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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.

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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 indepth 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.

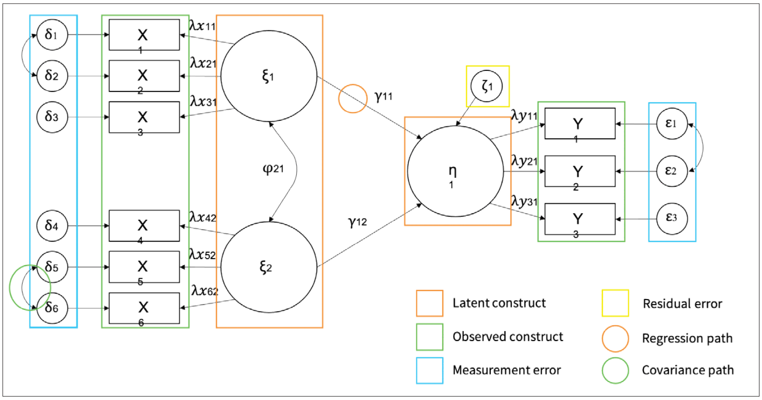

Figure 1 Example of Structural Equation Model. Source: graphically rearranged from Williams et al. 2009; Thakkar 2020

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.

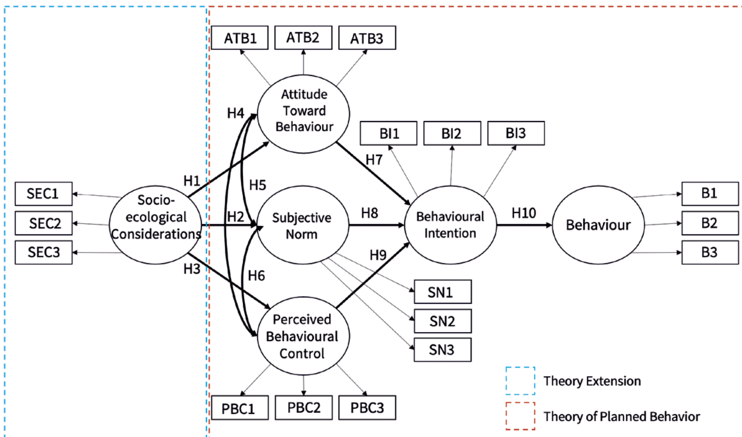

Figure 2 Example of Structural Equation Model regarding the extension of the Theory of Planned Behaviour with the theoretical construct of socio-ecological considerations. Source: Graphically rearranged from Williams et al. 2009; Thakkar 2020; Dunlap 2001; Paul et al. 2016

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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