



# Assessing the Potential of “Mobility as a Service” in Passenger Maritime Transport

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This article assesses the potential of Mobility as a Service in passenger maritime transport from the supply perspective by collecting and analyzing data provided by interviews to key experts in passenger transport from both industry and academia. “Mobility as a service” in passenger maritime transport (also in this article referred as “Maritime MaaS”) describes the integration of passenger maritime services with land mobility into a single mobility service delivered through a unique platform for planning, booking, ticketing, and payment. The scope of this article is to explore the potential interest of mobility service providers to develop a MaaS that has as a backbone coastal shipping at the Aegean Archipelagos, in Greece. The Maritime MaaS ecosystem with its key actors is identified, while the perceived challenges, opportunities, and benefits envisaged by the adaptation of this innovative concept from urban transport to the maritime sector are recorded. Computer-assisted interviews were performed at a panel of 17 experts representing different types of decision makers. Participants were selected according to their current industry position or their academic profile. A content analysis with the use of NVIVO was conducted, followed by a SWOT (strengths, weaknesses, opportunities, and threats) analysis based on the experts’ input, in order to assess the MaaS business environment. Results indicate that the maritime transport sector is relatively ready to adopt MaaS from a technological readiness perspective, while land transport seems to be in a lower level of technological readiness. PAYG (pay as you go) MaaS business model is preferred than a “MaaS package” model by most stakeholders. Finally, main challenges toward MaaS implementation are the discrepancies in reliability of service among different transport modes and the ferry fleet operational flexibility ceilings that are imposed by legal framework for ferry routings in Greece.

**Keywords:** passenger sea transport, short sea shipping, Aegean islands, ferries, MaaS (mobility as a service)

## THE CONCEPT OF MOBILITY AS A SERVICE

### Introduction

Many decades ago, economists have introduced the concept of personalized business services. For example, Hutchins, 1972, introduced the notion of a personalized mobility package as “the optimum mixture of rate or cost, routing, schedule, reliability, equipment features, and flexibility.” Also, more recently, marketing scholars highlighted the need that businesses should target rather on developing a “personal” relationship with their customers than only performing transactions (Gounaris, 2005;

Gummeson, 1999). Consequently, the notion of “mobility package” is timelier than ever, as further elaborated below. Latest developments in computer science provide the capability of offering personalized and integrated business services, which are able to contribute toward the previously mentioned target. This is valid in numerous business sectors, such as accommodation, transport, and entertainment industry. An interesting case is the “one stop shop” business model, but in a “modern” context, as in our days, “one stop shop” refers not to a physical place, but to an online interface (Kamargianni and Matyas, 2017). “Mobility as a service” (MaaS) is an innovation that emerged during the last years and constitutes the equivalent of a “one stop shop” in the transportation industry (Aapaoja et al., 2017). MaaS aspires to bring together planning and payment for various components of an intermodal trip, through one electronic user interface. Various definitions of MaaS have already been given by researchers and institutions, for instance, by Hietanen (2014), Atkins (2015), Ghanbari et al. (2015), (MaaS Alliance, 2017). A review of those definitions is available in the works of Sochor et al. (2018) and Jittrapirom et al., (2017). The definition that will be used in this article when we refer to MaaS is the one provided by Kamargianni et al. (2016), according to which:

“Mobility as a service is a user-centric, intelligent mobility distribution model in which all mobility service providers’ offerings are aggregated by a sole mobility operator and supplied to users through a single digital platform.”

## Value Proposition

Although relatively new, there is already a growing body of literature covering various aspects of MaaS. The majority of MaaS literature focuses on assessing user’s attitudes (Ho et al., 2019; Matyas, 2020; Alonso-González et al., 2020; Fioreze et al., 2019; Tsouros et al., 2021), willingness to adopt (Hensher et al., 2021; Caiati et al., 2019; Hörcher and Graham, 2020; Fioreze et al., 2019), and willingness to pay (Polydoropoulou et al., 2020a; Liljamo et al., 2020) for MaaS, whereas several studies concentrate on developing and assessing MaaS business models (Polydoropoulou et al., 2020b; Eckhardt et al., 2018; Aapaoja et al., 2017) and mobility service bundles (Sarasini et al., 2017; Aapaoja et al., 2017; Wong and Hensher, 2020; Reck et al., 2020; Polydoropoulou et al., 2020b), as well as policy aspects (Pagoni et al., 2021; Sakai, 2019; Jittrapirom et al., 2020; Jittrapirom et al., 2018; Li and Voegelé, 2017). Most of the above literature has considered MaaS in an urban environment including only land transport alternatives.

Being an innovation in the way transport services are delivered, and not a new means of transport (Kamargianni et al., 2016), MaaS is highly dependent on the characteristics of the existing transport industry. However, transportation industry’s internal and external characteristics alternate significantly among different spatial scales and geographical areas (Merkert et al., 2020). Thus, the research questions of the abovementioned studies need to be extended to investigate the potential of MaaS in intercity and non-land passenger transportation. The ambition of this article is to cover partially this research gap through assessing the potential of MaaS for

maritime transport. We will argue for this need in the next paragraphs.

