# PROMOTION OF PASSENGER INTERMODALITY AND USERS' REQUIREMENTS FOR SERVICE PERFORMANCE AT TERMINALS AND PASSENGERS' INTERCHANGE POLES

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## 1. INTRODUCTION

The promotion of intermodal transport for passengers and goods has been one of the main pillars of the European Transport Policy for the last three decades. The objectives of various policy developments towards promotion of Intermodality relate to a more rational modal split and better exploitation of resources, a better connectivity and accessibility of the European transport system and, mainly, the reduction of negative external transport effects on safety environment and quality of life.

Intermodal terminals' service performance plays a crucial role in the decision making process of users, since it affects modal (or intermodal) choice decisions and, consequently, route selection in several cases. In case of trips with tourism purpose, it may affect also the destination choice. In the case of passenger transport more particularly, the quality performance of services offered at "interfaces" relates not only to purely transport attributes (i.e. transport cost, transport time, waiting time, accessibility to other modes etc) but also to existence and quality of many other services to users (information, leisure, shopping, culture etc). In most of cases, interfaces between different modes correspond to a multi-polar "interchange" area rather than to an ideally defined physical nodal point. Examples of these interchange areas are big airports or maritime ports in spatial proximity with railway stations or metro/bus stations for short distance end haul transport, but subject to distinct

management authorities and organization. This involves a more complicated infrastructural environment and consequently, more complex users' approach as far as perceptions and requirements are concerned.

Therefore, this paper introduces the concept of "interchange" instead of that of classical passenger terminal. The paper aims at developing a methodology for exploring and quantifying the users' requirements for service performance at "interchanges" in the case of passenger intermodal transport, with emphasis on tourism trip purpose. The paper takes into account the development and analysis of new mobility schemes and associated organizational patterns at the interface and interconnection between transport networks.

The paper applies the proposed methodology in the case study of the port of Patras in Greece. The port of Patras, located in the north-west of Peloponnese, represents the main western gate of Greece. It knows among other an important demand of passenger transport for tourist purposes -with high seasonality due to tourism- between western and central Europe through Italy and the Adriatic – Ionian corridor to Greece. The paper develops the design of the research, the analysis of the collected data and a detailed description of the selected elaboration techniques.

The first part of the paper is concentrated on the identification of the key requirements of the travelers. It includes various categories of services such as travel, interconnectivity, information, banking, catering, shop, leisure, culture and other services to users. "Internal" and "external" services offered at the interchange are also distinguished. Based on a survey performed at the port of Patras, the paper assesses the relative importance of these services and their relative impact on terminal/route choice and, in certain cases, on the destination choice (the latter being strongly related to travelers having tourism as trip purpose). In the second part, the paper compares the users' requirements, as stated during the survey, with the perceived utility by the users for the actual capabilities and performance of the Port of Patras. In the third part, based on the outcomes of this comparison, the paper proceeds to suggestions for appropriate measures aiming at upgrading the interconnection between the port and the road and rail network, as well as at upgrading the port attractiveness.

Beyond the results from the statistical analysis of the questionnaire survey that took place in the port of Patras and the evaluation of the most important quality factors according to customers' opinion, the added value of the paper consists in designing the main axes of new organizational patterns for transport interchange hubs and intermodal chains. In the Conclusion, the paper develops such an organizational model. Based on the port of Patras survey, this model deals with organizational issues in order to develop more integrated managerial schemes between stakeholders, achieve better coordination and promote more efficient and attractive intermodal services. As pilot case of a new organizational model, a new –hypotherical- integrated intermodal transport service between the Adriatic-Ionian corridor and Crete is studied. This alternative intermodal transport service uses the western Peloponnese corridor and the port of Patras as main hub of the chain.

