regasification units, but still is hindered by France in making agreements with North African countries and in transporting gas through the Pyrenees[435]. Italy, once again, has an advantage: it holds more agreements with MENA countries with respect to Spain, so the only two things it has to do to embrace its strategic advantage and become Europe's energetic hub in the Mediterranean Sea are the following: increment its regasification capabilities and enhance its infrastructures to transport to Europe the incoming gas, electricity and traded goods through shortsea shipping. For what concerns the first point, the society Snam is equipping Italy with two new FSRUs called BW Singapore (to be located in Ravenna) and Golar Tundra (to be located in Piombino), while three regasification units already exist: Panigaglia (Liguria), Olt (Livorno), Adriatic Lng (Rovigo)[436]. This might make Italy a little less competitive than Spain. For what concerns the second point, Italy will nevertheless need to undergo a series of important reforms concerning its infrastructural and logistic system[437]. If Italian ports, overall the southern ones, want to become the gas gateways to Europe, they will need to follow the example of Gela, where gas coming from the Green Stream is transformed in the petrochemical plant and then distributed to the rest of the region[438]. This might be the chance for the South of Italy to develop a stronger economy and for Italy in general to grow a better infrastructural system. It is assessed that in the long-term gas imported from MENA countries and the Eastern Mediterranean will largely substitute gas imports from Russia and will even generate a surplus[439].

Concerning strategy number 3, the key document is represented by the NRRP. Under mission 2.3 (production and distribution of hydrogen[440]) 500 million euros have been reserved to the development of hydrogen technologies, of which 50 million will be destined to flagship projects while 450 million are to be given to regions that shall issue a call for the most competitive projects[441]. Up to today, 10 regions (Abruzzo, Basilicata, Calabria, Emilia Romagna, Liguria, Piemonte, Puglia, Sardegna, Toscana and Valle

[434] Limes, "Italia hub europeo del gas? Il piano Mattei e il Mediterraneo. Un'occasione per il Sud", YouTube Video, 01/31/2023, https://www.youtube.com/watch?v=7ebEdz1iVPE .
[435] Ibidem.
[436] C. Treccarichi, "Il gas dei nuovi rigasificatori basterà?", Today Economia, 05/16/2023, https://www.today.it/economia/rigassificatori-italia-ravenna-piombino-gas-quanto.html#:~:text=Al%20momento%20l'Italia%20ha,di%20rigassificazione%20costruito%20in%20Italia .
[437] Limes, "Italia hub europeo del gas? Il piano Mattei e il Mediterraneo. Un'occasione per il Sud", YouTube Video, 01/31/2023, https://www.youtube.com/watch?v=7ebEdz1iVPE .
[438] Ibidem.
[439] Ibidem.
[440] Italian government, Piano Nazionale di Ripresa e Resilienza, 04/23/2021, https://www.governo.it/sites/governo.it/files/PNRR.pdf .
[441] M. Spagnolo, "Hydrogen Valleys, l'UE dice sì agli incentivi italiani. Ecco i progetti finanziati", Rinnovabili.it, 04/03/2023, https://www.rinnovabili.it/energia/idrogeno/hydrogen-valleys-distretti-idrogeno/ .

d'Aosta) and the city of Trento have allocated the money of the NRRP to enterprises or consortia that presented projects fulfilling the requirements for establishing a hydrogen valley. The objective is to make Italy become a hydrogen hub capable of developing at least 10-50 MW power[442]. Hydrogen valleys need electric supply and must be located close to the vector's end users, this is why ports and their hinterlands are good milieus for the placing of hydrogen valleys. Through the NRRP, the government is trying to encourage the use of dismissed areas in the nearness of ports. Nevertheless, in order to produce green hydrogen renewable energies will be needed, and this might encourage and speed up the process of off-shore renewable energy production. In this framework, the Italian government already gave the authorization for the exploitation of maritime state areas, and the new government is about to assign them[443]. Port cities will be privileged in enjoying first-hand renewable energy before introducing it in the national network. Collaboration between companies producing offshore clean energy and those producing hydrogen on the inland will slowly allow regions to become energetically independent. Among the projects that have been presented one of the most interesting concerns the region Molise, where a Consortium of the enterprises Stellantis, Mercedes-Benz, and Total Energies with a public funding of 16 million euros is supposed to build a gigafactory for the production of green hydrogen that will be accompanied by a new technological pole working on the implementation of hydrogen technologies in the automotive sector. Given the region's small dimensions and the performance expected from the gigafactory, Molise is expected to become the first self-sustaining and energetically efficient region in Italy[444].