At first, it is important to highlight that in general, urban public transport (which, according to Polydoropoulou et al., 2020b, and Hensher et al., 2021, acts as the main transport supplier within MaaS schemes) is typically a non-profitable business in most cities of the world, with a very small number of exemptions. For instance, in Germany, public transit companies recover approximately 76% to 78% of their costs only (Schönberg et al., 2019). As a result, any attempt to innovate toward customer-centric services requires subsidies (Hensher et al., 2021). On the other hand, in the Aegean Archipelago, only a small percentage of the routes are running as subsidized Public Service Obligation routings. Hence, most of the ferry activity is—in the long run—a profitable business that is not subsidized by state funds.

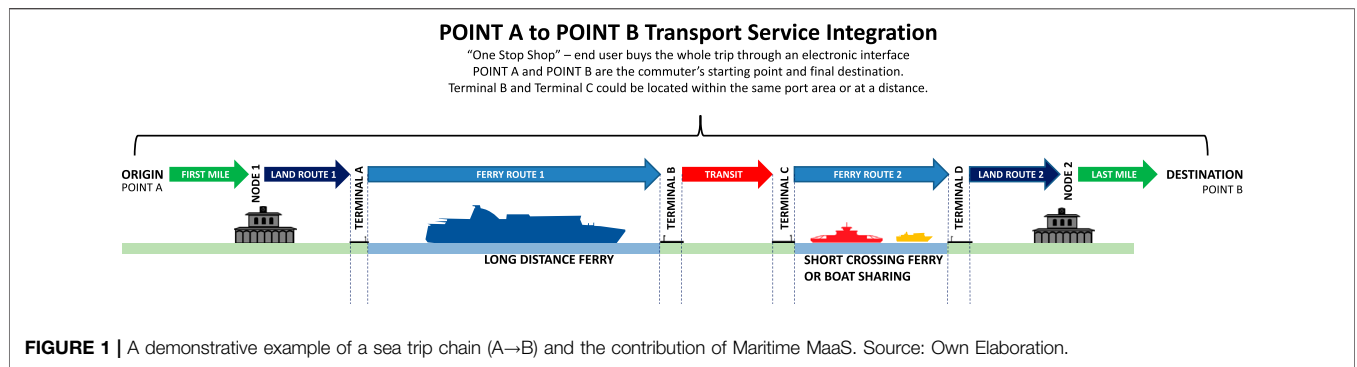
In addition, urban transportation systems are usually run by state-owned companies, while intercity transport (and ferries) is mostly (or even solely) run by private entities (Merkert et al., 2020). Thus, pricing for urban transportation is not flexible in general, while ferries (and airlines as well) adopt flexible pricing schemes based on modern revenue-management techniques. With the advent of electrification, automation and process digitalization transportation is becoming a high-technological-opportunity industry, where profitability highly promotes innovation (Audretsch, 1995). These principles easily apply to MaaS and more specifically MaaS in the ferry industry.

Furthermore, in the urban context, mobility is largely based on transport mode ownership. Hence, according to Wong and Hensher (2021), Gaudó Labarta (2017), MaaS aspires to transform the existing “asset ownership” model to a “subscription-based” mobility model. However, when referring to sea passenger transportation, very few people own a vehicle (i.e., a ship/catamaran/yacht etc). Consequently, for sea trips, the main objective of MaaS is to fill the need for an integrated system that enables different transport solutions together and consolidates trip planning and ticketing for every part of the total trip. This need is also highlighted in the work of Cruz and Sarmiento (2020).

Finally, the operational characteristics of transport among different spatial scales alternate. In the urban context, transport modes operate in much greater frequencies (i.e., number of services per time) than in intercity, airborne, or sea ferry transportation (Merkert et al., 2020; Eckhardt et al., 2018). This imposes challenges to a MaaS operator, as this entity needs to bring together modes that operate in very low frequencies and offer to its clients the transport solution that the customer perceives as optimal.

The abovementioned highlight the need for further investigation on MaaS for non-urban transport. To the best of our knowledge, this is one of the first studies exploring the potential of MaaS for interregional transport in island areas (connectivity between islands, as well as connectivity between islands and mainland).

The aim of this article is fourfold: (1) present the MaaS ecosystem in island areas, (2) assess the factors affecting the internal and external environment of MaaS in passenger



**FIGURE 1** | A demonstrative example of a sea trip chain (A→B) and the contribution of Maritime MaaS. Source: Own Elaboration.

shipping, (3) gain insight on the perceived benefits from MaaS implementation including coastal shipping for passengers, and (4) assess the potential roles of different actors in the MaaS maritime business model.