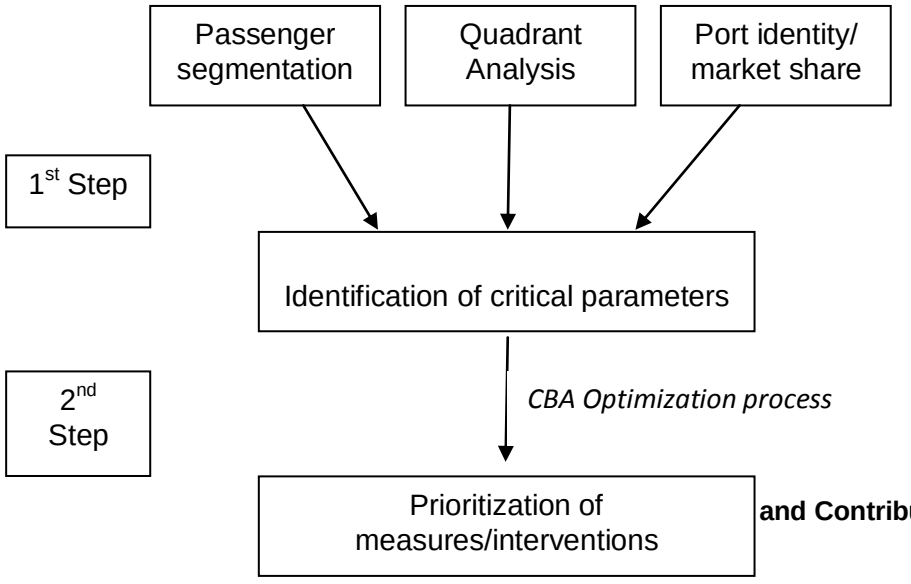
The outcomes are based on a passenger field survey that took place during September 2010 at the port of Patras. The research work was realized in the frame of the FP7 project “HERMES-High Efficient and Reliable Arrangements for Crossmodal Transport” which aims at the development and the analysis of new mobility schemes and associated organizational patterns.

## 2. METHODOLOGICAL FRAMEWORK

To respond to the paper objectives, the users’ requirements and the relevant performance criteria of interchange poles are examined at two distinct scales: a) at the scale of the interchange pole itself, by analyzing operations and “internal” services offered in terms of information, facilities, ticketing and comfort (“internal” quality) and b) at the scale of the network, by assessing the level of accessibility and interconnectivity between the interchange and the inland transport networks (road, rail), in terms of both infrastructure and service (“external” quality), from an Intermodality perspective.

Regarding the “internal” quality level, the results are based on the statistical analysis of a questionnaire survey that took place in the Port, which allowed the identification of the most important quality factors according to customers’ opinion and the evaluation of these factors. The methodology followed a two-step approach: In the first step the results of the passenger survey were processed statistically using some marketing techniques (passenger segmentation, analysis of Port identity/market share and Quadrant Analysis. This first step entails the identification of critical parameters for the passenger demand that are included in the formulation of the customer satisfaction index. In the second step, the prioritization of measures took place with the application of evaluation techniques (maximization of profit), in order to determine the optimal bundle of measures for the Port of Patras. The methodological approach for the assessment of internal performance characteristics and requirements is illustrated in Figure 1.

**Figure 1. Conceptual approach for assessing service performance at terminals and interchange poles**




**and Contributors 2011**

The assessment of the interchange pole performance at the “external” – network- level is based on a specific case study: the extension of the Adriatic – Ionian corridor from Peloponnese to Crete using the Port of Patras as main interchange hub. In the current situation, the maritime transport (ferry) services linking continental Greece -including Peloponnese- to Crete are mainly based on the Piraeus hub port; passenger flows coming from the Adriatic corridor and having Crete as final destination, are oriented from the port of Patras to the port of Piraeus through the road transport network (private cars or bus services) and then, they use ferry services to Crete.

