Ad Hoc Expert Meeting on Measuring Shipping Connectivity and Performance:
The Need for Statistics and Data.
Geneva, 15 May 2017

A multi criteria analysis method to measure islands' connectivity

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Outline

- Our Scope
- The Greek case, a challenge for research
- Literature review
- Methodology
- Key points and further research

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Our scope

Recognising the significance of **sea transport** for national **cohesion** and **economy** of **coastal** / **island** regions and therefore, the necessity for **measuring** its **effectiveness**,

We aim to evolve a **methodology** for the **assessment** of the level of **islands' connectivity**, in terms of **passenger ferry transportation**, based on the theory of **multi criteria analysis**

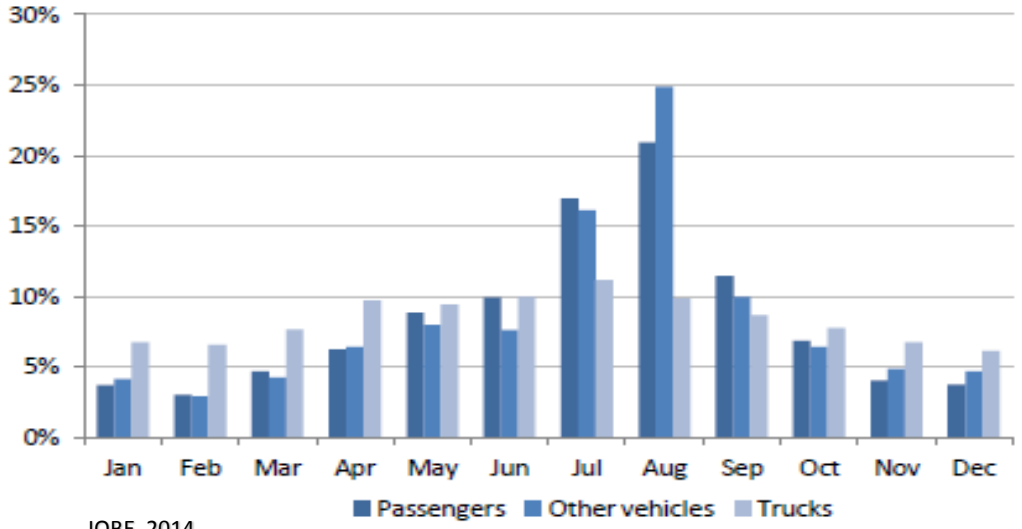
ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

The Greek case, a challenge for research

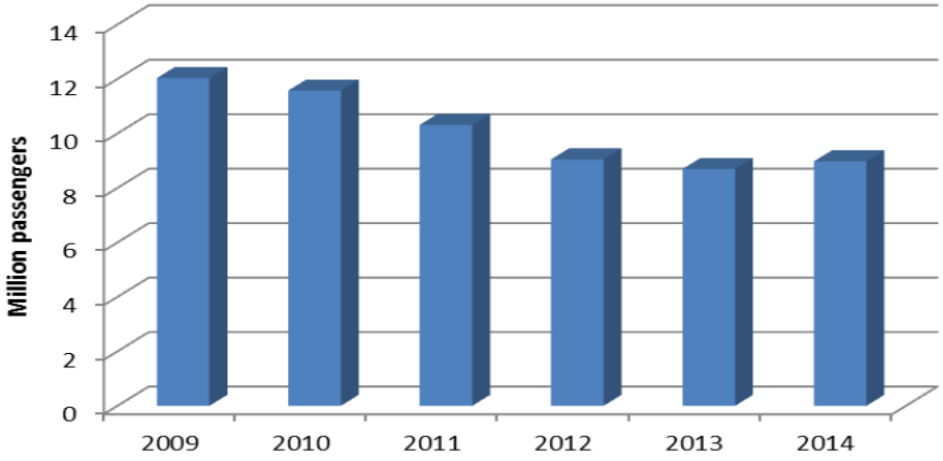
- 13,500 km of coastline
- 6,000 islands (227 inhabited)
- Complex network of 200 ports
- 1/3 of EU annual transport capacity
- Market oligopoly
- Ro-pax and Pax vessels service
- Intense seasonality

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

The Greek case, a challenge for research



IOBE, 2014



XRTC, 2015

- Many islands with low commercial interest
- Heavy State intervention (subsiding itineraries)
- Minimum itineraries' frequency criterion
- No qualitative or quantitative aspects
- Lack of open data and documentation