The remainder of this article is structured as follows: *MaaS Concept and Ecosystem in Passenger Shipping* presents the extended MaaS concept that includes passenger coastal shipping and the respective ecosystem. *Research Methodology* presents the research approach and study area characteristics, and *Results* presents the analysis of the data collected. *Conclusion and Further Research* concludes the article.

## MAAS CONCEPT AND ECOSYSTEM IN PASSENGER SHIPPING

**Figure 1** presents how MaaS can be extended to integrate coastal shipping with land transportation modes. The integration of the ferry system in a Maritime MaaS scheme will improve users' experience by offering customized, seamless, and convenient journey planning and purchasing of the required tickets. Currently, a similar concept that includes urban ferries, which are essential part to the city's public transport systems, has been implemented in Finland, where Whim offers MaaS packages for the city of Helsinki including HSL (Helsinki's public transport operator) ferry services to Suomenlinna island (HSL, 2020; Whim, 2020).

The key difference between MaaS in urban and rural areas and MaaS in island regions (also in this article referred to as "Maritime MaaS") is that, because of the low frequency in which ferries operate, MaaS services should focus on demand responsive transport (DRT), in addition to transport services integration into one single transport delivery service.

**Figure 1** presents an indicative example of a total transport chain for a sea trip between an origin and a destination, which are symbolized as "Point A" and "Point B." The commuter starts from the starting point and through passing from "Node 1," which may be a central railway/bus station arrives at the ferry terminal, symbolized as "Terminal A." Then, the commuter travels through a "long distance" ferry to "Terminal B" and commutes to "Terminal C." Afterward, the commuter travels either through short distance ferry or when/if available through boat sharing/boat pooling to "Terminal D." It is important to

mention that "Terminal B" and "Terminal C" could be within the same port area (i.e., a hub port) or at a distance (for instance, at the East and West parts of a large island; such an example could be the ports of Chios and Mesta in the island of Chios). After arriving at Terminal D, the commuter travels to "Node 2," which may also be a central railway/bus station from which the last mile part of the commuter's trip begins.

To further elaborate the concept of MaaS in coastal shipping, the MaaS ecosystem needs to be described. A business ecosystem is comprised by all the actors that constitute the sector and aims to present the relationships among them. The business ecosystem of MaaS has been described by Arias-Molinares and García-Palomares (2020), Kamargianni and Matyas (2017) and Karlsson et al. (2017). The two works of Kamargianni and Matyas, 2017 and Karlsson et al. (2017) approach the business ecosystem through different layers/levels, and the clustering is performed according to the degree of immediacy between the MaaS provider (which is the key actor of MaaS) and the other actors. MaaS actors are either key stakeholders (core partners) or enablers, depending on their role toward MaaS.

**Figure 2** presents the Maritime MaaS ecosystem. As with MaaS in urban environments, the MaaS provider is the "key" entity of a MaaS scheme. The provider integrates mobility through bringing together both MaaS key actors and MaaS enablers. The role of software providers, online ticketing providers, and e-payment providers is essential as they act as "integration drivers" of MaaS through providing the electronic interface needed for planning and payment integration, and support—from a technical perspective—its operation. The role of mobility providers is to provide the physical transport work through vehicles they own or lease. All the previously mentioned consist the key MaaS actors.

However, apart from the MaaS Core partners, the role of various enablers is also essential. Legal entities, which act as investors, have proven crucial for already existing MaaS schemes as many small businesses do not have the economic capability to undertake MaaS (Pagoni et al., 2021). Regulators/authorities are usually public institutions responsible for transport regulation applied in a country/region. It is important that regulators need to have a well-established culture of experimentation and continuous improvement and to be supportive to innovations (including MaaS). According to existing international experience, authorities may need to fund MaaS schemes for the MaaS benefits to be introduced, and then investors usually follow (Pagoni et al.,