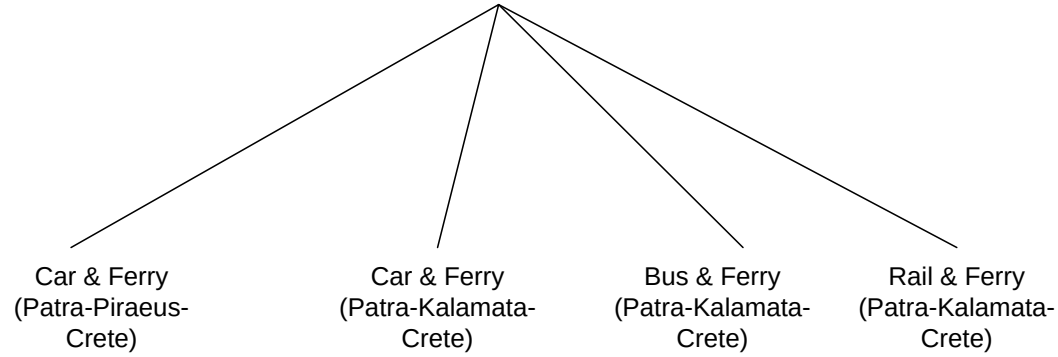
The selected hypothetical alternative case deals with the investigation and development of a fully integrated intermodal transport service for passengers between Western/central Europe through Italy and the Adriatic–Ionian corridor and Crete, avoiding deviation through Piraeus. The study examines the entire network configuration of such an integrated service, including: a) the long distance ferry transport between Italy and the port of Patras, b) the inland leg connecting the port of Patras to the southern Peloponnese and c) the medium distance ferry transport from southern Peloponnese to Crete. However the main focus of the study is the currently “missing link” i.e. the inland leg between Patras and Southern Peloponnese which needs to be integrated to the network.

Therefore, this Case Study deals with “accessibility” barriers between various network components of the aforementioned corridor. These barriers are mainly of functional and operational “service” character, since from the physical viewpoint infrastructural connections exist and, therefore, the necessary conditions are fulfilled. The proposed Case Study offers an alternative –optimised- network service solution for connecting the Adriatic corridor to Crete.

Regarding the performance assessment of Patras interchange through the perspectives of the proposed new intermodal service, a Mixed Multinomial Logit Model has been estimated, accounting for repeated observations from the same individuals in the data set. The model explores various scenarios of passenger transport chains between western and central Europe and Crete through the port of Patras. More concretely, it considers the existing route (Patras-Piraeus-Crete), as well as hypothetical new services using the ports of Patras and Kalamata as main interchange nodal points.

The proposed model allows identifying various segments of passengers travelling for touristic purposes in the region and forecasting their share. A graphical representation of the model is presented in Figure 2.

**Figure 2. Mixed Multinomial Logit Model**




Finally, it is noteworthy that although the overall methodology is applied to the port of Patras, the same approach could be utilized and expanded to other transport facilities and modes (public transport, air transport etc). The concepts used in the paper (passenger interconnectivity, Quadrant Analysis, passenger segmentation, customer satisfaction etc) are analyzed in the following paragraphs.

## 3. SURVEY DESIGN

### 3.1. Brief description of the site

It is broadly accepted that the Port of Patras plays an important role in the economic development of the City of Patras, as well as of the broader region and Greece in general mainly due to the ferry boats which connect Greece with Italy. More than 40 F/Bs are currently used for this line during the summer season. The main objectives of the case study is to upgrade the customer services of the port and also to improve the transport connections between the port with the road and rail network of the city in order to better serve the passengers who travel every year with the long distance ferries from Patra to Italy.

The Port Situated in Peloponnesus (Southern Greece) in the city of Patras which is the 3rd biggest city in Greece with population about 222.000 inhabitants. The port has an important role in the economic development of the City of Patras, as well as of the broader region.

The port has got four main piers and wharfs of approximately 3.000 m total length and 8.5-10.5m depth. It's capacity can afford passenger ferry ships up to 220 meters length. The Port has a (2.932 m2) 2-floor Passengers Terminal where there are the passenger lounges, the agencies of shipping companies, Customs office, duty-free stores and other services. It serves more than 50% of the international passenger flows in Greece (1.248.000 passengers out of 2.529.000 in total, 2005 data).

The Port is very close to the railway station, the interurban bus terminal as well as the urban bus station and the city center. This fact makes the achievement of good level of intermodality and interconnectivity of the port a quite easy target. But is this also the opinion of the passengers?