PORTS' POTENTIAL DIPLOMATIC ROLE

The incremented number of long-term policies involving the participation of MENA countries in many sectors, the many institutional visits conducted by the Italian government lately, the shift in the paradigm of globalization, the urgent need to act on climate policies, and the need for more security on critical infrastructures are all elements that pave the way to a new form of dialogue among Mediterranean countries.

Since this new type of dialogue covers different areas (energy, telecommunications, peace and security, trade) and is likely to foster exchange, investments and development in different states of the Mediterranean area, diplomatic effort towards these countries will need to be more frequent and consistent. For this purpose, it might be useful to increment the number of diplomatic seats on the Italian coasts facing the interested countries.

[442] Ibidem.
[443] A. Barone, S. Cianciotta, "In Molise soffia il vento della transizione energetica", Formiche!, 01/22/2023, https://formiche.net/2023/01/molise-transizione-energetica-barone-cianciotta/ .
[444] Ibidem.

While, according to international law, Embassies need to be placed necessarily in the Capital of a state and may only have one office in the hosting state, established Consulates may be more than one and may be both General Consulates and Honorary Consulates.

According to art. 5 of the Vienna Convention on Consular Relations of 1963, functions played by a Consulate are the following:

> "(a) protecting in the receiving State the interests of the sending State and of its nationals, both individuals and bodies corporate, within the limits permitted by international law;
>
> (b) furthering the development of commercial, economic, cultural and scientific relations between the sending State and the receiving State and otherwise promoting friendly relations between them in accordance with the provisions of the present Convention;
>
> (c) ascertaining by all lawful means conditions and developments in the commercial, economic, cultural and scientific life of the receiving State, reporting thereon to the Government of the sending State and giving information to persons interested;
>
> (d) issuing passports and travel documents to nationals of the sending State, and visas or appropriate documents to persons wishing to travel to the sending State;
>
> (e) helping and assisting nationals, both individuals and bodies corporate, of the sending State;
>
> (f) acting as notary and civil registrar and in capacities of a similar kind, and performing certain functions of an administrative nature, provided that there is nothing contrary thereto in the laws and regulations of the receiving State;
>
> (g) safeguarding the interests of nationals, both individuals and bodies corporate, of the sending States in cases of succession mortis causa in the territory of the receiving State, in accordance with the laws and regulations of the receiving State;
>
> […]
>
> (k) exercising rights of supervision and inspection provided for in the laws and regulations of the sending State in respect of vessels having the nationality of the sending State, and of aircraft registered in that State, and in respect of their crews;
>
> (l) extending assistance to vessels and aircraft mentioned in subparagraph (k) of this article, and to their crews, taking statements regarding the voyage of a vessel, examining and stamping the ship's papers, and, without prejudice to the powers of the authorities of the receiving State, conducting investigations into any incidents which occurred during the voyage, and settling disputes of any kind between the master, the officers and the seamen insofar as this may be authorized by the laws and regulations of the sending State;[…][445]"

Moreover, the Convention establishes that instituting honorary consulates must come with the consent of the receiving state. For what concerns the seat of the Consulate, a note of the Italian Ministry of External Affairs states that "As a rule, an Honorary Consulate is established in a Capital city of a region, or in other cities seat to a maritime port with high-density freight traffic[446]".

In last analysis, this note literally invests Italian ports with the possibility of becoming diplomatic entities at the forefront of the European rim facing MENA countries. This plausible and innovative role of ports might

[445] United Nations, Vienna Convention on Consular Relations, 1967, https://legal.un.org/ilc/texts/instruments/english/conventions/9_2_1963.pdf .

