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Silvio Nocera, Raffaele Pesenti,
Igor Rudan, Srđan Žuškin

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Abstract

Maritime transport is both a major source of environmental pollution and a great opportunity for reducing road traffic. Moreover, for some Mediterranean countries, maritime transport offers a way to improve cross-border connectivity.
However difficult this may be, improving maritime passenger transport is one way to increase cross-border connectivity and, in some cases, reduce the use of private cars. For this reason, the European Union is pursuing an intensive policy in support of the sustainable development of maritime transport, working on many fronts, including the strengthening of EU legislation on this topic, technical and financial support to reducing emissions from international shipping, investments for the improving of port facilities and infrastructures, involving national governments and regions in the definition of roadmaps and new targets towards 2050.
There are many possible directions for improving maritime transport: ship technologies, port management, interchange connectivity, transit planning, and so on. The goal of this book is to collect rigorous contributions about what are currently considered to be the main areas of improvement to be pursued in cross-border maritime passenger transport.
The book opens with an overview of EU policies on maritime and coastal transport. In the following chapters, a series of analyses and tools are proposed whose systematic application can significantly contribute to improving maritime passenger transport.
This book was conceived within the framework of the MIMOSA project (Maritime and Multimodal Sustainable Passenger Transport Solutions and Services, Interreg V-A Italy-Croatia CBC Programme 2014-20). The project is focused on the improvement of cross-border connectivity between Italy and Croatia by tackling the common challenge of increasing multimodality and reducing the impact of transport on the environment.

Keywords Sustainable passenger transport. Cross-border passenger transport. Multimodal passenger transport. Maritime transport. INTERREG Italy-Croatia.

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Preface

Paolo Dileno
Central European Initiative

The Central European Initiative (CEI) is the oldest and largest intergovernmental regional forum in Central Eastern and South-Eastern Europe. It was founded in 1989 – the day after the fall of the Berlin wall – by four countries (Italy, Austria, Hungary and former Yugoslavia) and now counts 17 Member States.[1] It aims at promoting European integration and sustainable growth in various areas through its strong support to regional cooperation as its main development tool.

Among the numerous CEI areas of intervention, particular attention has always been paid to strengthening the transport networks. By guaranteeing a better mobility of persons and goods in the CEI areas we not only contribute to promoting integration among peoples but also to supporting and stimulating economic and social development.

The CEI-Executive Secretariat implements its mission by using various tools, including – since 2004 – projects co-financed by the European Territorial Cooperation policies.

The strategic project Interreg Italy-Croatia MIMOSA (MarItime and MultimOdal Sustainable pAssenger transport solutions and services), founded on a solid partnership composed of regional adminis-

1 Albania, Belarus (suspended as of March 2022), Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Italy, Moldova, Montenegro, North Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia, Ukraine.

trations responsible for planning passenger transport services, port authorities, public transport operators, universities and research institutes, agencies, local and national authorities, aims to tackle four challenges: understanding the complex dynamics of passenger transport demand between Italy and Croatia, characterised by a strong prevalence of private mobility; identifying the bottlenecks that limit the development of multimodal solutions for passenger transport; promoting innovative sustainable mobility services and solutions; improving cross-border cooperation on passenger mobility issues, supporting the strengthening of institutional dialogue between the stakeholders of the area with positive impacts on the Adriatic-Ionian area.

The strong prevalence of private mobility in the area is not only due to the limited offer of alternative and efficient transport services but also a consequence of citizens behaviour that has to be better understood, working on raising awareness among users regarding the impact of mobility choices. This is combined with the commitment of project partners to promote new transport services and, more generally, better accessibility to sustainable mobility solutions in the cross-border area such as the smart card realised by the Istrian Development Agency, which guarantees – with a single ticket – full access to public transport and various other sustainable mobility services in the Region; the realisation of a bike centre in the Dubrovnik Neretva County dedicated to cycle tourists; the installation of multimedia info points and other facilities for comfort and information for passengers in the ports of Sibenik and Ancona, as well as the activation of new bike sharing services in the municipalities of Cervia and Rovinj.

However, the analysis of the dynamics of cross-border mobility could not but involve the analysis and promotion of maritime and coastal passenger transport, including the development of improved maritime connections between Italy and Croatia.

In this context, MIMOSA has effectively contributed to the improvement of present and future connectivity between Italy and Croatia. This, thanks to the launch – by the Friuli Venezia Giulia Region – of the experimental public transport maritime summer service Lignano-Grado, which is interconnected with the sea lines activated towards Trieste and the Istrian coasts. It guarantees the availability of more sustainable transport solutions, with positive impacts on the environment in terms of emission reduction.

And with regard to the issue of emission reduction and mitigation of the environmental impacts of passenger transport, two further initiatives which have been developed as part of the MIMOSA Project deserve mentioning: the analysis of carbon footprint of the various transport solutions on specific cross-border routes, where the strong competitiveness of maritime connections has clearly emerged, and the feasibility study for a new maritime connection between the Abruzzo region and Croatia, with LNG-powered ferries.

The set of initiatives carried out within the MIMOSA Project and the results achieved represent an important knowledge heritage, available for stakeholders in the area to continue promoting sustainable and innovative multimodal and maritime transport solutions, supporting on the one hand, the reduction of the use of private vehicles, on the other, a lower environmental impact of passenger transport services.

The wide cooperation network activated within the project will, therefore, be able to generate positive effects in the coming years, guaranteeing not only the continuation of the launched initiatives but also the capitalisation of the results and their possible integration within the sectoral policies at a regional, national and cross-border level. This would also guarantee long-lasting improvements and a positive impact in the European integration process.

Priorities for the Sustainability of Maritime and Coastal Passenger Transport in Europe

EU Policies on Sustainable Transport in Cross-Border Maritime Areas
Connecting European Coasts

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Comune di Venezia, Italia

Pier Paolo Pentucci
Università Ca' Foscari Venezia, Italia

Abstract The goal of the chapter is to review the European projects on the topic of sustainable passenger transport in cross-border maritime areas, financed in the last EU programming period (2014-20). Moreover, main EU policies will be reviewed, with a twofold specific approach: a) mapping measures related to foster better permeability and accessibility of the 'maritime' borders between EU Member States; b) collecting insights concerning the implementation of the principles linked to the paradigm of sustainable mobility.

Keywords Cross-border passenger transport. Maritime transport. European Territorial Cooperation. EU Cooperation Programme. EU cross-border policy.

Summary 1 Introduction. – 2 EU Policies Review on Maritime and Coastal Passenger Transport in European Cross-Border Areas. – 3 An Overview on EU Funding Programmes 2014-20: Better Connections for CB Maritime and Coastal Areas. – 4 Insights from Relevant Implemented Projects and Pilot Actions: Passenger Transport Sustainability in EU Maritime and Coastal Areas. – 5 Conclusions.

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1 Introduction

The aim of this chapter is to summarise recent European policies on cross-border maritime and coastal transport. For this purpose, 13 European projects on the topic of mobility and passenger transport were identified, among those financed during the 2014-20 programming period and implemented in the cross-border maritime territorial dimension. As the funded projects fit into EU strategies, we believe that through their analysis we can identify the main lines of EU policy.

The projects were identified through the online databases provided by the European Commission (Keep.eu, Cordis, TRIMIS): 10 out of 13 within the cross-border funding programmes of the Interreg CBC and 3 concerning feasibility studies and/or infrastructural works included in the Connecting Europe Facilities (CEF) Programme. The overwhelming project proportion financed by Interreg framework depends on the number of funding priorities specifically addressing the cross-border territorial dimension, including those targeting Member States (MS) geographically 'separated' by an internal maritime border line. Differently, considering EU funding programmes based on whole Member States' territorial eligibility, the specific features of the cross-border maritime dimension (strictly linked to the topic of connectivity and passenger transport) are linked to few particular cases, prevalently financed within the CEF framework and basically addressed to feasibility studies/implementation/enhancement of infrastructures identified as key-drivers for cross-border connectivity.

Based on this empirical dataset, the chapter provides a targeted analysis of the objectives, implementation phases and results of the selected projects to highlight the following main issues: quality, safety, and environmental sustainability of maritime passenger transport services in the maritime and coastal context. The chapter is organised into four main paragraphs: 1) a literature and EU policies review on maritime and coastal passenger transport services in cross-border areas; 2) an analysis of the 13 selected projects financed by European Programmes within the maritime cross-border dimension; 3) further insights concerning objectives and results of the project, focusing on their pilot actions; 4) conclusions and remarks on the overall framework of the financed projects and on the related European policies.

2 EU Policies Review on Maritime and Coastal Passenger Transport in European Cross-Border Areas

Framing the transboundary maritime dimension in the issue of internal borders and territorial spaces of EU Member States means, above all, defining the conventional characteristics of this geographical area. The United Nations Convention on the Law of the Sea (1982), signed by 165 countries and the European Union itself, traditionally accepted in its general outlines even by non-signatory countries (Bieda, Adamczyk, Parzych 2019), defines 12 nautical miles as the limit to the territorial waters of each state (UN 1982, Art. 3) and establishes the low tide line along the coast as the measurement baseline (UN 1982, Art. 5). Turning then to the transboundary maritime dimension, the Convention establishes the principle of "delimitation of the territorial sea between States with opposite or adjacent coasts" (UN 1982, Art. 15), defining it in legal terms as follows: "when the coasts of two States are opposite or adjacent to each other, neither State shall have the right to extend its territorial sea beyond the median line each point of which is equidistant from the nearest points of the baselines from which the breadth of the territorial sea of each of the two States is measured", and placing it as an effective maritime boundary line. Moving on from the mere internationally shared legal-territorial definition to EU policies, the 2006 Green Paper [EC COM(2006)275 final] represents one of the first structured interventions to propose an integrated vision of the European Commission (EC) concerning the sustainable development of the maritime territorial dimension. In this document, the role and strategic importance of an extremely peculiar 'geographical area' of the European Union, where major social, economic, political and environmental issues and interests have to be balanced, clearly emerge. The topic of the 'border' (internal and external), as well as maritime and coastal transport, inevitably play a predominant role in the European strategy. Moreover, as the EC emphasises in the introduction to the Communication, "more than two thirds of the Union's borders are coastal and the maritime spaces under the jurisdiction of the Member States are larger than those on land", and similarly, the numbers generated by maritime transport and European ports lead to define planning and management priorities shared between the Member States: 90% of foreign trade and 40% of domestic trade transits by sea, 3.5 billion/t of goods and 350 million passengers a year pass through European ports, not to mention the spill-over effect on employment and the ancillary industries in terms of services and other sectors involved [EC COM(2006)275 final]. But on top of all this, the sustainability topic bursts in. The maritime dimension (human activities) strongly affects the marine dimension (natural ecosystem) conditioning the delicate balance that should be established for a sustainable coexistence. Also for this reason the binary concept 'marine-maritime' becomes a reference topic within European Territorial Cooperation (ETC) Operational Programmes (Interact 2013). If we add to this framework the administrative-territorial restrictions included in the maritime 'border', the conflicts due to the dynamics: 'user-user' and 'user-environment', increasing. In this way, the sustainable development goal – without suitable planning and management tools, shared at European level – it is getting harder to achieve (Li, Jay 2020). Since 2005, the European Commission has set as one of its strategic objectives 2005-09 the fundamental need for an integrated maritime policy aiming to develop a thriving maritime economy, exploiting the full potential of all sea-based activities in an environmentally sustainable manner supported by scientific research, technology and innovation. [EC COM(2005)12 final]. This objective is realised in the specific 2007 Communication on Integrated Maritime Policy for the European Union [EC COM(2007)575 final] based on the results of the multi-stakeholder consultation process launched by the 2006 Green Paper, collected in Report EC COM(2007)574. In this way – from 2005 until today – a series of key points and specific tools have emerged within the EU maritime policy: a) an integrated and cross-sectoral approach for policies concerning European seas and oceans; b) the development of a Work Programme and an Action Plan coordinating all the specific projects, managing policies and decision-making levels within a governance framework; c) the development of fundamental tools such as Maritime Spatial Planning (MSP) – included an implementation roadmap (2008) –; d) an Integrated Coastal Zone Management (ICZM) coordination instrument; e) the creation of the European Marine Observation Network. The new architecture for the EU Integrated Maritime Policy is based on specific 'areas of intervention': the first objective is to create optimal conditions for the sustainable use of the oceans and seas, in this way, maritime transport, ports and related sectors play a strategic role as the 'backbone' of the maritime cluster. The topic of maritime transport features as a strategic element in all the maritime strategies launched by the European Commission. The Blue Growth strategy [EC COM(2012)494 final] defines the state of the art of existing European initiatives and identifies new opportunities for development, focusing on a number of specific areas of intervention in the field of transport: a) support to the EU Maritime Transport without Barriers for the simplification of administrative procedures of maritime transport between MS and development through the realisation of the Blue Belt (a belt of free maritime movement 'in and around Europe'); b) support for innovation in maritime transport both in terms of infrastructure and new technologies and propulsion in the nautical sector; c) within the Focus Area on 'Maritime, coastal and cruise tourism', Public Administrations are invited to adopt a strategic approach related to investments on enabling infrastructures: e.g., mooring capacities, ports and passenger transport services (in this case also in terms of tourism spillover for the coastal areas). Finally, in the recent Communication of 2021 [EC COM(2021)240 final], the topic of maritime transport further emphasises the direction to increase its environmental sustainability also considering the objectives of the EU Green Deal (90% reduction of GHG emissions for all modes of transport). Again, the key issues to addressed are: fuels and vessel propulsion, the role of ports as energy hubs, intelligent solutions and autonomous systems for optimising traffic flows and increasing short sea shipping. Surely, in the case of the above-mentioned policies, transport is part of a general guideline aiming at combining the development of the maritime economy with environmental sustainability; in the same way, the cluster of policies on mobility and maritime transport find their 'natural' space of development and implementation both in strategies and communications exclusively related to mobility and transport in Europe (up to the recent Sustainable and Smart Mobility strategy [EC COM(2020)789 final]), and in terms of strategic planning in communications and directives related to MSP and ICZM. On the European Parliament and Council Directive related to MSP framework (Directive 2014/89/EU), in Art. 5, among the objectives of MSP, Member States must contribute to the sustainable development of the maritime transport sector. In fact, the MSP is an integrated tool for achieving the objectives set by a series of EU policies related to different sectors, including EC COM(2009)8 final that defines the "Strategic goals and recommendations for the EU's maritime transport policy until 2018". The 2014 MSP Directive (Directive 2014/89/E) includes maritime transport routes and related traffic flows among the activities and uses relevant to oceans and seas (Art. 8). This because of maritime transport is the "main and traditional economic activity using maritime spaces" (Zaucha, Gee 2019, 477). In the latest 2022 Report [EC COM(2022)185 final] outlining the progress achieved in the implementation of Directive 2014/89/EU, emerged the need to adapt the MSP to the potential increasing of maritime transport (particularly the short sea shipping) consistently with the new Sustainable Mobility Strategy of December 2020 [EC COM(2020)789 final]. Also concerning the cross-border issue of maritime borders, in terms of planning, management and programming of interventions and actions, it is the MSP to provide the main guidelines and tools on the matter, especially to build the specific concept of Transboundary Marine Spatial Planning (TMSP), demonstrating how important it is to collaborate across borders, especially where the nature itself of marine resources and maritime activities is essentially cross-border (Li, Jay 2020). Clearly, this specific cross-border planning tool is firstly conceived for the conservation of the marine environment and the sustainability of human activities affecting it, taking into account the national guidelines of individual Member States and considering the issue of transport in terms of the impact of economic traffic and port infrastructure. This because: "by definition the shipping transport is considered as an international activity that naturally crosses different countries" (Pınarbaşı et al. 2020, 13, table A1). Furthermore, the maritime transport sector (as we have seen at the beginning) is regulated by international conventions and only in a collateral way can be influenced by MSP actions, although as an activity affecting maritime space it cannot be neglected together with the related stakeholders (Gómez-Ballesteros et al. 2021). In any case, cross-border maritime policies in terms of mobility and transport have specific relevance and concrete development opportunities in European Funding Programmes, in particular within European Territorial Cooperation (ETC). More specifically, it is the case of the Cross-Border Cooperation Programmes (Interreg A and IPA CBC) that provide the greatest contribution in this area for transport development, especially those including large maritime areas in the programme area: e.g., Italy-Croatia, Italy-France Maritime, Italy-Greece, and South Baltic. The objective, as stated by the European Commission in the Regional Policies, is "to tackle common challenges identified jointly in border regions and to exploit the untapped growth potential in border areas, while enhancing the cooperation process with a view to strengthening the overall harmonious development of the Union".[1] Furthermore, the fundamental boost provided by the macro-regional strategies, defining a framework for cooperation shared between Member States in the same geographical area. It's approved by the European Council and supported in many cases by the Structural and Investment Funds. At the maritime level, the Strategy for the Baltic Sea Region (EUSBSR) [EC COM(2009)248 final] and the Strategy for the Adriatic-Ionian Region (EUSAIR) [EC COM(2014)357 final] are particularly relevant. Both identify cross-border connections and transport as key priorities in both maritime and terrestrial areas, with specific focus on cross-border accessibility, overcoming physical and administrative barriers, environmental sustainability and multimodal development. Other funding opportunities for maritime and coastal cross-border regions area available in addition to the European Territorial Cooperation, such as the Connecting Europe Facilities (CEF) infrastructure investment funds and the research and innovation funds of the European Commission (Framework Programme – Horizon). Considering the evolution of the Interreg A CBC funding programmes, we can see that transport plays a relevant role at least since 2000-06 programming period (Medeiros 2018):

1 https://ec.europa.eu/regional_policy/en/policy/cooperation/european-territorial/cross-border/#1.

Table 1 Main thematic goals of Interreg A programmes from 1989 to 2020. Source: Medeiros 2018

Interreg A	**Main Goal**	**Financed Policy Priorities**
I. 1989-93	Prepare the border areas for the opening of the Single Market, with an eye to economic and social cohesion.	• Aid to SMEs • Tourism and culture • Energy supply • Rural development and commerce • Education and training • Protection of environment • Water supply and waste disposal • Accessibilities infrastructure • Spatial planning
II. 1994-99	Develop cross-border social and economic centres through common development strategies.	• Aid to SMEs • Tourism and culture • Energy supply • Rural development and commerce • Education and training • Employment and mobility • Health • Protection of environment • Water supply and waste disposal • A better public administration • Accessibilities infrastructure • Information and communication • Spatial planning
III. 2000-06	Develop cross-border economic and social centres through joint strategies for sustainable territorial development	• Aid to SMEs • Rural development • Urban and coastal development • Education and training • Culture • Employment and mobility • Health • Protection of environment • Energy efficiency and renewable energy • Better public administration • Legal systems • Information and communication • Transport

Interreg A	Main Goal	Financed Policy Priorities
IV. 2007-13	Reduce the negative effects of borders such as administrative, legal and physical barriers; tackle common problems and exploit untapped potential. Through joint management of programmes and projects, mutual trust and understanding are strengthened and the cooperation process is enhanced.	• Entrepreneurship • Education and training • Employment and mobility • Equal opportunities • Management of natural resources • Information and communication • Transport • Link between rural and urban areas • Joint use of infrastructure
V. 2014-20	Tackle common challenges identified jointly in the border regions and exploit the untapped growth potential in border areas, while enhancing the cooperation process for the purposes of the overall harmonious development of the Union.	• Aid to SMEs • Research and innovation • Education and training • Employment and mobility • Social inclusion • Low carbon economy • Combating climate change • Environment and resource efficiency • Sustainable transport • Better public administration • Information and communication

Taking into account the projects supported by CBC programmes in the field of transport and mobility from 2000 to 2013 we can count 411 projects (1.51%) (Medeiros 2018), while in the programming period 2014-20 the projects in the same thematic areas have been 279 (Mella 2021), though the transport and mobility projects related to maritime and sea cross-border areas are only a small chapter in the CBC book, as we will see in the following section.

Before addressing the analysis of programmes and policies it would be worth having a look at the evolution of the overall picture of the programmes' geographical areas **[fig. 1]** and noting that in the public consultations done by the European Commission DG Regio the maritime dimension of transport connections is seldom explicitly mentioned; this is to say that we're moving in a narrow sphere of the CBC domain.

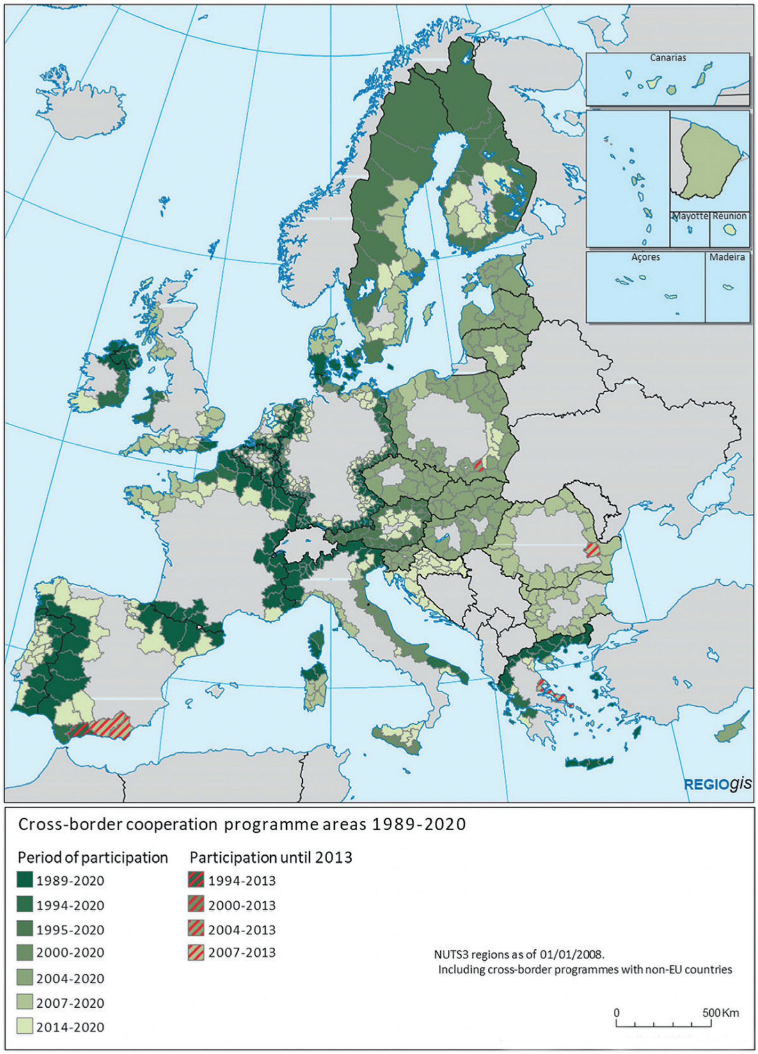

Figure 1 The evolution of Interreg A programmes areas from 1989 to 2020. Source: ECA 2021, 13

In the 2021-27 programming period the maritime dimension is confirmed and in the new regulation is clearly stated that CBC cooperation strand should aim at addressing common challenges and to contribute in overcoming main obstacles. Regions and areas eligible for Interreg A cooperation are "separated by a maximum of 150 km of sea where cross-border interaction may effectively take place or in which functional areas can be identified, without prejudice to potential adjustments needed to ensure the coherence and continuity of cooperation programme areas" [Regulation (EU) 2021/1059]. With the objective of achieving a better level of integration transnational cooperation around sea basins will involve partners in Member States and third countries.

3 An Overview on EU Funding Programmes 2014-20: Better Connections for CB Maritime and Coastal Areas

In this chapter we propose an overview of the projects financed during the European Programming Period 2014-20, related to the maritime cross-border dimension on the topic of mobility and passenger transport. Concerning the methodological level, the research was done using the main online databases provided by the different programmes, in order to understand which of the main EU funding lines have planned specific funds and/or thematic clusters for cross-border maritime geographic areas and which one of the eligible priorities included a focus on connectivity and passenger transport. In this first general survey, the following emerged as particularly significant: 1) the cross-border maritime programmes of the European Territorial Cooperation (ETC); 2) the financing instrument of the European agency INEA (Infrastructure and Environment Executive Agency, which from April 2021 was transformed into CINEA, European Climate, Infrastructure and Environment Executive Agency) named Connecting Europe Facility (CEF).

The cross-border maritime programmes of the ETC, certainly represent the most significant cluster specifically focused on this particular geographical dimension. According to their standard definition, they are

> characterised by the presence of the sea in the geography of their programme areas. These stretches of sea separate entirely at least one of the countries from the rest of the programme area. In comparison to the 'traditional' cross-border programmes, where participating regions share a land border and where cooperation is based on proximity of the regions, maritime programmes may involve several member states and regions of the EU along maritime borders separated by a maximum of 150 km. (Interact 2013, 5)

Through the Keep.eu database – implemented by the Interact programme to provide aggregated data on projects and beneficiaries of cross-border, transnational and interregional cooperation programmes from the 2000-06 programming period – a textual search was conducted using two specific keywords ('maritime' and 'sea'), in order to exclude the project developed on internal waterways border and selecting further restrictive criteria related to: "Interreg Cross

Border" (excluding IPA programmes); "Programming Period 2014-20"; and the following thematic fields: "Improving transport connections"; "Multimodal transport"; "Transport and mobility"; "Waterways, lakes and rivers"; and excluding thematic fields related to "logistics and freight" and "infrastructures" in order to maintain a clear focus on passengers mobility. This screening resulted in the following for the 2014-2020 period: 23 projects, 189 European partners involved, 203 development consortia and 9 specific programmes **[fig. 2]**.

