Methodology for the Sustainable Development of the Italy-Croatia Cross-Border Area: Sustainable and Multimodal/Cross-Border Passenger Services

Sirotić, Miljen; Žuškin, Srđan; Rudan, Igor; Stocchetti, Andrea

Source / Izvornik: **Sustainability, 2021, 13**

Journal article, Published version
Rad u časopisu, Objavljena verzija rada (izdavačev PDF)

https://doi.org/10.3390/su132111895

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:187:235538

sustainability

MDPI

Article

Methodology for the Sustainable Development of the Italy-Croatia Cross-Border Area: Sustainable and Multimodal/Cross-Border Passenger Services

Miljen Sirotić [1,*], Srđan Žuškin [2,*], Igor Rudan [2] and Andrea Stocchetti [1]

[1] Department of Management, Ca' Foscari University of Venice, 30121 Venezia, Italy; stocket@unive.it
[2] Faculty of Maritime Studies, University of Rijeka, 50000 Rijeka, Croatia; igor.rudan@pfri.uniri.hr
* Correspondence: miljen.siroti@unive.it (M.S.); srdan.zuskin@pfri.uniri.hr (S.Ž.)

Abstract: The efficient evaluation of the transport sector for the implementation of sustainable mobility solutions is a crucial challenge for governments and decisionmakers for strategically reducing the negative economic, social, and environmental impacts of transport. Current research trends on transport macromanagement indicate a lack of integrative and comprehensive approaches to mitigating transport sustainability parameters. Thus, a holistic perspective on transport macromanagement is deemed necessary for supporting the transition towards a more sustainable approach to transport macroplanning. This paper contributes to the development of transport macromanagement by offering insights, tools, and strategies for contemporary sustainable transitions in the transport sector. A methodology for sustainable and multimodal/cross-border passenger services for the Italy-Croatia cross-border area, with a systematic development cycle composed of six interconnected steps for fostering stakeholder cooperation, is proposed in this paper. Furthermore, a methodological framework, a SWOT analysis, and a gap analysis on the function of defining port improvement for the action plan are elaborated in this study. The study analysis is based on the international passenger terminal ports in a passenger liner service by using a survey analysis conducted among the port authorities in the cross-border area. Moreover, the main aim of the methodology is to provide a holistic framework for the sustainable development of a complex and multilayered transport environment that encompasses a multiplicity of various stakeholders.

Keywords: sustainable and multimodal/cross-border passenger services; transport macromanagement; methodology; holistic transport framework; multilayered environment

Citation: Sirotić, M.; Žuškin, S.; Rudan, I.; Stocchetti, A. Methodology for the Sustainable Development of the Italy-Croatia Cross-Border Area: Sustainable and Multimodal/Cross-Border Passenger Services. *Sustainability* **2021**, *13*, 11895. https://doi.org/10.3390/su132111895

Academic Editor: Efthimios Bothos

Received: 22 September 2021
Accepted: 25 October 2021
Published: 27 October 2021

1. Introduction

Progress, in traditional terminology, is the continuous cumulative and linear advancement of the major conditions of society in a desirable direction based on the prevailing values of societal development [1]. However, the traditional notion of progress is being questioned because of the paradigm shift towards sustainability initiated at the beginning of the twenty-first century. The emerging trend of sustainable development challenges the traditional notion of progress by addressing development as not purely an economic phenomenon but, rather, a multidimensional process involving the reorganization and reorientation of society under the umbrella of social wellbeing and ecological preservation [2]. The principal contemporary trend of sustainability in modern society has also increased its presence in the transport sector. The fundamental definition of sustainable transport is the capacity to support the mobility needs of a society in a manner that is least damaging to the environment and does not impair the mobility needs of future generations [3].

The successful implementation of the concept of sustainability in the European Union transport sector is vital because of the fact that transport is the backbone of the European economy, accounting for about 7% of GDP, and more than 5% of total employment in the European Union [4]. Specifically addressing the dynamic short-sea shipping sector of

the European maritime sector also contributes to the development of a competitive and resource-efficient transport system in the European Union. Contemporary European Union shipping accounts for around one-third of intra-EU exchanges, with annual embarkations and disembarkations of 400 million passengers at EU ports [5].

However, a substantial number of technological, administrative, organizational, and financial barriers are present within the European Union's short-sea shipping sector, especially between its member states of Italy and the Republic of Croatia [6]. The aforementioned barriers raise challenges that compromise the seamless facilitation of transport sustainability in the Italy-Croatia cross-border area. Transport connections between Italy and Croatia manifest themselves in structural gaps and the need for better environmental performance that requires long-term interventions to be implemented according to a series of strategic indications [7]. The cross-border area is characterized by the extensive use of road transport as the dominant transport mode, even though its geographical layout consists of the Adriatic Sea in its entirety. This results in adverse environmental impacts, transport entity fragmentation, and further challenges for organizations from the perspective of transport demand.

The complexity of the sustainable transport transitions of the cross-border area is further indicated by the lack of technological, organizational, and ICT aspects in terms of the intermodalities and multimodalities between the maritime, coastal, and hinterland competences involved [8]. Thus, it is important to provide a holistic and methodological framework for the sustainable transport development of the Italy-Croatia cross-border area by considering the following principal factors: (a) a balanced consideration of the three dimensions of sustainable development (economic, social, and environmental); (b) better integration by transcending the conventional boundaries imposed by discipline, space, time, stakeholder viewpoints, and operational needs; and (c) the practical application of innovative methods and tools throughout the full cycle, from data gathering to policy implementation and feedback.

2. Evaluation of the Sustainability Challenges of the Cross-Border Area Transport Sector

Cross-border area transport systems fall under the constituent elements of the European transport system and, as such, are an integral part of the common transport policy of the European Union. They are also reflected in other policy packages of the European Union (cohesion policy, environmental policy, health policy, etc.) and it is impossible to develop these policy packages without taking into account (evaluation) the transport system mobility specifics of the cross-border area [9]. The European Union, therefore, encourages a multiplicity of stakeholders at the local, regional, and national levels to regard the adoption of long-term policies based on the concept of sustainability, the need for which is urgent in complex transport environments. The elements of quality and accessibility in terms of cross-border area mobility are the fundamental backbones of sustainable transport systems. However, the development of efficient transport systems within the cross-border area is a complex problem because of the dominant paradigm of transport planning that emphasizes transport unimodality, regardless of whether it is the road, water, or air transport modes [10]. The approaches to the so-called ''hard path'' depend on the expansion of transport infrastructure, regardless of roads, ports, parking, or runways, where financial funding often covers all of the social and environmental costs and the economic consequences of such an approach. This paradigm of transport planning and policy can be understood as traditional and is called "business-as-usual" [11].