[446] Italian Ministry of Foreign Affairs, *Circolare n. 3: Consoli onorari stranieri in Italia. Criteri oggettivi previsti per l'apertura di Uffici consolari onorari di Paesi esteri. Criteri soggettivi per l'autorizzazione ai candidati titolari degli Uffici all'esercizio delle funzioni consolari onorarie. Procedure di verifica dei suddetti criteri*., 07/16/2010, https://www.esteri.it/mae/resource/doc/2017/07/Circolaren3del16luglio2010.pdf .

be a cornerstone in their becoming innovation hubs. During the ongoing change in the paradigm of globalization ports are running for the role of innovation poles where energy is produced, exchanged, stocked and transferred, where research and development will be conducted in several spheres such as energy, logistics, defence, artificial intelligence and digitalization in collaboration with the universities and the academic world, where new shortsea shipping routes will be implemented, where strategic underwater infrastructures will increasingly need to be patrolled, hence, a new type of all-embracing dialogue will be needed with the Mediterranean countries. Therefore, having consular offices located in ports, overall in the South of Italy, might enhance Italy's role in being the bridge between North Africa, the Eastern Mediterranean and Northern Europe, as these offices might serve as a facilitator of trade and development and might mediate the dialogue among the increasing number of stakeholders in the Mediterranean Sea.

CONCLUSIONS

This dissertation demonstrated that ports are multifaceted entities with great potential, even though they're somewhat underestimated and little-known to the majority of people.

The richness of ports stands in the multitude of tasks they can accomplish, among which one can find: them being critical intermodal nodes in the middle of the GVCs acting as facilitators of trade, bases of the navy that protects states' interests, maritime clusters and shipyards, hubs where oil and gas are extracted and refined and electricity is produced, seat for LNG transformation plants and FSRUs, seat for oil and gas pipelines as well as for internet underwater cables, forums where private and public interests meet, industrial clusters for the stockpiling, warehousing and transformation of products arriving by ship, logistic hubs for intermodal transport that allow freight carriers to shift mode and easily reach freight villages or European corridors through rail, road and airways. Furthermore, ports are critical infrastructures vital for the country at the point that their destruction would determine a risk to national security and health. Since they are critical infrastructures, classified data is shared through their internet platforms and must be protected, otherwise, any data breach could mean a risk for national security. Ports also have a political and economic value: they are subject to national law, EU law, UN law and several associations are dedicated to their advocacy. Ports also have an economic value: they might determine the growth or the collapse of a country's economy and be used for political and economic blackmail such as in the case of the so-called debt trap. At the same time, ports are among the most polluting entities in the world hence being subject to environmental impact and carbon footprint measuring, mitigation and adaptation measures. For this, many ports turned to industrial ecology initiatives and renewable energies adoption, which also made them centres for research and development of new technologies where there is room for collaboration with universities and the academic world. In ports many experimentation projects take place: from submarines, to underwater drones, to underwater stockpiling of Co2 captured from the atmosphere, to breakwaters and dams for marine energy, to hydrogen creation and so on.

Precisely this last point is what makes Italian ports innovation hubs. Their being centres for research and development overall in the field of renewable energies is now propelled from the arrival of the NRRP and RePower EU funds, that will materialise in the institution of 12 hydrogen valleys.

On the other hand, the convergence of underwater pipelines is what makes Italian ports energy gateways to Europe. This feature of Italian ports is now emphasized from the multitude of agreements taken with North Africa and the countries of the Eastern Mediterranean Sea in order to become independent from Russian gas in the short-term and to import low-cost hydrogen in the future.

In the latest years, for the first time Italian governments have advanced long-term plans for Italian energetic independency. These plans have generated great interest and enthusiasm among the society, but are Italian ports really ready to fulfil the role of European gateways and hubs? The answer achieved by the

author after the assessment done through this work is that Italian ports have all the preconditions to become such.

Positive preconditions can be deducted from chapters one and three: Italy has a geographical and strategic advantage on sea and may thus easily control inter-oceanic commercial routes through its more than competitive mercantile fleet. The shift in the paradigm of globalization is likely to favour shortsea shipping routes that Italy might master thanks to its geo-strategic advantage and to the programs SSS and MoS. The multiplying of agreements set with the Southern and Eastern rim of the Mediterranean are surely shaping the role of Italy as a stronger bridge between Europe and Africa: this will allow a smoother circulation of resources, know-how and investments. Finally, from chapters two and three it emerges that money coming from the NRRP, RePower EU and CEF have been addressed in projects that are aimed at the logistic, digital and environmental improvement of ports (as well as in renewable energy projects) thus aimed at making Italian ports Europe's innovation hubs.