### 3.2. Design of the survey

Customer survey and related data collection is the cornerstone for investigating customer needs. The customer survey has been based on a well structured questionnaire. The questionnaire practically contained two main – and large- parts: the first part collects Revealed Data while the second part collects Stated Preference data.

The first part contains five (5) sections, namely A, B, C, D and E:

- Section A deals with general travel information (origin-destination, travel in group or not, trip purpose, whole trip duration etc).
- Section B deals with information concerning modal choice of customers, decomposing the whole trip of passengers into legs.
- Section C deals with information at the Interchange level: services offered at the interchange, means to reach next transport mode, walking time, waiting time, information displays, signposting, travel services (Tickets/Booking, Luggage handling, Coordination of timetables between different networks, other services/facilities (Banking Services, Catering Services, Newsagents., Shops, Facilities for disabled people, Seating space etc). The customers evaluate the performance of the services offered and also rate the importance of each type of service.
- Section D deals with Alternative Routes, not selected by the customers for reaching their destination and focuses on the criteria of their choice (cost, travel time, comfort, quality of service at the means, quality performance of the interchange used etc).
- Section E collects data related to the Personal Profile of customers: age, gender, profession, income, nationality, educational level.

- Finally, the second Part (Section F) performs Stated Preference experiments in order to assess the attractiveness from the various attributes/services of the Port. The aim of Stated Preference experiments is to assess the attractiveness of the alternative chain proposed, compared to the current situation, and identify the conditions under which the demand for the new integrated transport service can be expressed. Obviously, a multitude of data types and results are extracted from the Stated Preference survey.

### 3.3. Data collection

The customer survey took place in the period 23-26 September 2010. The period was considered as typical because there was enough passenger volume during September but it was not the peak period and so there was

enough space inside and outside the ships in order to talk with the passengers and implement the survey.

The passengers had to describe analytically their trip and also to answer to question for the acceptable walking and waiting time in the terminal. In addition, they had to rate (rating scale -3 to 3) the importance and their satisfaction of the following measures/services.

Information and travelling:

- Information Displays
- Signposting & directions

Travel services :

- Tickets/booking
- Luggage handling
- Coordination of timetables between different networks
- Punctuality of transport modes
- Waiting times at the terminal/interchange

Other services/facilities:

- Banking Services
- Catering Services
- Newsagents etc.
- Shops
- Facilities for disabled people
- Seating space

Esthetics

The survey resulted in the collection of 560 questionnaires fully completed by passengers as well as the collection of more than 600 Stated Preference experiments, based on more than 270 questionnaires.

## 4. USERS' REQUIREMENTS AND INTERNAL TERMINAL PERFORMANCE: DESCRIPTIVE STATISTICS

Based on the customer questionnaire, as it is presented in the following figure (Fig 3), the origin of the transfer in percentage of 35% emanates from Attica and Sterea Hellas. Attica appears to be the basic feeder of the passenger traffic. For the percentage of the passengers that declares as origin the port of Patras, 21%, there is an important uncertainty as for the validity of answer. The most common destination (Fig 4), 36%, is Italy while the corridor Italy - Austria Germany assembles the 48%. It is marked that an important share of the transfers corresponds also to the Ionian Islands.

**Figure 3. Origin**

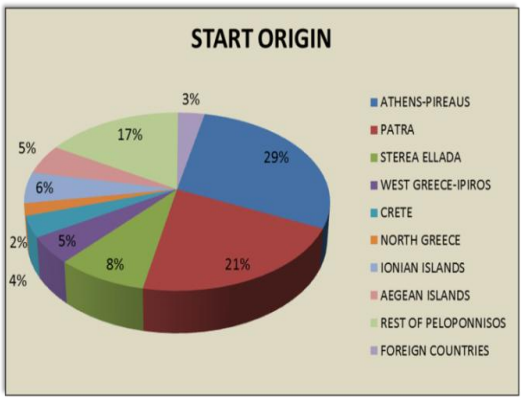
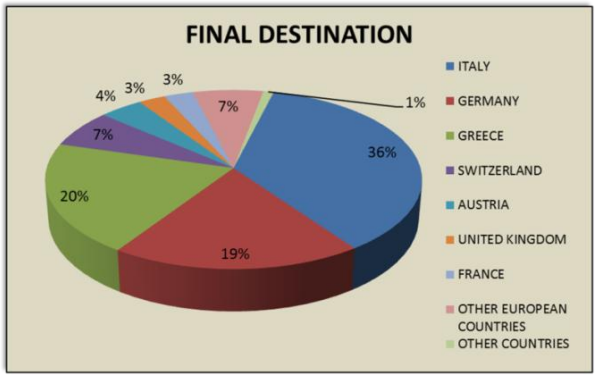