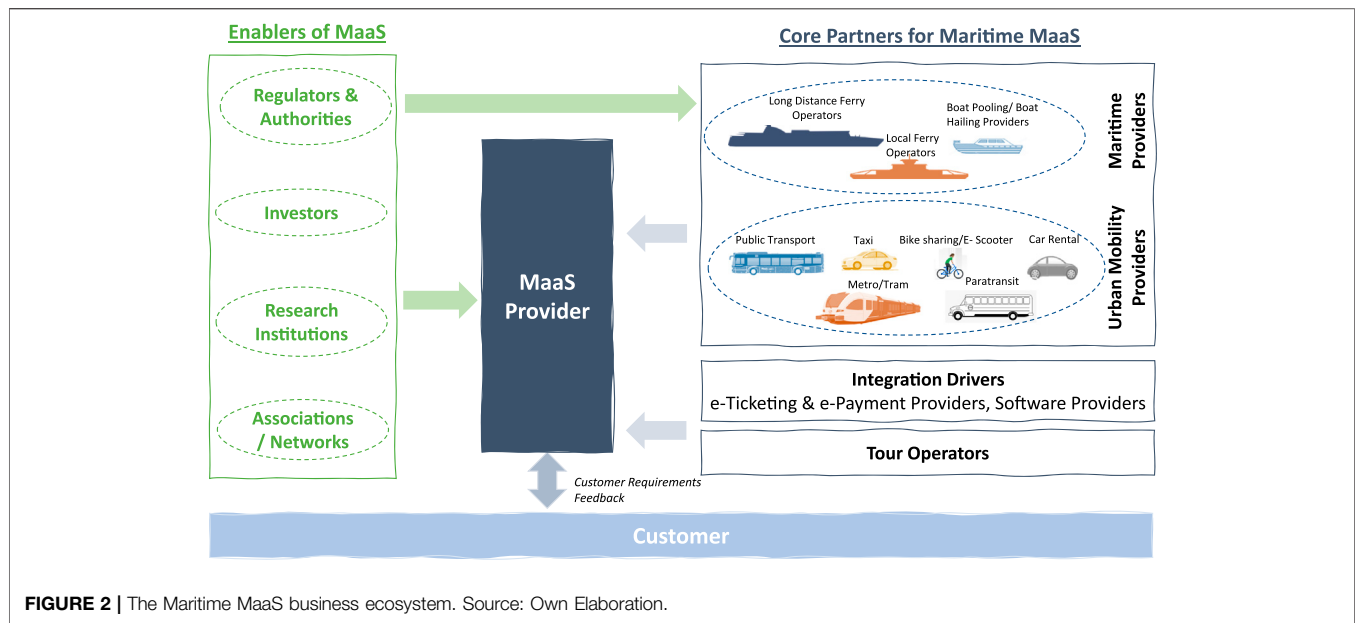


FIGURE 2 | The Maritime MaaS business ecosystem. Source: Own Elaboration.

2021). Research institutions also contribute to the MaaS development by providing research evidence and proof of concept through pilot MaaS demonstrations, as well as through the development of technical solutions that can be used from MaaS providers.

Customers (end-users) are the ones who use a MaaS application/MaaS platform to plan a trip, book, and pay for their mobility. Customers impose their requirements to the MaaS provider (e.g., constraints in budget, time, mode changes, etc.), and the MaaS provider returns feedback to the end-users subject to the input they have given (e.g., in vehicle time, waiting time, hours of departure, price, comfort, etc.) for their trip, through proposing specific alternative transport solutions. User selects the appropriate mobility solution for his/her trip (which could be a “mobility package” or pay-as-you-go [PAYG]).

It is commonly believed that Public Transport is the “backbone” of MaaS or one of the most important MaaS actors (Hensher et al., 2021, Polydoropoulou et al., 2020b; Holmberg et al., 2015). However, in the context of non-urban environments, the role of public transport appears to be limited (Eckhardt et al., 2018). In our case, the role of public transport limits only to the first and last mile. Also, one critical difference with the MaaS ecosystem presented by Karlsson et al. (2017) is the role of travel agents/tour operators. Currently, agents/tour operators organize packages for individuals, which include both transport and accommodation, and thus, they could play an active role in Maritime MaaS. Consequently, for passenger transport for long-distance trips to/from islanding areas, the MaaS ecosystem.

Thus, for passenger transport for long-distance trips to/from island areas, the MaaS ecosystem and the role of each of the entities that participate in MaaS system are not yet fully explored and subsequently constitute the focus of our research.