The ''business-as-usual'' transport planning paradigm is based on the objectives of conquering time and space, which results in the planning and design of transport infrastructure with the aim of achieving the greatest amounts of mobility and accessibility possible. However, if mobility is considered as the maximization of physical movement, or the optimization of space consumption, as implied in virtually every engineering and economic approach, the end result is the condition of hypermobility [12]. Hypermobility can be defined, in the broadest sense, as the excessive utilization of personal and freight

transport, which causes the overloading of the transport system, thus ultimately resulting in traffic congestion. In terms of cross-border areas, the ''business-as-usual" paradigm of transport planning has resulted in the construction and expansion of road infrastructure with the aim of mitigating traffic congestion and increasing the freedom of movement via personal vehicles. The opposite effect was achieved: it resulted in longer travel times of people and freight, a more intense "urban sprawl" effect, higher (irrational) consumption of space and energy, and the neglect of other transport modes, in this case, the water transport mode [13]. Hypermobility, with regard to the realization of the concept of sustainability within the cross-border area, creates the following negative consequences [14]:

1. A greater dispersion of society, a greater expansion of infrastructure, the degradation of natural areas, and greater distance from ports (as focal points of the cross-border area);
2. Greater social polarization and inequity between the highly mobile and those deprived of the benefits of mobility and accessibility, as well as increasing crime rates;
3. Greater danger for those who are exposed to road traffic, especially for children and other vulnerable people (elderly and retired), and greater chances of obesity and reduced fitness;
4. Less social and cultural diversity, fewer characteristics of democracy within transport policy, and less social participation.

The excessive reliance on cars as a transport mode between points of origin and points of destination (ports) within the cross-border area creates negative consequences, such as economic, social, and environmental problems, which deter the implementation of sustainable transport systems and, ultimately, the realization of a sustainable cross-border area. A shift from the use of the dominant transport modes and, thus, unimodality, can be achieved via the sustainability transport planning paradigm. This can be achieved with an integration of the traditional multistage strategic planning process within the logic of the noncentralized multistakeholder decisional context, as depicted in Figure 1.

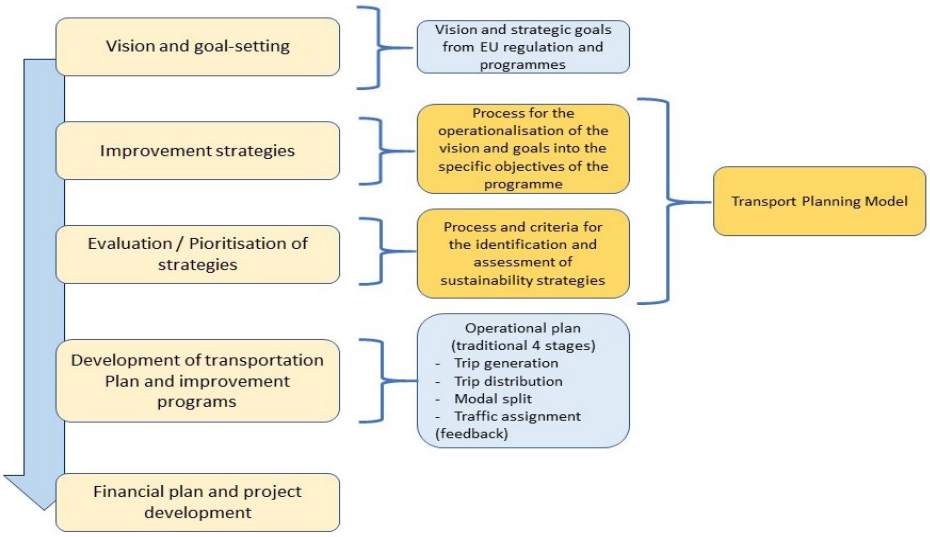

Figure 1. The process of the multistakeholder planning model [15].

The process for the multistakeholder planning model can be considered a backbone for the sustainability transport planning paradigm. This integration is necessary to overcome the limitations of the traditional ''business-as-usual" transport planning paradigm in terms of removing the limitations that mainly consist of assuming a centralized and deterministic (i.e., equilibrium-based) process, rather than a political one, which is strongly interrelated with socioeconomic implications [15,16].

The traditional ''business-as-usual" planning paradigm includes the following steps: analysis of the existing conditions, a trends forecast, identification of the current and future

demand and supply, additional needs, prioritization of issues, short- and medium-term action plans, operational strategies, and financial plans [17]. An evident limitation in such a process emerges to the extent that transport planning activities, in terms of sustainability, do not refer to a single coordinator/decisionmaker, but involve a multiplicity of stakeholders. The operational aspects of each individual stakeholder are characterized within an area of relative autonomy, although within a unitary regulatory context. The differences between the two transport-planning paradigm approaches for evaluating transport planning are presented in Table 1.

Table 1. The differences between two transport-planning paradigm approaches for evaluating transport planning [18].

Business as Usual (BAU)	Sustainable Transport (ST)
Emphasizes mobility and quantity (more, faster)	Emphasizes accessibility and quality (closer, better)
Emphasizes one transport mode (unimodality, automobiles)	Emphasizes the plurality of transport modes (multimodality)
There is no good connection between multiple transport modes	Emphasizes transport interrelationships (intermodality)
Accommodates and embraces trends	Aims at stopping and reversing harmful trends
Plans and builds based on probable demand forecasts (predict and provide)	Plans from preferred vision to planning and providing transport supply (examine and decide)
Expands road infrastructure to meet traffic demand	Actively manages the demand for transportation or mobility
Neglects many social and environmental costs	Includes full (sustainability) costs in planning and procurement
Transport planning is often unrelated to environmental, social, and other sustainability planning areas	Emphasizes integrated planning by combining transport with other relevant sustainability areas

The implementation of the sustainability transport planning paradigm, in the case of cross-border transport planning, is characterized by a very high order of complexity due to territorial jurisdictions, regulatory aspects, and problems of interoperability. Despite the aforementioned paradigms, through which the measures to achieve sustainability are implemented, there are barriers. A barrier is a set of circumstances that prevents a particular policy measure from being implemented [19]. Therefore, certain sustainability measures may be rejected, which results in a less effective transport development plan. The implementation of the measures of sustainable transport demands that management in the cross-border area can mitigate transport congestion and unimodality, which will result in meeting the economic, social, and environmental criteria. However, there is the possibility of rejecting these measures because of the inability to overcome sustainability barriers. Therefore, the emphasis for sustainability transport planning paradigm actualization should be on how to overcome barriers, not on how to avoid them. There are six barriers within the cross-border area that prevent the manifestation of sustainable transport transitions [19–23]:

1. Financial Barriers: To implement a measure, an adequate amount of financial and physical resources have to be available. If these resources are not available in time, and in the right amount, implementation will be delayed. Lack of money for implementation is closely linked to institutional barriers, as local, regional, and governmental authorities are unlikely to provide money for measures that do not concur with their policy priorities;
2. Legislative and Regulatory Barriers: Many transport policies require adjustments of laws and regulations, within or outside the realm of transport. If implementation is

complicated by legal requirements, or even made impossible by law, legal barriers are raised;

3. Government/Institutional and Organization Barriers: These relate to the problems with coordinated actions between different public and private organizations or levels of government, and to conflicts with other policies. A large number of public and private bodies are involved in transport provision, and this means that it is often difficult to achieve coordinated action by the implementing agency;
4. Political Acceptance Barriers: The building of transport infrastructure requires large investments and, therefore, decisions are taken at the highest levels of government. Sometimes national governments are reluctant to invest in transport infrastructure because of opposing political views, or when demonstrating opposition groups and the media oppose the strategy or measure;
5. Social/Public Acceptance Barriers: These concern the public acceptability of the measures. While some measures may theoretically be effective at promoting sustainable transport, their effectiveness is minimal if people do not accept their introduction or implementation. Sometimes this is due to differences in the cultures between departments (for example, bureaucratic versus market-oriented). The other example is that many people are reluctant to give up the perceived freedom associated with owning and using a car;
6. Technical Barriers: For management and cost, implementation, and administrative issues, technical barriers are key issues. In terms of infrastructure management, information systems, engineering design, and the availability of technology, technical barriers can limit sustainable progress. In terms of human capital, a lack of key skills and expertise can be a significant obstacle to progress and will be exacerbated by the rapid changes in the types of policies being considered with the emergence of new technologies.

3. Methodology for Reviewing Transport Sustainability Action Plan

The promotion of sustainability and the outreach of the goals for sustainable development require a thorough analysis of the economic, social, and environmental aspects of the Italy-Croatia cross-border area transport system from the viewpoint of organizational and technological feasibility. The main goal of the methodology is the provision of insights, tools, and strategies for the sustainability assessment of the overall cross-border area multimodal transport system, with a focus on passenger service. The methodological promotion of sustainable transitions of the cross-border area passenger transport systems can be further understood with the following related research questions:

1. Which organizational aspects within the cross-border passenger terminal ports need to be restructured in order to achieve a harmonization of multimodal transport options?
2. To what extent are the connections with coastal areas and islands adequate to ensure, in addition to satisfying passenger needs, a fair level of inclusion of the resident populations?
3. To what extent does port traffic affect (because of pollution, traffic movements, and other negative externalities) the quality of life of the populations residing in areas adjacent to ports?
4. Which technological aspects for cross-border passenger terminal ports need to be improved in the function of passenger demands?
5. Which technological and organizational improvements need to be conducted for hinterland connections and infrastructures?
6. Which technological improvements need to be conducted for cross-border passenger liner ships in the function of increasing safety awareness and reducing harmful environmental impacts?
7. What technological state and collateral activities, besides maritime technology, could be improved in the cross-border action plan?

The aforementioned questions indicate that, within the particular case of the transport systems of the Italy-Croatia cross-border area, the predominant aspects are inherently linked to sustainable transitions in short-sea shipping and intermodal transport. While the potential benefits of short-sea shipping have been highlighted in several studies, other contributions have identified both weaknesses and strong points in the Italy-Croatia maritime passenger liner connections [24,25]. The following crucial weak points, which are strictly related to the sustainable transport system transitions of the Italy-Croatia cross-border area, manifest themselves in the issues of port waterfront and hinterland integration with the water transport mode and the land transport modes, respectively, as well as in technological development, and intermodal transport:

- The lack of full integration of inter-coastal transport connections in a multimodal transport system;
- The lack of standardization of the documentation procedures in the Italy-Croatia short-sea shipping sector;
- Inadequate unification of the customs law regulations in the European Union;
- Unclear/inadequate coordinated maritime strategy;
- The general negative perception of maritime transport due to its linkage to the pollution produced by vessels in coastal areas.

Thus, the methodology will evaluate several main components, and their interrelations, key to the sustainable transitions of the transport sector of the Italy-Croatia cross-border area, from the point of view of technological and organizational feasibility, and the ports, ships, and land transport modes.

3.1. Methodology for the Assessment of Multimodal Passenger Ports from the Aspect of Sustainability

The main nodal points that connect the maritime transport mode and the land transport modes of the Italy-Croatia cross-border area are passenger ports. They are crucial for the transportation of people and secondary goods on an international level as well as at the national insular level. Passengers are the main users, along with other transport stakeholders, such as transport companies, shipping companies, and companies that use the port for the shipment or receipt of cargo. There are three types of passengers in the Italy-Croatia cross-border-area ports [26]:

1. Passengers who live in (or are coming from) the area that is served by the port and who visit (travel to) other areas with the use of passenger vessels;
2. Passengers who live in (or are coming from) another area and that travel to the area served by the port with the use of a passenger vessel;
3. Transit (international cross-border) passengers whose origins and destinations do not coincide with the area served by the port.

The aforementioned categorization leads to the conclusion that passenger ports, with their passenger line service, have under their jurisdiction complex logistical and organizational systems that function in the execution of business port activities and their surroundings. Their complexity is derived from organizational requirements oriented towards the promotion of efficiency, ensuring the passenger flawless transport through the port system, together with compliance with legislation, and the provision of stability and flow continuity. These are considered to be the substantial preconditions for the development of the traffic, tourism, and economic activities that serve a range of tourist services while, at the same time, fulfilling the preconditions for the passenger needs for transportation. The methodological framework for assessing ports from a sustainability viewpoint is depicted in Figure 2.

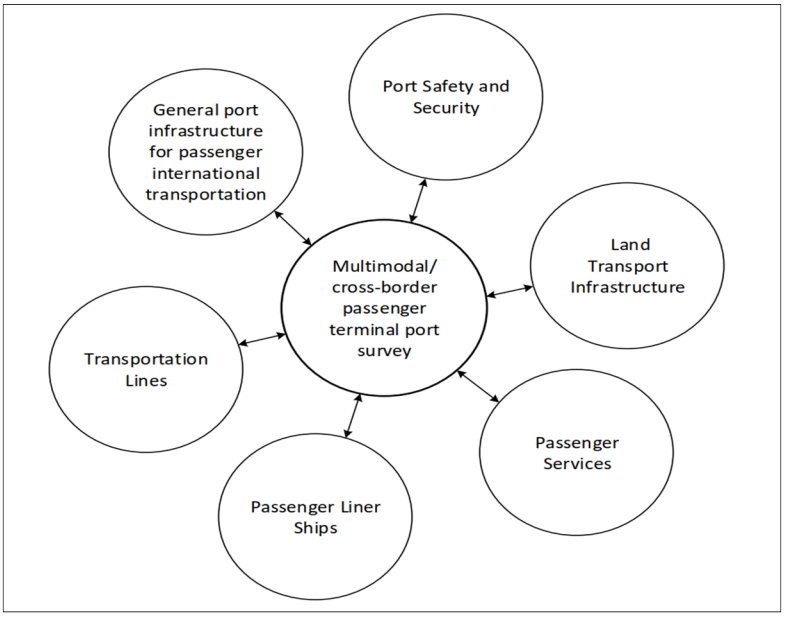

Figure 2. Methodological framework for assessing ports from a sustainability viewpoint.