Even though premises are good, some remarks have to be made. First of all, it is not always true that what is written on paper automatically falls into place when putting plans on the ground. Only time will tell whether what has been planned for the forthcoming years by the latest governments and by ports' administrations will actually take shape. Secondly, if Italian ports want to achieve the ambitious goal of becoming European gateways and hubs, they will have to undergo a series of proper reforms and be properly defended from new generation threats.

For what concerns the reforms, what emerges from the analysis of the documents listed in chapter three is that severe infrastructural weaknesses and logistic gaps with last mile policies have been individuated. Logistic connection is the main pillar of a good interconnected network with Europe, with this pillar tumbling down, Italy might probably be a hub but not a gateway for Europe. Traded goods might land on Italian soil and hardly reach European countries if ports are not adequately connected to the inland's airports, railways and highways capable of determining an inter-state transfer of goods. Therefore, if Italian ports want to cover the role of European gateways and fulfil the role of proper land-sea nodes on the logistic chain they will have to fill this gap providing better logistic connections enhancing last mile policies and developing wider storage and warehousing areas which are also missing.

Not only is the infrastructural gap important in the logistic sector (since SSS is expected to foster an increase in local trade), but it is also important in the energetic sector, overall for what concerns the LNG supply chain. If Italy aims at supplying all Europe with gas on the short term it will have to equip its ports with entry points for the gas network and with infrastructures for its distribution and transboundary transport, such as the doubling of pipelines and the so-called *gas highways*. If the Italian government wants to be more competitive with the other Mediterranean countries, Spain in particular, it will have to invest more money in regasification terminals, in FSRUs and in enhancing the gas network. Infrastructures are also important for what concerns the renewable energy sector and its distribution but, as analysed in chapter

three, the development and the implementation of clean energies will still require a lot of time and investments, especially hydrogen technologies. Even though the green transition proceeds at slow pace, it is very important for states to keep investing in such sector in order to make states energetically independent and reduce inter-state conflicts. Offshore clean energy production is likely to change the face of ports in the future, making them become even more targetable for grey zone attacks on one hand, and poles for innovation and energy exchange on the other. While this aspect increasingly renders ports innovation hubs, it is also true that proper gateways to Europe should foresee adaptation plans that up to now, haven't been set up or could produce much more effect.

Digitalization for Italy represents a controversial issue: on one hand, Italy boasts a worldwide record for the quality of its operational technology of on-board systems and its automation sector, but at the same time it seems in lack of the information technologies needed to empower and protect such technologies from cyber-threats. Lack in cybersecurity structures is also accompanied by a significant gap in the culture of cybersecurity: a good part of port operators yet doesn't seem to be ready to use IT technologies in their work and need a deeper training. Even the public administration still has significant gap in the optimization and use of digital technologies and the main issue in the analysed documents still revolves around making bureaucratic work paperless. When all paper will become digitalised and the workforce of the port sector will become more accustomed to use such technologies probably, then, facing the challenges of cybersecurity will be unavoidable. Cybersecurity should come with a deeper awareness of cyber risks and its management. If Italian ports want to become innovation hubs a growing of such culture in the port environment should definitely be more encouraged.

Apart from the reforms that will have to be taken in the three analysed fields, ports will also have to be adequately protected. From chapters one and two, it emerges that ports are fundamental assets for nations in the international arena. Italian ports have an enormous value and cover a role of greater strategic importance for Italy, the European Union and the global system. Hence, they must be better protected from potential new generation threats deriving from the actual international relations paradigm of perpetual competition: cyber-attacks, economic leverage, physical attacks to critical infrastructures whose paternity the perpetrator might easily deny. Underwater infrastructures such as internet cables, electricity cables, oil, gas and hydrogen pipelines, as well as offshore ones (regasification units, wind farms, etc.) and sensitive information concerning them are crucial for the existence of a country and must thus be properly watched over. Even though some improvements have been made in the aftermath of the Chinese purchase of the Piraeus (with the European Regulation (EU) 2019/452 for foreign direct investment screening) and after the attacks to the pipelines North Stream 1 and 2 (with the operations *Anti Inquinamento* and *Fondali Sicuri* in the framework of the *Vigilanza Marittima* operations), Italian ports still don't seem prepared to face many other grey zone issues such as cyber-attacks (digitalization in Italian ports still is quite underdeveloped), penetration of FDIs through the backdoor (i.e., Chinese penetration in