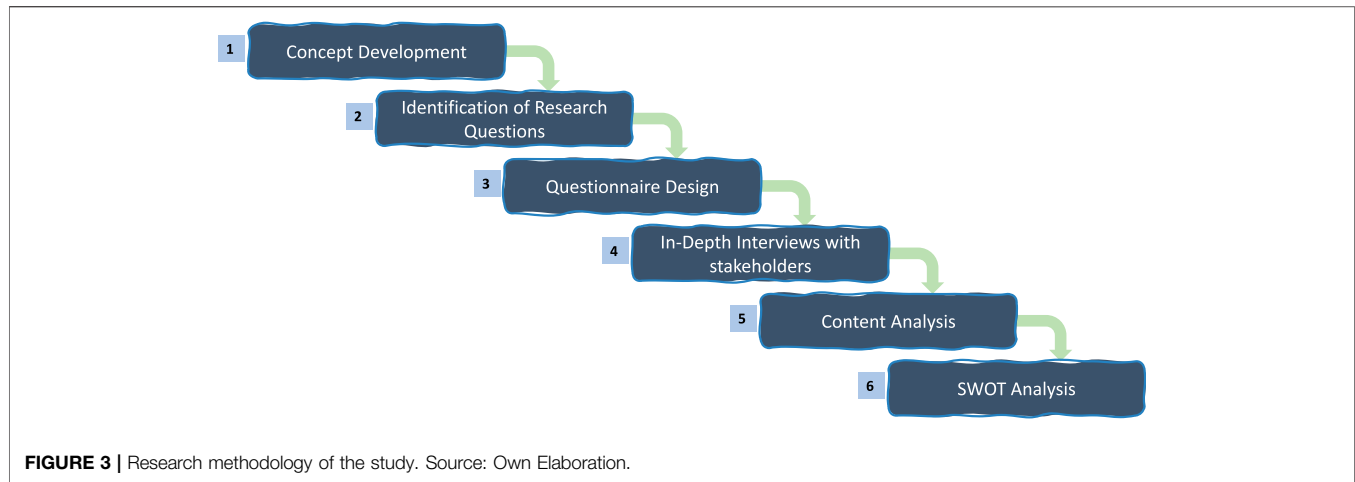
## RESEARCH METHODOLOGY

This article aims to assess how the concept of MaaS applies in passenger shipping. Maritime MaaS aspires to serve the needs of customers traveling (1) from the mainland to island destinations and *vice versa* and (2) between islands. For this purpose, our work develops a methodology for understanding the supply side of Maritime MaaS, by developing the concept; identifying the research questions; designing a questionnaire; performing in-depth interviews with key experts; conducting content analysis of results and finally performing a SWOT (strengths, weaknesses, opportunities, and threats) analysis.

The research methodology is demonstrated in the diagram of Figure 3. The main research questions posed are the following:

- What is the value created by the implementation of “mobility as a service” in passenger maritime transport?
- What is the business ecosystem structure, and which are the potential roles of different actors in the Maritime MaaS business model?

To achieve the objectives of the article, computer-assisted interviews (CAIs) with relevant stakeholders were conducted with the use of a semistructured questionnaire. Seventeen (17) key experts were interviewed during 2021. The questionnaire design included both closed-form and open-ended questions, whereas participants were encouraged to express their personal views based on their experiences and field of expertise. The interviews were recorded, given the permission of the respondents, and used later for the analysis. The participants were selected according to their current industry position or their academic profile. The sample includes 17 stakeholders: five representatives from port authorities, four representatives from shipping companies, one representative from the Greek Ferry



Maritime MaaS was performed, whereas the results were critically discussed in light of the literature.

### Study Area

Greece has a coastline length of approximately 18,000 km (Eurostat, 2009). There are within the country more than 200 inhabited islands, in which approximately 17% of the country’s total population resides, according to the Greek Population Census of 2011. A map of the study area is illustrated in **Figure 4**:

### Status Quo of Maritime Transport in the Study Area

It is estimated that the contribution of passenger shipping in the country’s total GDP (gross domestic product), considering also the indirect positive effects of short sea shipping on trade and economy, scales up to 7.4% for the year 2019 (Foundation for Economic and Industrial Research, 2020). It is also estimated that during 2019, approximately 19 million passengers used the ferry services within Greece.

Currently, commuters from or to islands need to use numerous tools for booking and ticket purchasing for each trip they need to conduct between an island and the mainland. Most of the available trip-planning tools focus on only one part of the trip (e.g., the first mile, the sea part, or the last mile) and do not offer integrated mobility to the client. In addition, there is also inconsistency in the payment means of operators, as most land transport operators accept cash only, whereas only few accept credit/debit cards.

The role of travel agents in the seaborne part of the route is vital in Greece, as most people still book and purchase their tickets through travel agents. E-purchase of tickets and e-check-in became available recently (as a COVID measure). Travel agents who participated in the interviews denoted that usually they receive a commission of approximately 5% to 8% of the nominal ticket price. The commission that travel agents receive is the outcome of negotiations between ferry operators and agents, as usually agencies have great market power as they

Operators Association, one representative from public transport authorities, two representatives from academia, one representative from rail operators, one representative from car rental companies, and two representatives from travel agencies. It is worth noting that most of the participants have more than 10 years of relevant work experience in their field.

After receiving the insights from the interviews, several knowledge analysis methods were considered, and the “content analysis” was selected as the most appropriate. Content analysis in general can be performed either manually or by the assistance of Computer-Aided Textual Analysis tools, which typically deploy Artificial Intelligence and/or Natural Language Processing to perform text-based classifications (Brunzel, 2021). In our work, based on the insights from the interviews, a content analysis with NVIVO followed by a SWOT analysis of



**TABLE 1** | Characteristics of the Sample.

Organization type	Position	No. of respondents	Years of experience
Ferry operators	CEO	3	>20
	Chief sales officer	1	>20
	Ferry operators association	1	>20
Port authorities	Member of executive board	4	>20
	CEO	1	>10
Public transport authorities	Planner	1	>10
Railway operator	Planner	1	<10
Travel agents	Agent	2	<10
Car rental providers	CEO	1	>10
Academia	Professor	1	>20
	Dr. research affiliate	1	>10

affect commuters' decisions through promoting to them the transport solution from which they can receive the highest commission.