The port methodological framework is structured from the following aspects for sustainability assessment:

1. General Port Infrastructure for Passenger International Transportation: The development and existing state of the port infrastructure for passenger international transport serves as one of the main aspects of sustainability assessment. From the point of view of infrastructure assets, an indicator of the port size, and its ability to serve as a core business, is the operational shore length (pier) intended for passenger international transport, together with the number of piers and ferry RORO ramps;
2. Port Safety and Security: Port safety and security are vital elements of the social aspect of sustainability. The concept of safety and security plays an important role in transport policy and significant aspects of the service quality provided to passengers. Port security refers to the security law enforcement measures employed to safeguard a passenger terminal, and passengers, from acts of terrorism and other unlawful activities and activists. It is derived from a maritime background (IMO), which deals with the safety of the ship, its crew, and its passengers and/or cargo, the safety of navigations, the prevention of pollution and environment protection, firefighting, and the medical aspect;
3. Land Transport Infrastructure: Land transport modes, such as road and rail, have a significant impact on the quality of the port infrastructure, together with logistic efficiency, and, furthermore, on the national economy and port global competitiveness. The sustainable transition of land transport modes in the port hinterland has to be achieved by shifting the use of private cars and taxis towards public buses and bicycle transportation;
4. Passenger Services: Passenger accommodation superstructure capacity is of vital importance for meeting passenger demands. Superstructure capacities at modern passenger terminals must be highly prolific in order to enable a quick and seamless flow of passengers with the aim of achieving passenger comfort [27];
5. Passenger Liner Ships: Passenger ships and terminal size are closely interrelated and strongly impact on one another. The increase in passenger ship sizes and passenger liner services inevitably lead to the growth of passenger flows and, thus, to maritime terminal port development. The increase in passenger flows has resulted in investments in port infrastructure and services, where ports not only invest in their infrastructure to address a larger number of passengers, but also invest in the number and quality of services provided to passengers;

6. Passenger Transportation Lines: The passenger liner service, from the observed terminal, includes the transport of passengers, cargo, and vehicles, which needs to be performed on the preestablished line according to the published conditions of the sailing schedule between two or more terminals (ports), together with the price list.

In order to evaluate the aforementioned sustainability aspects, it is important to perform a data collection survey on the port passenger flows in order to facilitate a comparison analysis of the existing and potential passenger demand.

3.2. Methodology for the Assessment of Passenger Liner Ships from the Aspect of Sustainability

Although it is the backbone of the globalizing economy, maritime shipping has gone largely under the radar of the political economy in terms of environmental analysis and sustainability evaluation [28]. As the enabler of global trade, international shipping undoubtedly draws attentions to sustainability because of its contribution to global greenhouse gas emissions and air pollution in port areas [29,30]. The International Maritime Organization (IMO) is committed to environmental, social, and economic sustainability in international shipping. According to the IMO, all passenger ships must comply with all relevant energy efficiency and air pollution requirements according to Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). The methodology for the assessment of passenger ships from the aspect of sustainability should contain data on [31]:

1. Eco-efficient ship designs, and improvements in engine design, propellers, hull forms, and coatings;
2. Slow steaming, speed optimization, and weather routing problems;
3. A change of fuel usage from heavy fuel oils to natural gas, biofuels, and fuel cells;
4. Development in hybrid solutions, battery systems, and ship electrifications;
5. Improving infrastructure to enable faster turnaround times and increase port capacity;
6. Maturing technologies within scrubber and exhaust gas recirculation;
7. System integrations, smart maintenance, automation, and remote operations;
8. The use of sensors, big data, computational fluid dynamics, and performance management systems.

The methodology for the assessment of passenger liner ships from the viewpoint of sustainability for the future development of the Italy-Croatia cross-border area has to integrate the abovementioned technical aspects in order to promote the social and environmental criteria of sustainable shipping, as well as the economic feasibility of the same activity. The inclusion of ships in the sustainability assessment of the cross-border area is of the utmost importance in order to enable a proper evaluation of the entire maritime passenger port terminal system. Passenger liner ships play a key role within the cross-border area because of the large number of passengers transported by them between passenger terminal ports. Thus, it is important to assess the cross-border passenger liner ships from the aspect of sustainability in order to provide ship owners with the proposed guidelines [32]:

1. The development of green business models with regard to passenger shipping operations;
2. The adoption of alternative and cost-effective fuel technologies for passenger shipping operations;
3. The improvement of technological specifications (i.e., reducing fuel consumption for existing ships via the implementation of ICT technologies, and improving energy-efficient engines and hulls for newly built ships);
4. The reduction of air pollution from ships by reducing sulfur, nitrogen, and particulate matter by the latest IMO mandatory regulations and measures (the Energy Efficiency Design Index for new ships, and the Ship Energy Efficiency Management Plan for all ships).

According to the IMO, all passenger ships must comply with all relevant energy efficiency and air pollution requirements according to Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL). The reduction of the sulfur in fuel oil to 0.50%, since 1 January 2020 (from 3.50%), is an important measure for protecting the health of people in ports and coastal areas, and the passengers and crew on the ships as well [33]. Thus, it is important for ship owners and relevant stakeholders to adhere to the aforementioned guidelines in order to analyze the existing passenger fleet in the transportation chain from the aspect of technological solutions for the improvement of cross-border passenger ships. One of the main technological analytical aims is the current state of the energy and efficiency of the passenger ships between the Italian and Croatian passenger terminals, together with a comparison of the best practices in other EU countries, according to the European directives for environmental protection.

3.3. Methodology for the Assessment of Land Transport Modes and Intermodal Connections from the Aspect of Sustainability

Maritime passenger transport has a significant impact on coastal areas in various aspects. In particular, the connection of ports with the hinterland, and the management of the first/last mile, are important aspects for the objectives of achieving a sustainable Italy-Croatia cross-border area [34]. Thus, the analysis should be facilitated in two directions:

1. First direction: reaching the boarding point from the port to the ship ("last mile");
2. Second direction: the utilization of tourist services at the target destination ("first mile").