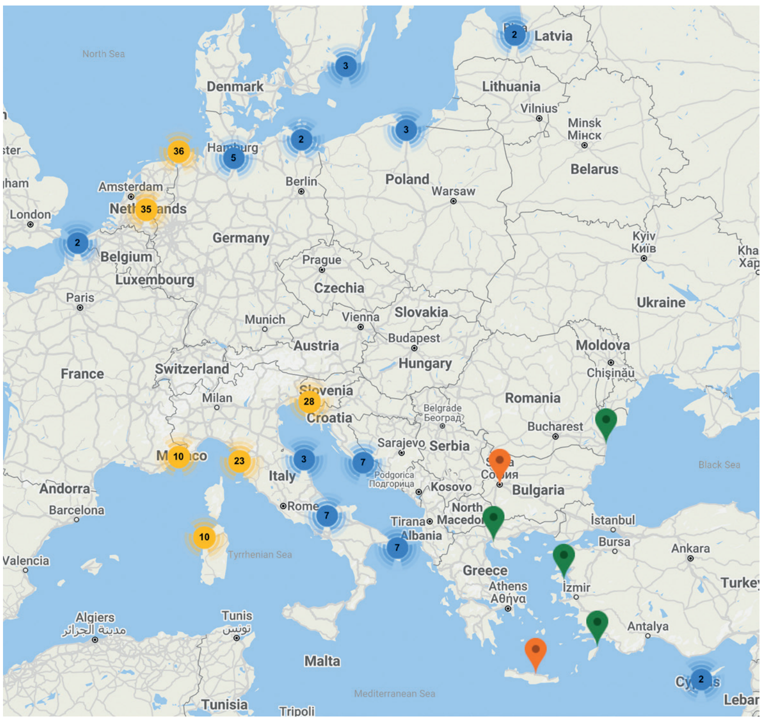

Figure 2 Maritime mobility and transport projects funded by CBC programmes in 2014-20.
Source: Keep.eu

Analysing the 23 projects in terms of their content and implemented activities, we realise a further selection to identify those projects that, in terms of their characteristics, activities and implemented pilots, focused on the following set of sub-topics: 1) quality of maritime passenger transport and coastal areas, 2) safety and environmental sustainability of marine and coastal transport services and nodes; 3) promotion and increase of multimodal services and accessibility. On the basis of these characteristics, 10 projects were identified as particularly significant **[tab. 2]**.

Table 2 Interreg V-A CB programmes: selected projects, 2014-20. Source: own elaboration and selection based on Keep.eu online database

1 Project name & implementation period	EU programme	EU contribution
ADAPT (2016-19)	Interreg Central Baltic	€ 1,636,075.00
Project short abstract		
The project has been supported by the Interreg Central Baltic Programme Specific Objective “Improved transport flows of people and goods” and it was coordinated by the Swedish Maritime Administration (Sjöfartsverket). The project aimed at developing safe, time-saving and fuel-efficient routes – to be more sustainable from the environmental point of view and to reduce emissions – for the transportation of passengers and goods in the Åland and Stockholm archipelagos. Partners ensured safer routes with lower CO2 emissions with shorter connections for commuters and users of public transport.		
Source `http://database.centralbaltic.eu/project/31`		
2 Project name & implementation period	**EU programme**	**EU contribution**
Efficient Flow (2018-21)	Interreg Central Baltic	€ 3,070,394.00
Project short abstract		
The project is a joint Swedish-Finnish initiative that gathers six partners and that contributes to the development of the corridor to and between the ports of Gävle and Rauma and the ScanMed corridor between Stockholm and Turku. The project delivers improved processes, business models and ICT tools for enhanced information exchanged among ports, operators, and ships. One of the project’s main results is the flow optimisation in the regular ferry traffic to improve situational awareness and facilitate higher predictability and efficiency.		
Source `http://database.centralbaltic.eu/project/96`		
3 Project name & implementation period	**EU programme**	**EU contribution**
DEEP-SEA (2019-22)	Interreg Italy-Croatia	€ 2,134,832.00
Project short abstract		
The DEEP-SEA project is coordinated by Aries (Special Agency Venezia Giulia Chamber of Commerce) and it aims to tackle the problem modal split, dominated by private cars and polluting maritime transport, together with the limited integration of mobility services. The project, through the development of a model, is designed to support marinas operators (MOs) and Public administration in planning and implementing sustainable mobility in the partners areas, increasing the efficiency of mobility services and the adoption of e-mobility sharing mobility solutions.		
Source `https://www.italy-croatia.eu/web/deep-sea`		
4 Project name & implementation period	**EU programme**	**EU contribution**
GUTTA (2019-22)	Interreg Italy-Croatia	€ 1,020,000.00
Project short abstract		
The GUTTA project aims to contribute to greener ferry routes between Italy and Croatia. The first preliminary objective is to release a web tool to reduce CO_2 emission in ferry routes; then partners work on the assessment of the added value of the information contents of the CO_2 emissions data collected under the EU Regulation 757/15 on MRV (Monitoring/Reporting/Verification). The project works also on the analysis of maritime mobility trends in the connections between Italy and Croatia, also considering the COVID-19 pandemic impacts.		
Source `https://www.italy-croatia.eu/web/gutta`		

5 Project name & implementation period	EU programme	EU contribution
METRO (2019-21)	Interreg Italy-Croatia	€ 2,520,000.00
Project short abstract		
The project is coordinated by the University of Trieste (Department of Engineering and Architecture) and its goal is the improvement of the environmental sustainability of tourist maritime transport in the North Adriatic, addressing some specific challenges of the area: maritime connections between Italy and Croatia; reduction of traffic congestion caused by seasonal tourist flows; improvement in local stakeholders' competitiveness. The project adopts a multidisciplinary approach to integrate technologies in the field of electrical shipboard power systems, ship design and land infrastructure study.		
Source `https://www.italy-croatia.eu/web/metro`		

6 Project name & implementation period	EU programme	EU contribution
MOSES (2018-19)	Interreg Italy-Croatia	€ 998,779.00
Project short abstract		
The project, led by the Autonomous Region of Friuli Venezia Giulia in Italy, capitalises on the results of the IPA Adriatic project EA SEA-WAY, aimed to enhance the accessibility and mobility of passengers in the Adriatic area through the development of new cross-border sustainable and integrated transport services and the improvement of related infrastructures. The partnership main outcomes are: one pilot ICT tool for e-booking and e-ticketing solutions, one pilot electric car/bike sharing system, a pilot action for a maritime fast-line transport service, a feasibility study to increase sustainable marine transport routes, recovery of operational quay in port of Susak.		
Source `https://www.italy-croatia.eu/web/moses`		

7 Project name & implementation period	EU programme	EU contribution
SUTRA (2019-21)	Interreg Italy-Croatia	€ 2,360,000.00
Project short abstract		
The overall objective of the project is to promote sustainable mobility on the Adriatic coast and its hinterland. By mainstreaming innovative mobility concepts for passenger transport, urban centres in the area covered by Italy-Croatia Programme aims at reducing traffic congestion, improve air quality and reduce CO2 emissions. The main outputs of SUTRA are: ten new eco-friendly multimodal transport services for passengers, one new maritime link between Italy and Croatia (between Caorle and Poreč) and a cross-border Manual for smart design and integration of soft mobility solutions in coastal areas.		
Source `https://www.italy-croatia.eu/web/sutra`		

8 Project name & implementation period	EU programme	EU contribution
DOCK-BI (2018-22)	Interreg Greece-Italy	€ 2,785,810
Project short abstract		
The project, coordinated by the Consortium for the Industrial Development Area of Brindisi, aimed at upgrading port areas and cross-border ferry connectivity between the key ports of Brindisi (Italy) and Igoumenitsa (Greece). DOCK-BI address the cross-border challenge given by the unsatisfactory multimodal accessibility and the lack of integration and interconnection of transport modes between the two ports. The infrastructural interventions foreseen by the project were: parking areas, Igoumenitsa passenger's terminal, street lighting, and access roads to Brindisi ferry port area.		
Source `https://greece-italy.eu/rlb-funded-projects/dock-bi/`		

9 Project name & implementation period	EU programme	EU contribution
INVESTMENT (2018-21)	Interreg Greece-Italy	€ 857,053.07
Project short abstract		
The project aims at delivering an e-platform supporting an ecosystem of services, addressing the requirements of stakeholders, citizens, tourists, and public transportation service providers, while offering, for the first time, a unified view of the – otherwise – fragmented transportation network between the region of Western Greece and Apulia Region (Bari, Taranto, Ostuni). The e-platform supports three core e-services: a multimodal public transit route planner, a multimodal tourist tour planner and a decision support system identifying bottlenecks across the public transport network.		
Source `https://greece-italy.eu/rlb-funded-projects/investment/`		

10 Project name & implementation period	EU programme	EU contribution
MOBIMART (2018-21)	Interreg Italy-France (Maritime)	€ 5,183,427,60
Project short abstract		
MOBIMART aims to develop a single infomobility tool for passengers (residents, tourists, commuters) travelling between Sardinia, Corsica, the Mediterranean region of France, Tuscany and Liguria. The information platform includes information on different means of transport (ship, train, bus and also air connections) and it aims to provide immediate information to users regardless of administrative borders or service operators. The starting point is the harmonisation of information systems, databases and IT platforms.		
Source `https://interreg-maritime.eu/web/mobimart`		

Concerning Connecting Europe Facility (CEF), the selection of projects was conducted through the “Search Hub” of TRIMIS (The Transport Research and Innovation Monitoring and Information System), a web portal of the European Commission, conceived as an integrated transport policy support tool: through TRIMIS, data and information on research and innovation (R&I) in the mobility and transport sector are collected and provided in open-access. This tool also contributes to the development, implementation and monitoring of the European STRIA agenda (The Strategic Transport Research and Innovation Agenda) through which R&I priorities are defined to foster the decarbonisation and sustainability transition of the European transport sector.[2] The database search concerning CEF-funded projects was based on the same thematic parameters set previously on Keep.eu for Interreg CBC (“Improving transport connections”; “Multimodal transport”; Transport and mobility”; “Waterways, lakes and rivers”) but in this case the number of projects identified has been reduced to three. The CEF, as mentioned above, concerning the transport topic (this financing instrument, in addition to Transport, provides two other different sectors of intervention: Energy and Telecommunications),

2 `https://trimis.ec.europa.eu/stria`.

supports, in terms of specific grants, the realisation of new transport infrastructures – or the regeneration and upgrading of already existing ones – according to forecasts and agendas scheduled by European policies and in particular by the TEN-T (Trans-European Transport Network) corridors – governed by Regulation (EU) no. 1315/2013, updated in a consolidated version in 2019 – and subjected by the EC to a consultation and review process between 2019 and 2021 **[fig. 3]**. The CEF-Transport projects have a total budget of €24.05 billion for the funding period 2014-20. The eighth Report of the European Commission on Economic, Social and Territorial Cohesion (EC, December 2021), first of all, takes stock of the EU policies aimed at achieving a "greener, low-carbon Europe". Considering the transport sector and related greenhouse gas (GHG) emissions, the picture does not appear so reassuring. It is interesting to remark **[fig. 4]**, how the data on GHG emissions from transport reveal that they have been increasing in recent years (2014-19), rather than following the general downward trend. In terms of the projection to 2035, it is also well emphasised how, despite the measures "currently planned by the Member States", GHG emissions will decrease by a small percentage, maintaining indexes above 1990 levels. A second, parallel projection shows how "additional" and "more ambitious" measures are extremely urgent equally in all "transport modes", if transport really wants to make its effective contribution to the achievement of the Green Deal targets (EC, Report December 2021, 72). In the last paragraph of the report, however, the role played by the CEF-Transport in the 2014-20 programming is highlighted, in terms of supporting European policies through the financing of cross-border projects, aimed at removing bottlenecks still existing between neighbouring Member States, and/or bridging missing links related to several sections of transport networks in the same territories. In 2014-20 **[fig. 5]**, the largest funding amount was invested in rail transport, but Member States also benefited from substantial shares in maritime and road transport (EC, Report December 2021, 284). Also in the case of the three selected CEF projects **[tab. 3]** – as well as in the Interreg projects – preference was given to cross-border maritime projects, based on an intervention logic related to quality, safety and sustainability on maritime infrastructures, with potential elements of convergence on the topics of multimodality and accessibility.

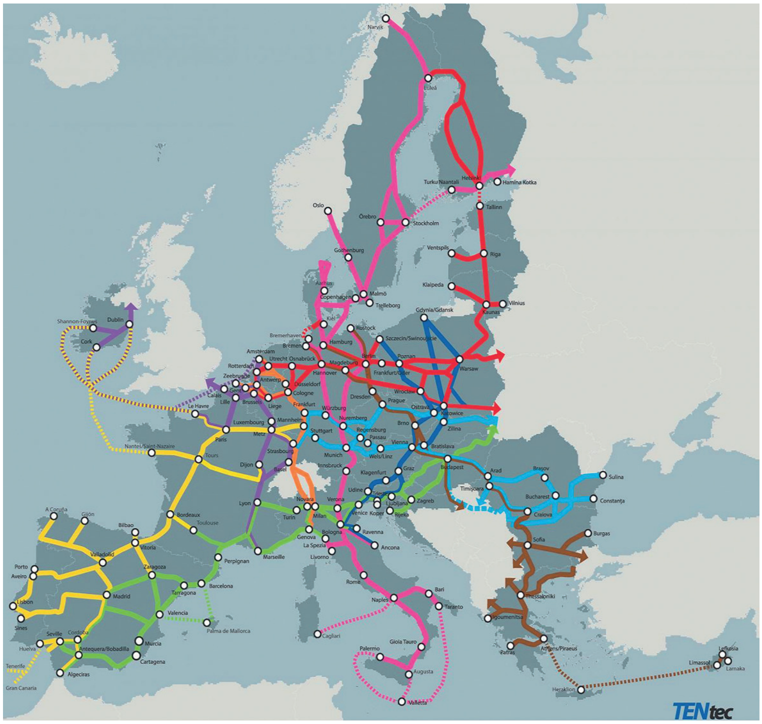

Figure 3 Trans-European Transport Network (TEN-T) – EU corridors.
Source: EC, Mobility and Transport website https://bit.ly/3uoqbFt

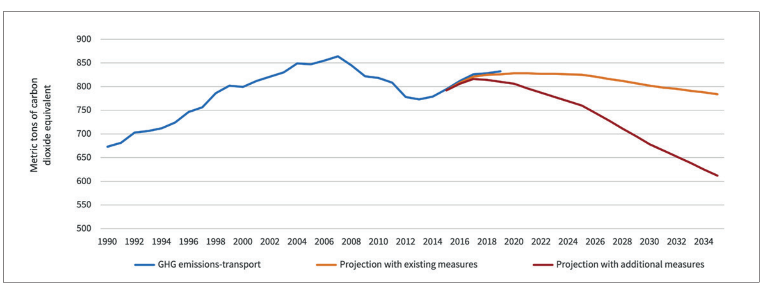

Figure 4 GHG emission in the transport sector since 1990 and projections to 2035, EU-27.
Source: EC 2021, 72 fig. 3.4

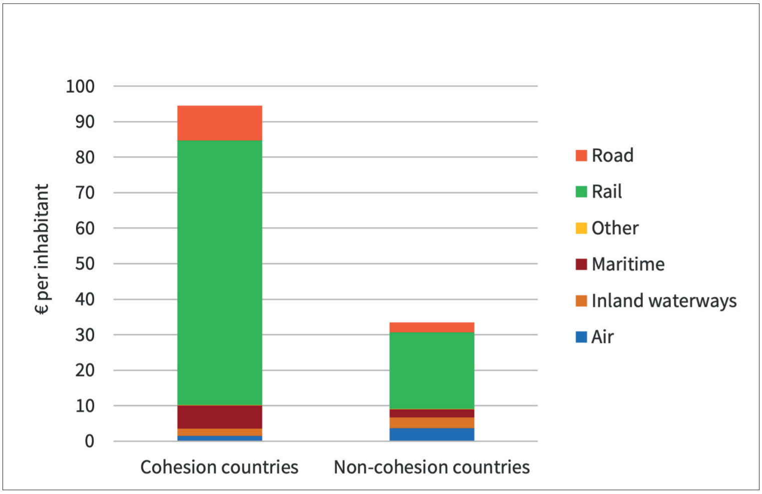

Figure 5 Connecting Europe Facility funding for cohesion and other countries by transport mode, 2014-20. Source: EC 2021, 284 fig. 9.3

Table 3 Connecting Europe Facility (CEF): selected projects, 2014-20. Source: own elaboration and selection based on Trimis.ec.europa.eu online database

1 Project name & implementation period	EU programme	EU contribution
Twin-Port IV (2020-23)	Connecting Europe Facility	€ 7,518,000.00
Project short abstract		
The action – a follow-up of the previous three “Twin-Port” projects – is part of a Global Project aiming at the development and upgrade of the “Motorways of the Sea” between the ports of Helsinki (Finland) and Tallinn (Estonia). The action aims at upgrading the efficiency of the maritime link and at reducing the negative impact on the environment. Activities foresee the upgrading of port infrastructures and hinterland connections in the Port of Helsinki, while in the Port of Tallinn some areas will be reconstructed in order to improve the hinterland connection. The proposal is coordinated by the Port of Tallinn.		
Source `https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2019-eu-tm-0192-w`		

2 Project name & implementation period	EU programme	EU contribution
NextGen Link (2017-21)	Connecting Europe Facility	€ 11,259,630.00
Project short abstract		
The overall objective of the action is to upgrade the existing maritime link between the ports of Turku, Finland and Stockholm, Sweden and the port of Mariehamn in the northern Baltic Sea along the Scandinavian-Mediterranean Corridor. The project aims at improving the ports connectivity, at developing sustainable maritime transport routes and to promote green shipping and the use of alternative fuels following the EU’s clean fuel strategy (Directive 2014/94/EU).		
Source `https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2016-eu-tm-0092-w`		

3 Project name & implementation period	EU programme	EU contribution
Zero Emission Ferry (2014-17)	Connecting Europe Facility	€ 13.150.630,00
Project short abstract		
The action was financially supported by Connecting Europe Facility and coordinated by Forsea Helsingør ApS (Denmark), and its main objective was to introduce innovative concepts and technologies. The project converted to RoPax vessels powered with heavy oil to electrically powered ships. The actions took place in the comprehensive TEN-T network ports of Helsingör (Denmark) and Helsingborg (Sweden). The actions contributed to significantly improve the air quality of densely populated areas.		
Source	https://ec.europa.eu/inea/en/connecting-europe-facility/cef-transport/2014-eu-tm-0489-s	

4 Insights from Relevant Implemented Projects and Pilot Actions: Passenger Transport Sustainability in EU Maritime and Coastal Areas

Considering contents, activities and pilot actions of the selected projects, the most numerous groups have been selected within the Interreg Italy-Croatia Programme 2014-20 **[tab. 1, projects 3-7]**, a cross-border territorial cooperation instrument that covers the territories of the two MS on the opposite sides of the Adriatic Sea. Out of the four thematic priority axes composing the Operational Programme, the axis on maritime transport (Priority Axis no. 4) has provided an ERDF (European Regional Development Fund) budget of €43.3 million (21.54%) allocated for the period 2014-20, out of an overall ERDF total of €201 million. As pointed out in the Key Facts of the Programme Manual, on which the financing and implementation strategy of the 2014-20 projects is based:

> Regarding transport of passenger Adriatic Croatia is the second among the NUTS2 regions of Europe, with more than 13 million passengers transported in 2013. Nevertheless, the large majority of the passengers is represented by tourists having as destination Croatia, while the relatively low number of routes between the two shores of the Adriatic is affecting the accessibility of the overall area. Moreover, the high seasonality of tourism, the increasing numbers of visitors and travellers, together with the lack of efficient multimodal nodes in the area are generating traffic congestions in the coastal zones, especially in the areas of more important ports. The situation reveals the importance of transport in the overall economy of the programme area, but in the meanwhile represents an important challenge for the accessibility of the region in terms of connectivity, inter-operability and multimodality. (CP 2014-20, v. 5.0, pp. 14-15)

The situation related to traffic congestion in some places of the programme area (particularly due to seasonal tourism flows) is highlighted within the 'weak points' in the SWOT analysis related to the 'sustainable growth', leading the consequent need for a relevant reduction of road traffic in coastal urban areas, especially during the seasonal peaks of tourism. This is counterbalanced by two challenges/opportunities to be addressed, favouring their potential development: a) realising "more systemic, integrated and efficient maritime connections from/to the eligible territories and between them" (CP 2014-20, v. 5.0, p. 19); b) developing cooperation among the ports located in the programme area, especially implementing an integrated ICT system for the exchange of data and information, and integrated ticketing for passenger transport. It is also for these reasons that the Italy-Croatia Programme has identified within its thematic objectives (Thematic Objective no. 7): "Promoting sustainable transport and removing bottlenecks in key network infrastructures", identifying as an investment priority [Investment Priority no. 7(c)] the development and strengthening of sustainable and low-carbon transport systems – including all the main transport modes – increasing of multimodal connections, especially at regional and local level (CP 2014-20, v. 5.0, p. 21). Considering the projects financed in Italy-Croatia, it seems interesting to highlight specifically some initiatives. For example, the DEEP-SEA project **[tab. 1, project 3]** has set as specific objective to provide support to marina operators and public administrations on the planning/implementation of sustainable mobility especially in terms of integration of services and multimodal solutions. At the same time, the focus of this project on alternative fuel technologies and electric boats is interesting. A technological focus is implemented under further development perspectives by the METRO project **[tab. 1, project 5]**, in this case, with a target on tourist connections in the Upper Adriatic, this focus is based on 'hybrid' technological solutions (again for tourist transport boats) but also on refuelling/recharging infrastructures suitable for small marinas. The MOSES and SUTRA projects too **[tab. 1, projects 6-7]** are focused – including pilot actions – on the issue of passenger transport in coastal areas, in relation to the traffic problems specifically due to the relevant impact of tourist flows between the two shores.

The first (MOSES), capitalising a best practice of a previous IPA-Adriatic project, implemented a panel of pilot actions with a wide range of transport solutions testing with different perspectives of approach. In fact, new short-sea shipping lines have been tested by introducing e-ticketing and e-booking options and by developing feasibility studies taking into consideration hypotheses of vessels with a lower environmental impact. Concerning the passenger arrival destinations, the actions are targeted on the improvement/widespread of multimodal options, infrastructure accessibility, comfort and safety, and info-mobility with a specific focus concerning the improvement of connections between coast and hinterland. E-bike and bike&bus services were tested to ensure travel between the main transport nodes. The SUTRA project implemented solutions for the integration of services, also focusing on sustainable and multimodal connections between coast and hinterland, including the possibility of activating new cross-border maritime links. It is important to emphasise in this project the activation of a network between the involved municipalities of the different areas, in order to co-design and implement mobility shared actions to improve accessibility and transport systems in the different communities, also through the experimentation of new governance models. Finally, the GUTTA project **[tab. 1, project 4]** – the last of the selected project financed by Interreg Italy-Croatia – has based its activities on the reduction of the environmental impact of the ferry lines between Italy and Croatia through three specific objectives within its work programme, proposing interesting solutions also in terms of research and innovation: a) the realisation of a web tool to optimise ferry routes in terms of CO_2, based on operational meteo-marine forecast data; b) assessment of the added value of the information content of CO_2 emission data (ex Reg. EU 757/15 – MRV); c) analysis of past and present trends in maritime mobility within Italy-Croatia area, also in relation to the post-pandemic horizon. The two projects selected in the cross-border Interreg Central Baltic Programme – ADAPT and Efficient Flow **[tab. 1, projects 1-2]** – are, in our opinion, interesting for the proposals they have been designed within the objectives of this cross-border programme. Central Baltic (CB) territorially involves Finland (including Åland), Estonia, Latvia and Sweden; the programme priority related to transport is in this case no. 3: "Well-connected region" and is focused on accessibility in the whole programme area, including also the economic competitiveness and tourist attractiveness. The programme promotes and support planning activities of integrated and multimodal transport systems also in the urban dimension, and the sustainable development of the network of small Baltic Sea ports. This priority is declined by the programme in two specific objectives (SO):

- SO 3.1: improvement of freight and passenger transport flows (reduction of travel time and reduction of CO_2 emissions through integrated multimodal systems; improvement of the area's corridors and transport nodes);
- SO 3.2: improvement of the services of the small Baltic ports in function of local, regional and tourist mobility (upgrading of port infrastructure and equipment; planning and introduction of ICT systems; development of port network marketing).

The programme priority on transport and the two specific objectives respond in this case to specific needs highlighted by the socio-economic and territorial analysis of the Cooperation Programme

(CP 2014-20, v. 3.1). In this case, the Central Baltic cross-border area is affected by accessibility gaps in peripheral areas, between islands and coastal areas and in rural regions. In these different territories also the urban contexts are lagging behind compared to relevant cities of the macroregion: the transport infrastructures and services are inadequate and several missing links still affecting passenger mobility and freight transport. Clearly, maritime transport on the Baltic Sea has a central function,

> the most frequent passenger connections run between Finland and Estonia, Finland and Sweden […] The most intensive passenger turnover (over 9 M passengers in 2013) is between Helsinki and Tallinn ports.The dependency on fossil fuels is, however, still high in all transport modes. (CP 2014-20, v. 3.1, pp. 14-15)

Furthermore, there is a wide network of small ports (commercial – tourist – fishing). These small ports are crucial for local and regional mobility and they should definitely be developed and strengthened. The specific objective 3.2 addressed this topic concerning small port. The Italy-Greece Programme, another cross-border Interreg – hence the DOCK-BI and INVESTMENT projects **[tab. 1, projects 8-9]** –, identifies in its Cooperation Programme as a strong key point (SWOT analysis on "Sustainable Growth") the leadership of Italy and Greece in maritime passenger transport and in the volume of passengers transported, but at the same time highlights the weaknesses of poor accessibility in terms of multimodality, and in general in rural and peripheral territories. In addition, the obsolescence of traffic monitoring and management tools and the inadequacy/inefficiency of the railway infrastructure in the programme area, particularly in the eligible territories of Greece, produce a negative impact on the whole transport system. The most important opportunity provided by cross-border cooperation between territories is identified in this case in the possibility of jointly developing infrastructures and strengthening networking between all the authorities of the different transport systems in order to increase the efficiency and competitiveness of the whole area. The need to introduce the best use of ICT technologies in transport is also emphasised. Facing a decrease in maritime passengers in transit in the programme area over the period 2010-13, the increase of competitiveness of transport nodes (in all sectors) combined with a joint work on interconnections and multimodality represents a challenge to be grasped through the 2014-20 funding opportunities provided by cross-border cooperation (CP 2014-20, v. 3.1, pp. 7-9). Also in the case of the IT-GR programme, the thematic objectives include: "Promoting sustainable transport and removing bottlenecks in key network infrastructures" (TO-7). The priority Axis focused on the transport topic is the third: PA3 "Promoting

Multimodal Sustainable Transport System", including decarbonisation and pollution decreasing in the urban areas. Considering what is planned by the programme in terms of needs, opportunities and challenges, the DOCK-BI project addressed the development of connections between the ports of Brindisi and Igoumenitsa (the latter being the most important Greek port for trade with Italy). The project is based on a big pilot action with several specific tasks involving the whole Ferry's transport system on the maritime line. In cross-border terms, the common objectives concern: a) improving the multimodal accessibility of the two ports of call; b) providing for the integration and interconnection of transport modes between the two ports. Furthermore, on the Italian side: c) parking areas (cars and trucks) will be upgraded in the Brindisi hinterland; d) the access road network to the port of Brindisi will be improved; on the Greek side: e) the third passenger terminal at Igoumenitsa will be completed; f) the street lighting in the access roads to the Greek port will be improved. In the INVESTMENT project, on the other hand, the innovation process is at the heart of the cross-border transport services included in the financed proposal (Western Greece – Bari-Taranto-Ostuni). The main tool realised within the project life-cycle is an integrated ICT platform that can be functional for the needs of the whole panel of transport service users/operators (citizens, tourists, LPT operators). The architecture is conceived on the homogenisation, consolidation and sharing of data of the different transport modes, through three main e-services: 1) a multimodal public transit route planner able to optimise end-to-end routes by involving the transport network of the programme area; 2) a multimodal tourist tour planner, based on a wide range of daily tour proposals through the use of LPT; 3) a DSS (Decision Support System) supporting the network of LPT operators, planners and policy makers, according to the identification of specific interventions on bottlenecks present in the LPT network.