**Figure 4. Final Destination**




As it is presented in the figure 5, the main reason of this trip is vacation and this is the reason why the duration of the whole trip for the most of the participants lasts up to 10 days and for more than 50% lasts up to 15 days. But we must mention also that the percentage of the people travelling for business is high 24%, and most of them have a European destination (Germany, Italy, Spain).

**Figure 5. Trip purpose**

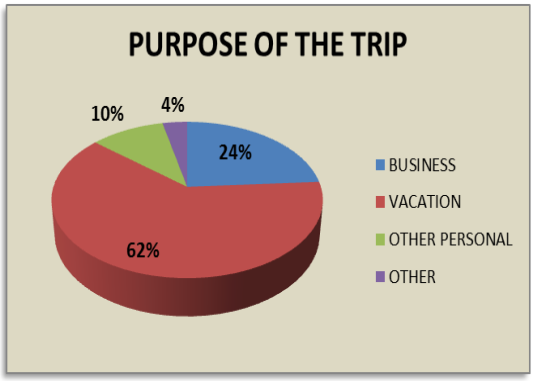
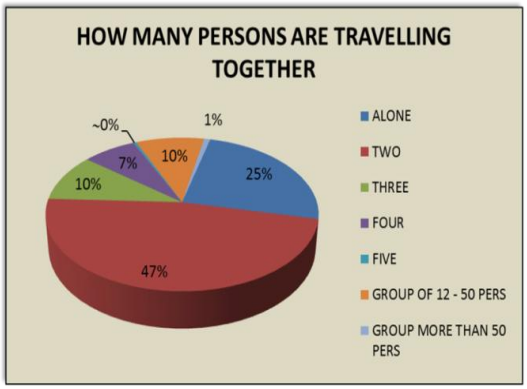
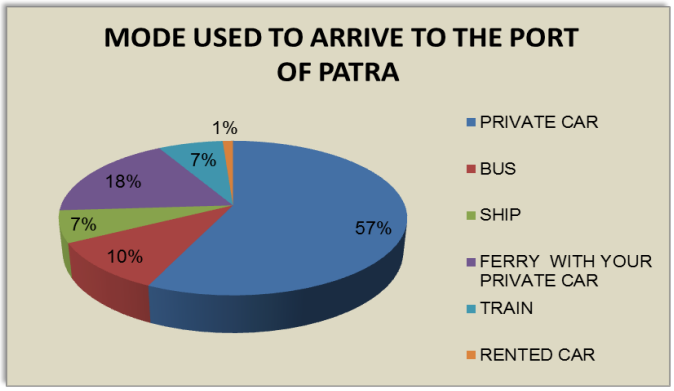



**Figure 6. Persons travelling together**




The percentage of the passengers that approaches the port with private transport mode exceeds the 50% (57%). Respectively the percentage of the passengers who used bus in order to reach the port is 10%. Globally, the users of public transport modes reach the 45%. This percentage is high enough and it is connected with the total level of service of the transport means, the infrastructure and total organization of the interchanges.

**Figure 7. Modes used**




The transfer time at the terminal/interchange is in high level as we see that the 52% of the passengers participated in the survey have been transferred in the area of the port in at maximum 5 minutes. Percentage that grows to 76% for transfer in 10 min (Fig 8). This fact implies the satisfactory level of exploitation of the port infrastructure, the cooperating transport modes and the organization of the port operation.

The waiting time until the next departure imply undeniably that the frequencies of the itineraries are satisfactory (Fig 8).