Both directions should be reviewed via the technological solutions for land transport modes by considering the interconnections of boarding points with the transport networks at various levels, from the TEN-T networks to the local nodes and transports of the Italy-Croatia cross-border area. Accessibility measures should also be applied to compare the situation of the ports with regard to possible future development plans. Thus, a level of effort with regard to technological and financial coordination is required for the implementation of the technological solutions in the first and last miles [35]:

- Identification and classification by size/traffic of the main boarding points (ports);
- Identification of road and rail interconnections of the main nodes (ports);
- Evaluation of the offer of intermodal transport services to/from the boarding points (ports), and measurement of the accessibility;
- Analysis of existing road, rail, and bicycle interconnections, and of the public transport system via collaboration with the local authorities of the areas affected by the ports and through the analysis of maps;
- Review of possible existence of projects for the improvement of accessibility in progress by the port authorities, or from other subjects involved in various capacities, in the first/last miles near ports.

The first-mile mobility is mainly attributed to the local mobility in tourist destinations from the aspect of how passengers benefit from the local services and the territory in the surroundings of the arrival points. Further steps should encompass an analysis of the existing offers of local mobility alternatives to cars, and infrastructure for the development of local sustainable mobility.

4. Methodological Framework for Setting the Action Plan with Case Study in Italy-Croatia Cross-Border Area

The methodology for the sustainable development of the Italy-Croatia cross-border area, in terms of the coordination and harmonization of the waterfront and hinterland multimodal transport operations, as well as the international passenger terminal port action plan, consists of a systematic development cycle composed of six main connected steps, depicted in Figure 3.

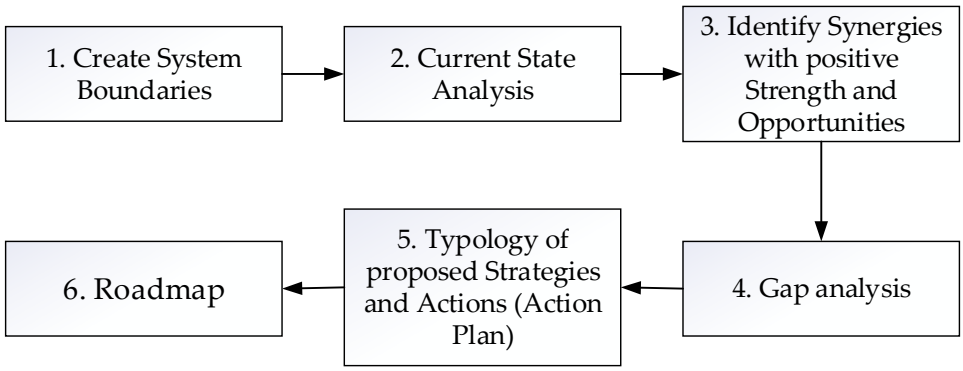

Figure 3. Methodological framework for setting the action plan for sustainable and multimodal/cross-border passenger services.

The implementation of the sustainable transport planning paradigm, in the case of promoting sustainable transitions in cross-border area multimodal transport systems, is fostered by further elaboration with the following identified steps:

1. Create system boundaries in international passenger terminal ports in the cross-border area with the main stakeholders involved. A sustainability assessment of the cross-border area multimodal transport systems, and the supportive stakeholders, is the system boundary under which they are evaluated in their adherence to the economic, social, and environmental criteria for creating passenger-centric services at the local, regional, and cross-border levels of integration;
2. Current-state analysis for international passenger terminal ports in the cross-border area. The analysis synthesizes the main threats and weaknesses for the evaluated criteria by selecting the main issues to be highlighted as priorities in future development.
3. Identify synergies and positive strengths and opportunities for achieving passenger terminal sustainable development in the cross-border area;
4. Gap analysis in the function of port improvement according to the weaknesses and threats from the analysis. Utilize the gathered knowledge from information and experience exchanges, and the results from the actions of leading and supportive stakeholders, for the comparison of the actual performance with the potential and desired performance, as a method of self-correction and redirecting between the leading and supportive stakeholders;
5. Create a typology of the proposed strategies and actions for improvement in order to foster sustainable development. What activities, measures, and indicators must be implemented by the stakeholders in order to foster sustainable transitions in cross-border area multimodal transport systems (action plan)?
6. A roadmap for creating the action plan for international passenger terminal ports in the cross-border area, and for making improvements that include indicative timeline intervals, action priority level definitions, complexity, and the financial aspects.

The international passenger terminal seaports are considered to be the main nodal points of the Italy-Croatia cross-border area. The methodological framework for setting the action plan in the abovementioned areas is based on the case study of all the international passenger terminal seaports in the passenger liner service between Italy and Croatia by using a survey analysis and the elaborated questions in Section 3.

Passenger terminal seaports are considered to be the main nodal points of the Italy-Croatia cross-border area. This indicates their worth as excellent initial points for emphasizing the activities of the leading and supportive stakeholders because the complexity of their surroundings is good for integrated planning by combining transport with other relevant passenger-centric sustainability areas, such as general passenger-terminal-port overview, passenger-terminal-port environmental protection maturity, the passenger safety and security status, and the state of the technological improvement of the cross-border area passenger liner ships. The leading stakeholders within the cross-border area must be

identified as the national, governmental, municipal, and maritime authorities who will administer the guidelines for sustainable transitions. The supportive stakeholders must be identified in accordance with their public and private sector affiliations, and in accordance with the specific economic activities they are engaged in, ranging from passenger transport organization, the offering of passenger services, safety insurance, security surveillance, tourism promotion, information-communication technologies, waste management disposal, and environmental monitoring.

Furthermore, the survey analysis in the function of the case study presentation is based on the port authorities analysis in the cross-border area (Table 2), as a main stakeholder which gathered all the relevant data. From the survey results, the initial first step (system boundaries creation) has been established, together with the evaluation of the sustainability challenges of the cross-border area transport sector (Section 2), and the methodological framework for assessing ports from a sustainability viewpoint (Section 3).

Table 2. The list of the international passenger terminal ports in the cross-border area.

Italy	Croatia
Ancona	Dubrovnik
Bari	Hvar
Cesenatico	Hvar Stari Grad
Civitanova Marche	Mali Lošinj
Grado	Novalja
Lignano	Poreč
Marano	Rab
Ortona	Split
Pesaro	Umag
Pescara	Zadar
Ravenna	
Trieste	
Vasto	
Venice	

The progression of sustainable transitions in the transport sector is addressed by both Italy and Croatia via the development of national strategies specifically oriented towards the improvement of passenger (tourist) flows and accessibility. Particular attention is devoted to the reduction in car traffic by promoting a modal shift to transport modes with higher sustainability factors. A fundamental requirement for promoting the modal shift for both travel mobility at the place of destination, and for tourist mobility, concerns the ability to make travel comfortable in all phases, including the upstream and downstream phases of cross-border transport.