Finally, the last of the selected Interreg projects: MOBIMART **[tab. 1, project 10]** allows us to examine a different cross-border area, in this specific case characterised by a maritime space. Interreg Italy-France (maritime), in fact, includes a programme area from the coastal areas of Provence, Alpes-Maritimes and Côte d'Azur (France) to those of Liguria and Tuscany (as far as the province of Grosseto) on Italian territory, including the two large islands of Corsica and Sardinia. Transport is financed in Priority Axis no. 3 ("Improving the accessibility of territories"), with an ERDF allocation of €26.3 million (CP 2014-20, v. 3.1). In this area, the accessibility of territories between coastal areas and islands needs adequate infrastructures to guarantee the connections with the TEN-T networks and a cross-border governance able to integrate the different administrative levels involved. Environmental sustainability must involve ports and freight villages, developing multimodal solutions. The MOBIMART project boosted the development of infomobility through an integrated platform able to connect the eleven public administrations involved in order to achieve a fruitful cooperation, through the exchange of data, involving the whole network of public transport services to set up and provide multimodal solutions. In the previous paragraph (§3), we have already analysed the general framework of the Connecting Europe Facility (CEF) financing instrument. The three selected projects **[tab. 2]** addressed some specific challenges in order to develop and implementing targeted actions on maritime transport infrastructures and services. Twin-Port IV is one of the linked projects addressing different implementation steps of a single wide initiative on the route between the ports of Helsinki and Tallinn (within the framework of the 'motorways of the sea'). The optimisation of this specific infrastructure (including road connections) aiming at increasing the efficiency and environmental sustainability of one of the congested maritime routes in the Gulf of Finland. The main aim is to make maritime transport an effective and sustainable alternative to road transport. In the same way, NextGen Link is part of an overall project, related to the introduction/experimentation of LNG fuel, in this case on the North Baltic Sea cross-border maritime link between Turku and Stockholm (Finland-Sweden). The project aims to improve connectivity between ports. The need for better connections in the peripheral region of the Åland Islands included within the project framework. The Zero Emission Ferry, a project involving the TEN-T ports of Helsingör (Denmark) and Helsingborg (Sweden). This is the last selected one of CEF-funded projects and its main aim is testing an exclusively electrically-powered ferry connection. The project involved both the vessels (plug-in system) and the charging infrastructure. The objective has been to switch, through a new technological solution, this ferry line to zero environmental impact, with a significant improvement in air quality, particularly considering the heavy traffic affecting the maritime link in that specific area.

5 Conclusions

The review presented in this chapter on the topic of sustainable transport in some cross-border maritime areas through the related European policies and their funding programmes has allowed to highlight a series of relevant insights useful for analysing and addressing the new programming period (2021-27) that has just begun.

First of all, the peculiarity of the cross-border maritime (and coastal) dimension of passenger transport has achieved over the years, and particularly in the previous funding period (2014-20), an increasingly relevant and strategic role in order to fully and effectively address two of the main objectives on the European Commission's agenda:

- firstly, the construction of the European single market and the achievement of a territorial cohesion level able to making the internal MS borders increasingly 'permeable' and merely 'formal';
- then promoting and accelerating – especially over the past decade – the transition to a new EU mobility and transport ecosystem truly 'sustainable' and able to reduce GHG and pollution levels.

Concerning the first point, we have seen how the analysed projects have increasingly focused their activities and pilot actions, including the maritime dimension, to overcome those still persisting bottlenecks and realise the 'missing links' in order to guarantee 'accessibility', 'connectivity' and 'multimodality' also at cross-border level, particularly for the most marginal, peripheral and isolated areas of Europe. In this specific areas, where frequently the border and at the same time the barrier is the sea, the main challenge is to provide effective mobility for all citizens not only between states but also at a local and regional level (e.g., islands, peninsulas and archipelagos). Moreover, the Staff Working Document SWD(2020)331final that accompanied the Sustainable and Smart Mobility Strategy of the EC [EC COM(2020)789final] points out that, despite the large amount of funds used in the 2014-20 programming period, some of which specifically earmarked for "building cross-border links to better integrate national networks", it is still specifically to work towards the achievement of objectives and standards in terms of accessibility and multimodality in the cross-border dimension (including the maritime dimension). The EU Funding programmes 2021-27 will probably continue to pursue these objectives, especially cross-border territorial cooperation programmes. Finally, concerning the transition towards sustainable mobility, we can remark how a significant number of the analysed projects addressed the environmental issue in the cross-border and maritime dimension also in terms of technological innovations (e.g., the GUTTA project for Interreg CBC and the Zero Emission Ferry project for CEF). Even in this case, the European strategy and related funding programmes will probably still invest in the testing of alternative fuels with less impact on the marine environment (e.g., 'FuelEU maritime initiatives'), as well as in the technological experimentation of new forms of ship propulsion systems.

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Analysis of New Sustainable Mobility Solutions for Maritime Passengers Transport

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Abstract This chapter aims to describe new sustainable people's mobility solutions, in the field of maritime cross-border transport. The review proposed here extends beyond the typical review of technological solutions. Starting from the need to profile the cross-border traveller and the overall context, four possible strategies for reducing the environmental impact of a transport system are identified. Technology is an important catalyst of sustainable transport strategy but the changes in behaviours, the adoption of data-based planning process and the definition of targeted policy measures (e.g., soft measures adoption) are important as well.

Keywords Sustainable mobility. Cross-border transport. Maritime passengers transport. Transport environmental strategy. Environmental impact of transport.

Summary 1 Introduction. – 2 Strategies for Dealing with Environmental Impacts of Cross-Border Passengers Flows. – 3 The Role of Innovation in Cross-Border Transport Modes. – 4 New Technologies for Transport Flows Data Collection and Analysis. – 5 New Trends in Soft Measures for Sustainable Mobility. – 6 An Empirical Investigation on Italy-Croatia Mobility Trends and Opportunity. – 6.1 Transport Modes Currently in Use. – 6.2 Cross-Border Passenger Liner Ships. – 6.3 Means of Transport and Infrastructure for Croatian Nautical Tourism. – 7 Policy Implications and Conclusions.

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1 Introduction

This chapter aims to describe new sustainable people's mobility solutions in the field of maritime cross-border transport.

Instead of usual technology-based analysis, in our view the premises are in the identikit of the cross-border travellers and in the description of the current situation, as reference points for the identification of the main strengths and weaknesses of passenger mobility solutions in use. Innovations are considered by virtues of their feasibility and environmental impacts.

The process at the basis of the analysis proposed in this chapter is outlined below in figure 1.

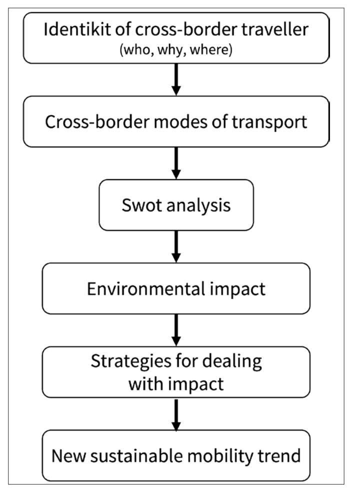

Figure 1 The framework of analysis

We start by proposing four relevant strategies for dealing with environmental impacts of cross-border passengers flows (§ 2).

Then an analysis of the main innovations follows. They concern new technological solutions that the producers of transport means and in turn the operators of the passenger transport adopt. New fuels and infrastructure related solutions are no less relevant. Their adoption is based on economic, social and environmental criteria (§ 3).

New technologies for transport flows data collection and analysis are the object of the fourth paragraph. They can orient travellers' behaviours towards more environmental sensitive habits, for example in the choice of new transport means and new routes.

New trends are emerging in travellers' mobility also in territorial tourist systems: sharing mobility and non-profit groups promoting alternative mobility solutions. They are increasingly active in local territorial governance alongside public bodies, promoting alternative transport modes to the private car (§ 5).

Then an empirical description of previous issues is proposed presenting cross-border, maritime and coastal people's flows between Italy and Croatia. The case-study sums up some of the main results of analyses conducted within the European Project "MarItime and MultimOdal Sustainable pAssenger transport solutions and services" with acronym MIMOSA (Interreg Programme Italy-Croatia) (§ 6).

2 Strategies for Dealing with Environmental Impacts of Cross-Border Passengers Flows

Generally speaking, in cross-border transport there are at least four strategic directions that are considered crucial for the reduction of the environmental impacts:

1. changes in the habits and behaviour of cross-border travellers;
2. intervention by public bodies (State, Regions, Counties) for the definition and implementation of targeted public policies and reliable public transport solutions;
3. adoption of innovations (both technological and organisational) by cross-border passenger transport operators;
4. planning tools based on data collection analysis, traffic models and visualisation by advanced ICT tools (e.g., Web-Gis tools related to both transport solutions and passengers' habits and behaviours).

Public policies and transport solutions, adoptable to reduce the flow of cars and the consequent environmental damages, must take into account various aspects related to people's behaviours and habits; in particular: their travel reasons and length of stay in the host country (hikers, tourists) (Pafi et al. 2020).

In order to influence behaviour and habits of passengers (to orient them towards environmental protection), it is necessary to know them. In recent times, technology has been making new tools available to collect information on the habits and behaviour of passengers. Private companies and public bodies can adopt these new technologies for collection and analysis of data on the modes of transport used (whether car, bus, ferry, airplanes, train), on routes taken, on frequencies and more other.

On the side of travellers, these instruments can be useful to choose the transport mode, to help change their travel behaviour. In addition, on the side of public bodies, they can provide data useful in planning the mobility of people at local, regional and national level and could contribute to contain pollutant emissions.

The change – voluntary or induced by public policies – in the travel habits of cross-border travellers from the use of the car to the use of the bus could be a solution, because it is much more environmentally-friendly than the car: the bus has a much lower rate of pollution per passenger than car. In fact, double-deck coaches can transport up to 80 passengers, thus substituting on average from 15 to 35 cars, while smaller coaches can provide up to 45/50 seats, virtually taking away from the road up to 25 cars. But the tendency to travel by bus is decreasing, with a decrement of about -13% over the time period between 2015 and 2019.

In seaborne passenger transportation, a distinction should be made between passenger liner services and tourist shipping services.

Public bodies in collaboration with private companies are making significant efforts to integrate passenger terminals into a single transport network and coordinate them with air, rail and road transport to ensure the fastest possible passenger traffic.

In addition, passenger terminals should have possibility to extend port limits and general activities in function of prosperity and future development. But there are low possibility to expand their terminal infrastructure areas.

Analysing services provided usually into passenger terminals, lack of adequate service activities/infrastructure is observed inside the port area or in vicinity, in particular: passenger long-stay accommodation facilities, food facilities, rent a car/bike, etc. But also lack of communication services through ICT integration that support interoperability (free Wi-Fi availability, ICT tools for providing adequate real-time information for the passenger, on-line ticket purchasing, etc.). Furthermore, to promote sustainability in function of environmental protection, port area vicinity should have possibility for rent and infrastructure to charge electric vehicles and bicycles.

The next two sections are dedicated to innovations in transport means and new technologies for data collection analysis.

3 The Role of Innovation in Cross-Border Transport Modes

As it is known, cross-border passengers flows cause significant environmental damages, generating negative externalities whose control and regulation by neighbouring countries can be difficult. There are some viable ways to reduce transport pollutant emissions. In the previous paragraph four strategies are proposed.

Public policies and transport adoptable solutions are among the most relevant. Both are based on knowledge of the main characteristics that distinguish travellers, in particular habits and behaviours, reasons of travel, destinations, length of stay (one day for hikers; more than one day for tourists).

In recent times, technology has been making new tools available to collect information about passengers' habits. They are soft solutions that are combined with hard solutions: the innovations that are taking place or will be effectively implemented in the various modes of transport. When adopted by passenger transport operators, they will prove useful in fighting polluting emissions.

The most important innovations in environmental terms concern maritime transport and road transport. Those of air transport will be of lesser impact.

In fact, in air transport, relevant innovations expected in particular in transport means (airplanes) by 2030 will lead to a -13% reduction in CO2 emissions (ICAO 2019). But usually, for their short distances, the volumes of cross-border passengers traffic by airplanes are too low to contribute to significant reductions in total quantities of emissions.

In maritime transport, important innovations are expected. They will lead to a -40% reductions in CO2 emissions caused by vessels and ships (IMO 2021; 2018).[1]

Key innovations will concern new technological solutions in ships, new fuels (liquefied natural gas, hybrid propulsion, full electric, cold ironing) and related infrastructural solutions.

Technological innovations in ships have to be based on economic, social and environmental criteria. The economic criteria concern the decoupling of financial growth from social and environmental externalities.

In fact, the improved efficiency of the new ships leads to lower fuel consumption. These savings, in turn, lead to lower operating and maintenance costs, which consequently lead to more affordable ticket prices. As a consequence, more people can travel by the new ships improving social inclusion, obtaining positive social impacts and externalities.

On the other hand, financial growth from economic efficiency of innovative ships leads also to consumption of lower carbon content fuels and consequently to ecological preservation.

The contribution of international passenger ships to the production of these positive externalities is guaranteed by ships that must comply with all relevant International Maritime Organization (IMO) standards, including the Safety of Life at Sea (SoLaS) Convention and requirements for the prevention of pollution from ships together with Load Lines Convention regulations.

In addition, the social criteria are related to security design and ship infrastructure safety in terms of mobility elements of (vulnerable) passenger groups.

The ecological criteria encompass eco-efficient ship design in terms of hull shape, engine type, fuel type, propulsion and information-communication technologies use as well. Passenger liner ships have to be technologically designed in a way that will alleviate the negative con-

1 https://www.imo.org/en/MediaCentre/HotTopics/Pages/Reducing-greenhouse-gas-emissions-from-ships.aspx.

sequences of passenger self-organisation in terms of excessive car use, which means that ship design has to be passenger-centric and focus on creating multimodality with other environmentally friendlier modes of transport such as bicycles for achieving social inclusivity.

In addition to new technological solutions described above, another key innovation are the new fuels and related infrastructural solutions.

Focusing on fuel types (Directive 2014/94/EU) and their role in environmental protection, hydrogen propulsion systems have the best environmental balance but the conditions for their large-scale deployment will not be in place for at least 10-15 years. In the short term, liquefied natural gas (LNG) and hybrid systems are the most promising solutions. LNG system as a shipping fuel will have most probably wider application on the passenger vessel. LNG is already widely used, especially on freighter. In addition, passenger liner ships will mostly use LNG as a fuel in the future. Presently, one of the limiting factors for ships using LNG as a shipping fuel is the insufficient number of ports with fuel supply capabilities. On the other hand, hybrid propulsion systems achieve lower fuel consumption and consequently lower emissions. The application of existing hybrid solutions is possible on almost all passenger ships of coastal liner shipping and does not impose any additional restrictions. The technology is fully developed and applicable to all ships with diesel-electric propulsion and even the largest ones. The biggest barrier to this solution given by significant initial investment.

A possible alternative for ships sailing on a short distance and in protected area is the full-electric propulsion mode. Of course, the emissions of an electric ship are not zero but this technology provides a significantly reduced range compared to a liquid fuel propulsion.

Provision of cold ironing, i.e., supplying vessels, boats and crafts with shore-side electrical power, represents the must-have port's ability, in order to provide a comprehensive service, while at the same time maintaining control on energy consumption. Cold ironing acts as a segment of efficient vessels handling in a whole, thus controlling emissions from vessels in terms of emissions inventories and emissions monitoring.

In road transport, over the last five years, trends have been underway that are leading to an ever increasing adoption by vehicle manufacturers of engines based on new forms of power supply: the main ones are hybrid and electric powertrains.

If, by way of example, we consider the Italian situation, given its current renewal rate, it is possible to make some predictions on the composition of the Italian car fleet in 2030. In the most optimistic scenario, in case of enduring incentives, by 2030 the share of hybrid cars will be 20%, 10% for electric cars and at least 40% for Euro 6 standard. The remaining 30% will be made up of cars of the Euro 5 standard or one below this.

Consequently, the major reduction in emissions of car fleet would not come from the growth in the share of electrified powertrain, rather from the progressive elimination of older cars up to Euro 5, which currently make up more than 60% of the Italian car fleet. An average value of CO_2 emissions per car has been calculated as weighted average of standard emissions **[fig. 2]**.

From these estimates, it emerges that at the current modal split the efficiency gain of the internal combustion (IC) car provides the greatest benefit. In fact, for every percentage point of CO2 reduction of IC vehicles, total emissions decrease by more than 1,739 tons in the low growth scenario and by 2,261 tons in the high growth scenario **[fig. 2]**.

Of course, the overall benefit depends on the intensity of use of each mode. Planes, which have much higher emissions per passenger than the car, are however much less used and therefore their improvement has a relative lower impact on the overall reduction of emissions (see the figure below). Maritime transport deserves a separate discussion, as different types of ships have very different emissions per passenger depending on their age and type. In addition, a key role will be played by the switch to liquefied natural gas, which significantly reduces emissions and for whose large-scale use both shipping companies and ports are gearing up **[fig. 2]**.

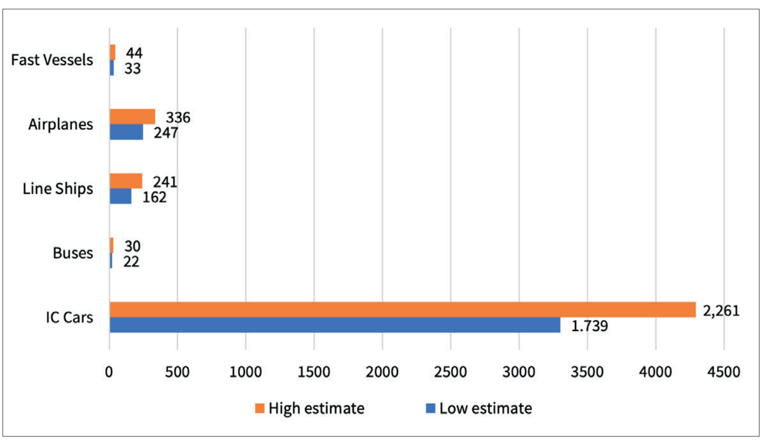

Figure 2 Yearly reduction in CO_2 emissions (tons) of travels between Italy and Croatia (projected to 2030) for each percentage point reduction in emissions from the various transport means. Source: MIMOSA Project, Passenger Transport Demand Analysis (0.3.1)

Innovations in transport means can modify people behaviours and habits. But, as said above, in next years, cars are expected to remain the most used mean of transport.

Differently, a shift from cars to buses can be observed in the future years above all among the youths and visitors without accompanying children, given a series of conditions, among the following seem particularly relevant:

- there will be a further diffusion of long-distance bus or minibus lines/rental services (following the business model of, for example: Flixbus, Go-Opti, etc.), and related services (e.g., luggage transfer, high-comfort equipment, etc.);
- there will be an improvement of first/last mile connectivity and nodes accessibility;
- new services of (fast) vessels from and to main coastal attractors, especially within a logic of increasing the attractiveness of sea travels by offering improved services, such as bicycle transportation or all-inclusive packages.

In addition, for segments of young and highly educated people, other alternative forms of passengers mobility can be identified, oriented towards multimodality that does not use cars, but a combination of at least two transport modes, the most frequent of which are: bike + bus, bike + ship, bike + train, etc.

New technologies for transport data collection and analysis can also help to change people's behaviour, as explained in the next section.

4 New Technologies for Transport Flows Data Collection and Analysis

Gained experiences, best practices of the countries of the European Union[2] and lessons learnt in the Anglo-Saxon world[3] allow us to affirm that the current situation in passenger transport, habits and behaviours of cross-border and resident travellers will be changed by new technologies, innovative solutions, smart and interactive tools, because they will make regional connections more accessible through multimodal solutions and sustainable passenger mobility.

New technologies for transport flows data collection and analysis are acquiring a special role, gradually more and more important.

These innovative technologies collect and analyse data from mobile telecommunication operators. Mobile phone operators, who provide large anonymised datasets, have significant market shares. This

2 Please see UNECE 2020.

3 See "The Major of London transport strategy" adopted in 2018, available at: `https://bit.ly/3bQffdt`.

guarantees that their information refers to significant portions of the resident population and tourists.

Their datasets contain information for better understanding of the needs, habits and behaviours of cross-border visitors and residents and for taking strategic decisions on planning and development of sustainable transport solutions.

So, these big datasets collect data on travel habits, intensity and structure of traffic flows by transport mode, and distribution of traffic flows for target geographic areas. Then, each one of these target areas is further analysed regarding its spatial content, mobility status, including infrastructure and mobility services and the identification of traffic samples within target areas for target population groups. In addition, key points of interest (i.e., ports, transport passengers' terminals, public transport stops, border crossing points, etc.) and the associated corridors are identified. Demographic and economic data related to these geographic areas are also inserted in the big datasets.

These points of interests are geographical locations and elements of transport infrastructure that can be used to detect modes of transport. Other points of interest (such as: hospitals, restaurants, and the like) can be used to identify the purpose of travel (such as: commuting, school, shopping and personal care, leisure, work, transport of goods, etc.).

The next step in the analysis involves the identification of the trip. It is defined by time, spatial and speed thresholds, which are essential to determine each trip (or travel).

The list of all trips (travels) can be used for different types of analysis and visualisations. The analysis may include the determination of origin/destination (OD) travel matrix for all types of means of transport, the identification of OD travel matrix for specific types of transport, the calculation of travel-related statistics (e.g., average speed between zone pairs for a predefined time period, etc.).

The analysis of information contained in big datasets provided by mobile phone companies is completed with the display of the main results using a Web-Gis visualisation tool. It is used to visualise, display, and generate reports based on information obtained by analysing the anonymised datasets. It has a function to display the geographical map as background, the locations of transport terminals and other defined points of interest (e.g., ports, stations, airports, border crossings, etc.) and their associated geographic interest zones (described above).

5 New Trends in Soft Measures for Sustainable Mobility

New tendencies are emerging in passengers' mobility. Here we specifically highlight the two major trends we consider relevant for the goal of this analysis: sharing mobility and private/non-profit groups promoting alternative mobility.

While private transport is still dominant and widely used, in many European regions, there is a new growing wave of mobility modes that belong to the wide sphere known as 'sharing mobility'. Sharing mobility is a new socio-economic phenomenon affecting transport sector both on demand and supply side. On the demand side, sharing mobility demonstrates a transformation of individuals' behaviour, as they tend to prefer temporary access to mobility services rather than using their own means of transport. On the supply side, this phenomenon consists in the affirmation and diffusion of mobility services that use digital technologies to facilitate the sharing of vehicles and/or journeys, creating scalable, interactive and more efficient services.

Sharing mobility, in its various forms, provides viable solutions to different contexts. Typically, it is implemented in the urban transport, where the emphasis is placed on the problem of traffic jams on the roads in the centres of major cities and tourist destinations and on parking. But it is also an important tool of potential development of cross-border mobility. Still today, the majority of European cross-border areas are territory characterised by low short-haul passengers' demand, where regular bus or train services are not considered financially viable, such as the rural or peri-urban areas. These areas can today be reached by the so-called demand-responsive transport (DRT), a form of transport where vehicles alter their routes based on particular transport demand rather than using a fixed route or timetable. Private operators working on this business models are already present also in cross-border routes. Moreover, DRT and sharing mobility in general can integrate existing transport, thus contributing to the creation of a resilient, accessible multimodal transport infrastructure, which is a precondition for sustainable and smart transport and mobility [EC COM(2020)789 final]. Studies conducted in the framework of the MIMOSA Project has shown that in maritime transport nodes connectivity has a crucial impact both on environmental aspects and on the reduction of car dependency.

Another trend refers to the increasing role in public transport of non-profit groups that promote the use of alternatives to the private car. There are in fact groups that promote daily bike use, other groups that watch out for passenger rights, for the maintenance of pedestrian areas or even for traffic surveillance. These groups (neighbourhood associations or common interest groups, non-governmental organisations, etc.) can help the local administrations and transport authorities in their duties and help to promote the use of the public transport. The participation of such associations, local groups and non-governmental organisations in the transport planning decisions should be promoted and considered.

6 An Empirical Investigation on Italy-Croatia Mobility Trends and Opportunity

The issues presented in the previous paragraphs will be now investigated in the cross-border flows of passengers between Italy and Croatia.

These passengers are made up of 'excursionists' (cross-border travellers returning to their own country in the day) and tourists (cross-border travellers spending at least one night in the other country). The National Institutes of Statistics (Istat in Italy, DSZ Državni Zavod Za Statistiku in Croatia) periodically collect data of tourists using the information provided, by law, by hotels and structures that host them. Instead, information on hikers is not collected by the Statistical Institutes, but is estimated through sample surveys conducted mostly through interviews with travellers at border crossings, thanks to specially designed research activities carried out by public bodies.

In 2019, the last year before the COVID-19 pandemic, it is estimated that cross-border and coastal passengers[4] reached the total number of 4.8 million: 4.2 million Italians (87%) and about 600,000 Croats (13%).

The main travel reasons for Italian tourists are vacation and holiday in coastal Croatian places. Instead, for Croatian tourists they are cultural interests, cities of art and naturalistic sites.

The main reasons why 'excursionists' travel cross-border are business/work-related, visiting parental and shopping (reason stated exclusively by Croatian hikers ones).

6.1 Transport Modes Currently in Use

In cross-border connections between Italy and Croatia all the main modes of transport are used: car, bus, ship, train, plane. A particular role is played by intermodal transport solutions.

The means of transportation usually adopted by excursionists differ significantly from those used by tourists. Excursionists (as daily visitors) travel usually by car or coach, respectively 99.3% and 0.7% of them. It is estimated that they generate an annual flow of between 1.3 and 1.5 million cars.

4 They are passengers travelling by car, coaches, planes, vessels (high speed vessels), liners.

On the other hand, for 'tourists' of both nationalities, between Italy and Croatia, the preferred transport mode is the car, which in the case of Italian tourists is estimated to be used by 90% of travellers, while for Croatian tourists this percentage drops to 76%.