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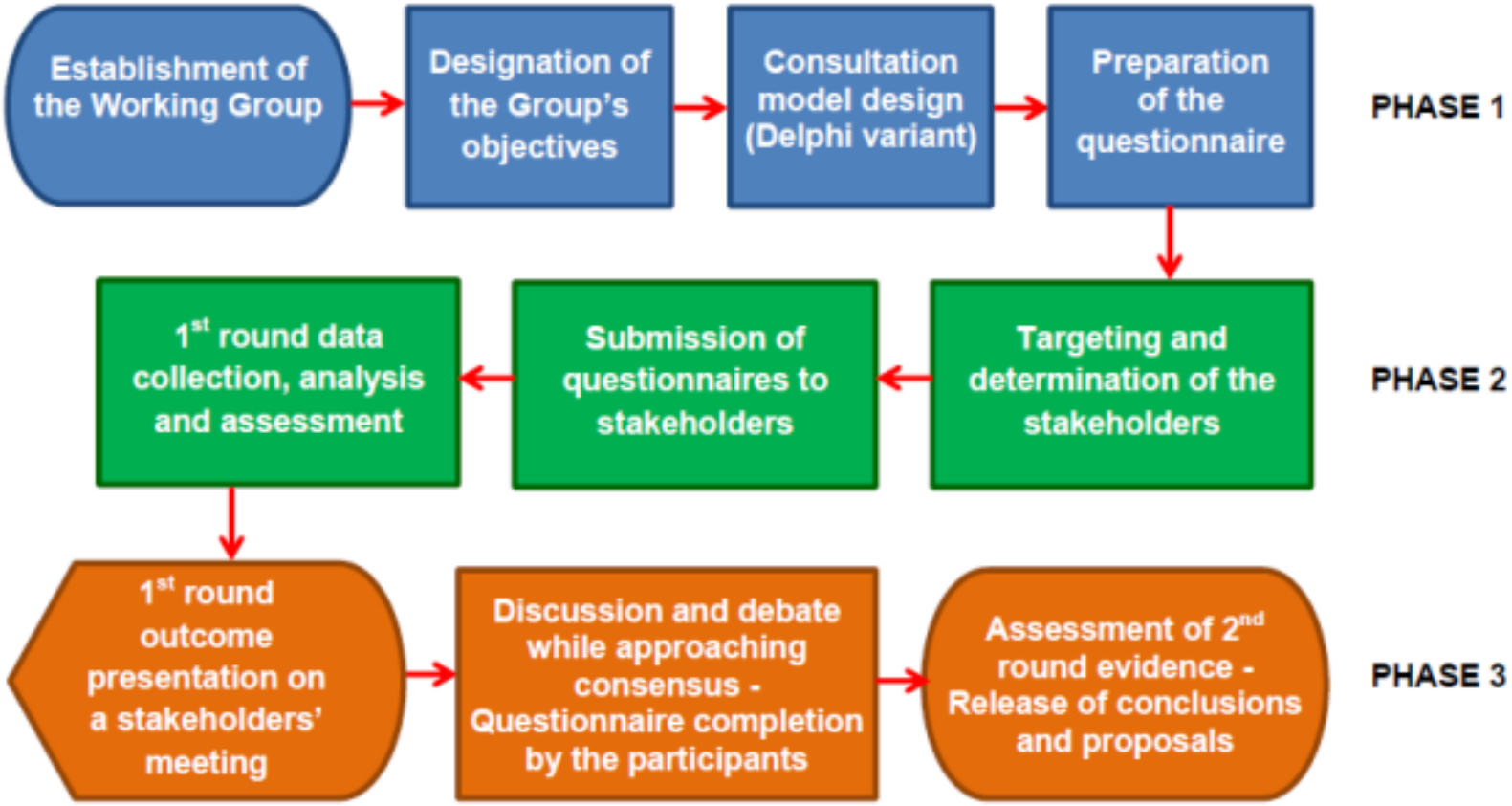
The Greek case, a challenge for research

A participatory experiment:



ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

The Greek case, a challenge for research

Some of the consultation's recommendations:

- Redesigning the **minimum islands' connection** requirements
- Implementing joint or **multi modal transport systems**
- Establishing a **"coastal shipping observatory"**
- Allocating the **annual compensation** of the subsidized lines based on a **documented methodology**
- Elaborating a **5-year horizon study for the transport system** with emphasis on maritime and air domestic transportation

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Literature review

- **Connectivity measurements**, in terms of passenger transport have extensively been applied to **aviation**
- Maritime networks' connectivity, and especially ports and cargo **liner shipping,** have been **sufficiently studied**, but **no significant attention** has been paid to island's **passenger ferry connectivity**
- **The indicators** that have already been developed are either **just qualitative or quantitative** and usually derive as a function of selected but rather limited parameters
- **The islands**, mainly due to insularity, constitute a **special case study** regarding transport accessibility

Literature review

Research gap:

The **measurement** of the relative **connectivity level** of an **island** with respect to its **transport needs**, through a documented method, taking into account the most appropriate **qualitative** and **quantitative** parameters

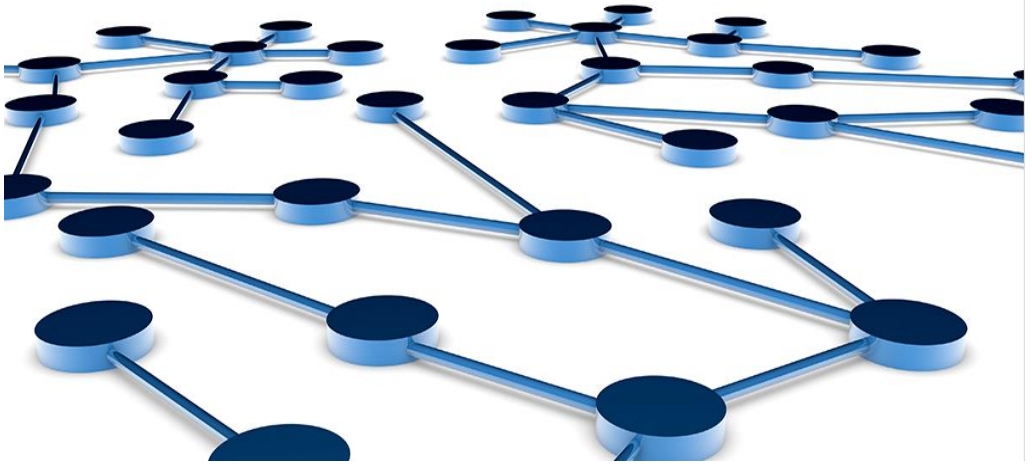
Applicability:

Except from an alternative **scientific approach**, the method might be a **decision making tool** both for the **regulators** and the **operators**

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

A definition:



Connectivity is the *availability* of transport that enables people and goods to *reach* a range of *destinations* at a *reasonable* generalized cost in an *accountable* and *accepted* way.