## RESULTS

This section presents the analysis of the data collected by the stakeholders. The content analysis was conducted with the use of NVIVO software. **Table 1** presents the characteristics of the sample.

### Perceptions About MaaS

Most of the respondents, infrastructure administrators and transport operators, denoted that MaaS is an evolvement that is certain to happen and, furthermore, that it will occur soon. Ferry operators perceive Maritime MaaS as “the creation of an online interface easily accessible to end-users that will facilitate holistic planning and payment.” More specifically, MaaS is proposed by ferry operators as an innovation that should:

- Offer to end-users (through coordination of numerous services which now operate as “selfish routings”) travel solutions, which now are not available. According to the interviews, MaaS is useful for holistic planning in Greek islands by combining air, land, and ferry trips.
- Offer to end-users the convenience of planning and paying only one time for all the components of their trips.

According to both the railway operators and ferry operators, there is currently a package with MaaS characteristics offered to specific groups of customers such as foreign tourists (Blue Star Ferries, 2021). Both believe that this initial MaaS product should be further developed (including integration with other land and sea transport modes). A good example provided by these stakeholders is “Rome to Rio” site (<https://www.rome2rio.com/>), which offers the capability of ticket booking with several transport modes, without, however, offering ticket integration (i.e., one ticket and boarding pass for all the components of the trip). Finally, car rental operators denoted that small-average sized car rental companies would

be keen to participate in a MaaS scheme as it may enhance their patronage.

An interesting case of MaaS stakeholders are the travel agents, who currently sell a large portion of the total of ferry tickets. According to the interviews, business size of travel agencies is of crucial importance for their attitudes toward MaaS. Most of the travel agents are small businesses (4–8 people) and focus their business on providing agency for ferries only. Thus, they perceive MaaS as a competitive service. They, however, mentioned in the interviews that large travel agencies could either participate in MaaS or become MaaS providers because of their market power and business size.

All industrial stakeholders (ferry, railway, public transport, and port infrastructure operators) stated that they regularly perform customer surveys to assess customers satisfaction from their services. Through these surveys, they have identified that many of their passengers would prefer, if it exists, electronic booking of tickets, instead of ticket booking through physical presence at a desk. Ferry operators also stated that “MaaS is the future, and we would like to have it not today but yesterday.” However, they differentiate their opinions on the topic of optimal business approach toward MaaS.

### Readiness for MaaS

The Greek maritime transport market is relatively ready to adopt MaaS. It seems that there is technological readiness among most of the MaaS actors. Ferry operators are ready to adopt MaaS as the key challenges that usually exist in MaaS applications at urban environments, such as unwillingness to share data and collaborate with competitors, lack of common APIs, and lack of technological infrastructure (Polydoropoulou et al., 2020c; Pagoni et al., 2021), are limited in the case of the Greek ferry market. More specifically, all ferry operators already facilitate e-booking infrastructure, whereas a common API (and two common CRS systems) is used by all of them for their bookings. Also, railway operators offer online booking and payment capability, using similar APIs.

Intercity bus operators in Greece (also widely known as “KTEL”) are not at the same level of technological readiness, as few of them offer the capability of online booking and only for specific routes (usually from/toward Athens and Thessaloniki). In addition, most of the public buses that operate in the islands do

not offer booking services (neither physically nor electronically), while ticketing is performed most of the times onboard the bus with cash, or rarely via ticketing machines where credit/debit cards can be used. Most times, the tickets purchased from bus operators in the islands are valid for a single trip and can be used at any time of departure.

Across all interviews, experts expressed their concern regarding the availability of resources (e.g., adequate human and economic assets) for the adoption of MaaS. All ferry terminal operators denoted that they do not have neither the appropriate human assets nor the economic capability for developing a MaaS on their own. The same applies also for all small-size transport operators with few employees. Thus, the role of investors is of crucial importance for the creation of a MaaS scheme (Pagoni et al., 2021). Either the larger MaaS actors in terms of business size (for instance ferry operators), or any third parties, could become investors.

The existing legal framework for coastal passenger shipping may need important modifications for MaaS to be applied. The main law for short sea shipping in Greece (law 2932/01) allows three types of ferry routing as follows:

- Yearly routing: the ferry operator may deploy a ferry at a specific route for a year which is the period between 1/11 of year  $n$  and 31/10 of year  $n+1$ .
- Fast ferry routing: the ferry operator may deploy a fast ferry (catamaran, monohull, hydrofoil, etc.) for only 5 months of a year (the peak season), of which 3 months need to be successive.
- “Extraordinary” routing: the ferry operator may deploy a ferry at a route at any time of the year if “extraordinary/unpredictable” transport demand occurs for a specific route, due to extreme circumstances.