Italians also use ships more than Croats. 7% of people from Italy to Croatia travel by vessels or liner ships. This percentage decreases to 2% for Croats from Croatia to Italy.

The main reason is due to the fact that most Italian travellers go to Croatia for tourism on the Adriatic coast or in the Croatian islands, and the best way to make at least the last few kilometres of the trip is by boat.

Instead, unlike what happens for ships, Croats use plane more than Italians: 6% of travellers from Croatia to Italy use airplane, and just 2% of Italians from Italy to Croatia. It is due to the fact that among the preferred destinations of Croatian tourism there are also cities of art and natural and cultural sites located far from ports.

It is estimated that 1% of Italian tourists travel by bus from Italy to Croatia, and this percentage becomes 16% for Croatian tourists.

The train is a residual modal transport for cross-border tourists (rarely even for excursionists).

But, at least one in two travellers on their cross-border journey between Italy and Croatia uses more than one transport means. In fact, it is estimated that a percentage between 55 and 60% of tourists and excursionists both Italian and Croats have a multimodal trip, meaning that they use at least two transport modes during their travels. The public transport as additional mode is higher than expected, about 67.9%, including bus, local public transport and long range bus transport that are the three most used. Then car rental/taxi, ferry/cruise, train and bicycle follow in this order.

6.2 Cross-Border Passenger Liner Ships

As the natural border between Italy and Croatia is entirely on the sea, maritime transport should have a special role in the cross-border transport mode in use. Even if, as said just above, less than 10% of all cross-border Italian and Croat tourists travel by sea, respectively 7% Italians and 2% Croats.

Currently, 21 passenger liner vessels operate between Italy and Croatia, offering connections with the mainland and between the islands.

They are of different types: 4 are coastal liner passenger ships, 9 are Ro-Ro passenger ships (ferry) and 8 are high-speed passenger crafts (Jugović, Mezak, Lončar 2006).

Although the use of ferries for cross-border passenger transport is minimal and the connections offered are few, they represent an important element in helping to make cross-border transport intermodal. Strengths are certainly represented by the shortness of connections and the availability of Ro-Ro passenger vessels and high-speed passenger craft.

Relevant weaknesses are represented by the fact that the fleet operating in the cross-border area is very old: 39 years for long distance Ro-Ro passenger vessels and 27 for high-speed passenger crafts. It inevitably leads to strong pollutant according to the propulsion system, fuel in use and ship construction.

6.3 Means of Transport and Infrastructure for Croatian Nautical Tourism

In Italy and Croatia there are 24 seaports that provide access to cross-border travellers. The Italian coast is home to 14 of the 24 ports, with the 10 remaining on the Croatian side of the Adriatic area. Passenger terminals are located near widely known sights and they are visited by millions of tourists each year. General terminals infrastructure is adequate for existing traffic demand.

A particular segment of maritime transport is the nautical tourism (Onofri, Nunes 2013). It is mainly a type of tourism of Italians in Croatia. Once they arrive in Croatia, as transport means they use boats that can stay in port or move along the Adriatic coast. Usually average stay of boaters is twice as long as the average stay of other kinds of tourists. In addition, two thirds of nautical tourists use charter boats for navigation and the sailing season correspond to the period between April and October, with a peak in July and August.

Therefore they need adequately equipped port infrastructures. The inclusion of ICT system in technology of production of nautical tourism ports services is necessary to improve quality and streamline operations. In fact, modern ICT technology allows most of the classic port functions such as berth reservation, vessels monitoring or online service payment.

Location of all nautical tourism ports, with minor exceptions envisaged mainly within hotel complexes, are planned within guidelines of the Spatial Development Strategy, defined at County level. Main obstacles are related to outstanding communal sewage infrastructure, especially on islands. Therefore, the most important thing is to resolve land sewage infrastructure utility as base of installations of sewage system collection plant from yachts. It is also necessary to solve the collection and disposal of waste on the islands in accordance with EU legislation and MarPol 73/78 Convention.[5]

5 The International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978.

Part of the planned nautical tourism ports (up to 2,200 berths) is paired with the construction of hotel resorts. Together they activate such a synergy that, in those particular locations, represent the only way to build ports for nautical tourism at low cost. The construction of a hotel and nautical tourism complex are classified into:

a. dominant hotel complex and nautical tourism port is a supplement with added value for the hotel;
b. dominant nautical tourism ports and the hotel facility is in function of nautical tourism ports with added value for ports.

In the first group, indisputably, nautical tourism port creates added value to the quality of the hotel resort. In these cases, when nautical tourism ports is planned in isolated locations, the construction of nautical tourism ports without the construction of a hotel resorts is not realistically expected.

Another case is the construction of hotels to complement the content of nautical tourism ports, due to lack of or insufficient capacity in existing hotels in the vicinity. Such an example is the planned nautical tourism port in Ploče. In this case, the construction of the hotel enables more profitable business to the nautical port and better service to the yachtsmen. It is not uncommon in the world that hotel and nautical tourism ports complement each another and, in that case, hotels are mostly B&B (4 stars) services with open facilities, such as restaurants and bars, becoming cult gathering places for sea lovers. Usually in such cases, hotel chain and marina chain enter into strategic alliances. And each one for its part contributes to the overall result.

Spatial plan of some Municipalities and Counties foresee additional capacity building in public ports. This form of competition at public ports built with public money, adversely affects the investment entrepreneurial climate, especially on islands where revenue is based mainly on transit seasonal nautical tourism.

Positive impacts of the construction of nautical berths in public ports is the management of the use of the coast and anchorages in an environmentally acceptable manner and provision of modern ICT technologies and services in ports for environmental protection.

But nautical tourists also need multimodal transport solutions, which can be subdivided in two categories. On one hand, there is part of the trip from and to the region of origin, with the predominant use of cars and airplanes, the biggest traffic polluters.

On the other hand, there is the second part of multimodal transport, that takes place in the ports of nautical tourism where yachtsmen berth and use car rental, bicycles or wind or kite surfing for sightseeing or active holidays. In particular, they use light modes of transport that connect the docking port areas to the hotels for any overnight stays and to the urban centres for any visits and excursions during their stay in port.

This opportunity is provided at all mainland ports of the nautical tourism, where yachtsmen can cycle around the natural and cultural heritage – of which the local landscape is rich – and get acquainted with ways of life of rural areas. On some islands, recreational cycling has been developed with the possibility of renting a bicycle, while on others there is a lot of room for improvement. By implementing cycling into the nautical ports, it will add new value to port.

7 Policy Implications and Conclusions

Previous paragraphs describe strategies and innovations being defined in individual transport areas for the containment of polluting emissions and aimed at defining new sustainable solutions for cross-border passengers' transport.

Over the last decade, development strategies related to cross-border and coastal passengers' mobility by the European Union[6] have been based on a vision focused on improving quality and sustainability. In our case-studies about flows between Italy and Croatia, we can find this same vision in the strategies contained in the pillars[7] of the EU Strategy for the Adriatic and Ionian Region (EUSAIR).

Therefore, the general EU policy framework and the current situation of the area under consideration with its strengths and weaknesses are the basis for identifying operational priorities for sustainability in cross-border passenger transport. As discussed in this document, they consist essentially in: a) reducing car use; b) reducing maritime transport-related emissions; c) improving connections to the hinterland, islands and coastal areas; d) supporting multimodal transport.

Therefore a first important contribution to the sustainability of the connections is given by public policies that support alternative means of transport to cars, given the very high number of cross-border passengers using the car.

It is a topic that concerns travellers' behaviours, technologies currently available, adoption of innovations in the sector of vehicle man-

6 In particular: a) White Paper from the European Commission "Roadmap to a Single European Transport Area" (2011); b) EC COM(2009)8 final; c) The "European Green Deal" (Brussels, 2019); d) "Maritime Transport Strategic Approach of the European Union" (Brussels, 2020); e) "Integrated Maritime Policy of the European Union" (IMP) (Brussels, 2020).

7 The key strategies of EUSAIR pillars 1 and 2, respectively: Blue Growth and Connecting the Regions. More specifically: a) to improve sea basin governance, by enhancing administrative and institutional capacities in the area of maritime governance and services (pillar 1, specific objective 3); b) to strengthen maritime safety and security and develop a competitive regional intermodal port system (pillar 2, specific objective 2); c) to develop reliable transport networks and intermodal connections with the hinterland, both for freight and passengers (pillar 2, specific objective 3).

ufacturers, the speed of renewal of the fleet in use. So, it is a theme that concerns wide-ranging public policies, defined at European and national level.

A second contribution of cross-border connections to sustainability is related to maritime transport, because the natural border between Italy and all Mediterranean Countries (including Croatia) is entirely on the sea.

From an infrastructural point of view, in order to guarantee efficient maritime line services, it is crucial that local spatial planning tools provide for an adequate number of berths and a sufficient operational shore length. In addition, as for passenger services, the organisational aspects of port surface area within the cross-border passenger terminals need to be restructured to achieve a harmonisation of multimodal transport options, oriented towards sustainability principles. But, in some cases, there are system boundaries that hamper this progress. For instance, passenger terminals should encourage the use of electric bicycles and vehicles, thus promoting intermodality and raising awareness of environmental safety, but one of the boundaries is that many ports do not have proper infrastructure (e.g., chargers for electric bicycles or vehicles).

On the other hand, in order to facilitate passengers in the process of buying tickets, all ports should have appropriate conditions for tickets sales and availability of buying tickets online. Other examples of ICT integration regarding the passenger demands are: free Wi-Fi, real-time information systems for passengers, schedule information/itinerary of maritime transportation lines.

Regarding the organisational aspect, line schedule could be implemented in function of harmonisation of multimodal transport options. As third contribution to sustainability of cross-border maritime interconnections.

Furthermore, consider that usually a hub terminal and its operational coast essentially consists of several Ro-Ro ramps for the acceptance of Ro-Ro passenger ferries. A greater number of Ro-Ro ramps increases the number of ferries that can moor at the same time. This makes the organisational aspects related to ferries more complex, but allows the activation of more passenger transport lines, according to the requests of passengers. Also, larger operational coast gives the possibility to enlarge the number of high-speed-passenger crafts, which give the possibility for increase passenger traffic flow.

Together with multi- and intermodality, the development of environmental impact procedures of a passenger terminal acts as a key indicator of port's sustainable development in terms of reduction of pollution and raising environmental awareness.

In this field, consider supply of alternative energy sources other than fossil fuels. The main advantages of such energy are their inexhaustibility and renewability, as well as usage of techniques that, in significantly less extent, affects the environment. The development of alternative energies (wind, solar energy, hydrogen gas, tidal energy, biomass energy, and biofuels) contributes to port competitiveness on the market, as well as its environmental sustainability. For all these reasons, regional and local public authorities should support alternative energy sources also in maritime transport, even more than what is already happening.

A fourth contribution should be focused on improving connections to the hinterland, islands and coastal areas, because the sustainable development of cross-border transport is determined by technologies, infrastructures but also by links between coast and its hinterland. Also in this case, regional and local authorities are called to improve the infrastructural equipment and the connections (as stated in the pillar 2 of the EUSAIR strategy).

The four recalled contributions (reduction of the car use; ways to reduce maritime transport emissions; multimodal transport options; improvement of hinterland links) allow the definition of concrete and operational interventions by public entities and private operators to support new solutions for sustainable mobility and protection of the environment.

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Priorities for the Sustainability of Maritime and Coastal Passenger Transport in Europe
edited by Silvio Nocera, Raffaele Pesenti, Igor Rudan, Srđan Žuškin

Identifying Travel Demand Priorities in Maritime Transport
A Behavioural Approach

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Abstract This chapter deals with the analysis of hidden aspects of travellers' behaviour that are the key determinant of the sustainability and efficiency of sustainable mobility policies. We propose to complement the typically descriptive approach of flow-based and/or time-series analysis with techniques for analysing perceptions and intentions that can provide insights on travellers', such as the behavioural determinants or the perceived priorities. Together with the general description of two models, we will present an application concerning travellers between Italy and Croatia, an interesting case in which travellers can choose between maritime, air and land alternatives.

Keywords Travellers' behaviour. Behavioural analysis. Kano Model. Travel choice determinants. Travel demand analysis.

Summary 1 Introduction. – 2 The Analysis of Travellers' Behaviour as a Fundamental Tool for Improving the Sustainability of Transport. – 3 "It's nice but I don't really care". Distinguishing What is Appreciated from What is Necessary. – 4 Perceived Priorities for Italy-Croatia Maritime and Coastal Transport Services. – 5 Inferring Behavioural Determinants from Travellers' Surveys. – 6 The MIMOSA Experience on Travellers' Behavioural Analysis. – 7 Conclusions.

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1 Introduction

The relevance of environmental and social issues in transport and mobility steadily increased the awareness at Institutional level, leading to unprecedented efforts by policy makers to shift towards more sustainable patterns. The results are clearly visible as the combined effect of cleaner technologies, sustainability-oriented public policies and higher environmental awareness of citizens led to what can be labelled as a change of paradigm. On the other hand, we are living in times of constant, rapid and often unpredictable changes. Events such as the SARS-CoV-2 pandemic that erupted globally in early 2020 or the Russian-Ukrainian war started in 2022 show that many of the advances we take for granted can quickly vanish in the face of catastrophic events and major global threats. The transport sector is extremely exposed to global threats, so that resilience must be considered as a priority in every aspect of planning. Clearly, we are not only talking about physical and technological resilience, but also (and foremost) about the ability of transport to respond flexibly to the needs of demand, this representing the key to long-term economic sustainability.

This chapter deals with the analysis of demand as a function of the ability to identify those hidden aspects of travellers' behaviour that are the key determinant of the sustainability and efficiency of sustainable mobility policies. What we propose, in particular, is to complement the typically descriptive approach of flow-based and/or time-series analysis with techniques for analysing perceptions and intentions. In the following paragraphs, we will explain how, through appropriate demand survey techniques, it is possible to obtain incisive insights on travellers' behaviour in order to identify behavioural determinants as well as the priorities of travel demand. In addition to the general description of the theoretical models, we will present an application performed within the MIMOSA Project and thus concerning travellers between Italy and Croatia, representing an interesting case to study as cross-border travellers can choose between maritime, air and land alternatives.

2 The Analysis of Travellers' Behaviour as a Fundamental Tool for Improving the Sustainability of Transport

Framing sound strategies and policies consistent with the envisaged goals of players – such as transport operators or policy makers – call for a better understanding not only of *how* people behave, but also *why* they do so, and what are their priorities. This knowledge is a *conditio sine qua non* for a thorough understanding of which measures are likely to be more effective in an evolving framework that sees policies increasingly focused on social aspects and soft measures, as opposed to a mobility paradigm that in the past was exclusively based on infrastructure investment and regulation (Lanzini, Stocchetti 2021).

Traditional approaches to analysing commuters/travellers' behaviours fall often short of providing an adequate picture of the behavioural determinants, the priorities and how the latter affects choices. On the one hand, this is related to the specific type of tool adopted (surveys with a descriptive approach), while on the other hand, it depends on how our behaviours follow a precise order of priorities. For instance, if travellers are asked whether they would like to have e-bikes available at the final destination of the trip or in the city centre, most of them might be likely to answer positively: yet it might turn out that, once available, only a minority will actually use them, as they are perceived as an interesting and positive option, yet not a priority for the specific situation for which it is provided. This type of problem becomes evident when pilot activities are developed with the task of testing the effectiveness of possible mobility solutions. In such a context, the actual utilisation of experimental infrastructure or services is often far lower than what preliminary investigations might suggest.

We hereby present two modes of analysis that we consider particularly useful in identifying the priorities expressed by travel demand, namely: a) the analysis carried out on the assumptions of what is known as the "Kano Model", combined with "Importance-Performance Analysis" or IPA (Martilla, James 1977; Oh 2001), and b) the general concepts of analysis based on the inferential approach. We propose these two models as practical tools to identify priorities for action within a range of (existing or potential) traveller services (e.g., bike sharing) and/or their characteristics (both electric and conventional, accessibility, etc.). In the last paragraph we will present the results that emerged in the MIMOSA Project, regarding the priorities identified by demand in the area of maritime transport and coastal interconnections.

3 "It's nice but I don't really care". Distinguishing What is Appreciated from What is Necessary

Very often, the transport planner's vision is based on the detected flows of travellers. However, the planning of new services or changes to existing ones cannot simply view flows as a mechanical phenomenon, as it should consider these flows being the result of choices that have their roots in an evaluation of alternatives by travellers. For this reason, it becomes essential to perform an analysis that investigates those aspects that are most closely linked to individual attitudes, preferences and utility.

IPA is a very well-known tool aimed at classifying services and characteristics of services according to their relevance in determining the overall attitude of demand towards the offer. Such an analysis allows to identify the priorities to be followed in improving services, as well as the strengths and weaknesses of the offer. However, as we shall see later, its interpretative capabilities have limitations that can be overcome by integrating this analysis with the principles of the Kano Model.

The IPA procedure consists in identifying a set of choice-relevant services or service features and asking respondents to rate the subjective relevance (*r*) of each service as well as their satisfaction (*s*) with the service. Such survey highlights strengths and weaknesses through mapping services according to the average value of relevance and performance (or satisfaction). It also provides a summary judgement of the 'criticality' *C* of the services considered, using the algorithm $\sum_{i=1}^{n} s_i \cdot {}^{1}/_{r_i}$, that is: the overall criticality *C* of the service or characteristic taken into consideration is given by the weighted sum of the performance ratings *s* made by each subject *i* (*n* is the total amount of interviewee) weighed with the inverse of the importance *r* **[fig. 1]**.

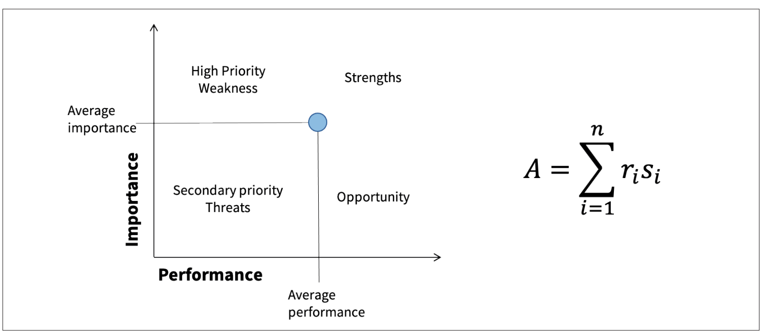

Figure 1 Scheme of the importance-performance analysis results

Values of *C* below 1 correspond to those features/services that perform less than they should: while an approximate indication, it is indeed useful in discriminating priority areas of intervention.

In addition to greater or lesser relevance and level of performance, an important specification is whether services and their features are considered as necessary rather than optional elements for the quality of the offer. There are characteristics and services that are perceived as very important, yet being minimal requirements they do not necessarily contribute to increased satisfaction once present, while their absence or poor performance is highly disappointing for customers. Some services, on the other hand, might be considered ancillary or little known with a low rating but, at the same time, be able to convey better satisfaction. For this reason, an important complement to the IPA is the Kano analysis (Sauerwein et al. 1996; Yang 2005), which is aimed at shedding light on the role that services or characteristics being investigated have in generating (dis)satisfaction. Specifically, this model uses joint questions on attitudes towards situations of presence or absence of benefits/services. Questions are hence proposed both in:

- functional form (e.g., *how would you feel if* there was a bus service to the ferry boarding point?).
- dysfunctional form (e.g., *how would you feel if* there was no bus service to the ferry boarding point?).

Through the analysis of the joint answers to the two semantic forms of the same question, it is possible to infer whether a service (or its features) provide a different type of utility (or disutility) according to a classification of respondents' attitude towards it. Such classification can be illustrated as follows:

a. attractive: the service might provide satisfaction/utility, but since it's not expected or not known, it doesn't provide dissatisfaction/disutility if missing or inadequate;
b. one-dimensional: it provides satisfaction or dissatisfaction according to the level of performance;
c. must-be (prerequisite): it is considered essential and as such it cannot generate additional satisfaction or utility, but only dissatisfaction if not present or inadequate.

To match answers with respondent's attitude, the answers are analysed on a one-by-one basis (that is, one respondent at a time) and their matching leads to the identification of how the service / feature was perceived by the single individual, according to the analytical structure at the basis of the model summarised in table 1 (*Questionable* stands for non-reliable answer, while *Reverse* indicates that the presence of a feature/service leads to dissatisfaction, and vice-versa).

Table 1 Classification of customers' requirements according to the Kano Model interview structure

		Answer to question in dysfunctional form				
		Like	Must be	Neutral	Live with	Dislike
Answer to question in functional form	Like	n.r.	n.r.	Attractive	Attractive	One-dimensional
	Must be	n.r.	n.r.	Attractive	Must-be	Must-be
	Neutral	Reverse Attractive	Reverse Attractive	Indifferent	Indifferent	Reverse Must-be
	Live with	Reverse Attractive	Reverse Attractive	Indifferent	Indifferent	Reverse Must-be
	Dislike	Reverse one-dimensional	Reverse must-be	Reverse Attractive	Reverse Attractive	n.r.

The three categories of attitude are represented in figure 2, specifically by the three curves plotted in the diagram joining the level of performance and its effect in terms of satisfaction/dissatisfaction. Moreover, according to the positioning of a service it is possible to infer (approximately) different policy recommendations, as shown in the extended SWOT matrix on the right [fig. 2].

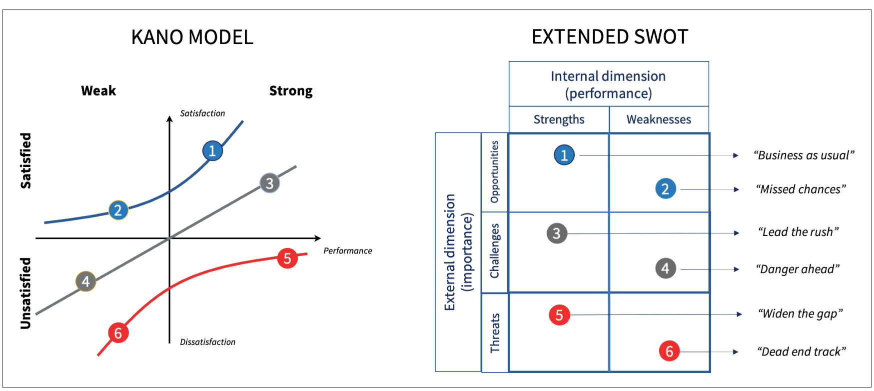

Figure 2 The Kano classification of service and characteristics and the relationship with policy implications (extended SWOT representation)

The Kano Model is useful to gain better insights on how demand perceives different aspects and features of the service provided. It is therefore a tool to understand where to concentrate efforts, insofar producers/providers need to allocate most resources on those aspects that are crucial in orienting customer satisfaction. It is hence possible to distinguish aspects that are perceived as necessary from aspects that are not, regardless of the level of importance attached to them. In this sense, the Kano analysis is a fundamental complement to IPA, and in the next paragraph we will see how, within the MIMOSA Project, we were able through the joint IPA-Kano analysis to highlight perceived priorities in maritime transport and coastal mobility services in the Italy-Croatia Programme Area.

4 Perceived Priorities for Italy-Croatia Maritime and Coastal Transport Services

The MIMOSA Project relied on an ad-hoc survey about perceived priorities on the maritime and coastal transport services. Services and features to be investigated have been defined through a focus group, that highlighted a set of crucial questions to be addressed that led to the investigate the following situations:

a. availability of free bicycles rental at destination;
b. destination in an area closed to vehicular traffic;
c. destination accessible for people with motor disabilities;
d. possibility to do the whole trip with public transport modes;
e. availability of door-to-door luggage service;
f. possibility to consult all trip information on a single App;
g. maritime cruises adopting technologies that reduce environmental impacts;
h. possibility at the final destination area to move only on foot or with zero-emission vehicles;
i. possibility to do the entire travel from Italy to Croatia or vice-versa by train;
j. connections with Croatian islands/Italy by daily public transport services at regular times and without the need to book in advance.

Consequently, a questionnaire including these topics has been submitted to a representative sample of the population of the Italy-Croatia Programme Area, in native languages since answers can be at times influenced by semantic aspects of the questions. The results of the survey are summarised in table 2. For a better understanding of the table, please note that: “attractive” indicates benefits/features that generate satisfaction if present but do not create dissatisfaction if absent; “one-dimensional” indicates benefits that the more they are present, the more they create satisfaction, while they cause dissatisfaction if absent; “must be” represent priorities that can only generate dissatisfaction if missing.

Table 2 Shares of Kano-analysis type of requirement by proposed characteristics / situations

	Attractive	Must be	One-dimensional	Indifferent	Reverse
Free bike rental	40%	3%	20%	36%	n.s.
Area closed to vehicles	30%	3%	10%	44%	13%
Guaranteed accessibility for the disabled	7%	40%	25%	28%	n.s.
Whole trip feasible with public transportation	18%	19%	24%	36%	n.s.
Door to door luggage service	26%	7%	11%	53%	3%
All travel info on single App	34%	10%	24%	31%	1%
Sustainable maritime cruises	11%	27%	42%	18%	n.s.
Only pedestrian and 0 emissions vehicles area	34%	11%	16%	31%	7%
Entire travel feasible by train	30%	6%	21%	39%	4%
Islands increased accessibility	27%	11%	36%	25%	n.s.

<3% n. s.	< 10%	11% - 24%	26% - 39%	> 40%

At a first glance, there are three relevant priorities emerging from the survey: a) to guarantee the accessibility to people with motor disabilities, b) the sustainability of maritime cruises, and c) the accessibility of the islands.

Although we estimate that the percentage of respondents that would personally need to use services for the physically challenged is very low in the sample, 40% consider it as a "must be" requirement, the higher share among all features. We think that this is an example of a possible effect of personal and social norms on perceived priority.

The sustainability of passenger ships scores the highest "one-dimensional" percentage and the second "must be", thus being considered as an issue affecting the attitude towards this travel mode by 69% of respondents. This is also the topic having the lowest percentage of indifferent responses (18%).

Accessibility of islands scores the second highest "one-dimensional" attitude (36%) and, together with "must be" respondents, almost 47% of the sample would be seemingly dissatisfied by inadequate services in this field. On the other hand, this is also a source of opportunity, given that 27% of respondents consider islands' increased accessibility as an attractive feature.

Among other insights from this analysis, the only feature that is viewed negatively by a detectable proportion of respondents is the closure to traffic (reverse = 13%). However, on this controversial issue, 44% declare themselves indifferent, 30% consider it an attractive and 10% a one-dimensional benefit. According to this result, any restriction of vehicle traffic in a coastal tourist destination would be more welcomed rather than opposed by travellers. This is confirmed by the fact that the number of respondents who oppose closed traffic zones halves if they are given the opportunity to travel by zero-emission vehicles (7%), indifferent respondents decrease from 36% to 31% and respondents being overall in favour (one-dimensional) raise from 10 to 16%. As a whole, it can be estimated that a fully pedestrian zone is welcomed by 43% of travellers, while an area accessible only by pedestrians and zero-emission vehicles would be welcomed by 61% of travellers. Of course, since the closure to vehicular traffic also creates problems for residents and physically challenged people, a possible approach to policy in this direction should take into considerations balancing the restriction in various ways. We will return to this point when discussing policy implications.