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

The islands' level of connectivity in terms of passenger ferry transportation may be primarily estimated according to the following main attributes:

Passenger ferry services

Islands' transport potential

Methodology

Island's Connectivity = f(quantity ; quality) =

Transport Capacity * Performance Indicator

Performance Indicator:

An additive value function for a given ranking of specific criteria / sub criteria (Analytical Hierarchic Process) on a reference set of alternatives A_R (islands), according to the UTA (UTilités Additives) multi criteria decision making methodology (Jacquet-Lagreze and Siskos, 1982)

Methodology

Passenger Ferry Services

Island's Connectivity: IC = P * u(g)

IC =[FP + APeq] * u(g) = [FP + c(g)*AP] * u(g) = FP * u(g) + AP * u(g)*c(g)

P = is the total number of the passenger transport **capacity provided through the port(s) and airport(s)** of an island

FP, is the number of the ferries' passenger capacity

AP, is the number of the airplanes' passenger capacity

Apeq, is the air (to sea) equivalent passenger capacity value

c(g)= is a transport mode conversion factor

u(g), is the qualitative additive value function (**performance indicator**) of the transport services criteria g

$$u(g)=\sum_{i=1}^{n} p_i * \sum_{j=1}^{m} p_{ij} * u_{ij}(g_{ij})$$

Island Connectivity Index: ICI =IC / IC_{max}

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

Passenger Ferry Services' index (ICI) criteria and sub criteria:

Criteria g_i	***Sub criteria g_{ij}***
FINANCIAL COST	Fare cost - Cost for accessing port - Cost for "on board" services
TIME	Trip duration - Consistency of timetables - Access time to ports
ACCESSIBILITY	Number of itineraries - Frequency of itineraries - Number of transits - Number of interconnected destinations
QUALITY OF SERVICES	Ship's accommodation - On board services - Information services - Ticket purchase facilities
SOCIAL COST	Ships' environmental performance - Ships' age - Corporate social responsibility of passenger ferries' operators

Methodology

Island's Transport Potential

Islands' Potential: IP = N * v(f)

N = is the size of the **island's population** (winter season), or
the gross sum of the **island's population plus the total available beds** in all the island's tourist accommodation establishments (summer season)

v(f), is the qualitative additive value function (performance indicator) of the transport potential of an island related to the islands' transport needs criteria f

$$v(f)= \sum_{i=1}^{n} q_i * v_i(f_i) * \sum_{j=1}^{m} q_{ij} * v_{ij}(f_{ij})$$

Island Transport Potential Index: IPI =IP / IP_{max}

Island Connectivity Adequacy Index: IPI =ICI / IPI

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

Islands' Transport Potential index (IPI) criteria and sub criteria:

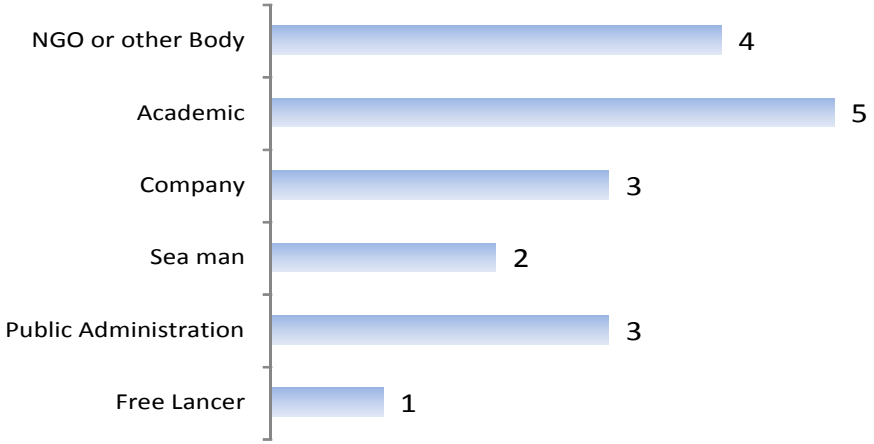
Criteria f_i	***Sub criteria f_{ij}***
DEVELOPMENT	Per capita income - (Un)employment rate - Entrepreneurship rate
TOURISTIC ATTRACTIVENESS	Interest for visiting - Availability of cultural sites, touristic areas and resorts - Multitude of cultural, athletic and touristic events and activities - Availability of hosting, catering and entertainment services
INFRASTRUCTURE	Adequacy of ports - Internal transport system - Existence of airport - Public services
LOCATION	Remoteness and isolation - National interests

ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

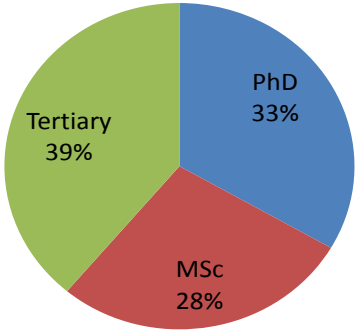
Methodology

Estimating the weights of criteria and sub criteria using AHP

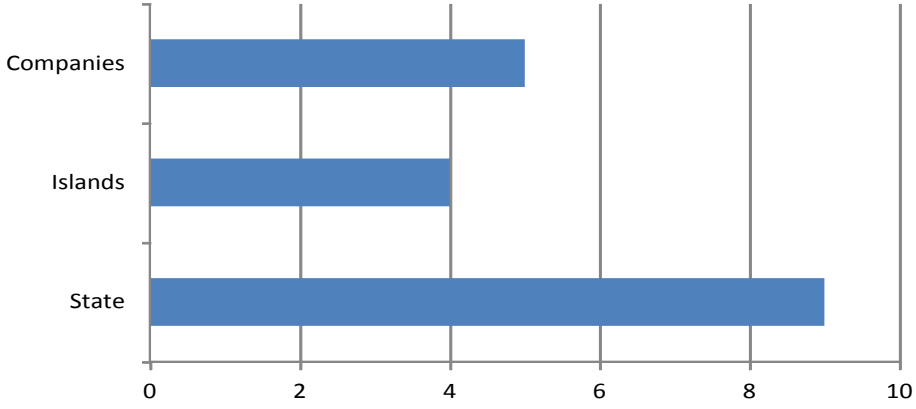
Number of stakeholders per professional qualification