port terminals) etc. Southern European Gateways surely cannot go without an adequate protection: they must be equipped and ready to protect its assets and underwater infrastructures because a grey zone attack to the Italian ports would mean an attack to all of the European system and according to the latest news, even to the detriment of NATO.

With all of these reforms that need to be applied, the greatest challenge for future Italian administrations will be to provide Italian ports for efficiency in all of these fields without damaging a territory full of environmental and cultural constraints while reducing their environmental impact on air, land and water.

Further structuring Italian ports is a matter of international security.

In last analysis, if preconditions for Italy to become European Southern gateways and hubs are acceptable and even favourable, it is also true that in order to make Italian sea-citadels equipped, secure, decarbonized, well-structured and prepared for future challenges the Italian establishment still has a long way to go.

Nevertheless, the future must always be looked at positively. In history, even when times were hard, progress always had its way. And since history teaches us progress, it is always useful to keep in mind our ancestors' teachings. This is why the vessel Amerigo Vespucci, accredited by the US Navy to be the most beautiful ship in the world, holds as a motto an idiom which is considered to be the answer to the Italian idiom "That who well begins is at half of its work". According to an old Italian legend, Leonardo da Vinci used to answer: "…not that who well begins, but that who persists!".

GLOSSARY

AgID	Agenzia per l'Italia Digitale, Italian Agency for the Digital Transformation
BIMCO	Baltic and International Maritime Council
CCCC	China Communications Construction Company
CEF	Connecting Europe Facility
CEF	Connecting Europe Facility
CFZ	Custom Free Zone
CIP	Critical Infrastructure Protection
CMRE	Center for Maritime Research and Experimentation
COSCO	China Ocean Shipping Company
CPS	Cyber-Physical Environment
CPZ	Cable Protection Zone
CTP	Common Transport Policy
DEASP	Documento Energetico Ambientale di Sistema Portuale, Energetic and Environmental Document of the Port System Authority
DHS	Department for Homeland Security
EC	European Commission
ECI	European Critical Infrastructures
ECSC	European Carbon and Steel Community
EPCIP	European Program on Critical Infrastructures' Protection
ESPO	European Sea Port Organization
EU	European Union
EWEA	European Wind Energy Association
FSRU	Floating Storage Regasification Unit
GVC	Global Value Chain
ILO	International Labour Organization
IMO	International Maritime Organization
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
ISAC	Information Sharing and Analysis Center
ISAO	Information Sharing and Analysis Operations

ISO	International Standard Organization
IT	Information Technology
MENA	Middle East and North Africa
MoS	Motorways of the Sea
MoU	Memorandum of Understanding
NCI	National Critical Infrastructures
NRRP	National Recovery and Resilience Plan
OPS	On-Shore Power Supply
OSE	Operatori di Servizi Essenziali, Essential Services Operators
OT	Operational Technology
OWE	Offshore Wind Energy
PCS	Port Community System
PLN	Piattaforma Logistica Nazionale, National Logistic Platform
POT	Piano Operativo Triennale, Three-Year Operational Plan
PPA	Piraeus Port Authority
PSA	Port System Authority
RFI	Rete Ferroviaria Italiana
SLOC	Sea Line of Communication
SRM	Studi e Ricerche per il Mezzogiorno, Study & Research for Southern Italy
SSA	Sector Specific Agency
SSS	Short Sea Shipping
SUA	Sportello Unico Amministrativo, Collective Administration Platform
TEN-T	Trans-European Network of Transport
UN	United Nations
UNCTAD	United Nations' Conference for Trade and Development
UNEP	United Nations' Environmental Program
UNFCCC	United Nations' Framework Convention on Climate Change
WCO	World Customs' Organization
WTO	World Trade Organization

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