An interesting example of how this analytic model provides useful insights is represented by the availability of free bike rental. This service is considered as a one-dimensional benefit by 20% of respondents and it is much appreciated by travellers between the two countries of the program, although its absence would cause dissatisfaction only in a small number of die-hard bicycling enthusiasts (given that 40% of respondents consider the service “attractive”, while 35% state their indifference). In a typical descriptive analysis (“how would you rate the availability of…”), the result would have probably been 60% positive and 35% indifferent – a result that could lead us to assume that this kind of service would have a potential demand of 60% of travellers. Instead, according to our analysis, the actual potential demand is only 20% (the one-dimensional portion of the sample), this being a clear proof of the utility of the technique in estimating potential demand for new services.

In a nutshell, with the IPA-Kano analysis it is possible to go beyond a simple definition of ‘satisfaction’ or liked/disliked, gaining indeed valuable insights on what is perceived as necessary versus what is perceived as liked but not necessary, leading thus to a sound priorisation of actions to be implemented. In this respect, we propose two different perspective of the results.

In the first one we take up a criterion for reading the data that transposes the results of the Kano analysis in terms of opportunities/challenges/threats and strengths/weaknesses. These assessments take up and extend the categories used in the SWOT matrix. However, in our study, the performance of the situations presented was not measured and therefore only opportunities/challenges and threats can be considered. Situations with the highest concentration of evaluations in the “attractive” category are considered as opportunities, given that they represent potential policy levers useful to improve travellers’ satisfaction while making travel and the use of the destination more sustainable. Those with the highest percentage of “must be” are classified as threats, representing conditions that would provide a very negative evaluation if not properly managed. Those with the highest percentage of “one-dimensional” are regarded as challenges, as they are relevant for better or worse and need constant attention for the level of performance to remain above or equal to expectations. Our results show that free bike rentals, an app capable of providing exhaustive information on the whole travel and areas only for pedestrian and zero emissions vehicles are the major opportunities highlighted by the survey. To make islands more accessible, through regular/daily line services requiring no booking in advance is the main challenge, together with the improvement of maritime vessel emissions. However, this is also a potential threat (second as for share of “must be”), while the non-accessibility for disabled people is a condition that would provide a major threat as for the perception of travellers **[fig. 3]**.

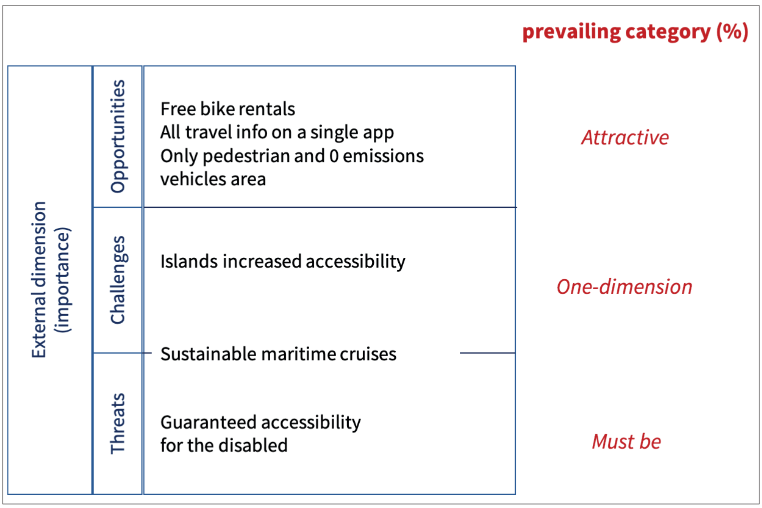

Figure 3 Opportunities, challenges and threats emerging from the Kano analysis

The results shown in figure **3** are the outcome of a qualitative assessment of the Kano’s answers given by the sample that classifies the main requirements in terms of the strategic role they play in mobility policies (i.e., they have the highest concentration in “must be”, “attractive”, etc., as explained above). Such evaluation, however, does not necessarily reflect the priority of actions in terms of what should be considered more relevant or “urgent” to fulfil, since the same weight is given to what is considered necessary and to what is considered pleasant or attractive.

A further way to highlight priorities emerging from this analysis is to provide a measure of the listed situations/characteristics according to a method emphasising necessity over liking. To do this, the priority can be measured by the weighted sum of the shares for each type of requirements. Specifically, $P = \sum_{i=1}^{n} S_i \cdot r_j$, where P is the measure of the priority, S the share of the i-th situation or characteristic, and *r* is the weight assigned to the *j*-th type of requirement. In the logic of this model, the more the requirement impacts satisfaction/dissatisfaction, the higher its priority. The values of *r* should therefore reflect such impact. In this study we have calculated the overall priority of each situation/characteristic adopted the following scores: "must be" = 1; "one-dimensional" = 0.8; attractive = 0.3; indifferent = 0; reverse = -0.5. This priority indicator is constructed in such a way as to assign a higher score (the maximum score is 1) to a characteristic/situation according to the potential it has to create dissatisfaction, rather than rewarding opportunities arising from unexpected and welcome benefits. Table **3** shows the results of this calculation and the consequent rank of priorities. The need for maritime cruises to adopt technologies that reduce environmental impacts and the accessibility for people with motor disabilities have, by far, the highest priority in our sample, followed by islands accessibility and by the development of cross-border public transport **[tab. 3]**.

Table 3 Priorities emerging from the Kano analysis

	P	Indexed 1st = 100
Sustainable maritime cruises	0.634	100
Guaranteed accessibility for the disabled	0.616	97
Islands increased accessibility	0.474	75
Whole trip feasible with public transportation	0.426	67
All travel info on single App	0.389	61
Free bike rental	0.305	48
Only pedestrian and 0 emissions vehicles area	0.305	48
Whole travel feasible by train	0.298	47
Door to door luggage service	0.221	35
Area closed to vehicles	0.135	21

It is worth noting that situations previously identified as opportunities are not at the top of ranking, while threats and challenges are. This reflects the logic of this model of analysis. The priorities identified with this criterion outline strategies for improvement which, if implemented, will affect what the public considers to be minimum requirements for acceptability. In this sense, the results, although developed in the context of the Italy-Croatia Programme Area, are not merely related to the specific case of the travel between the two Countries but represent a general perception.

5 Inferring Behavioural Determinants from Travellers' Surveys

The second method that is here presented is the inferential approach, which enables to shed light on which are the key levers for soft measures of behavioural change.

The so-called inferential approach consists of using data collected from a representative sample of a population to test, using statistical techniques, hypotheses and thus make inferences about the characteristics of the entire population. This type of approach is particularly important in behavioural studies because it supports tracing the psychological determinants of actions and decisions, and in order to be applied it requires certain precise conditions, of which the following are particularly relevant: a) knowing or at least being able to hypothesise the distribution of the population with respect to the variables to be used; b) having 'validated' tools for analysing behaviour (scales, questionnaires, etc.).

A survey is considered to be 'validated' when it has been demonstrated, by means of repeated tests, that the results obtained are reliable and statistically representative. In behavioural studies, the aim is typically to establish a relationship between individuals' psychological conditions and specific behaviours. For instance, to investigate the relationship between how habitual a person is (in general) and the means of transport they use, we will need a validated scale for measuring the weight of habits in everyday behaviour. Based on the result, we will be able to know whether a policy (communication, fares, new services, etc.) aimed at counteracting the weight of habits is appropriate.

Another fundamental aspect is the pre-existence of theoretical constructs, already tested and validated at a general level, within which to frame the specific analysis related to the problem to be addressed. For instance, we know that a very important factor in travel and mobility choices is related to the perception of being able to act as desired. This variable is called 'perceived behavioural control'. Thanks to numerous previous studies, we can use inferential statistical techniques to understand whether in a group of citizens a certain mode of transport is perceived as consistent or in opposition to this variable, and then evaluate interventions accordingly.

In a nutshell, these techniques do not only tell us 'what' people do or think, but also 'why', and thus become a key tool for taking soft measures to change behaviour in the desired direction. In the case of cross-border travel, this type of analysis is also useful for segmenting the types of travellers according to the purpose of the trip, which often corresponds to precise criteria for the choice of means of transport.

6 The MIMOSA Experience on Travellers' Behavioural Analysis

The MIMOSA Project founded its activities on a solid analytical basis, which included an in-depth investigation of cross-border traveller behaviour between Italy and Croatia. It was therefore also an opportunity to adopt theoretical models that are widely adopted in scientific research, yet only marginally used by operators and policy makers interested in performing analyses of commuters/travellers behaviours. Investigated behaviours were related both to the cross-border travel and to mobility choices at the destination and on coastal areas.

As mentioned above, this approach starts from established theoretical models to identify the weight that one or more individual variables have in determining behaviour. The MIMOSA Project relied on well-established models of individual behaviour, which have been extensively adopted for the analysis of travel behaviours and modal choice.

The Theory of Planned Behaviour (Ajzen 1991) postulates that people adopt a specific behaviour as long as they develop first the intention to do so, and intentions in turn depend on our general predisposition towards an activity (attitudes: "do we like doing this?"), on social pressure (subjective norms: "would my friends/relatives/colleagues approve if I do this?"), and on how easy or difficult it is to perform an activity (perceived behavioural control: "do I have the opportunity and the competences to do this?").

A second theory that can be used to investigate travel mode choice pertains to our altruistic values, and to the fact that sometimes we do something because, even if it does not maximise our own utility, "it is the right thing to do". The Norm-Activation Model (Schwarz, Howard 1981) assumes that the triggering elements of our intentions (and thus behaviours) are the so-called 'personal norms', which emerge when we have feelings of moral obligation towards doing something, or refraining from doing so: "I would love to use my car, but I know it is better for people around me and for the environment if I take the bicycle instead".

The third stream of research focuses on the role exerted by habits (Verplanken, Aarts 1999), as we often do something because we are so used to that we do not even consider other options, and we automatically opt for the traditional choice: "I always went on holiday with the car, and although now there is an efficient train connection to my final destination I do not even consider it as a viable alternative".

Indeed, most behaviours are the outcome of a complex decisional process where both rational and automatic mechanisms play a role. As a consequence, we included all different models in our analysis, focusing also on the mutual interrelations. Figure 4 represents an example of such interrelations, as it depicts a model encompassing the variables of the Theory of Planned Behaviour integrated with habits: the arrows represent relationships that might be investigated through statistical techniques (regressions) telling us whether such relationships actually exist and are significant determinants of the behaviour.

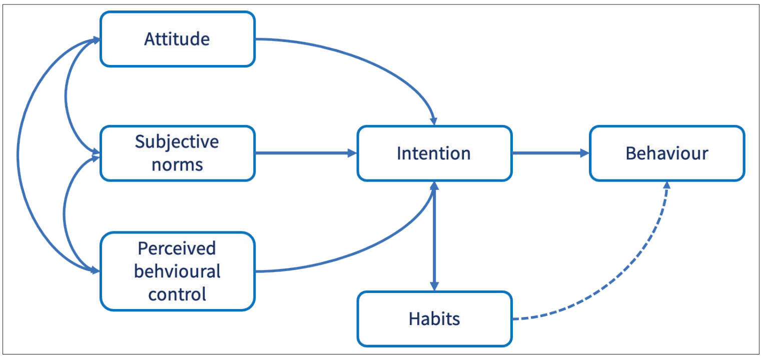

Figure 4 Example of an integrated model: Planned Behaviour and Habits

The relationships are studied through surveys adopting validated scales assessing the role of each variable in shaping behavioural patterns. In other words, this methodology does not tell what a specific individual or group of people do, but rather what are the elements (psychological, contextual and social) that make people choose different available options. This is a key element of a solid informational background on which to base sound strategies and policy measures: indeed, if I only observe what people do it might be extremely complicated to understand how to intervene in order to change behaviours and make them consistent with the envisaged goal.

Collected data are analysed with well-grounded statistical techniques based on correlational and/or regression analyses. It is the case for instance of the MIMOSA Project, where such approach has been adopted to investigate which are the elements at the basis of the decision to choose a specific transport mode when travelling between the two Countries of the study. Table 4 illustrates the correlation matrix between the constructs and, although regarding the specific setting of the project, it represents a useful example to clarify the broader methodology.

Table 4 Example of a correlation matrix (bicycles)

	PBC	SN	PN	HAB	INT	BEH
ATT	0.29444	0.61247	0.27154	0.35923	0.74827	0.26335
PBC		0.30647	0.08386	0.15521	0.22167	0.19459
SN			0.18272	0.17418	0.49642	0.18704
PN				0.14486	0.27223	0.03506
HAB					0.44081	0.46094
INT						0.33518

The correlation between the different variables measures how the variables move in relation to one another, and it can assume values ranging from -1 (perfect negative correlation) and +1 (perfect correlation). This is relevant insofar there are heterogeneous drivers of individual behaviours: we might choose what modal option to choose based on egoistic drivers, altruistic drivers or habits, and typically on a mixture of all of them, with the salience of either of them depending on the individual, the behaviour or the context being investigated. Since many different variables play a role in shaping our behaviours, it is important to gain insights about which variables are, on average, more important in a specific population. In our example, we might for instance want to understand whether most travellers base their decisions mostly on attitudes and generic predispositions towards the single alternatives, or mostly on deeply rooted habits. In other words, is it more important what I have been doing so far, or whether I like or not a specific travel mode?

The results of such analyses can be used to understand which are the priorities of the investigated population, and which should be the priorities when it comes to investing resources to act on different levers and change behaviours. If we look, for instance, at the relationship between attitudes (ATT) and intentions (INT), we see that there is a high positive correlation (0.75), which means that the two variables are strictly linked and, the more individuals display positive attitudes towards cycling, the more they develop the intention to choose bicycle as the transport mode (if one variable increases, so does the other). Yet, looking at the data, we can understand that although attitudes have a strong correlation with intentions, the correlation with actual behaviours (BEH) is much lower: on average, individuals in the population are interested in bicycles, yet rarely transform a generic intention triggered by positive attitudes into behaviours: “I like the idea of using the bike, but then I don’t actually use it”. This could be explained by different factors. It could be for instance that there are contextual constraints that make it hard for the individual to use the bicycle, and this is a piece of information that we can get from analysing the role of perceived behavioural control. Or, it could be a matter of priorities: since different modal choices are mutually exclusive, it is not sufficient to analyse with traditional questions whether individuals would like to use a bike: the answer might reflect a generic positive predisposition, yet not translating into actual behaviours as other alternatives are preferred.

Similarly, we can analyse the role of personal norms: the correlation between them and attitudes might be misleading for the analyst, and trick into thinking that focusing on the sustainability of the modal choice is an effective strategy to convince travellers to use bicycles. However, the correlation with actual behaviours is extremely low, so that perhaps, although moral obligations play a relevant role in shaping our generic predisposition towards certain alternatives perceived as environment-friendly, they do not represent the variable orienting behavioural trajectories.

7 Conclusions

In pilot activities, and more generally in implementations of transportation improvement policies, there is often a tendency to focus more on technological and infrastructural opportunities than on social needs. In maritime and coastal transport this is made even more evident by the clear preponderance of infrastructural aspects over 'soft' ones. However, the perceptions and priorities expressed by demand are relevant elements in the ongoing improvement of services, as well as in orienting planning toward choices that are also sustainable from a social, as well as an environmental, point of view.

In this chapter we have partly recounted the experience of the MIMOSA Project, in which known and validated models of behaviour analysis were used to identify the priorities expressed by a representative sample of travellers between Italy and Croatia. The results were only partly close to expectations, which confirms how appropriate survey techniques can bring out aspects that would otherwise be overshadowed.

Of course, those presented in this chapter are only two among many possible methodologies for behaviour analysis. These were chosen because they exemplify analyses that can be carried out with little effort and in reasonable time, thanks to the wide availability of already validated techniques. Above all, however, we would like to emphasise how behavioural and intention analysis methodologies, such as those presented here, are a relevant complement to descriptive analyses and participatory processes, insofar as they provide reliable indications of individual determinants of travel choices and perceptions of priorities to be pursued.

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Priorities for the Sustainability of Maritime and Coastal Passenger Transport in Europe
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Evaluating the Level of Service of Ferry Ports
A Methodological Proposal

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Abstract Quality of transport service is a crucial factor to provide transport services in line with the users expectations. In this research, we start from previous knowledge of the concept Level of Service (LOS) in the transport sector to evaluate whether tools and scales defined in previous studies are also applicable in defining the level of service in the ferry port. We decided to focus on the tool for measuring service quality in Ro-Ro ferry ports because they are the most important and often the only connection between the island and the mainland. Therefore, they are an essential factor in ensuring the sustainable development of the islands.

Keywords Maritime passenger services. Level of service. Port management. Transport service quality. Maritime transport.

Summary 1 Introduction. – 2 The Concept of Level of Service in the Transport Sector. – 3 Shortcomings of Previous Research on the Level of Service. – 4 Main Ferry Port Land Areas. – 5 Proposal of Methodology. – 5.1 Evaluation of the Capacity and Level of Service of the Quay Apron Area. – 5.2 Evaluation of the Capacity and Level of Service of the Marshalling Area. – 5.3 Evaluation of the Capacity and Level of Service of the Area for Passenger and Luggage Accommodation.

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1 Introduction

The quality of transport services is a crucial factor for providing adequate transport services that meet the needs and desires of users. In this research, the previous knowledge on the concept of level of service (LOS) in the transport sector was analysed to find out whether the LOS scales defined in previous research and used as tools for determining service quality in road and air transport planning manuals are also suitable for determining service quality in the ferry port. The LOS guidelines and technological processes described in the HCM (*Highway Capacity Manual*), ADRM (*Airport Development Reference Manual*), and TCQSM (*Transit Capacity and Quality of Service Manual*) manuals were analysed to answer this research question.

In these manuals, each scale is explicitly defined for each subsystem of the transport system. For this research, the Ro-Ro ferry port area has been divided into three main subsystems based on the technological processes of transport within the port area: quay apron area, marshalling area or vehicle staging area and area for passenger, and luggage accommodation.

Based on the results of desktop analysis of existing maritime port service quality concepts and formulas for calculating sustainable capacity of Ro-Ro ferry ports, a methodology for assessing capacity and service levels in Ro-Ro ferry ports was proposed using the existing LOS scales.

2 The Concept of Level of Service in the Transport Sector

In traffic engineering, the quality of service of a particular traffic object is often determined with the concept of 'level of service' (hereafter: LOS), which uses a six-level scale from A to F, where A means an excellent quality of service, while F is an unacceptable quality of service (often also defined as a system breakdown). This concept presents and rates the quality of service of each traffic object in a simple way. The simplicity of this concept makes it easier to present the current and future performance of the traffic object to the decision-makers and the general (non-technical) public.

The concept of LOS for traffic objects was first defined in the second edition of the HCM in 1965 after the concept of traffic capacity had been defined in the previous first edition in 1950. Since then, LOS has been used as an elementary benchmark for the planning, design, and organisation of road facilities. The HCM guidelines have become a standard reference code when defining capacity and LOS procedures in road transport, especially after the third edition in 1985 and other editions since then.

For walkways, including stairways, LOS is further defined in 1970 in the doctoral thesis of John J. Fruin (1970) and in his book (1971), published as a result of the author's dissertation.[1]

Based on the HCM and the Fruin guideline for LOS, Transport Canada (TC)[2] defined the concept of LOS for airports in the mid to late 1970s. This concept was adopted in 1981 by the Airport Associations Coordinating Council (IATA 1981), now Airports Council International (ACI) and International Air Transport Association (IATA), which incorporated it in the ADRM with some modifications.[3] As the publisher of the ADRM-a is IATA, these guidelines are often referred to in practice as 'IATA guidelines'.

The methods for analysing the capacity and quality of public transport from the perspective of passengers and transport operators are, in addition to the HCM, also defined in the TCQSM. The first TCQSM was published in 1999 (Kittelson & Associates 1999) and summarised the methods for determining public transport capacity and LOS for bus and rail transport objects.[4] Although the determination of capacity for ferry transport is not defined in the first edition,[5] it has been included in the second and last third editions (TCRP 2003; 2013)

All previously listed authors/manuals define LOS using a six-level scale from A to F. Still, the parameters and the way of determining these levels differ from author to author, i.e., manual to manual. Moreover, the parameters for traffic objects also change regarding the perception of space in different cultures (Šimunović 2006, 180).

1 Fruin (1970, 1971) has produced guidelines for the design of walkways and stairways based on his research at bus and rail terminals managed by the Port Authority of New York and New Jersey.

2 The results of the research and definition of LOS TC were published in the *Interim Level of Service Standards* and *Airport Services and Security*. During the research, a methodology for measuring LOS was developed known as CASE (Canadian Airport System Evaluation). The TC has defined standards for a total of five main passenger stopover areas, namely: counter, waiting/circulation area, holding area, baggage claim area and police, customs, or immigration control. These standards and methodology are shown in TRB 2010a, 146-50.

3 The 1981 ADRM has been regularly updated and is now known as the manual that provides guidelines for designing airport facilities with user needs in mind.

4 The concept of LOS for rail transport is defined in the TCQSM, which defines this concept LOS according to the guidelines provided by Fruin. In addition to TCQSM, the LOS concept according to Fruin has also been adopted by the British railway company Network Rail (Network Rail 2011) to define guidelines for assessing the capacity of a passenger railway station.

5 In the first edition, ferry transport is mentioned only as one of the modes of transport offering regular public transport services.

3 Shortcomings of Previous Research on the Level of Service

Previous research on LOS has not considered the perception of passengers with reduced mobility and safety as indicators for service level, nor has it recognised that they need to be considered in future LOS research.

When planning transport facilities, persons with reduced mobility should be considered so that they can board, access, move around, stay and work without hindrance. At the EU level, the accessibility of buildings for all persons is considered one of the essential requirements for buildings. It is laid down in Regulation No 305/2011 (EU 2011). The standards for transportation facilities in the United States of America are laid down in the Americans with Disabilities Act (ADA) (U.S. Department of Transportation s.d.). According to the provisions of ADA, all new transport stations must be accessible to persons with reduced mobility.

For maritime passenger transport, the guidelines are issued jointly by the Irish Department of Transport and the National Disability Authority (NDA s.d.). In contrast, in the UK, the DPTAC (Disabled Persons Transport Advisory Committee) issues guidelines for the shipbuilding industry with the support of the IMO. The latter guidelines were evaluated for their uptake and effectiveness between 2004 and 2005 as part of the UK national project, whose final report was published in 2006 (Keith et al. 2006).

The needs of persons with reduced mobility must be considered in the design of the object. It is also important to consider the condition of emergency evacuations in individual facilities (safety).

4 Main Ferry Port Land Areas

The maritime port area comprises the sea and land areas of the port and is used for the conduct of port activities. The port's land area includes all port infrastructure and port superstructures, from the coastline to the final land boundary of the port area.

Different authors have classified the maritime port areas differently in analysing the port area, so there is no universally accepted classification. From the perspective of the functional elements of the port, previous works have divided the maritime port area into:

- quayside, yard, landside, and hinterland (Böse 2011, 13-21; Bichou 2009, 136-44);
- marshalling yards, passenger facilities, berth facilities (Agerschou et al. 2004, 291-7);

- terminal forecourt (landside),[6] terminal (wetside),[7] buildings (PIANC 1995, 33-8);
- landside facilities, dockside facilities, en-route (vessel route) (TCRP 2013, 9-28).

Considering the technological processes of traffic in the ferry port and the functionality and connectivity of the individual port facilities, the land area of the ferry port is divided into three areas (Stupalo 2015, 30):

1. quay apron area;
2. marshalling area or vehicle staging area;
3. area for passenger accommodation.

5 Proposal of Methodology

The analysis of the LOS scales identified in the available literature and described in the previous chapters has shown that specific scales can be used in ferry ports to assess capacity and service levels. The applicability of these scales to evaluate individual parts of public transport passenger terminals, including the maritime passenger terminal, has already been identified in the TCQSM manual.

The scales identified have separately assessed the area for passengers and the area for road vehicles. These areas within the ferry terminal can be further divided into three subsystems: 1) processing area, 2) holding areas, and 3) links or corridors. The appropriateness of this subdivision in the analysis of traffic objects has already been recognised in studies by the National Academies of Sciences, Engineering, and Medicine (TRB 2010a, 147) and IATA (1981, 8). Although these areas have been recognised, the LOS scale for the processing area has not been identified in previous research, but the LOS scales for the other two subsystems have.

In line with the mainland areas of the ferry port defined in the previous chapter, the following sub-chapters pay particular attention to the level of service in each of these areas.

6 Port connections to the public road network.

7 Area from the forecourt to the final land boundary of the port area.

5.1 Evaluation of the Capacity and Level of Service of the Quay Apron Area

The Quay apron area can be divided into two elementary subsystems:

- area for the movement and stay of passengers/pedestrians (if boarding is not via a bridge)
- area for the movement and stay of road vehicles.

The level of service of an area designated for passenger/pedestrian movement can be further divided into three subsystems:

- traffic processing points – need not be part of the quay apron area subsystems. It takes place when the passenger (with or without a vehicle) buys the ticket or hands it over to the ticket officer in this area, e.g., when boarding the vessel. As mentioned above, the LOS scale for this subsystem has not been identified in the literature;
- holding area – if more passengers/vehicles arrive at the vessel than can be handled via the loading ramp/bridge, a queue forms next to the ship. A queue may also form when a passenger buys a ticket or hands it over to a staff member at that location. Given the characteristics of this subsystem, it can be evaluated:
  - for passengers – using the LOS scale for queuing, defined by Fruin (1987, 84-7)
  - for vehicles – no LOS scale has been identified in the literature that could apply to this subsystem. Considering the characteristics of this subsystem, it was concluded that the application of the LOS scale within the HCM for the intersection system is not appropriate. Intersections are evaluated in the manual by the indicator 'regulated waiting', i.e., the difference between the time of free passage of the vehicle and the time of passage, which includes the time of stopping and restarting the vehicle,
  - for vehicles – no LOS scale applicable to this subsystem was found in the literature. Considering the characteristics of this subsystem, it was concluded that the application of the LOS scale within the HCM for the signalised and unsignalised intersections is not appropriate. Indicator *control delay*[8] is the main service measure in the HCM for evaluating LOS at the intersection.

8 "Control delay includes delay associated with vehicle slowing in advance of an intersection, the time spent stopped on an intersection approach, the time spent as vehicles move up in the queue, and the time needed for vehicles to accelerate to their desired speed" (TRB 2010b, 4-15).