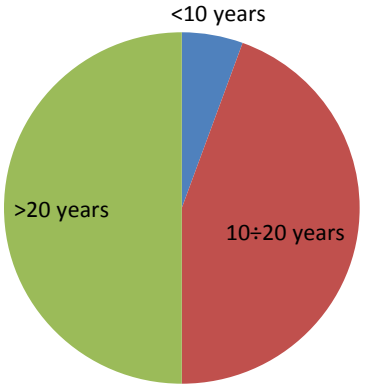
Educational attainment of stakeholders



Stakeholders' perception for the applicability of the method



Stakeholders' professional experience



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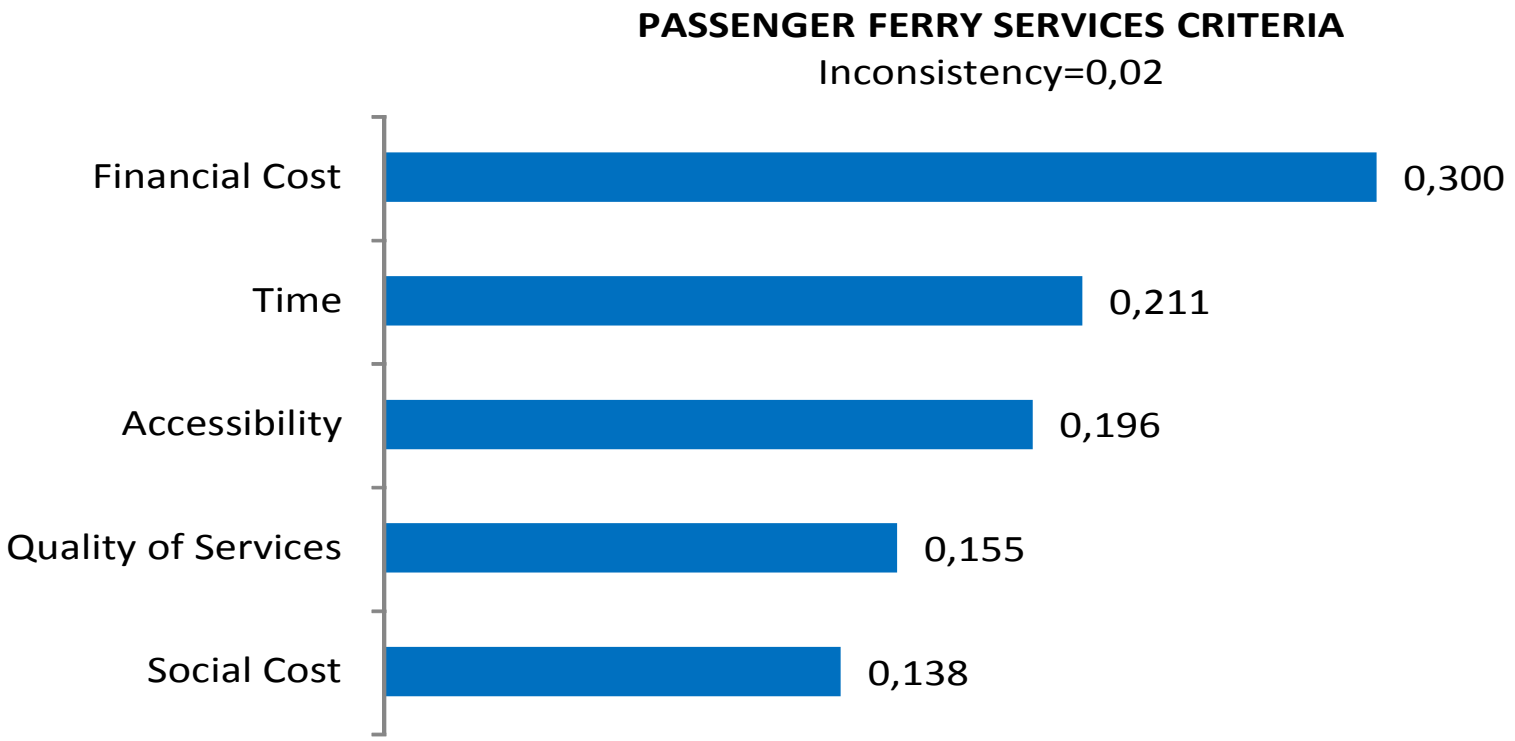
Methodology