However, there are barriers that hinder the seamless sustainable development in the Italy-Croatia cross-border area. Further steps for the methodological framework for setting the action plan for sustainable and multimodal/cross-border passenger services from the analysis are based on the SWOT analysis for identifying synergies and positive strengths and opportunities, together with a gap analysis on port improvement according to the weakness and threats.

The SWOT analysis in Table 3 presents the strategic evaluation of the capabilities for achieving sustainable transitions in the Italy-Croatia cross-border area, and the action plan developed.

Table 3. SWOT analysis of Italy-Croatia cross-border area.

Strengths (S)	Weaknesses (W)
• Mutual benefit for achieving sustainable transitions in the cross-border area transport sector due to cooperation between Italy and Croatia • The cross-border action plan provides minimum requirements and legal aspects for adhering to the Italy-Croatia passenger ports from the aspect of sustainability and environmental protection • Development of passenger transportation lines outside the Croatia-Italy borders • Progressive guidelines for improving multimodal passenger ports from the aspect of sustainability • Progressive guidelines for improving passenger liner ships from the aspect of sustainability • Progressive guidelines for land transport modes and intermodal connections from the aspect of sustainability • Highly developed public transport infrastructure and network • Promotion of nonmotorized transport modes (bicycles) • Substantial capital investments in sustainable transport modes • Potential for shared mobility solutions • The willingness to promote social inclusivity and healthy lifestyles • Promote international passenger terminal seaports in function of tourism development	• Not reacting to trends quickly enough because of limited cooperation between the relevant government (public sector) and numerous business (private sector) port stakeholders • Insufficient length of operational shore for increasing traffic demand with the low possibility for terminal infrastructure area expansion (conflict with urban space) • Deficiency of specific port infrastructure and equipment in function of passenger demands and comfort together with adequate service (especially for children and passengers with reduced mobility) • Lack of proper safety and security implementation with insufficient relevant infrastructure, equipment, procedures, and personnel • Deficiency of specific port infrastructure, equipment, and procedures for the implementation of initiatives to reduce the environmental impact • Disproportion between passenger liner ports with regard to technical and organizational characteristics and standards • Unprepared for the implementation of alternative energy production and the delivery of alternative fuel • Substandard multimodal connectivity between multimodal passenger ports of the Italy-Croatia cross border area due to the lack of organizational direction and environmental protection • Limited passenger liner service according to passenger demands
Opportunities (O)	**Threats (T)**
• Adaptation of new organizational approaches in transport systems • Introduction of greener fuels in maritime transport modes • Improvement of existing fuel efficiency via technological innovations • Constant improvement in international passenger ports • EU funding enabling upgrades • Development of sustainable cross-border collaboration via ICT communication services integration which supports interoperability • Effective management of multimodal transport within the Italy-Croatia cross-border area will result in the improvement of seamless passenger flows	• Lack of financial resources for the implementation of sustainable transitions • Inability of legislative and regulatory adjustments withsustainable transport policies • Lack of social or public acceptance due to the fact that private vehicles are associated with personal freedom • Technical barriers in terms of engineering design, infrastructure management, information systems, etc.

On the basis of the indicators of the SWOT analysis and the survey results, the facilitation of sustainable transitions of the Italy-Croatia cross-border area can be achieved via technological and organizational approaches and solutions. Moreover, the analysis, as identified in Steps 2 and 3, gives the current-state perception, together with the main threats and weaknesses, for the evaluated criteria by selecting the main issues (gaps) to be highlighted, and by identifying the synergies, and the positive strengths and opportunities for achieving passenger terminal sustainable development in the cross-border area.

According to the analysis for the Italy-Croatia cross-border area, the main priorities and visions for international passenger terminal seaports are classified as follows:

- Improve port infrastructures to reduce emissions in order to support multimodality, vessel technology innovation, and to ensure safety and security;
- Improve connections with the hinterlands and opportunities to reduce car use;
- Improve vessel technology to increase efficiency and reduce emissions.

The development of these objectives can be obtained by following the different types of actions that are defined in the methodological framework (Section 3) of this research. Therefore, these actions are considered to be the priorities for that which concerns:

- The overall improvement of passenger terminals;
- Improvement in the service of passenger terminals;
- The safety and security of passenger terminals;
- Environmental impact reduction;
- Port accessibility and intermodal connections improvement;
- The improvement of passenger liner ships.

The beneficial aspects of the capabilities of the Italy-Croatia cross-border area manifest themselves in the highly advanced transport infrastructure, which can be used as a starting point for implementing and promoting cooperative sustainable transport solutions and for developing the action plan. All the travel phases can benefit from the adoption of technologies that function for environmental protection. From the organizational point of view, the stated negative consequences of the hypermobility of the Italy-Croatia cross-border area should be mitigated by defining mobility policies that are set out in the context of a clear vision and measurable goals for addressing the long-term challenges of cross-border mobility.

Furthermore, from the survey results in this research, the fourth step (gap analysis) has been established, together with the divergences between the existing situation (current state) and the desired developed situation, expressed by the shared vision and its operationalization provided by the goals for maritime transport sustainability. Moreover, the gap analysis in the function of port improvement with three gap levels (low, medium, and high gaps), according to the divergences between the current and the desired developed states, has been elaborated through the survey in the following table (Table 4).

Table 4. Gap analysis with established gap levels for the international passenger terminal seaports in the cross-border area (Italy-Croatia).

Gap Analysis for the Passenger Terminals in General	**Gap Level**
Not reacting to trends quick enough (slow in decision-making) because of limited cooperation between the relevant government (public sector) and numerous business (private sector) port stakeholders	Medium gap
Insufficient length of operational shore and number of RORO ramps for increasing traffic demand	Medium gap
Conflict with urban space risking that development might be hindered, together with the low possibility for terminal infrastructure area expansion	High gap
Gap Analysis for Service Improvement of Sustainable and Multimodal/Cross-border Passenger Terminal Ports in Function of Passenger Demands	**Gap Level**
Deficiency of specific port infrastructure and equipment in function of passenger demands and comfort (proper boarding equipment, passenger short-stay accommodation facilities, luggage management system, sanitary facilities, etc.)	Medium gap
Lack of adequate service activities/infrastructure inside the port area, or in the vicinity	Low gap
Lack of facilities/services for passengers with reduced mobility and for children	High gap
Lack of communication services through ICT integration, which support interoperability	High gap
Gap Analysis for Safety and Security of Passenger Terminal Ports	**Gap Level**
Lack of sufficient firefighting, pollution prevention, and medical infrastructure/equipment with trained personnel in the port infrastructure	Medium gap
Lack of port safety and security plan implementation, including a cyber security plan, according to the latest EU directives	Medium gap
Lack of communication services through ICT integration, which support mobility and interoperability	High gap
Lack of appropriate customs facility inside the passenger terminal, under custom administration legislation, with adequate equipment	Medium gap
Gap Analysis in Implementation of Initiatives to Reduce the Environmental Impact	**Gap Level**
Lack of environmental procedures and initiatives towards pollution reduction and the mitigation of potential environmental impacts, and all related services which follow particular procedures	High gap
Lack of environmental infrastructure facilities and/or the organizational reception for ship waste (garbage management), waste oils and oily water, ballast water sediments, air pollution, etc.)	High gap
Unprepared for implementation of alternative energy production and the delivery of alternative fuel (e.g., LNG fuel, cold ironing implementation, wind/solar/hydrogen/tidal/biomass energy, etc.)	High gap
Gap Analysis on Technological Solutions for the Improvement of Cross-border Passenger Liner Ships	**Gap Level**
Very old passenger liner ships together with very old fleet in the cross-border area	High gap
Passenger liner ships as strong pollutants according to the propulsion system, fuel in use, and ship construction (unpreparedness of particular shipowners due to environment legislation)	High gap
Limited passenger liner service (low connections) in the cross-border area according to passenger demand	Medium gap