- links or corridors – the primary purpose of links or corridors in the quay apron area is to connect the area intended for passenger accommodation (if embarking/disembarking of passengers is not done across the bridge) and the marshalling area with the vessel (when embarking), and connecting the vessel with port exit points when disembarking). Given the characteristics of this subsystem, it can be evaluated:
  - for passengers – depending on the design of the links or corridor, different LOS scales have been identified in the literature. In the ferry port, the links or corridors of the quay apron area are located primarily near the vehicle movement area. Therefore, the LOS scales defined within the HCM for pedestrian mode (TRB 2010b), for urban street and segment measures, were identified as applicable for the evaluation of pedestrian/passenger links/corridors. In addition to these scales, walkway sections can also be valued using Fruin's LOS scales for walkways (Fruin 1987, 74-8) and stairways (Fruin 1987, 79-83). The analysis of Fruin's indicators showed that the values are approximate but not identical to the HCM indicators (TRB 2010b, ch. 23, 3-4) used to evaluate off-street pedestrian facilities. It was concluded that there is no satisfactory way to determine the most appropriate scale. The selection of the scale should be on the traffic planner who evaluates the facility.
  - for vehicles – after analysing quay apron area; it was concluded that no LOS scale is applicable for evaluating the roads of this area, since the level of service within this area, perceived by the passenger, depends on various factors decided mainly by the (for example location of each vehicle on the vessel, order (priority) of parking, method of disembarkation/embarkation, etc.). Factors that port has influence relate to ensuring appropriate marking of this area and its width.

5.2 Evaluation of the Capacity and Level of Service of the Marshalling Area

Research conducted by Stupalo (2015) didn't identify the LOS scale, which could be applied to evaluate the capacity and level of service of the marshalling area. Therefore, the need for additional research focused on defining the LOS scale of the marshalling area was recognised.

Possible indicators for the evaluation of this area are the capacity of the area and the width of the holding lanes. Based on these indicators suitability of this area can be evaluated depending on the traffic demand (whether the area is sufficient for the accommodation of all vehicles in rest, and whether it is suitable for passenger accommodation, the possibility of unobstructed entry/exit of passengers to/from the vehicles).

According to Morales-Fusco and Saurí (2009) optimal size of marshalling area in Ro-Ro terminals is the size that can accommodate twice as many vehicles as capacity of the biggest vessel that reaches the terminal. In this type of terminal vehicles usually do not leave the port area immediately upon disembarkation but are stored within the port area. However, this is not the case in the ferry port, where vehicles, after disembarking, usually immediately leave the port area. Therefore, the optimal capacity of the marshalling area in the ferry port would be the one that enables simultaneously accommodation of vehicles which corresponds to the capacity of the average vessel or the biggest vessel that reaches the terminal.

While considering the level of service of the marshalling area, the proposal for the boundary between LOS C and LOS D is when the length of the holding lanes stops being enough, and there is an overflow of traffic to adjacent roads. This proposal is consistent with the IATA definition for the boundary between LOS C and D (TRB 2010a, 150) for passenger queuing. If overflow causes dysfunction to the port's secondary processes, they could be used to further elaborate scale to lower LOS levels.

The percentage of area utilisation, its design, and organisations, including the entrance system for vehicles to the marshalling area (e.g., ticket booths, the possibility of reservation), could also be considered. All these factors affect the time spent within the marshalling area.

5.3 Evaluation of the Capacity and Level of Service of the Area for Passenger and Luggage Accommodation

The area for passenger and luggage accommodation is intended for movement and retention of passengers/pedestrians.

Processors, which refers to the ticket, customs and police booths and other similar facilities for monetary, regulatory or security processes of traffic, are not defined by LOS scales in the before mentioned manuals. But the need for their definition has been recognised. Further research should focus on defining adequate processing time in these facilities based on the data obtained from passengers and service providers. Maximum queuing time guidelines are defined in ADRM but not using the LOS scale.[9]

9 The maximum waiting time has been defined for different areas (e.g., check-in economy, baggage claim, security), but only as a time that is "short to acceptable" and "acceptable to long" (IATA 2004, 189).

The level of service of *reservoirs* can be determined based on standards defined by IATA (2004) and Fruin (1987) for:

- ticket or check-in queue area – two LOS scales have been identified:
  - IATA's LOS scale for check-in queue area (IATA 2004, 180-7) is based on the size of the area for passenger/pedestrian (sq. meter/occupant) regarding the width of the queue, number of bags and number of luggage carts;
  - Fruin's LOS scale for queuing (Fruin 1987, 84-7) is based on average pedestrian area occupancy (sq. feet/person) and average inter-person spacing (feet).

  It was concluded that there is no satisfactory way to determine the most appropriate scale. The selection of the scale should be on the traffic planner who evaluates the facility.
- wait/circulation area – the LOS scale for this space is defined by IATA and is based on the size of the area for passenger/pedestrian (IATA 2004, 297-8) and, only for LOS C (IATA 2004, 184), on location (before and after check-in), presence of luggage carts and the passengers' speed;
- holding area – the LOS scale for this space is defined by IATA based on the percentage of occupied space (IATA 2004, 186, 297-8).
- border control area – two scales have been identified:
  - IATA's LOS scale for passport control (IATA 2004, 185-6);
  - Fruin's LOS scale for queuing (Fruin 1987, 84-7).

  Both scales evaluate the object concerning the surface area per passenger, and the values of the indicators are approximate, although not identical. Therefore, there is no satisfactory way to determine the most appropriate scale, and the selection of the scale should be on the traffic planner who evaluates the facility.

The level of service of links/corridors within an area for passenger and luggage accommodation can be determined based on Fruin's guidelines, which are also recommended in the TCQSM manual (TCRP 2013, ch. 10, 39-62) for:

- doorway and walkways – the LOS is based on the pedestrian space (sq. feet/person), avg. speed (feet/min), flow per unit width (persone/feet/min) and volume-to-capacity ratio (v/c);[10]
- stairways – the level of service is based on average pedestrian area occupancy and average flow volumes (Fruin 1987, 79-84;

10 Volume-to-capacity (v/c) or demand-to-capacity (d/c) ratio is a special case service measure. This measure is used when defining a boundary between LOS E and LOS F, but not to define other LOS thresholds. This measure cannot be measured directly in the field, nor is it a measure of traveller perceptions. Until capacity is reached (i.e., when flow breaks down or ques build on) the d/c ration is not perceived by travellers (TRB 2010b, ch. 5, 9).

TCRP 2013, 10-48). LOS for stairs is also prescribed by HCM (TRB 2010b, ch. 23, 3), but since TCQSM recommended using Fruin's LOS scale, its application should be considered when measuring the level of service of the ferry port.

Links or corridors connecting the port building to the outer entrances and exits of the port (with the exception of the bridge connecting the terminal building to the ferry) can be assessed using indicators defined in the HCM defined indicators for urban roads and sections of urban roads, i.e., based on LOS scales defined for the evaluation of facilities with interrupted traffic flow.[11]

The study period[12] should be minimum during the peak hour. For evaluation analysis, approach C (TRB 2010b, ch. 16, 2) should be used, with a study period of one hour with consecutive analysis periods of 15 minutes. This approach considers systematic variations in traffic flow between periods and queues that carry over to the next analysis period and produces a more accurate representation of delay.

From the manuals described earlier, it can be concluded that the LOS at the ferry port, whose main purpose is to provide public transport services, should be from LOS D (in shorter periods) to LOS C or even higher. This means that the LOS should not be below LOS C during the busiest 15 minutes of the peak hour. A higher level of service can be adopted by ferry ports that want to attract shipowners and passengers with quality service.

The proposed methodology analyses the level of service from the perspective of passengers, i.e., users of transport services, and does not include an analysis of the level of service from the shipowner's perspective (transport service provider). The methodology covers the area from the entry into the port area to the boarding into the ship (ship's ramp).

As a result of the defined methodology answer to the research question from the introduction is: The service level guidelines set out in the road, and air transport manuals are applicable when evaluating the capacity and service level of a ferry port.

11 Guidelines are defined in TRB 2010b.

12 The study period is the time interval represented by the performance evaluation. It consists of one or more consecutive analysis periods. An analysis period is the time interval evaluated by a single application of the methodology.

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Fostering Strategic Management Approaches in Cross-Border Maritime Transport Systems Complexity

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Abstract The increasing complexity of the interactions between passenger flows and travel infrastructures requires new analysis tools able to cope with such complexity by providing adequate predictions (or at least a description of travellers' behaviour). This chapter proposes a different approach to evaluating the pivotal factors influencing cross-border traveller mobility behaviour. The analysis is conducted via application of the structural equation modelling research methodology on the structural associations of the theory of planned behaviour under theory extension endeavours with socio-ecological considerations.

Keywords Maritime transport systems. Structural equation modelling. Cross-border transport. Travellers behaviour. Theory of planned behaviour.

Summary 1 Introduction. – 2 The Theoretical Framework of Structural Equation Modelling. – 3 Application of Structural Equation Modelling in Cross-Border Maritime Transport Systems Complexity. – 4 Conclusion.

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1 Introduction

Regional cross-border cooperation and adaptive coordination efforts are becoming an increasingly present proactive obligation of local – central networks of governmental institutions and economic agents due to the emerging effect of globalisation as a consequence of trade liberalisation and market deregulation (Brunet-Jailly 2022). This applies in particular to the European Union because the emphasis on EU cross-border cooperation and mobility is a consequence of inter-EU Member State commuting as an essential spatial equilibrating mechanism in the internal EU labour market. Even though EU cross-border cooperation via territorial cohesion policies is a priority for the European Union, the idea that an increase in cross-border integration contributes to more European unity is hindered via the processes of EU Eastern enlargement and Western Balkans enlargement that occurred in 2004-07 and 2013 respectively (Smallbone et al. 2007; Watson 2011; European Parliament 2021). This resulted in a unique geopolitical enlargement process comprising the addition of EU internal border regions covering up to 40% of the EU territory, generating up to 30% of the EU GDP, housing up to 30% of the EU population and hosting approximately two million cross-border commuters (EC 2017a; 2017b).

However, the majority of the newly added countries with their respective regions are characterised by different levels of development. Moreover, their integration into the EU has increased regional disparities within Central and Eastern European Countries (Lackenbauer 2004). Such claims are further supported by the evidence from the 2016 European Commission case study that categorised the disparities into four main groups: 1) socio-economic disparities; 2) physical obstacles limiting cross-border access; 3) cultural obstacles, including linguistic or cultural differences; 4) institutional obstacles arising from the different administrative cultures on either side of the border (EC 2016b). The study further elaborates that the losses stemming from the legal and administrative barriers in cross-border regions represent a monetary value of €458 billion, accounting for 3% of total EU and 8.8% of cross-border regions' GDP. These losses translate into an estimated 6 million fewer jobs, accounting for 3% of the total EU and 8.6% of cross-border regions' employment (ECA 2019). Thus, it is evident that cross-border integration is a complex process because the newly added socio-economically underdeveloped regions create coupling barriers of technical, organisational, administrative, legal, and cultural nature. The aforementioned barriers further manifest themselves in the disability of economic agents to interact due to insufficient transportation and communication infrastructures as well as the lack of financial and organisational guidelines that promote territorial cohesion development (ESPON 2007).

The complexity of cross-border integration is specifically present and prevalent in the cross-border area of Italy and Croatia. Pivotal factors fostering such claims stem from the statistical evidence regarding the aforementioned EU Member States' cross-border area territorial, demographic and socio-economic characteristics (European Territorial Cooperation 2014). The entire territorial unit of the cross-border area consists of a surface area of 85,562 square kilometres inhabited by a population equaling 12,465,861 people. Further segmentation of the Italy-Croatia cross-border area on national boundaries points to the fact that the Italian side constitutes a territorial unit of 57,221 square kilometres (67% of the territorial area) with a population of 10,925,027 tenants (88% of the population), while the Croatian side constitutes a territorial unit of 28,341 square kilometres (33% of the territorial area) with a population of 1,540,834 tenants (12% of the population).

The differences in the Italy-Croatia cross-border economy in terms of market health and GDP growth rate further exacerbate the spatial and territorial disparities because the Italian side averages a GDP per capita of €24,848 while the Croatian side averages a GDP per capita of €9,577. This reflects on the tourism industry segment of both EU Member States. The Italian tourism industry segment contributes to the national GDP with a share of 10.3%, employing 2.6 million people, while the Croatian industry segment contributes to the national GDP with a share of 14.4%, employing 83,488 people (European Territorial Cooperation 2014). Even though both Member States promote sustainable transitions in their tourism industry sector, it is vital to indicate that such intentions are hindered due to inadequate transportation practices.

Statistical evidence with regard to contemporary specific traits of Italy-Croatia cross-border travel demand-destination and mode indicates that Italian tourists in Croatia utilise personal automobiles as the most dominant transportation mode with a share of 90-91%, liner ships are utilised with a share of 5-6%, private vessels and airplanes are utilised with a share of 1-2%, while coaches and busses are utilised with a share of 1% (European Territorial Cooperation 2014). Croatian tourists in Italy utilise personal automobiles as the most dominant transportation mode with a share of 75-77%, coaches and buses are utilised with a share of 16-17%, airplanes are utilised with a share of 6-9%, liner ships are utilised with a share of less than 1%, while private vessels remain completely unutilised. Statistical evidence indicates that the cross-border area is characterised by the extensive use of road transport in terms of personal automobiles as the dominant transport mode, even though its geographical layout consists of the Adriatic Sea in its entirety (Sirotić et al. 2021). This results in adverse environmental impacts, transport entity fragmentation, and further challenges for organising sustainable transport demand.

Thus, it is indispensable to develop integrated strategic management approaches to public transportation modes' implementation and utilisation due to their higher quality of social and ecological attributes in order to support sustainable tourism development along the Italy-Croatia cross-border area. New approaches to changing the mobility behaviour of tourists can be achieved by influencing customer behaviour to select the maritime transportation mode as a sustainable transport mode via examining structural associations of the theory of planned behaviour with structural equation modelling by extending the theory with socio-ecological considerations.

2 The Theoretical Framework of Structural Equation Modelling

Structural equation modelling (SEM) is a multivariate quantitative statistical technique utilised to interpret, clarify, test, and evaluate the relationships of multiple cause – and – effect connections between observed latent constructs to validate a theoretical model in terms of theory testing and extension (Tarka 2017). The multivariate analysis is conducted with the objective to assist the researcher for in-depth explanatory analysis with required statistical efficiency. The aforementioned characteristics of structural equation modelling resulted in a large segment of management research in recent years to utilise structural equation modelling as an analytical approach that simultaneously combines factor analysis and linear regression models for theory testing (Williams et al. 2009). The scientific terminology of structural equation modelling stipulates that latent constructs (factors) are deemed unobservable because they cannot be directly measured, and represent the concepts of the theory. Observed constructs (factors) are deemed observable because they can be directly measured and are thus utilised as data inputs for statistical analyses that provide evidence regarding the relationships of the latent constructs with their observed constructs and relationships with other latent constructs (Wisner 2003). Figure 1 represents the graphical depiction of an example structural equation model.

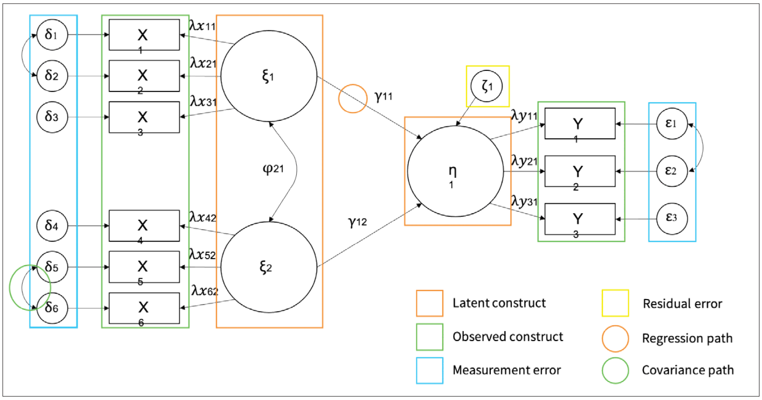

Figure 1 Example of Structural Equation Model. Source: graphically rearranged from Williams et al. 2009; Thakkar 2020

The observation of figure 1 requires knowledge regarding the technical definitions of key terminologies used in structural equation modelling. They include the following (Thakkar 2020):

1. **Latent construct** a variable that cannot be observed and measured directly is known as a latent construct. Latent variables in factor analysis are known as factors. It is an amalgamation of the sum of observed constructs within the structural equation model. Thus, it can only be quantified on the basis of response to the questionnaire. It increases the complexity of SEM as the researcher needs to consider all the questionnaire items and has to measure the responses (observed constructs) that are used to quantify the latent constructs, variables or factors.
2. **Observed construct** a variable that is observed and measured directly is known as a manifest variable. Manifest or observed variables are also known as indicator variables. The exclusive examination of the interrelationships between observed variables is called path analysis (PA).
3. **Measurement error** the fundamental difference between SEM and PA lies in the assumption of error. PA assumes the measurement of only observed constructs that do not account for error, whereas SEM utilises latent constructs and observed constructs to account for measurement error. Measurement error in SEM is also known as systematic error. The pivotal factor contributing to such definition is bias in the collected responses during the questionnaire. Measurement error is mainly a consequence of the way the questions are formulated, in what manner the questionnaire is admin-

istered, and the experience of the person responding to the questionnaire.

4. **Residual error** the error that represents a path coefficient for regression of one or more latent constructs into another latent construct. Residual errors are also known as the deviations of data points from a regression slope.
5. **Regression path** it is considered the building block of how the data will be represented when conducting any programming or model specification within a software program or package that implements structural equation modelling. It is a statistical technique based upon a linear equation system utilised to examine causal relationships between two or more latent constructs. Further segmentation of the regression path segregates latent constructs into two types: 1) independent variables (constructs); 2) dependent variables (constructs). In a regression path, each independent variable has a direct effect on the dependent variable.
6. **Covariance path** in the context of SEM, covariance paths between observed constructs are essential because they enable the researcher to include a relationship between two observed constructs (variables) that is not necessarily causal. In practice, most structural equation models contain both causal and non-causal relationships. Obtaining covariance estimates between observed constructs allows the researcher to better estimate direct and indirect effects between them, particularly in complex SEMs that require an estimation of a large number of parameters.

Structural equation models consist of a research process that is segregated into two main interrelated components: 1) the structural model; 2) the measurement (equation) model (Schwab 2005). The first component consists of the necessity to establish operational measures of the conceptualised latent constructs in terms of their relationship stipulated by the theory being subjected to testing. The second component consists of the utilisation of equations with the aim of measuring and testing the relationships between the conceptualised latent constructs as hypothesised by the theory being subject to testing. The aforementioned two main interrelated components of structural equation modelling are further segregated into four main subcomponents (Lendaris 1981; Valenzuela, Bachman 2017; Watkins 2018; Prudon 2015):

1. **Structural model subcomponent**
   1.1 **Structural Modelling (SM)** It includes modelling activities in which the intention of the researcher is to embody the geometric and descriptive approach, rather than the algebraic and calculative or quantitative approach. A structural model is a diagram that consists of a set of nodes and connections between the nodes. The purposes of structural equation modelling dictate that the structural model is utilised to specify the relationships of direct or indirect nature among the examined latent constructs in order to illustrate specific cause and effect relationships between the examined latent constructs.
2. **Measurement model subcomponents**
   2.1 **Path Analysis (PA)** In SEM methodology, it is a statistical technique for examining and testing hypothesised directional or non-directional relationships among a set of measured (observed) constructs and latent (unobserved) constructs. It differs from the traditional path analysis due to the fact that traditional path analysis considers and contains only measured (observed) constructs, meaning it does not consider latent (unobserved) constructs. This results in the inability to account for measurement error in the traditional path analysis.
   2.2 **Exploratory Factor Analysis (EFA)** It is an iterative variable grouping analysis utilised for identification and reduction of the number of dimensions in the dataset with the aim of developing and validating theories and measurements. It tests the meaningfulness of latent constructs in relation to their measured constructs via a set of consecutive iterations in an effort to find the best fitting measured construct for latent constructs in terms of correlation for each measured construct after the path analysis.
   2.3 **Confirmatory Factor Analysis (CFA)** It is also known as guided factor analysis and it is utilised to confirm the latent construct and measured construct structure established during the exploratory factor analysis. It is considered the final step of structural equation modelling because it indicates to what extent the proposed model is veritable in comparison to the relationships in the observed model as derived from the exploratory factor analysis. The estimation of the proposed model validity in comparison to the observed model is conducted via goodness-of-fit indices that consist of: 1) absolute fit indices; 2) incremental fit indices; 3) parsimony fit indices.

The mathematical expressions in terms of formulae mandatory for conducting structural equation modelling are introduced and indicated by Eboli and Mazzulla (2012) on an introductory level and by Thakkar (2020) on an advanced level.

Structural equation modelling is perceived as an applicable and useful technique because it establishes a series of interdependent relationships among latent constructs by describing the amount of variance explained by solving multiple equations (Davcik 2014). The main aim of structural equation modelling is to provide theory confirmation by determining how well the proposed model can estimate a covariance matrix for the sample data in the observed model (Hair et al. 2014). Structural equation modelling enables the researcher to indulge to a deeper inquiry through a process of scientific hypothesis testing and extending the present body of knowledge by discovering complex relationships among constructs by the two following options (Thakkar 2020):

1. if the hypothesised theoretical model is supported by the sample data, then the researcher has the possibility of incorporating additional phenomena in the initial model in order to attempt the investigation of a more complex theoretical structure;
2. if the hypothesised theoretical model is not adequately supported by the sample data, then the researcher is obligated to conduct a modification of the initial model or develop an alternative model for scientific hypothesis testing.

Thus, the first step the researcher must consider is identifying and defining the series of relationships that form an adequate theoretical model for analysis. The next consecutive step consists of the researcher constructing a path diagram in order to obtain a structural model that is a graphical representation of the relationships. The penultimate step consists of the researcher conducting data collection activities in accordance with the software program or software package he is utilising. The final step the researcher must adhere to is the analysis of the collected data via path analysis, exploratory factor analysis, and confirmatory factor analysis in order to estimate the strength of the relationships. The final step allows the researcher to examine the data validity regarding how adequately the data fits the structural model. This leads to the conclusion that the researcher wants to verify to what extent the hypothesised theoretical model is adequate for the sample data in order to confirm the theoretical model or to develop an alternative theoretical model.

3 Application of Structural Equation Modelling in Cross-Border Maritime Transport Systems Complexity

Transportation activities within the cross-border area of Italy and Croatia are characterised by extensive use of private vehicles in terms of personal automobiles. Contemporary notions of personal automobile overreliance stem from the belief that the absence of convenient public transport options stimulates passenger behaviour to select the personal automobile as the only viable transportation option (Abdelhamid et al. 2018). However, personal automobile overdependency is increasingly being perceived as a facilitator of various adverse socio-ecological impacts. The most prominent are anthropogenic health issues, greenhouse gas emissions, fine particle emissions, and noise pollution (Mrozik, Merkisz-Guranowska 2021). The majority of road transport networks are not designed to accommodate the rising travel demand for personal automobile utilisation. This results in road transportation network oversaturation via personal automobile congestion due to rush hours which stimulates an even higher level of adverse socio-environmental impact occurrence and simultaneously decreases the functionality of public transport options (Afrin, Yodo 2020).

The rapidly rising prevalence of the concept of sustainability is stimulating approaches to mitigate personal automobile overreliance by achieving a modal shift to sustainable transport modes such as public transport (OECD 2021). Thus, under the context of the Italy-Croatia cross-border area collaboration, convincing personal automobile owners to accept and adopt sustainable public transport options such as the maritime transport mode has to be incorporated into the transport marketing strategies of economic agents. The influence of sustainable mobility solutions is changing the interaction between economic agents and customers, which implies that strategic management has to account for the increased complexity of customer behaviour relations by advertising environmentally friendly travel options (Lu 2021). The initial step toward alleviating the complexity of customer behaviour relations is to examine the determinants influential for changing the existing habitual behaviour of personal automobile utilisation towards creating new habitual behaviour of customers regarding the selection of environmentally significant transport modes, i.e., maritime transportation mode. It can be postulated that the increase in ticket purchases will result in higher utilisation of maritime transportation mode in the Italy-Croatia cross-border area. Thus, the central element of study is the passengers' behavioural intention to purchase a ticket for utilising the maritime transportation mode.

In order to change customer behaviour, it is necessary to comprehend the main determinants of customer behaviour (Hauslbauer et al. 2022). The theory of planned behaviour developed by Ajzen is the most widely accepted and thus most frequently utilised theory for explaining the behaviour of individuals, i.e., customers. The principal elements of the theory of planned behaviour stipulate that behaviour is a consequence of behavioural intention, which is a consequence of three main antecedents: 1) attitude toward behaviour; 2) subjective norm; 3) perceived behavioural control (Ajzen 1991). Even though behaviour is the primary outcome of the theory of planned behaviour because it seeks to explain the observed response of the individual within the observed set of circumstances with respect to the individual's target, Ajzen advanced the view that behavioural intention is the key component of the theory of planned behaviour. Behavioural intention is the motivation, preparedness, and willingness of the individual regarding the performance of the observed behaviour (Ajzen 2022). It depends on three motivational factors pivotal for influencing the individual to perform the observed behaviour where the stronger the intention to perform the behaviour, the higher the chances the behaviour will be performed.

Attitude toward behaviour is the first motivational factor. It is defined as the degree to which the individual harbours a favourable or unfavourable assessment of the behaviour the individual is interested to perform. Subjective norm is the second motivational factor. It is defined as the set of positive and negative social pressures directed toward the individual (Ajzen 1991). It relates to the individual's subjective opinions about whether people of importance in his life approve or disapprove of the behaviour. Perceived behavioural control is the individual's perception of his capability regarding the difficulty or easiness of performing the behaviour of interest (Ajzen 2022).

Even though the five aforementioned theoretical constructs constitute the main theoretical body of the theory of planned behaviour, a substantial number of studies from the field of environmental psychology concluded that the three antecedents of the theory of planned behaviour positively influence passenger behavioural intention regarding the selection of public transport modes instead of the personal automobile (Harland et al. 1999; Gardner, Abraham 2010). The determining factor influencing such behavioural intention is that sustainability is rated as an important purchase criterion in terms of customers making green purchase decisions (Zhang, Dong 2020). Customers increasingly intend to participate in society regarding achieving the goals of sustainable consumption by means of engagement in sustainable behaviour. Sustainable behaviour is defined as the set of deliberate and effective actions that result in the conservation of natural and social resources (Tapia-Fonllem et al. 2017). This opens the possibility of extending the theory of planned behaviour by including the theoretical construct of socio-ecological considerations as the fourth antecedent towards the theoretical construct of behavioural intention as well as to the remaining three theoretical constructs (Dunlap 2001). Figure 2 represents the graphical depiction of an example structural equation model regarding the extension of the theory of planned behaviour with the theoretical construct of socio-ecological considerations.