Weights for Passenger Ferry Services Criteria



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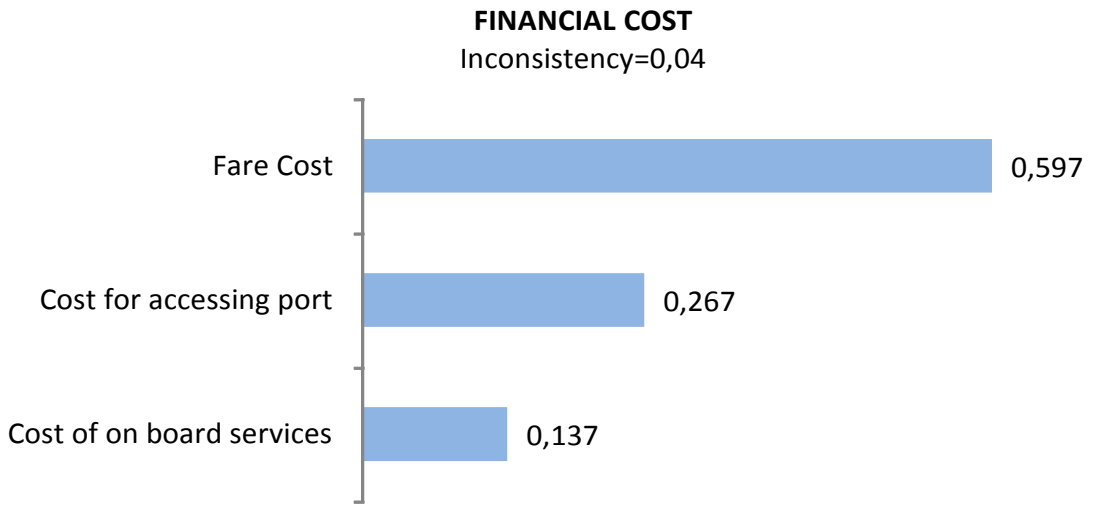
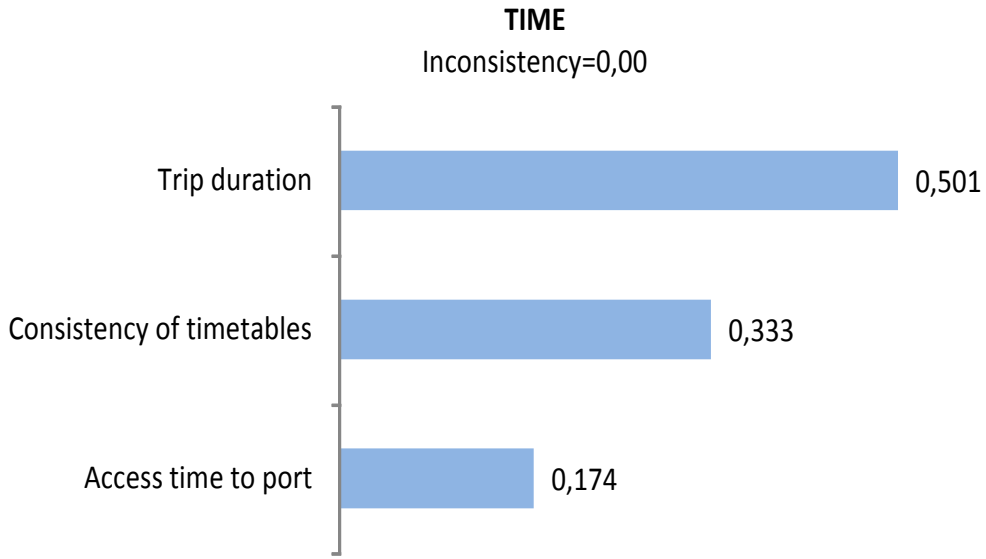
Methodology