In order to modify the departure/arrival time at ports and to add/remove routes at a specific area, an operator needs to submit a request to the “Coastal Shipping Council.” The coastal shipping council is only an advisory board, and the final decision is taken by the Minister of Shipping. However, usually the minister only validates the council’s advice. This procedure is usually time consuming and acts as an obstacle toward supply of Demand Responsive Transport, which is a key element for intercity MaaS. Also, this procedure acts as an obstacle for early opening of booking plans from ferry operators, as in some cases it may need months for a routing or route modification request to be assessed, as the “Coastal Shipping Council” usually convenes five to seven times per year. It is clear that the routing legal framework needs to become more transparent and more flexible.

Also, car rental legal framework modifications may be needed, in order to increase flexibility of car rental providers to offer short-time (<24 h) car rentals.

## MaaS Governance Model

Although governance is not a black and white dilemma, in literature there are two main governance models for MaaS, the MaaS broker and the MaaS coordinator. In the former, a MaaS broker buys capacity from the operators and then resells capacity

as part of a new bundled product to its customers, while bearing all the risks. In the latter, a MaaS coordinator undertakes the role of coordinating MaaS among the various actors that participate in the MaaS scheme. The key difference between the two MaaS governance models is the risk bearing, as in the coordinator model, the risk is distributed among the different MaaS actors (Rouboutsos et al., 2021).

Ferry operators appear to be extremely negative to the broker governance model as they are not willing to sell part of their capacity to another entity. They feel that selling capacity will make them less flexible. Flexibility is of crucial importance for ferry operators, as they often need to replace (for a short amount of time) a ship with another (either larger or smaller) according to transport demand. Also, they expressed fears that intervention from third parties to the creation of MaaS packages will be accompanied by financial claims from those third parties, which may make MaaS services expensive and unattractive to end-users. Car rental providers, on the other hand, prefer the broker model, as they feel that preselling of some capacity helps them to manage better their fixed costs associated with car operation. Also, the coordinator model should follow the price trends of each season.

A key challenge of the MaaS coordinator model is the revenue allocation among the participating entities in the MaaS scheme. The representatives from the ferry sector stated that the optimal option of revenue allocation should be the direct allocation of revenue to operators based on ticket purchases. On the other hand, car rental providers mentioned that if MaaS follows the coordination model, then car rental prices offered through MaaS should follow the price seasonality of car rental services accordingly to demand.

## MaaS Business Models

All operators that participated in the interviews are positive to participate in a MaaS scheme, depending, however, on the characteristics of such a scheme. An important consideration came from the ferry operators which stated that they want their firm’s name to be visible within MaaS (i.e., the end-user should be aware of the ferry operator who offers the service), whereas other MaaS actors do not set this as a prerequisite. Furthermore, ferry operators would like passengers to be able to use the loyalty programs they currently offer, even if the passenger has purchased his/her ticket through a MaaS platform. Finally, end-users should be also able to use the “transport equivalent” credits when they book tickets or mobility packages through MaaS. The concept of “transport equivalent” is further analyzed in the works of Lekakou et al. (2019) and Lekakou et al. (2021).

All transport service providers intend to continue offering their services in parallel with MaaS, thus competing in terms of speed, price, and comfort. Reliability and quality of services are also a critical issue. Many operators declared that “we are not willing to risk our firm’s reputation through collaborating with other operators who may be unreliable or offer services of inferior quality compared to our services.” A similar finding also has been reported at the work of Merkert et al. (2020).

An important fact is that the Greek railway network is not directly connected with the ports, and thus, passengers need to

self-transfer between the railway station (which is located usually at the city center) and the ferry terminal. This transfer may be covered by the inclusion of taxi/ride hailing/paratransit schemes in the MaaS packages. In addition, there are some routes (e.g., the Larisa-Volos line) in which there is simple railway track, and thus, infrastructure capacity limits are stricter than the general railway network. This may act as an obstacle for DRT from the railway side.

Car rental providers tend to be negative to provide car rentals with duration of less than 24 h. In general, all providers mentioned that their optimal rental duration is more than 3 days and less than 2 weeks. The issue of commission charges by a MaaS platform is crucial, as currently, ferry operators pay a 5% to 8% commission of ticket price to travel agents. If the platform requires greater commission, this will be a drawback, and ferry operators may not join the scheme.

Business models of Maritime MaaS should be customer-centric and offer mainly PAYG products as the unwillingness of ferry operators to presell capacity renders the development of Maritime MaaS packages unnecessary.

Transport operators expect that travel agents will either attempt to compete with Maritime MaaS packages by attempting to offer cheaper tickets (e.g., through receiving a lower commission rate), or they could also seek to undertake the role of the MaaS broker or coordinator. Travel agents highlighted an important detail about the broker model. According to them, a MaaS broker may adjust the MaaS package price according to demand. For instance, at time periods with low demand for specific MaaS packages, a MaaS broker could sell these packages in prices less than the prices it purchased this capacity in order to limit losses, whereas in periods with high demand, it could sell this capacity in greater prices.