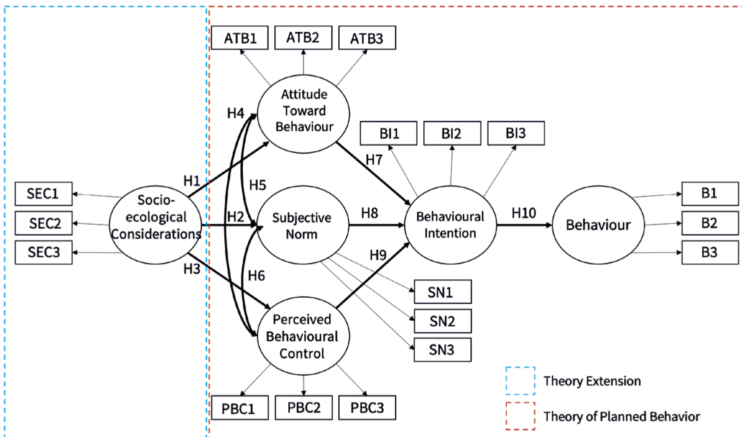

Figure 2 Example of Structural Equation Model regarding the extension of the Theory of Planned Behaviour with the theoretical construct of socio-ecological considerations. Source: Graphically rearranged from Williams et al. 2009; Thakkar 2020; Dunlap 2001; Paul et al. 2016

The observation of figure 2 implies that the totality of 10 scientific hypotheses represent the structural associations necessary for establishing the series of interdependent cause-and-effect relationships among latent constructs regarding the intent of passengers to engage in sustainable behaviour by purchasing a maritime transportation mode ticket. The scientific hypotheses presented in figure 2 can be verbally expressed as follows:

Hypothesis 1 Socio-ecological considerations of the customer positively affect the attitude toward behaviour of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 2 Socio-ecological considerations of the customer positively affect the subjective norm of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 3 Socio-ecological considerations of the customer positively affect the perceived behavioural control of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 4 The positive mutual reinforcement of the attitude toward behaviour and the perceived behavioural control will positively affect the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 5 The positive mutual reinforcement of the attitude toward behaviour and the subjective norm will positively affect the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 6 The positive mutual reinforcement between the subjective norm and the perceived behavioural control will positively affect the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 7 The attitude toward behaviour mediates the positive relationship between the socio-ecological considerations and the behavioural intention of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 8 The subjective norm mediates the positive relationship between the socio-ecological considerations and the behavioural intention of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 9 The perceived behavioural control mediates the positive relationship between the socio-ecological considerations and the behavioural intention of the customer regarding purchasing a maritime transportation mode ticket.

Hypothesis 10 The behavioural intention of the customer positively affects the behaviour of the customer regarding purchasing a maritime transportation mode ticket.

The principle of parsimony and simplicity must be applied during the formal wording of the scientific hypotheses in order to avoid unnecessary complexity that may render the scientific hypotheses incomprehensible (Fan et al. 2016). The wording of the scientific hypotheses must be constructed with the aim of complying with the intended analytical approach by stating the direction (positive or negative) of the expected cause-and-effect relationships of the examined latent constructs. The acceptance or rejection of the scientific hypotheses is verified by the explanatory power of the R-squared statistical measure regarding the expected cause-and-effect relationships of the examined latent constructs. R-squared is a statistical measure that represents the proportion of the variance for a dependent latent construct that is explained by another independent latent construct or a multitude of independent latent constructs in a regression model, i.e., structural equation model (Suhr 2006). Further accepted or rejected hypotheses confirmation is validated by the p-value ranging from the represented values of 0.05, 0.01, to 0.001. The p-value is a statistical measurement used to validate the accepted or rejected hypotheses against the observed data by measuring the probability of obtaining the observed results (Suhr 2006).

The possibility of subjecting the proposed theory of planned behaviour extended by socio-ecological considerations to testing by structural equation modelling can reveal the structural associations pivotal for predicting the customers' willingness to engage in sustainable behaviour by purchasing a maritime transportation mode ticket. The expected findings could extend the present body of knowledge of cross-border area collaboration and be utilised as evidence for the following strategic management advances in the Italy-Croatia cross-border area (EC 2016b):

1. alleviation of socio-economic disparities;
2. removal of physical obstacles limiting cross-border access;
3. mitigation of linguistic and cultural differences;
4. mitigation of different administrative cultures on either side of the border.

The expected findings might alleviate socio-economic disparities by encouraging economic agents to create push and pull advertisement strategies for the maritime transportation mode utilisation (Khmeleva et al. 2022). This might mitigate tourist overreliance on personal automobiles, resulting in higher social inclusivity, and less environmental pollution via greenhouse gasses and noise. Physical obstacles removal that limits cross-border access might be mitigated because the expected findings might serve as evidence for making capital-intensive investments in sustainable transport infrastructures such as integrated public transport systems (EC 2016a). The expected findings might assist in the mitigation of linguistic and cultural differences by implementing technological knowledge in terms of bilingual information-communication systems (Fai, Rebecca 2003). This would foster the role of language in knowledge transfers within the Italy-Croatia cross-border area. The expected findings might serve as a mutual basis for bilateral collaboration efforts of economic agents in the cross-border area (Beck 2015). This might stimulate positive management practices in overseeing business operations due to mutual recognition of business objectives, resulting in the mitigation of differences in administrative cultures on either side of the border.

4 Conclusion

Cross-border cooperation and coordination are key instruments for achieving sustainable development goals in EU Member States. The European Union highly promotes EU cross-border cooperation and coordination policy toward its Member States as a methodology for overcoming mutual barriers and ensuring the maximisation of the potential of each side of the Member States' border territory. The main aim of the policy is to foster the exchange of resources to increase the standard of living and well-being of the border population by improving technical, technological, economic, organisational, administrative, cultural, and environmental characteristics of border areas.

However, the multiplicity of the aforementioned factors increases the complexity of the cross-border integration process because cross-border areas consist of interconnected and diverse territorial regions. The necessity to disentangle the relationships of the factors involved in EU Member States' cross-border integration processes remains vague in certain aspects, which results in the difficulty of correctly identifying the determinants of cross-border cooperation. The study addresses the aforementioned necessity by highlighting the importance of cross-border mobility via sustainable transport modes utilisation in order to mitigate personal automobile overreliance. The maritime transport mode is selected as the sustainable transport mode due to the geographical characteristics of the Italy-Croatia cross-border area. An example structural equation model is presented as a methodology for testing the theory of planned behaviour extended by the theoretical construct of socio-environmental considerations.

The analysis of the structural associations necessary for establishing the series of interdependent cause-and-effect relationships among latent constructs regarding the intent of passengers to engage in sustainable behaviour by purchasing a maritime transportation mode ticket creates conditions for providing clarity regarding the correct identification of the determinants of cross-border cooperation. The establishment of the series of interdependent cause-and-effect relationships provides an opportunity for economic agents to create and foster strategic management approaches in the Italy-Croatia cross-border area with higher transparency and precision.

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State of The Art on Strategic Planning for Maritime Passenger Transport
A Bibliometric Review

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Abstract This chapter presents the results of a bibliometric analysis in the field of strategic planning for maritime passenger transport, conducted with the goal to critically assess the maturity of the maritime passenger transport scientific literature. Bibliometric analysis provide a portrait of the relevance assigned by the scientific community to specific topics. Through a rigorous and critical evaluation of articles via guided content analysis we have identified four research directions that are gaining increasing attention: 1) maritime tourism, 2) environmental externalities, 3) maritime transport, and 4) marine passenger ports.

Keywords Maritime passenger Transport. Bibliometric review. Statistical research methodology. Maritime planning. Maritime tourism.

Summary 1 Introduction. – 2 Results of the Bibliometric Analysis Statistical Research Methodology. – 2.1 General Results of the Bibliometric Analysis Statistical Research Methodology. – 2.2 Specific Results of the Bibliometric Analysis Statistical Research Methodology. – 3 Future Research Directions and Discussion. – 3.1 Maritime Tourism. – 3.2 Environmental Externalities. – 3.3 Maritime Transport. – 3.4 Marine Passenger Port. – 4 Conclusion.

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1 Introduction

Maritime passenger transport represents an essential mode of passenger transport even though it is an under-researched segment of the maritime industry within the academic community (Stupalo, Jugović, Mrvica 2016). This study critically assesses the maturity of the maritime passenger transport scientific literature from the aspect of strategic planning for maritime passenger transport. Strategic planning is a management technique utilised for assisting economic agents in setting future goals and objectives to achieve more stable and predictable growth (Pérez, Zapata 2020). It is a managerial methodology that develops and employs a business-specific roadmap for creating feasible, coherent, competitive, and strong business operations. It enables economic agents to create long-term plans in consideration of the risks and opportunities associated with the economic agents' business operations. However, the fragmented nature of maritime passenger transport generates challenges in identifying the essential steps and actions required to reach the goals of strategic planning for maritime passenger transport.

In order to address the aforementioned barrier, a thorough investigation of the conceptual and intellectual structure of the scientific field of strategic planning for maritime passenger transport is conducted via bibliometric analysis statistical research methodology. The utilisation of bibliometric analysis techniques, such as historiographic citation, bibliographic coupling, keyword co-occurrence, and thematic mapping via the employment of key bibliometric terms of Total Local Citation Scores, Total Global Citation Scores and Average Total Global Citation Scores, resulted in the identification of impactful research perspectives deemed indispensable for setting future research directions and actions for achieving the goals of strategic planning for maritime passenger transport.

The rigorous and critical evaluation of articles via guided content analysis revealed different innovative and progressive strategic alternatives manifested in four future research directions for strategic planning for maritime passenger transport: 1) maritime tourism, 2) environmental externalities, 3) maritime transport, and 4) marine passenger ports. The four future research directions provide the possibility of aiding economic agents in increasing the extent of the understanding of their business operations in order to better adapt their growing attention to the concept of emerging sustainable transitions in the maritime passenger transport segment of the maritime industry.

2 Results of the Bibliometric Analysis Statistical Research Methodology

Bibliometric analysis is a quantitative and qualitative statistical research methodology utilised to measure the impact of scientific literature in order to ascertain the level of maturity in the inquired research domain in terms of output volume, scientific quality, interdisciplinarity, and network strength (Ellegaard, Wallin 2015). The quantitative aspect of bibliometric analysis manifests itself through the element of science mapping, which is an efficient and powerful quantitative technique for reviewing a copious and extensive amount of scientific literature studies. The main advantages of science mapping are creating the structure of scientific fields and revealing the dynamics of scientific fields (Aria, Cuccurullo 2017). This enables the researcher to find and evaluate the most impactful scientific works with mitigated subjective bias within the inquired scientific field. Thus, it is considered indispensable for conducting a systematic, transparent and replicable literature review as it provides better objective and reliable scientific analyses (Zupic, Čater 2015).

The qualitative aspect of bibliometric analysis manifests itself through the element of guided content analysis, which is also known as performance analysis. Content analysis is a research methodology utilised to intellectually comprehend the unstructured content of recorded human communications media such as texts, images, symbols, or audio data in order to determine their contextual meaning for creating further replicable and valid inferences (Gheyle, Jacobs 2017; White, Marsh 2006). Performance analysis is a research methodology that utilises strict procedural rules in terms of coding in order to create systematic guidelines for intellectual inference from recorded human communications media that results in structured conclusions from the examined media. Thus, it is a specialist discipline involving systematic observations to enhance performance and improve decision making, i.e., to evaluate individual and institutional research and publication performance (Gaur, Kumar 2018; Narin, Hamilton 1996).

The initial supposition of bibliometric analysis is that researchers publish their most important scientific results in academic journals and embark on new research projects primarily based on articles published in similar academic journals (Munim, Saeed 2019). This creates the condition to establish a four-step approach regarding the state of the art on strategic planning for maritime passenger transport bibliometric analysis. Figure 1 represents a graphical depiction of the four-step approach which is concurrently the workflow of this chapter.

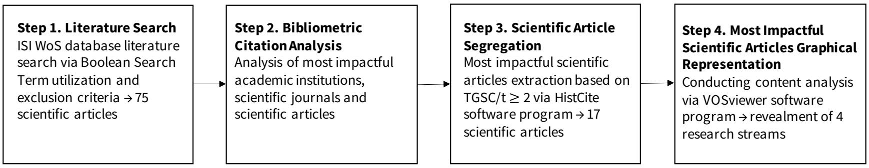


Figure 1 The four-step workflow approach regarding the state of the art on strategic planning for maritime passenger transport bibliometric analysis. Source: graphically arranged by the Author

The observation of figure 1 implies that the first step consists of a thorough and systematic literature search, and a comprehensive evaluation of the scientific field via exclusion criteria. The second step consists of a comprehensive analysis of the most impactful academic institutions, scientific journals, and academic articles in order to identify key publication trends within their respective domains. The third step consists of scientific article segregation with the adherence to the Total Global Citation (TGC) criteria in order to identify the most impactful scientific articles within the scientific field. The fourth and final step is an extension of the third step in terms of graphically representing the most impactful scientific articles within the scientific field in order to synthesise the main findings and provide future research directions.

2.1 General Results of the Bibliometric Analysis Statistical Research Methodology

The primary basis of the bibliometric analysis is the collection of bibliographic citations from the ISI Web of Science (WoS), the most renowned scientific database in the entirety of academia. The ISI WoS is a database of bibliographic citations of multidisciplinary areas that covers the various journals of medical, scientific, and social sciences including humanities.[1] The process of thorough and systematic literature search in terms of impact and relevancy is performed via keyword search in the WoS database with adherence to Boolean search terms. The systematic literature search yielded a total of 75 scientific articles on strategic planning for maritime passenger transport. Table 1 contains guidelines for the thorough ten-step process that resulted in the totality of 75 scientific articles on the strategic planning for maritime passenger transport.

1 https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/web-of-science#:~:text=Web%20of%20Science%2C%20previously%20known,and%20social%20sciences%20including%20humanities.

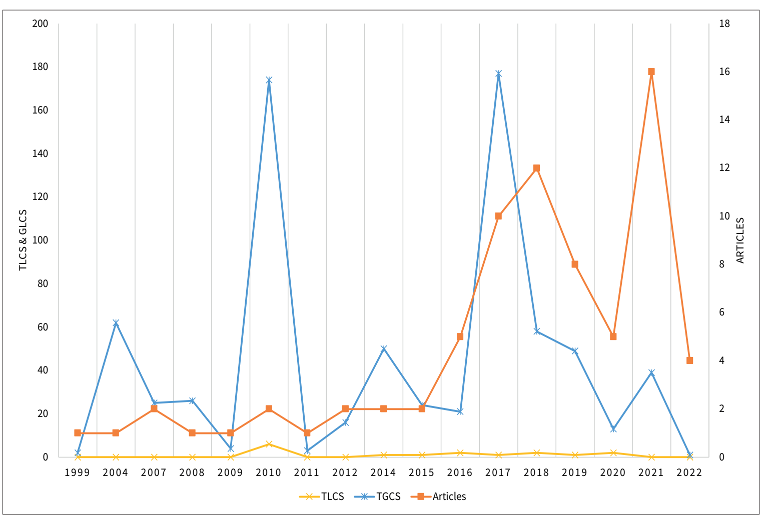
Table 1 ISI WoS research findings on the strategic planning for maritime passenger transport. Source: descriptively arranged by the Author

Step	Boolean Search Term	Number of Articles WoS
1.	"Maritime Passenger*"	18
2.	"Maritime Passenger*" OR "Maritime Tourism"	50
3.	"Maritime Passenger*" OR "Maritime Tourism" OR "Passenger Port*"	75
4.	"Maritime Passenger*" OR "Maritime Tourism" OR "Passenger Port*" OR "Marine Passenger Transport"	76
5.	"Maritime Passenger*" OR "Maritime Tourism" OR "Passenger Port*" OR "Marine Passenger Transport" OR "Passenger Accessibility"	81
6.	"Maritime Passenger*" OR "Maritime Tourism" OR "Passenger Port*" OR "Marine Passenger Transport" OR "Passenger Accessibility" OR "Green Transport Planning"	107
7.	"Maritime Passenger*" OR "Maritime Tourism" OR "Passenger Port*" OR "Marine Passenger Transport" OR "Passenger Accessibility" OR "Green Transport Planning" OR "Green Transport Management"	133
8.	Exclusion criteria: Journal Article	88
9.	Exclusion criteria: English Language	80
10.	Exclusion criteria: Article Manual Screening for Inquired Relevance	75

The adherence to the information within table 1 indicates that the initial step of keyword search "Maritime Passenger" resulted in 18 scientific publications. The second step of keyword search conjoins the "Maritime Passenger" keyword and "Maritime Tourism" keyword with a Boolean operator "OR", resulting in 50 accumulated scientific publications. The third step of keyword search includes the third keyword "Passenger Port" with a Boolean operator "OR", resulting in 75 accumulated scientific publications. The fourth step of keyword search adds the fourth keyword "Marine Passenger Transport" with a Boolean operator "OR" and results in 76 accumulated scientific publications. The fifth step of keyword search incorporates the fifth keyword "Passenger Accessibility" with a Boolean operator "OR", resulting in 81 accumulated scientific publications. The sixth step of keyword search involves the sixth keyword "Green Transport Planning" with a Boolean operator "OR" and results in 107 accumulated scientific publications. The seventh and final step of keyword search conjoins the seventh keyword "Green Transport Management" with a Boolean operator "OR" and results in the totality of 133 accumulated scientific publications.

The refinement process begins at step eight via the applications of exclusion criteria, of which the first consist of incorporating journal articles only as the examined scientific publications. The pivotal reason contributing to such a decision stems from the rigorous quantitative and qualitative aspects of the peer review process indispensable for the article acceptance within the scientific journal (Gill 2020). The application of the first exclusion criteria compacted the totality of accumulated scientific publications from 133 down to 88 journal articles. The second exclusion criteria consist of considering only the English language in journal articles as the medium for knowledge exchange. The principal reason for this is that the English language is the prevalent international language of scientific publication (Ferguson, Pérez-Llantada, Plo 2011). The application of the second exclusion criteria further constricted the totality of accumulated journal articles from 88 down to 80 journal articles. The third and final exclusion criteria consist of the journal article manual screening for inquired relevance within the selected sample of the ISI WoS database. Journal articles only briefly covering the topic of strategic planning for maritime passenger transport were removed, spanning from historical, biomedical, anthropological, and cultural studies. The application of the final exclusion criteria concludingly narrowed down the totality of accumulated journal articles from 80 journal articles down to 75 journal articles.

Graph 1 is a statistical representation of the remaining totality of 75 journal articles.



Graph 1 Statistical representation of the remaining totality of 75 journal articles. Source: graphically arranged by the Author

The examination of graph 1 indicates that the topic of strategic planning for maritime passenger transport constitutes itself in the 75 published journal articles within a time period from 1999 to 2022. Further examination of graph 1 requires knowledge regarding the key bibliometric terms Total Global Citation Score (TGCS) and Total Local Citation Score (TLCS). Total Global Citation Score represents the number of times an article is cited by any other articles that are available on the ISI WoS database (Mustikarini, Adhariani 2021). Total Local Citation Score represents the number of times an article is cited by any other articles in the sample of the study (Mustikarini, Adhariani 2021). Thus, TGCS is a bibliometric term indicating the frequency of cited articles outside the sample of 75 articles on the topic of strategic planning for maritime passenger transport. Accordingly, TLCS is a bibliometric term indicating the frequency of the 75 cited articles on the topic of strategic planning for maritime passenger transport within the academic community researching such topic. Further examination of graph 1 with adherence to the aforementioned key bibliometric terms leads to the following conclusions. The selected time period from 1999 to 2022 indicates a steady and stable growth in the publishing of articles until 2020, when a receding of article publishing occurs. However, the recovery in the publishing of articles follows soon in 2021 and continues throughout 2022. The adherence to the TGCS reveals that the most impactful results occurred in 2004, 2010, and 2017. Further segmentation reveals that in 2004 one article was published representing a 62 TGCS value, in 2010 two articles were published representing a 174 TGCS value, while in 2017 ten articles were published representing a 177 TGCS value. However, it is important to note when the number of published articles is divided by the TGCS for the particular year, better objectivity regarding the impact of the article(s) can be obtained. Thus, 2004 marks 62 TGCS per article, 2010 marks 87 TGCS per article, and 2017 marks 17.7 TGCS per article. This leads to the conclusion that 2010 is the most impactful year regarding the topic of strategic planning for maritime passenger transport. The adherence to the TLCS reveals a low rate of article impact, with only 2010 being the most impactful representing a 6 TLCS value. Pivotal reasons contributing to such a low level of TLCS value may include overreaching research fragmentation due to occurring obstacles regarding the university-industry collaboration, and university-university collaboration (Rowland 2008). Divergences in values, norms, and mindsets between the representative of academic management and knowledge-transfer professionals divide academic and business institutions in terms of culture, expectations, and ultimately knowledge transfer (Muscio, Vallanti 2014).

2.2 Specific Results of the Bibliometric Analysis Statistical Research Methodology

The specific results of the bibliometric analysis constitute the activity of evaluating the scientific output and the scientific impact of the most prominent academic institutions, scientific journals, and scientific articles regarding the topic of strategic planning for maritime passenger transport. The detailed analysis of the ISI WoS key scientific discipline categories reveals that the sample of 75 articles belongs to the following top five categories: 1) Transportation Science Technology (25.3%); 2) Transportation (21.3%); 3) Engineering Marine (20.0%); 4) Environmental Sciences (16.0%); 5) Environmental Studies (14.6%). The remaining 3% accounts for a multiplicity of economic, oceanography, geography, and hospitality scientific discipline categories. The interconnectedness of the diversity of scientific discipline categories indicates the multidisciplinarity and interdisciplinarity of the topic of strategic planning for maritime passenger transport.

2.2.1 The Most Prestigious Academic Institutions

The identification and evaluation of the most prestigious academic institutions regarding the topic of strategic planning for maritime passenger transport is performed with adherence to two crucial bibliometric analysis citation score objective measures. The first objective measure is the total aggregate sum of the published articles associated with the respective prestigious academic institution. The second objective measure is the key bibliometric term of Total Global Citation Score (TGCS) which represents the number of times an article is cited by any other articles that are available on the ISI WoS database. The principal reason for evaluating the scientific performance and output of the most prestigious academic institutions by comparison analysis of the aforementioned two objective measures stems from the fact that even though certain prestigious academic institutions may have a higher publication rate, not all of the published articles have the same scientific impact.

Even though the Total Local Citation Score (TLCS) is equally important as the TGCS, the general results of the bibliometric analysis reveal a low level of frequency in the respective key bibliometric term. This resulted in the exclusion of this criteria in the evaluation of the scientific performance and output of the most prestigious academic institutions regarding the topic of strategic planning for maritime passenger transport. Table 2 contains the top 10 prestigious academic institutions regarding the topic of strategic planning for maritime passenger transport based on the total aggregate sum of the published articles and the key bibliometric term of TGCS.

Table 2 The top 10 prestigious academic institutions regarding the topic of strategic planning for maritime passenger transport based on the total aggregate sum of the published articles and the key bibliometric term of TGCS. Source: descriptively arranged by the Author

No.	Evaluation criteria: total aggregate sum of the published articles			Evaluation criteria: the key bibliometric term of TGCS		
	Institution	**Article No.**	**TGCS**	**Institution**	**Article No.**	**TGCS**
1.	University of Split, Faculty of Maritime Studies	8	17	University of Piraeus	1	144
2.	St Petersburg State University Aerospace Instrumentation	5	11	University of Pavia	1	66
3.	University of Dubrovnik, Faculty of Maritime Studies	5	8	Yarmouk University	1	62
4.	University of Rijeka, Faculty of Maritime Studies	4	10	Bournemouth University	1	42
5.	National Technical University of Athens	3	33	University of West London	1	42
6.	University of Las Palmas de Gran Canaria	3	18	Cardiff University	1	39
7.	University of Zagreb, Faculty of Transport and Traffic Sciences	3	2	Iran University of Science and Technology	1	39
8.	University of Bologna	2	4	National Technical University of Athens	3	33
9.	University of Montenegro	2	8	National Research Council of Italy	1	30
10.	Admiral Makarov State University of Maritime and Inland Shipping	1	1	University of the Aegean	1	30

The adherence to the information within table 2 indicates a great level of heterogeneity among the most prestigious academic institutions regarding the topic of strategic planning for maritime transport. Further analysis of table 2 on the basis of the total aggregate sum of the published articles reveals that the University of Split, St Petersburg State University Aerospace Instrumentation, University of Dubrovnik (Faculty of Maritime Studies), University of Rijeka (Faculty of Maritime Studies), and National Technical University of Athens belong to the top five most prestigious academic institutions.

The consecutive analysis of table 2 on the basis of the key bibliometric term of TGCS reveals that the University of Piraeus, University of Pavia, Yarmouk University, Bournemouth University, and University of West London belong to the top five most prestigious academic institutions. This leads to the conclusion that, on the basis of the total aggregate sum of the published articles, Croatia is the leading country in prestigious academic institutions, while, on the basis of the key bibliometric term of TGCS, Greece is the leading country in prestigious academic institutions.

2.2.2 The Most Prominent Scientific Journals

Maritime organisational sciences characterise a diversity of scientific discipline categories that are the research focus of various scientific journals. The application of bibliometric analysis software programs is utilised to identify and evaluate the most prominent scientific journals regarding the topic of strategic planning for maritime passenger transport. The identification and evaluation are conducted on the basis of the objective measures of the total aggregate sum of the published articles associated with the respective prominent scientific journal, and on the basis of the key bibliometric term of TGCS. Table 3 contains the top 10 most prominent scientific journals regarding the topic of strategic planning for maritime passenger transport based on the total aggregate sum of the published articles and the key bibliometric term of TGCS.