Weights for Passenger Ferry Services Sub Criteria

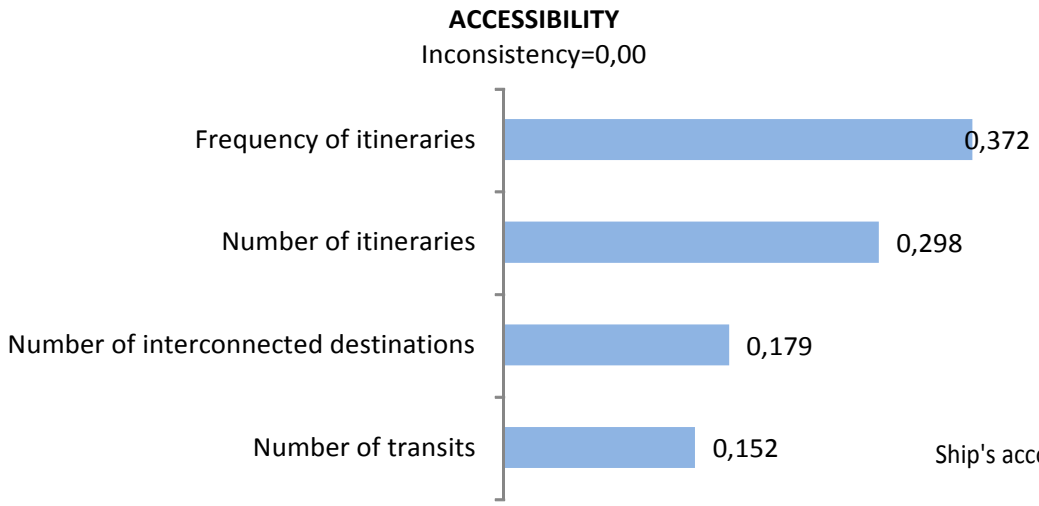


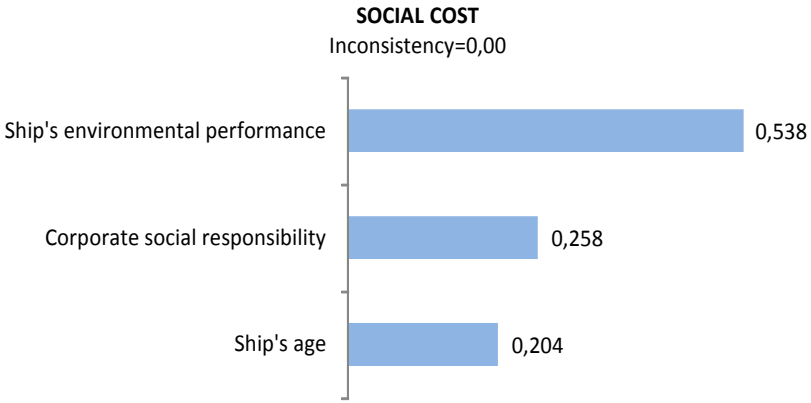


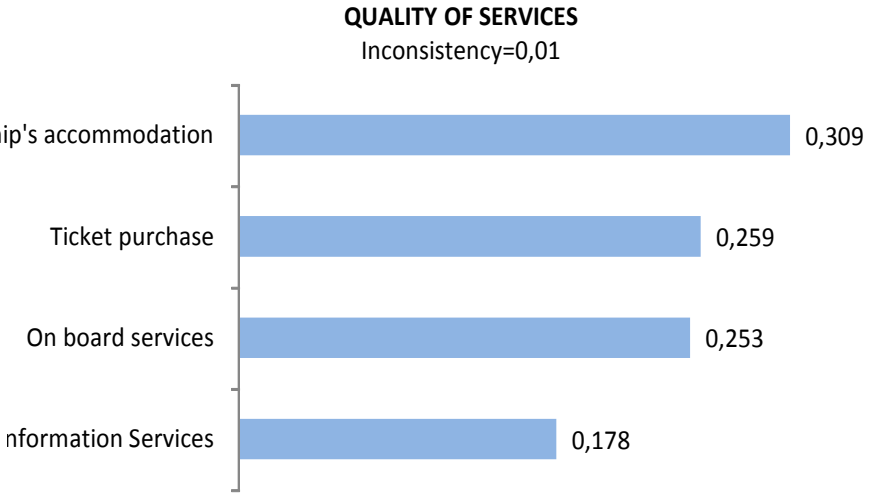
ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

Weights for Passenger Ferry Services Sub Criteria



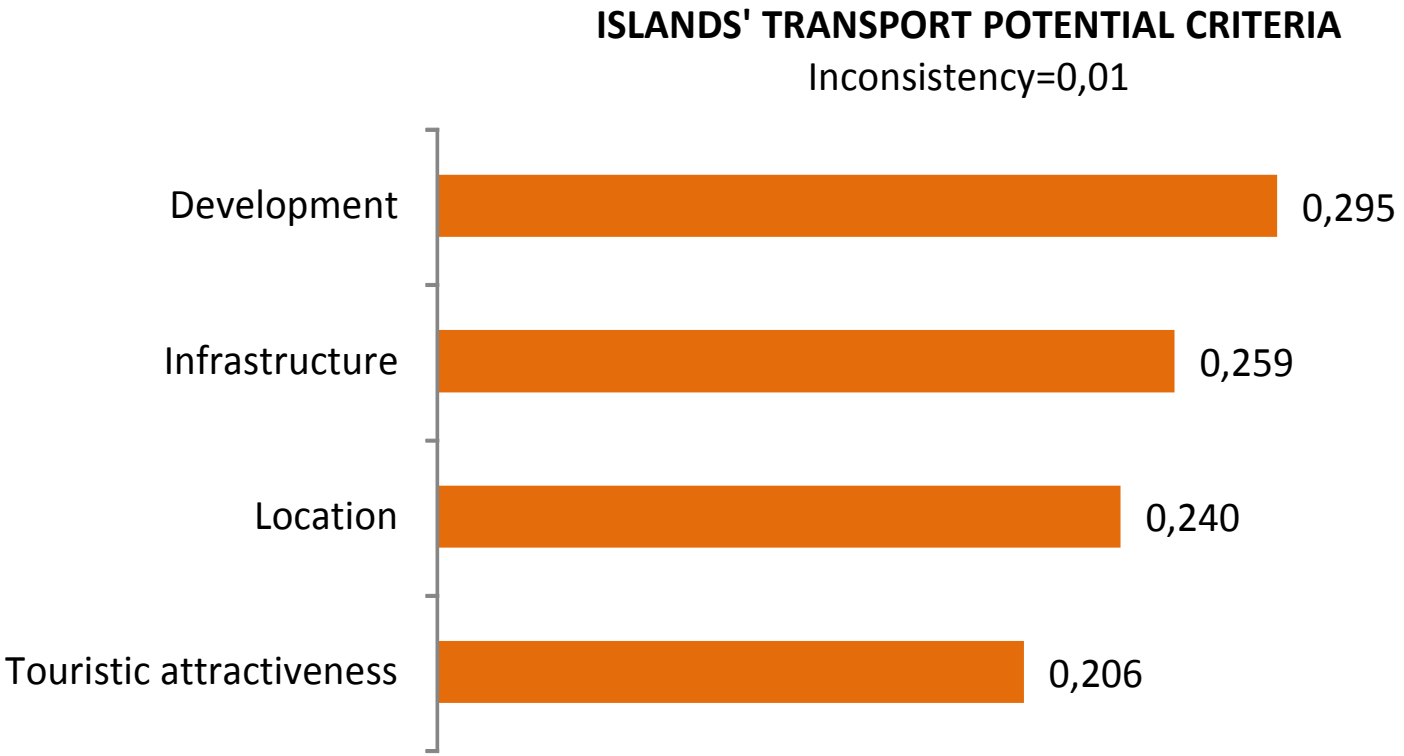




ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑ

Methodology

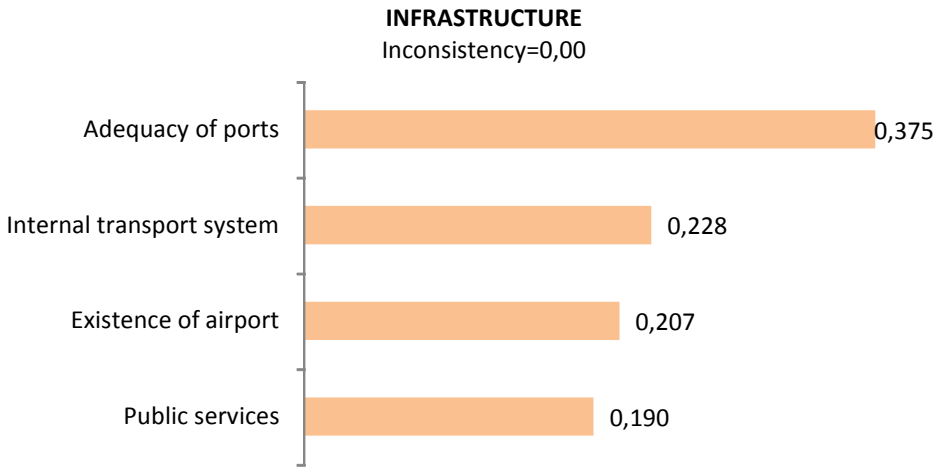
Weights for Islands' Transport Potential Criteria