Table 4. *Cont.*

Gap Analysis for the Passenger Terminals in General	Gap Level
Gap Analysis on Port Accessibility and Intermodal Connections	**Gap Level**
Limited connections between sea and land transportation (road and rail connection improvements in each passenger terminal environment)	Medium gap
Main transportation connecting nodes without proper intermodality and environmental awareness	Medium gap
Low, or nonuse, of e-sharing mobility services with appropriate infrastructure	High gap
First/last-mile, rental, and sharing services diversity approach	High gap
Lack of DSS for sustainable smart port accessibility in port area for all existing transport nodes	High gap

In order to mitigate these gaps, it is important that the public and private stakeholders of the Italy-Croatia cross-border area create a typology of actions that will slowly adopt the sustainable transport planning paradigm (action plan) while, at the same time, gradually remove the business-as-usual transport planning paradigm. The business-as-usual transport-planning paradigm emphasizes mobility and quantity (more, faster), and is planned for only one transportation mode (unimodality) by being unrelated to environmental, social, or other sustainability planning areas. This leads to a lack of quality connections and congestions at transport hubs that connect multiple different transport modes (ports). Both public and private stakeholders should replace the aforementioned models by emphasizing accessibility and quality (closer, improved) via the fostering of transport interrelationships (intermodality). In order to preemptively reduce the negative aforementioned gaps of system maturity, it is important to identify the synergies and conflicts between the actions of the public and private stakeholders that cooperate with the port authority as a main stakeholder.

The stated gap analysis serves as a guideline for developing a cross-border area important sustainable transport planning approach because of the significant change towards the growing awareness with regard to the role of passenger terminal ports in the sustainability debate.

Passenger terminal ports have the obligation to boost the efficiency of their regional statuses within the cross-border area with the aim of fostering greener transportation options for passengers. This has to embody the criteria of smartness, sustainability, and inclusiveness for passengers, which will be achieved by following the priorities of decarbonization in order to reduce GHGs from shipping, digitalization to promote a secure environment for the automation of information (single window for information), investment to foster new and sustainable passenger services within the passenger port terminals, and innovation to promote social inclusiveness by improving the quality of operations within passenger terminal ports and its land-transport-mode hinterland connections.

5. Conclusions

The establishment of a sustainable cross-border transport sector requires technical and organizational adherence towards three key sustainability criteria: economic prosperity, social welfare, and ecological preservation. The identified sources of the technical and organizational competitive advantages for fostering sustainable transitions in the Italy-Croatia cross-border area transport sector are the highly developed public transport infrastructure and network, and the influx of substantial capital investments in sustainable transport modes. They can serve as a bedrock for promoting cross-border cooperation with regard to the realization of transport sustainability by promoting nonmotorized transport modes, such as bicycles, and the potentials for shared mobility solutions, social inclusivity, and healthy lifestyles. However, current transport planning strategies lack cooperative and integrative approaches for creating guidelines towards achieving the equilibrium of transport multimodality. This results in transport unimodality and hypermobility in terms of the excessive use of private vehicles. In order to prevent the negative aforementioned trends, this paper presents insights, tools, and strategies from a methodological approach, with a systematic development cycle composed of six interconnected steps to

foster stakeholder coordination and decision-making for the sustainable transitions in the cross-border area transport sector. Moreover, the methodological framework for setting the action plan was reached within the defined system boundaries, and used current state analyses with identified synergies, which lead to the performance of a gap analysis of port improvement by survey analysis from passenger terminal seaports in the passenger liner service of the Italy-Croatia cross-border area. The survey analysis results were obtained from the port authorities, with the presented gap analysis mostly showing the medium and large discrepancies between the current and desired developed states of international terminal seaports.

In order to mitigate these gaps, it is important that the public and private stakeholders of the Italy-Croatia cross-border area create a typology of actions that will slowly adopt the Sustainable Transport Action Plan (Action Plan). The port authorities are, therefore, obliged to take into account these public and private stakeholder objectives in the sustainable maritime passenger transport planning process by the identification of the critical stakeholders who can better contribute to achieving the sustainability mission and strategic objectives of the port community (realization of passenger-centric transport planning approach), and to provide adequate coverage of the different abovementioned aspects. Future research can be conducted on the action plan development, with complexity levels and financial aspects, in the cross-border area of Italy-Croatia.