Table 3 The top 10 most prominent scientific journals regarding the topic of strategic planning for maritime passenger transport based on the total aggregate sum of the published articles and the key bibliometric term of TGCS. Source: descriptively arranged by the Author

No.	Evaluation criteria: total aggregate sum of the published articles			Evaluation criteria: the key bibliometric term of TGCS		
	Scientific Journal	Article No.	TGCS	Scientific Journal	Article No.	TGCS
1.	*Naše More*	6	18	*Atmospheric Environment*	1	144
2.	*Sustainability*	5	15	*Transportation Research Part D – Transport and Environment*	4	85
3.	*Transactions on Maritime Science – TOMS*	5	6	*Biofouling*	1	66
4.	*Transportation Research Part D: Transport and Environment*	4	85	*Marine Environmental Research*	1	62
5.	*Pomorstvo – Scientific Journal of Maritime Research*	3	8	*Current Issues in Tourism*	1	42
6.	*Promet – Traffic & Transportation*	3	12	*Ocean & Coastal Management*	2	35
7.	*Transport Problems*	3	3	*Maritime Policy & Management*	2	31
8.	*Transportation Research Record*	3	4	*Marine Pollution Bulletin*	1	27
9.	*Energies*	2	3	*Tourism Economics*	1	26
10.	*Journal of Coastal Research*	2	3	*Journal of Transport Geography*	1	25

The adherence to the information within table 3 indicates a substantial occurrence of heterogeneity among the most prominent scientific journals regarding the topic of strategic planning for maritime transport. Further analysis of table 3 on the basis of the total aggregate sum of the published articles reveals that *Naše More*, *Sustainability*, *Transactions on Maritime Science – ToMS*, *Transportation Research Part D: Transport and Environment*, and *Pomorstvo – Scientific Journal of Maritime Research* belong to the top five most prominent scientific journals. The successive analysis of table 3 on the basis of the key bibliometric term of TGCS reveals that *Atmospheric Environment*, *Transportation Research Part D: Transport and Environment*, *Biofouling*, *Marine Environmental Research*, and *Current Issues in Tourism* belong to the top five most prominent scientific journals. The basis of the total aggregate sum of the published articles suggests that Croatia is the leading country regarding the most prominent scientific journals. On the other hand, the basis of the key bibliometric term of TGCS indicates that Netherlands is the leading country regarding the most prominent scientific journals.

2.2.3 The Most Impactful Scientific Articles

The ranking of the most impactful scientific articles and their respective authors is conducted with adherence to a two-step approach utilising the key bibliometric terms of TGCS and Average Total Global Citation Score (TGCS/t). TGCS/t represents the published article average global citation count per year beginning at the designated article publication year and ending at the designated year of the conducted study. Thus, TGCS/t is a bibliometric term indicating the average frequency of cited articles outside the sample of 75 articles on the topic of strategic planning for maritime passenger transport beginning from the article publication year to 2022 which is the final year of the bibliometric review. Table 4 contains the top 10 most impactful scientific articles regarding the topic of strategic planning for maritime passenger transport based on the key bibliometric term of TGCS.

Table 4 The top 10 most impactful scientific articles regarding the topic of strategic planning for maritime passenger transport based on the key bibliometric term of TGCS. Source: descriptively arranged by the Author

No.	Author(s)/ Article Title/ Publication Year	Journal	TGCS
1.	Tzannatos, E. “Ship Emissions and their Externalities for the Port of Piraeus-Greece” (2010)	*Atmos. Environ.*	144
2.	Ferrario, J. et al. “Role of Commercial Harbours and Recreational Marinas in the Spread of Non -indigenous Fouling Species” (2017)	*Biofouling*	66
3.	Abu-Hilal, A.; Al-Najjar T. “Litter Pollution on the Jordanian Shores of the Gulf of Aqaba (Red Sea)” (2004)	*Mar. Environ. Res.*	62
4.	Bowen, C. et al. “Maritime Tourism and Terrorism: Customer Perceptions of the Potential Terrorist Threat to Cruise Shipping” (2014)	*Curr. Issues Tour.*	42
5.	Eshtehadi, R. et al. “Robust Solutions to the Pollution-Routing Problem with Demand and Travel Time Uncertainty” (2017)	*Transp. Res. D. Transp. Environ.*	39
6.	Vaggelas, G.K.; Pallis, A.A. “Passenger Ports: Services Provision and their Benefits” (2010)	*Marit. Pol. Manag.*	30

No.	Author(s)/ Article Title/ Publication Year	Journal	TGCS
7.	Menegon, S. et al. "Addressing Cumulative Effects, Maritime Conflicts and Ecosystem Services Threats Through MSP–Oriented Geospatial Webtools" (2018)	*Ocean Coast. Manag.*	30
8.	Mali, M. et al. "Assessment and Source Identification of Pollution Risk for Touristic Ports: Heavy Metals and Polycyclic Aromatic Hydrocarbons in Sediments of 4 Marinas of the Apulia Region (Italy)" (2017)	*Mar. Pollut. Bull.*	27
9.	Diakomihalis, M.N. "Estimation of the Economic Impacts of Yachting in Greece Via the Tourism Satellite Account" (2008)	*Tour. Econ.*	26
10.	Grubesic, T.; Zook, M. "A Ticket to Ride: Evolving Landscapes of Air Travel Accessibility in the United States" (2007)	*J. Transp. Geogr.*	25

The adherence to the information within table 4 reveals the most impactful articles being the foundation and highly influencing the topic of strategic planning for maritime passenger transport.

Even though identifying the foundations of the topic of strategic planning for maritime passenger transport regarding where it stems from is essential, identifying future research directions regarding where it is heading is considered indispensable. Thus, the application of the key bibliometric term of TGCS/t revealed what articles are frequently cited on the basis of average cite frequency. The rate of cite occurrence enables to indicate an emerging future research direction in conjunction with the TGCS/t ≥ 2 exclusion criteria, resulting in the identification of 17 articles representing a sample size of the top 22.6% most frequently cited articles. Table 5 contains the top 10 most impactful scientific articles regarding the future research directions on the topic of strategic planning for maritime passenger transport based on the key bibliometric term of TGCS/t.

Table 5 The top 10 most impactful scientific articles regarding the future research directions on the topic of strategic planning for maritime passenger transport based on the key bibliometric term of Average Total Global Citation Score (TGCS/t). Source: Descriptively arranged by Author

No.	Author(s)/ Article Title/ Publication Year	Journal	TGCS/t
1.	Tzannatos, E. "Ship Emissions and their Externalities for the Port of Piraeus-Greece" (2010)	*Atmos. Environ.*	11.08
2.	Ferrario, J. et al. "Role of Commercial Harbours and Recreational Marinas in the Spread of Non -indigenous Fouling Species" (2017)	*Biofouling*	11.00

No.	Author(s)/ Article Title/ Publication Year	Journal	TGCS/t
3.	Eshtehadi, R. et al. "Robust Solutions to the Pollution-Routing Problem with Demand and Travel Time Uncertainty" (2017)	*Transp. Res. D. Transp. Environ.*	6.50
4.	Menegon, S. et al. "Addressing Cumulative Effects, Maritime Conflicts and Ecosystem Services Threats Through MSP–Oriented Geospatial Webtools" (2018)	*Ocean Coast. Manag.*	6.00
5.	Progiou, A.G. et al. "Air pollutant emissions from Piraeus port: External costs and air quality levels. 2021	*Transp. Res. D. Transp. Environ.*	5.50
6.	Gedik, S.; Mugan-Ertugal, S. "The Effects of Marine Tourism on Water Pollution" (2019)	*Fresenius Environ. Bull.*	5.25
7.	Bowen, C. et al. "Maritime Tourism and Terrorism: Customer Perceptions of the Potential Terrorist Threat to Cruise Shipping" (2014)	*Curr. Issues Tour.*	4.67
8.	Mali, M. et al. "Assessment and Source Identification of Pollution Risk for Touristic Ports: Heavy Metals and Polycyclic Aromatic Hydrocarbons in Sediments of 4 Marinas of the Apulia Region (Italy)" (2017)	*Mar. Pollut. Bull.*	4.50
9.	Storkersen, K.V. et al. "One Size Fits All? Safety Management Regulation of Ship Accidents and Personal Injuries" (2017)	*J. Risk. Res.*	4.00
10.	Vazques, R.M. M. et al. "Analysis and Trends of Global Research on Nautical, Maritime and Marine Tourism" (2021)	*J. Mar. Sci. Eng.*	4.00

The information within table 5 reveals the top 10 most impactful articles pivotal for identifying the future research directions regarding where the topic of strategic planning for maritime passenger transport is heading and how it is evolving. A thorough discussion of the entirety of the 17 most impactful articles is outlined in the upcoming section in order to address the main future research directions.

3 Future Research Directions and Discussion

The selected 17 articles representing a sample size of the top 22.6% most frequently cited articles on the basis of the TGCS/t ≥ 2 exclusion criteria are subjected to the VOSviewer bibliographic software program via keyword co-occurrence analysis matrix. VOSviewer enables the researcher to evaluate the strength of the co-occurrence relationship between article keywords by combining the graph-based and distance-based approach. This constructs a map in which the graph-based approach represents the lines between the items to indicate relations, whereas the distance-based approach represents the distance between items to reflect the strength of the relation between the items (Jan van Eck, Waltman 2010). Figure 2 represents a graphical depiction of the co-occurrence relationships between the keywords of the selected 17 articles in order to indicate the future research directions on the topic of strategic planning for maritime passenger transport.

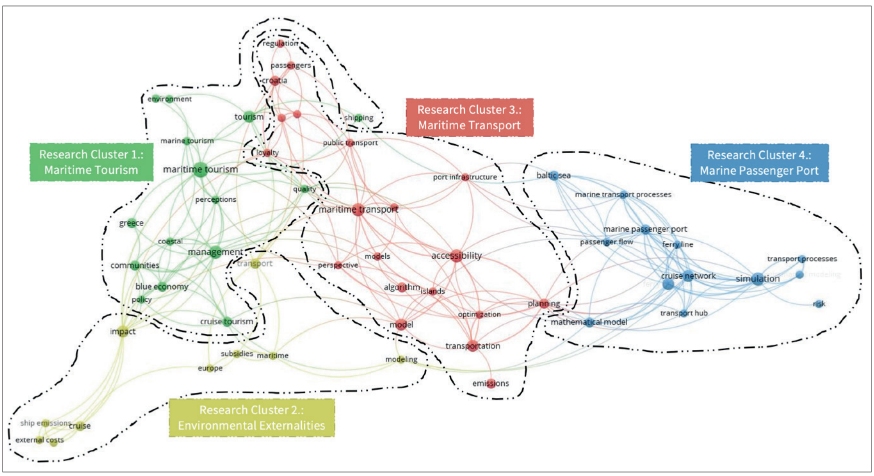


Figure 2 Keyword co-occurrence map regarding the future research directions on the topic of strategic planning for maritime passenger transport. Source: graphically arranged by the Author

The examination of figure 2 reveals that co-occurrence linkages are depicted by the lines connecting the nodes. The node size and the colour reflect the influence and distinction of the articles on the basis of total global citation scores received. This creates the condition to conduct a guided content analysis, which is a critical review of each article's title, author, journal, research question(s), theory, data sources, variables, category and key findings (Bahoo, Alon, Paltrinieri 2020). The combination of the keyword co-occurrence map and the guided content analysis resulted in the identification and clustering of four distinct but interrelated future research directions on the topic of strategic planning for maritime passenger transport: 1) maritime tourism, 2) environmental externalities, 3) maritime transport, and 4) marine passenger ports.

3.1 Maritime Tourism

Tourism is highly perceived in policy creation regarding its function in fostering economic growth via employment generation and its potential in valorising natural and cultural assets. Gedik and Mugan-Ertugal (2019) state that sustainable tourism development is not feasible without considering the contemporary challenge of improving resource management in maritime and coastal areas. Their main contribution is prominent in showcasing constructive guidelines regarding the individual and economic agent approaches in interaction with the physical environment regarding the mitigation of unplanned tourist enterprises in coastal areas, waste/refuse problems, and marine vehicle effects on the coastal and marine ecosystems. Mali et al. (2017) centre their research on the maritime tourism segment and its close relationship with the physical environment in natural and anthropogenic interactions on a more detailed level. They determined the concentration levels of 10 metals, 16 PAH congeners, and main nutrients regarding pollution risk in four representative touristic ports of the Apulia region in Italy. Effects range-median quotient assessed the hazard degree while the principal component analysis indicating anomalous pollution trend.

3.2 Environmental Externalities

Environmental externalities are the economic result of unaccounted environmental impacts of production and consumption that affect enterprise cost and consumer utility outside the market mechanism. Carreño and Lloret (2021) address and rate the environmental impacts of passenger ships in Mediterranean coastal regions by their classification in different categories following a risk assessment matrix. High impacts include anchoring impacts on seagrass meadows, toxic antifouling products, motor noise disturbance, and transport of exotic species. Moderate impacts include air pollution, oil leaks, fuel leaks, and grey water discharge. Low impacts include black water discharge, marine litter, sediment resuspension, animal feeding, and artificial light emissions. Menegon et al. (2018) examine the cumulative effects, maritime conflicts and ecosystem services threats by utilisation of MSP-oriented geospatial webtools in the Northern Adriatic Sea. They apply cumulative effects assessment and maritime use conflict webtools to conduct a marine ecosystem service threat analysis. Their main research findings indicate that the anthropogenic activities of ports, fisheries, coastal and maritime tourism, and maritime shipping require the most effort in regional planning and resource management in order to preserve marine biodiversity.

3.3 Maritime Transport

Maritime passenger transport consists of a transportation mode encompassing the relationship between tourism aspects and marine-based travels. It indicates the role of passenger ships in the provision of sea crossings for tourist travel and where the maritime context is the focus of the tourist experience. Bowen, Fidgeon and Page (2014) highlight maritime terrorism as a neglected area of research in maritime tourism, specifically the utilisation of scenario planning to comprehend and assess potential threats to the cruise industry. They advance the notion that even though the fact of safety and security being the hallmark of cruising in the maritime passenger transport segment, cruise shipping companies are obliged to improve further safety and security aspects due to passenger resignation to the fact that risk is associated with maritime travel in the twenty-first century. Storkersen, Antonsen and Kongsvik (2014) address safety management regulation as an essential supplement to market forces to establish a sufficient safety level in high-risk industries such as the short sea shipping sector. They examine the peculiar fact of personal injuries experiencing a decrease while ship accidents experiencing an increase in occurrence in the period during which safety management regulation was implemented. The semi-structured interview of key maritime passenger transport stakeholders concluded that the negative consequences of regulation, such as proceduralisation, specifically influence the performance of safety-critical tasks, such as navigation in fairway channels and coastal areas. Thus, ship accidents have continued to increase regardless of the regulations aimed at improving safety.

3.4 Marine Passenger Port

Modern passenger seaports are value-adding nodes in global passenger flows networks characterised by preeminent maritime attributes and a functional and spatial clustering of port-related activities. Contemporary notions of seaport governance and management demand sustainable transitions in the seaport sector in terms of defining strategies and activities the seaport must undertake to meet the current and future needs of passengers while at the same time preserving human and natural resources. This is mainly prevalent in air pollution from ships in seaports due to the ships' direct effect on the human population and the built environment in many urbanised ports. Tzannatos (2010) applies an in-port ship activity-based emissions calculation methodology for manoeuvring and berthing coastal passenger ships and cruise ships calling at the passenger port of Piraeus. Research findings estimate that between 2008 and 2009 overall ship emissions in the Port of Piraeus reached 2,600 tons annually with evaluated externalities of €51 million. Further segmentation analysis reveals that coastal passenger shipping exceeds cruise shipping in terms of associated externalities share. Vaggelas and Pallis (2010) provide important insights on the ongoing sustainable transformation of passenger ports regarding the modern port product and the optimum interface of the public and private sector in the port industry. They employ a literature review and brainstorming sessions with experts along with the application of a modified Analytical Hierarchical Process in the 20 major European passenger ports. The research results provide a useful tool for formatting port policies in two sustainable pathways: 1) ex-post cost recovery "long-run marginal costs" pricing method, and 2) ex-ante "full distributed costs" method that stems from the share of the service output in the total output of the passenger ports.

4 Conclusion

The bibliometric analysis statistical research methodology is conducted to identify the origins of the topic of strategic planning for maritime passenger transport and to address its future research directions. The critical examination of the selected 75 articles from the ISI WoS database is performed on the basis of the key bibliometric terms of Total Local Citation Score (TLCS), Total Global Citation Score (TGCS) and Average Total Global Citation Score (TGCS/t). The maturity of the topic of strategic planning for maritime passenger transport is assessed via impact ranking of academic institutions, scientific journals, and articles. According to the TGCS, the University of Piraeus (Greece) is the most prestigious academic institution; Atmospheric Environment (Netherlands) is the most prominent scientific journal; and the most impactful article is from Tzannatos (2010). TGCS/t revealed four future research streams regarding the evolution of the topic of strategic planning for maritime passenger transport: 1) maritime tourism, 2) environmental externalities, 3) maritime transport, and 4) marine passenger port. TLCS indicated low levels of researcher collaboration along with research direction fragmentation. This further strengthens the claim that maritime passenger transport is an under-researched segment of the maritime industry within the academic community. Thus, future research on the topic should focus on researcher collaboration via the convergence of the four future research streams.

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EUSAIR, Cross-Border Initiatives Strengthening the Connectivity of the Region
An Interview with Pierluigi Coppola

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Abstract This short interview with Mr. Pierluigi Coppola, the Italian Coordinator of the Pillar 2 of EUSAIR, provides an overview of the upcoming joint priority efforts to be developed for a sustainable transport planning in the area. The discussion framework focuses on cross-border maritime transport through 5 questions conceived in parallel with the ongoing implementation of the MIMOSA Project.

Keywords EUSAIR. Maritime transport. Cross-border transport and mobility. European Territorial Cooperation. Transport policies and planning.

Discussion Framework

This interview with Mr Pierluigi Coppola[1] is an insight conceived in parallel with the ongoing implementation of the MIMOSA strategic project, financed by the Interreg V-A CBC Italy-Croatia 2014-20.

1 Pierluigi Coppola is the Italian Coordinator for the Pillar 2 (*Connecting the Region*) of the EUSAIR (Adriatic-Ionian) macro-regional strategy and coordinates the Thematic Steering Committee no. 2, together with colleagues from Serbia and North Macedonia.

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The project is focused on maritime and multimodal sustainable passenger transport solutions and services, involving 17 partners and several associated institutions from the whole Programme Area. It thus jointly tackles the common challenge of increasing multimodality and reducing the impact of transport on the environment.

The goal of the conversation is to identify some relevant links bridging between the specificity of cross-border transport topics (e.g., bottlenecks, missing links, etc.) and the working framework on mobility and transport currently faced within Pillar 2 of EUSAIR.

Interview

[QUESTION] Mr Coppola, the official launch of the EUSAIR Strategy took place in 2014 and the focus of Pillar 2 *Connecting the Region* concentrates efforts and initiatives on mobility and the transport system between the Member States and the non-EU countries included in the Adriatic-Ionian region (e.g., the Western Balkans). Eight years after its launch, what is your overall assessment of the Pillar 2 initiatives?

[ANSWER] The EUSAIR Action Plan [SWD(2014)191 final] is focused on two priorities (Priority Actions): 1) the maritime transport dimension in the macro-region; 2) the inter-modal connections between ports and railways, particularly for freight transport. The implementation of the Strategy has led to the identification of projects of macro-regional relevance with a specific focus on implementing technological and digital solutions for improving connections between ports in the Adriatic and Ionian Seas, and for better connections sea-to-land (and vice versa), i.e., links between port and the rail networks.

This concept has been described and fully transferred into a specific chapter (on inter-modality) of the EUSAIR Transport Masterplan for the Adriatic-Ionian region which is – together with the identification of projects of macro-regional relevance (i.e., EUSAIR-'labelled') – one of the main lines of action we are working on. Within the EUSAIR Masterplan – which is still in progress – the ongoing projects included in the national transport plans of each single Countries (such as, in the Italian case, the PNRR ones) were examined;[2] besides, the needs for the implementation of a transnational transportation network in the macro-region have been identified in light of the opportunities of the TEN-T extension to South-East Europe.

2 PNNR, *Piano Nazionale di Ripresa e Resilienza*, i.e., the Italian National Recovery and Resilience Plan (https://www.mef.gov.it/en/focus/The-National-Recovery-and-Resilience-Plan-NRRP/).

The EUSAIR Action Plan is now being revised also based on the analysis and the results of the Interreg projects on transport, such as the MIMOSA Project (that got the EUSAIR label in 2020) and other projects within the European Territorial Cooperation (ETC) Programmes that are supporting the main objectives of the Strategy. More specifically, we are going to propose some additional targeted topics such as urban transport and connections between the major cities of the macro-region.

[Q] If we switch the focus to the cross-border dimension and to the several EU cross-border funding programmes insisting in the EUSAIR area (e.g., Italy-Croatia, Slovenia-Croatia, Italy-Greece, etc.), what is the relevance of the cross-border issue within the EUSAIR Strategy and how do you evaluate the achievements in mobility and transport, both in terms of concrete results and as for their integration within the same macro-regional strategy?

[A] Concerning the cross-border dimension, TSG2 of EUSAIR mainly worked on freight transport, where relevant issues emerged in terms of crossing time through internal and external borders of the Adriatic-Ionian macro-region. In fact, the procedure needed for the customs clearance of goods still represents a bottleneck, especially between EU Member States and non-EU countries.

In this sense, during the COVID-19 emergency, an EC-tailored initiative was developed and revealed as a best practice to be capitalised also beyond the emergency: we're talking about the use of the so-called 'green lanes' (EC, DG for Mobility and Transport 2020), which have proven their effectiveness, allowing more efficient border crossings. There are also European Territorial Cooperation projects presenting interesting results achieved and successful pilot actions: as an example, we can mention ADRIPASS (Interreg ADRION 2014-20) aiming at integrating multimodal connections in the Adriatic-Ionian region that has tested how cross-border freight transport procedures can be optimised through the development of technological platforms.

Other ETC-funded projects have demonstrated strong potential in capitalising and transferring best practices to enrich the supply of transport services in the Region also for passenger transport.

From my point of view, cross-border connections could benefit from the creation of new rail passenger services – see, for instance, the CROSSMOBY Project (Interreg V-A Italy Slovenia 2014-20) between Italy and Slovenia – and from the improvement of the existing maritime connections between the two shores of the Adriatic Sea.

Further analysis ought to identify the potential markets for new passenger services, overcoming the geographic difficulties and bureaucratic barriers in order to increase cross-border rail and maritime connectivity. The contribution of ETC projects, such as MI-

MOSA, is essential in proving successful pilot experimentations and demonstrating innovative solutions, producing context and market analyses, up to feasibility studies.

[Q] The thematic steering group 2 (TSG 2) is working on the EUSAIR transport masterplan. Could you give us some insight into the topics of the work-in-progress and the future enhancements planned both within the master plan and in the EUSAIR Strategy/Action Plan as a whole?

[A] The environmental sustainability of transport in the Adriatic-Ionian region is one of our priorities, together with cohesion and accessibility to internal areas. This is definitely a priority provided that in some countries physical infrastructure and links are completely missing. Connectivity is a need not only for transport of goods (e.g., new maritime services between ports) but also for improving passenger mobility and boosting some economic sectors (e.g. tourism). We need to bridge up the territorial gaps in road safety standards, cross-border control procedures and, last but not least, the need to update the railway network, having a significant impact on the whole multi-modal transport system.

The importance of a transport masterplan for the Adriatic-Ionian macro-region is proved by the need of coping with the disparities in the transport systems of Member States and non-EU states, and by the specific actions needed to achieve the targets of the new TEN-T corridors in the area.

Besides, it would be important to strongly support the introduction of the EU instrument of Sustainable Urban Mobility Plans (SUMP) [EC COM(2013)913 final], considering positive results it is producing at European level. Developing urban nodes in a EUSAIR perspective, considering the presence of many ports and the relevant maritime dimension, means developing and shaping the concept of 'city ports', firmly linked to the paradigm of sustainable mobility. In fact, ports included in urban contexts, inevitably contributes with an additional and relevant pollution burden for the city (e.g., ships stationing at dock) and at the same time generates negative externalities, such as crossing traffic and the consequent congestion problems. Thus, it is necessary to safeguard both the port as a city asset for income and economic development, on the one hand, and the environmental sustainability of ports and maritime related activities, on the other hand. Considering this framework, 'city-ports' could be considered as a perspective for change. This topic would be also proposed by TSG-2 in the review process of the EUSAIR Action Plan.

[Q] In order to make transport in maritime and coastal areas more efficient and sustainable, cross-border planning models must be considered. What do you think is the most effective governance model in cross-border maritime transport planning?

[A] The issue of governance certainly represents a key point both in relation to the topic of transport planning and management in the macro-region and more generally in the overall EUSAIR strategy implementation. Being part of the EUSAIR governing board as Pillar Coordinator, I was able to participate in the implementation of the 'multi-level governance' model related to day-by-day process management of the strategy and the action plan within a complex institutional context, such as the Adriatic-Ionian macro-region, achieving some good results despite the fact that EUSAIR has not any direct funds to manage. This is the case of the so-called 'embedding' process, i.e., the introduction of some priority line of action in the ETC and mainstream programmes, and other initiatives to foster the dialogue with other stakeholders (e.g., financial institutions, the chamber of commerce etc.) in the Region.

[Q] To conclude, when considering transport priorities, within the EUSAIR perspective, which ones do you consider crucial and still to be tackled or that need further efforts to be developed?

[A] Surely, it should be kept in mind that the work of EUSAIR has been conditioned, like any other process and activity, by the two years of global pandemic emergency. Despite the difficulties, the development of the strategy and action plan, including TSG-2 activities, has move ahead. In the future, the work done on the two priorities identified from the outset, a) maritime transport (new services and synergies) and b) the development of intermodal systems and solutions able to connect even the most inland regions, has to be continued. This should be matched in parallel by a process of harmonisation and optimisation on a macro-regional scale, involving all countries, also through compensation measures aimed at bridging some territorial gaps, as not to leave anyone behind.

It is at the same time essential to identify new priorities and focuses, both in terms of freight and passenger mobility, within the current revision process of the EUSAIR Action Plan in order to give greater strength to the strategy implementation and outreach (e.g., city ports, connection with TEN-T networks, implementation of SUMP on a macro-regional scale, management and sustainability of tourist flows, etc.).

Moreover, considering the launch and recent activation of the new European 2021-27 programming period by the EC, a new boost should be given both to the synergy/coordination between the EUSAIR Strategy and the Interreg ADRION programme, and to the processes of capitalisation of the most interesting results emerging from the implementation of identified project initiatives financed by European Territorial Cooperation and other mainstream programmes in the field of mobility and transport.

Finally, the Transport Masterplan for the Adriatic-Ionian region is certainly a crucial working tool and represents a key element for the TSG-2 initiatives. It should be implemented in the subsequent development phases and it should be able of incorporating updates and new policy guidelines, and it must be shared as much as possible by all the macro-region's players. This is even more possible if the stakeholder engagement process – involving, in the last years, many transport operators, mobility experts, local and regional administrators, enterprises and public institutions from all countries – will be continued and further strengthened.

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