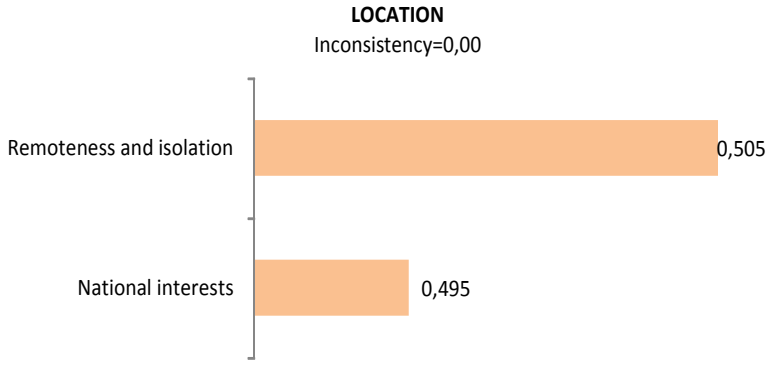


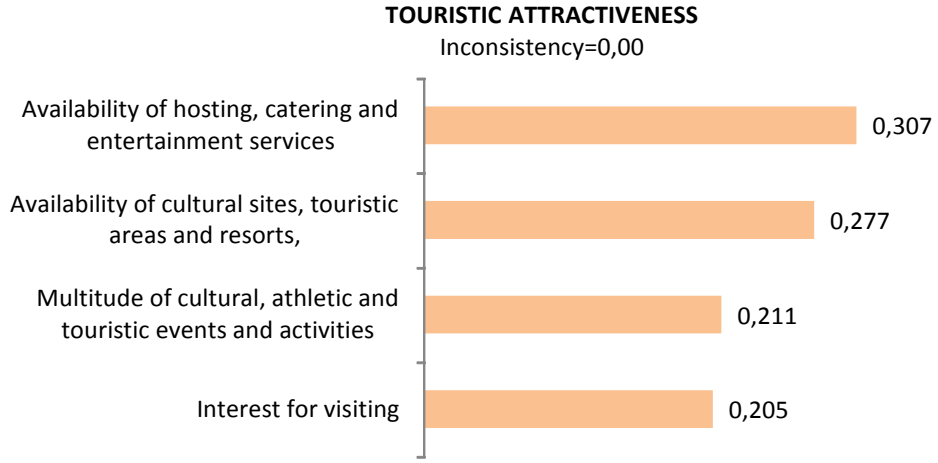
ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