Author Contributions: Conceptualization, M.S., S.Ž., I.R. and A.S.; methodology, M.S., S.Ž., I.R. and A.S.; writing—original draft preparation, M.S., S.Ž., I.R. and A.S.; writing—review and editing, M.S., S.Ž., I.R. and A.S.; visualization, M.S. and S.Ž.; supervision, I.R. and A.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research is funded by the Interreg Italy-Croatia CBC Programme, project Maritime and Multimodal Sustainable Passenger Transport Solutions and Services (MIMOSA)—ID number 10249002.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Acknowledgments: This research was supported by the European Regional Development Fund within the Interreg Italy-Croatia MIMOSA project.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Noll, H. Concept of Development. Available online: https://www.researchgate.net/publication/340127781_Concept_of_Development (accessed on 25 March 2021).
2. Rodrigue, J.P. *The Geography of Transport. Systems*, 5th ed.; Routledge: New York, NY, USA, 2020; ISBN 9780367364632.
3. European Commission. A Sustainable Future for Transport. Available online: https://www.eea.europa.eu/policy-documents/a-sustainable-future-for-transport (accessed on 25 March 2021).
4. Maritime Year: EU Priorities and Actions. Available online: https://ec.europa.eu/transport/modes/maritime/maritime-transport_en (accessed on 25 March 2021).
5. Trans-European Transport Network (TEN-T). Available online: https://ec.europa.eu/transport/themes/infrastructure/ten-t_en (accessed on 25 March 2021).
6. European Commission. Ports: An Engine for Growth. Available online: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM%3A2013%3A0295%3AFIN%3AEN%3APDF (accessed on 26 March 2021).
7. Munasinghe, M. *Sustainable Development in Practice: Sustainomics Methodology and Applications*; Cambridge University Press: Cambridge, UK, 2009; ISBN 9780511626777.
8. European Commission. A Blueprint to Safeguard Europe's Water Resources. Available online: https://www.eea.europa.eu/policy-documents/a-blueprint-to-safeguard-europes (accessed on 28 March 2021).
9. Rossolov, A.; Kopytkov, D.; Kush, Y.; Zadorozhna, V. Research of effectiveness of unimodal and multimodal transportation involving land kinds of transport. *Easter Eur. J. Enterp. Technol.* **2017**, *5*, 60–69. [CrossRef]
10. Johansson, H.; Sandvik, K.O.; Zsidákovits, J.; Łutczyk, G. A Need for New Methods in the Paradigm Shift from Mobility to Sustainable Accessibility. *Transp. Res. Procedia* **2016**, *14*, 412–421. [CrossRef]
11. Khisty, C.J.; Zeitler, U. Is Hypermobility a Challenge for Transport Ethics and Systemicity? *Syst. Pract. Action Res.* **2001**, *14*, 597–613. [CrossRef]

12. Kenworthy, J.R.; Laube, F.B. Automobile dependence in cities: An international comparison of urban transport and land use patterns with implications for sustainability. *Environ. Impact Assess. Rev.* **1996**, *16*, 279–308. [CrossRef]
13. Sachs, W. *For Love of the Automobile*; University of California Press: Los Angeles, LA, USA, 1992; ISBN 9780520068780.
14. Litman, T. *Introduction to Multi-Modal Transportation Planning: Principles and Practices*; Victoria Transport Policy Institute: Victoria, BC, Canada, 2020; ISBN 9781138185487.
15. Schiller, P.L.; Brunn, E.C.; Kenworthy, J.R. *An Introduction to Sustainable Transportation: Policy, Planning and Implementation*; Earthscan: Washington, DC, USA, 2010.
16. Zuidegeest, M.; Maarseveen, M. Transportation Planning for Sustainable Development. Available online: https://www.semanticscholar.org/paper/Transportation-planning-for-sustainable-development-Zuidgeest-Maarseveen/a506ae295772f331f4117be45843643470162fb0 (accessed on 1 September 2021).
17. Kane, L.; Del Mistro, R. Changes in transport planning policy: Changes in transport planning methodology? *Transportation* **2003**, *30*, 113–131. [CrossRef]
18. Forward, S.; Hylén, B.; Barta, D.; Czermański, E.; Åkerman, J.; Vesela, J.; Isaksson, K.; Dębicka, O.; Brand, R.; Forward, S.; et al. *Challenges and Barriers for a Sustainable Transport System—State of the Art Report*; Transforum: Koln, Germany, 2014.
19. Rietveld, P.; Stough, R.R. *Barriers to Sustainable Transport: Institutions, Regulation and Sustainability*; Taylor & Francis: New York, NY, USA, 2005; ISBN 9780415646048.
20. Zelenika, I.; Pearce, J.M. Barriers to Appropriate Technology Growth in Sustainable Development. *J. Sustain. Dev.* **2011**, *4*, 12–22. [CrossRef]
21. Wolny, A.; Ogryzek, M.; Źróbek, R. Challenges, opportunities and barriers to sustainable transport development in functional urban areas. In Proceedings of the 10th International Conference on Environmental Engineering, Vilnius, Lituhania, 27 April 2017.
22. May, A.D.; Kelly, C.; Shepherd, S.; Jopson, A. An option generation tool for potential urban transport policy packages. *Transp. Policy* **2012**, *20*, 162–173. [CrossRef]
23. Comi, A.; Polimeni, A. Assessing the potential of short sea shipping and the benefits in terms of external costs: Application to the Mediterranean basin. *Sustainability* **2020**, *12*, 5383. [CrossRef]
24. Jugović, A.; Debelić, B.; Brdar, M. Short sea shipping in Europe factor of the sustainable development transport system of Croatia. *Pomorstvo* **2011**, *25*, 109–124.
25. Vaggelas, G.K.; Pallis, A.A. Passenger ports: Services provision and their benefits. *Marit. Policy Manag.* **2010**, *37*, 73–89. [CrossRef]
26. Jugović, A.; Mezak, V.; Lončar, S. Organization of maritime passenger ports. *Pomor. Zb.* **2006**, *44*, 93–104.
27. Lister, J. Green Shipping: Governing Sustainable Maritime Transport. *Glob. Policy* **2015**, *6*, 118–129. [CrossRef]
28. Wan, Z.; Zhu, M.; Chen, S.; Sperling, D. Pollution: Three steps to a green shipping industry. *Nature* **2016**, *530*, 275–277. [CrossRef] [PubMed]
29. International Maritime Organization. Third IMO GHG Study 2014. Available online: https://www.imo.org/en/OurWork/Environment/Pages/Greenhouse-Gas-Studies-2014.aspx (accessed on 4 April 2021).
30. Sustainable Shipping: Why Does It Matter and What Does It Entail? Available online: https://www.hellenicshippingnews.com/sustainable-shipping-why-does-it-matter-and-what-does-it-entail/ (accessed on 7 April 2021).
31. Sustainable Shipping: European Maritime Safety Agency. Available online: http://www.emsa.europa.eu/we-do/sustainability/environment/sustainable-toolbox.html (accessed on 7 April 2021).
32. International Maritime Organization. International Convention for the Prevention of Pollution from Ships (MARPOL). Available online: https://www.imo.org/en/About/Conventions/Pages/International-Convention-for-the-Prevention-of-Pollution-from-Ships-(MARPOL).aspx (accessed on 7 April 2021).
33. Bányai, T.; Illés, B.; Bányai, Á. Smart scheduling: An integrated first mile and last mile supply approach. *Complexity* **2018**, *4*, 5180156. [CrossRef]
34. Stocchetti, A. The Sustainable Firm: From Principles to Practice. *Int. J. Bus. Manag.* **2012**, *7*, 34–47. [CrossRef]
35. European Commission. Guidelines: Developing and Implementing a Sustainable Urban Mobility Plan. Available online: https://www.eltis.org/sites/default/files/guidelines-developing-and-implementing-a-sump_final_web_jan2014b.pdf (accessed on 12 April 2021).