Finally, according to the participants, “MaaS should be neutral in terms of business policy and should only integrate the different business policies of the operators that participate in it, and not create a new business policy.” Thus, MaaS should include and adapt to any discounts/loyalty programs available from transport operators, in addition to legally protected discounts that all operators offer (such as student or soldier discount). Finally, travel agents denoted that they could provide assistance to MaaS clients for a small commission. Personal assistance by a travel agent could be included as an extra optional service at a MaaS package, for a small extra price.

## MaaS Customers

According to the experts interviewed, there is no limitation to client groups that MaaS can target. Some of the main potential client groups, however, could be foreign tourists, permanent island residents, professionals who travel for business, or all other domestic travelers who travel for personal, educational, or tourist purposes. Consequently, focusing on a specific target group would not be a best practice. According to the interviews, “the key point for success of MaaS is the user friendliness of the whole interface and its flexibility to adapt to A) new demand trends and B) maritime transport network alternations from period to period.” In Greek coastal shipping, the network (except Public Service Obligation routes) develops from year

to year in a fully market-oriented manner based on the expected demand. Thus, ferry routings alternate according to transport demand from year to year. For instance, during the previous years, there was a significant traffic between Athens and Cyclades. However, during the last years, there is also a very large demand for the routes from Mykonos to the rest of Cyclades, which derives mostly from people who arrive to Mykonos and Santorini by plane (from mainland Greece and abroad) and then use ferry for the last part of their trip. A successful Maritime MaaS should closely monitor such market trends and adjust its offerings accordingly.

## SWOT Analysis of MaaS in Passenger Ferry Transport

SWOT analysis is a systematic qualitative consensus to assess the internal and external environment of an organization (Ghazinoory et al., 2011). “Strengths” and “weaknesses” refer to the organization’s internal environment, and “opportunities” and “threats” refer to the external environment. Therefore, a SWOT analysis for Maritime MaaS focusing on Greek passenger shipping is presented in **Figure 5**. Results of the SWOT analysis are based on the CAI that were performed and include the main points that stakeholders highlighted during the interviews.

## CONCLUSION AND FURTHER RESEARCH

As already existing academic literature mentions, MaaS is not a new mode of transport, but an organizational innovation in the way transport services are delivered. Thus, the main advantage of Maritime MaaS is that it offers to the end-users personalized services and the opportunity to design, plan, and pay for their trip in a user-centric, convenient, and holistic manner. This article explores the potential of Maritime MaaS in Greece.

The accessibility of island regions is crucial for residents, tourists and development of economic activities (Lekakou et al., 2021). As Greek islands constitute a continuously growing tourism market, Maritime MaaS could have a great potential as a tool for further development of tourism, due to the convenience it offers relative to planning and payment for traveling to, from, and between islands.

Stakeholders and decision makers discussed in detail the development of MaaS in the island areas and its implications to the existing maritime transport system. Contrary to urban environments, where MaaS is highly based on public transport, in island regions, sea transport (and air transport, when available) plays the role of the system “backbone.”

It was acknowledged by most stakeholders that island residents experience inequality with respect to their accessibility in comparison to urban and rural areas residents of Greece, as they are dependent on the frequency, quality of service, and capacity that ferry operators provide, while they usually pay a higher price per mile and travel for a longer time than land residents. This is also in accordance with the work of Lekakou et al. (2021). Our analysis indicates that MaaS in combination with the already existing “Island Transport Equivalent” measure may bring the “Just Transition”





proposed by the European Green Deal (European Commission, 2020). In the study by Eckhardt et al. (2018) MaaS is already found to (1) increase accessibility to transport for people who do not own a vehicle and (2) improve level of service in rural areas due to economies of scale/scope/network gained from the application of MaaS. Also, according to the European Green Deal, “Transport by inland waterways and short sea shipping should increase by 25% by 2030,” and mobility should become “affordable and accessible in all regions and for all passengers” (European Commission, 2020). Maritime MaaS contributes toward this direction. Thus, no islandic resident will be left behind, through the increased accessibility offered by the Maritime MaaS, integrating multiple transport modes and applying DRT solutions.

This research focuses on the supply side, through applying a qualitative research methodology to investigate the objectives of this work. However, further future research should also focus on forecasting the demand for Maritime MaaS and the users' willingness to pay for these services. It is expected that if the Maritime MaaS offers to travelers better perceived quality of service than the existing modal alternatives, it will attract many new users. Thus, the understanding and modeling of users'

behavior and needs, in the specific context of archipelago geographical areas, are essential for the success of the Maritime MaaS.

Furthermore, the assessment of a holistic interregional MaaS plan for Greece should be the ultimate objective. In addition, investigation of policy related implications of MaaS and how should local authorities and communities exploit the benefits that mobility integration may offer is a crucial topic of future research.

## DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article. The raw data analyzed in this study will be made available by contacting the corresponding author.

## AUTHOR CONTRIBUTIONS

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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