Weights for Islands' Transport Potential Sub Criteria



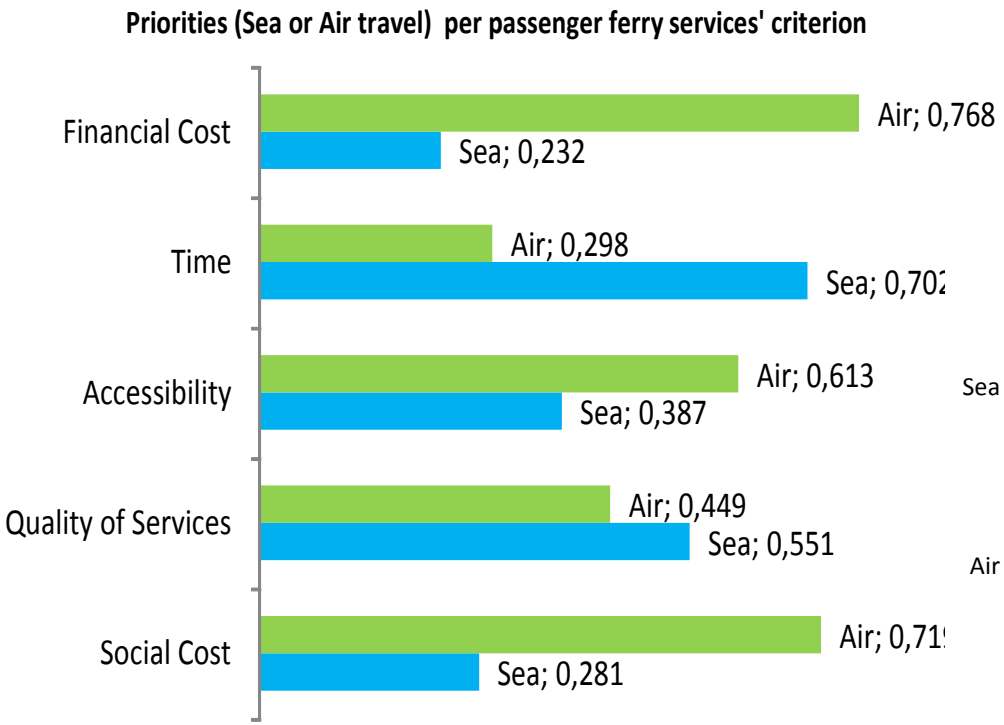


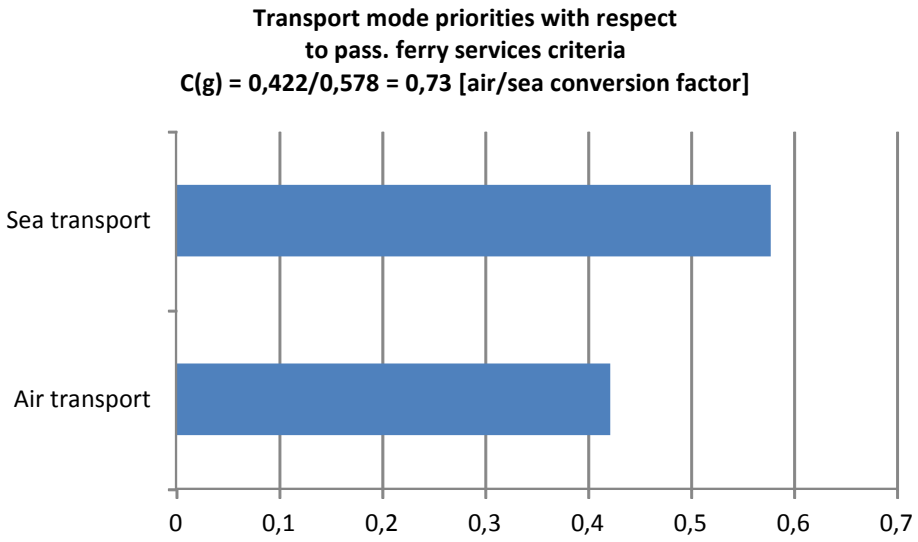


ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Methodology

Transport Mode Priorities and Correlation





ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Key points

- The methodology introduces a **novel** but **simple** and **reliable** approach for the estimation of an islands' relative connectivity level
- All performance indicators are **comparative** and **dimensionless**
- The selection of the applicable **criteria** and the estimation of their weights, as well as, the choice of the most appropriate **performance indicators** may be **adjusted** on the specific characteristics of the **islands under review**
- The proposed connectivity indexes may provide a **decision making tool** for the policy makers with respect to the islands' transport
- The **availability** and the systematic and consistent collection of **statistics and data** from reliable sources is absolutely essential

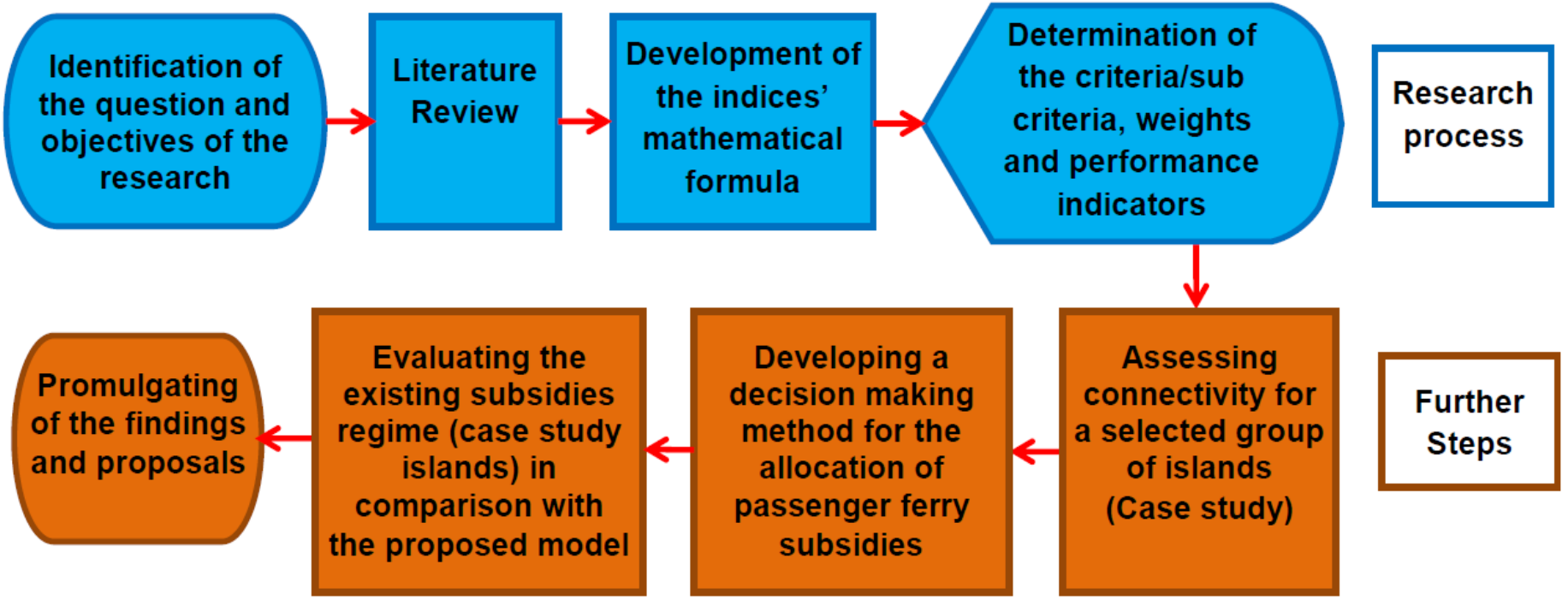
ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

Further research

- Collection and processing of data for the estimation of the connectivity indexes for a group of Greek Islands (**case study**)
- Developing a **decision making algorithm** for the allocation of passenger ferry subsidies
- Evaluating the **existing regime** for the for the allocation of passenger ferry subsidies in **comparison** with the proposed decision making algorithm (case study islands)

Further research

The research process



ΠΑΝΕΠΙΣΤΗΜΙΟ ΑΙΓΑΙΟΥ

...Keep Ithaca always in your mind.
Arriving there is what you are destined for...

[C.P. Cavafy, Ithaka]

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