**Figure 8. Optimum transfer time**

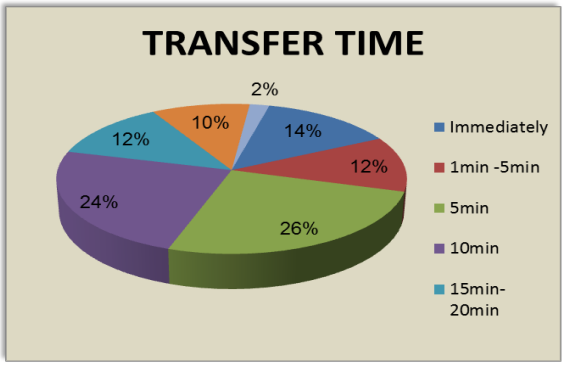
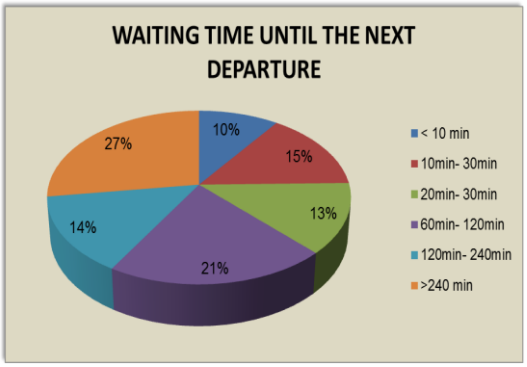



**Figure 9. Waiting time until next departure**




46% of the participants believe that the acceptable time to spend at the terminal/interchange is up to 30 min. Comparing the results of Figure 10 with Figure 9 seems that the passengers are satisfied with their stay at the port of Patras since the waiting time until their next departure is in the acceptable limit and only a small percentage of 16% is probably disappointed.

**Figure 10. Maximum acceptable time to spend at the terminal**

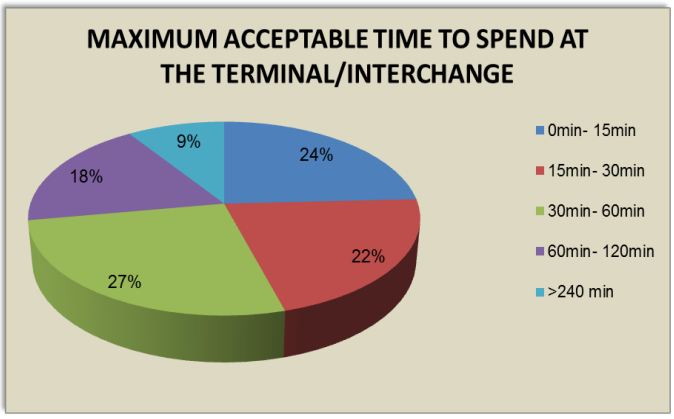
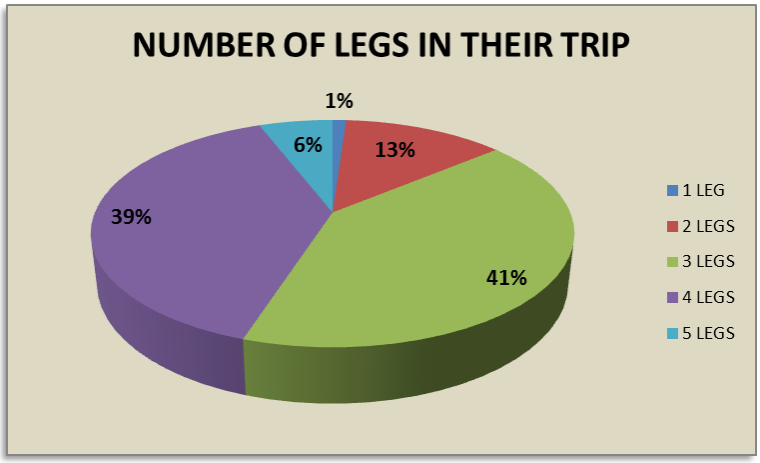


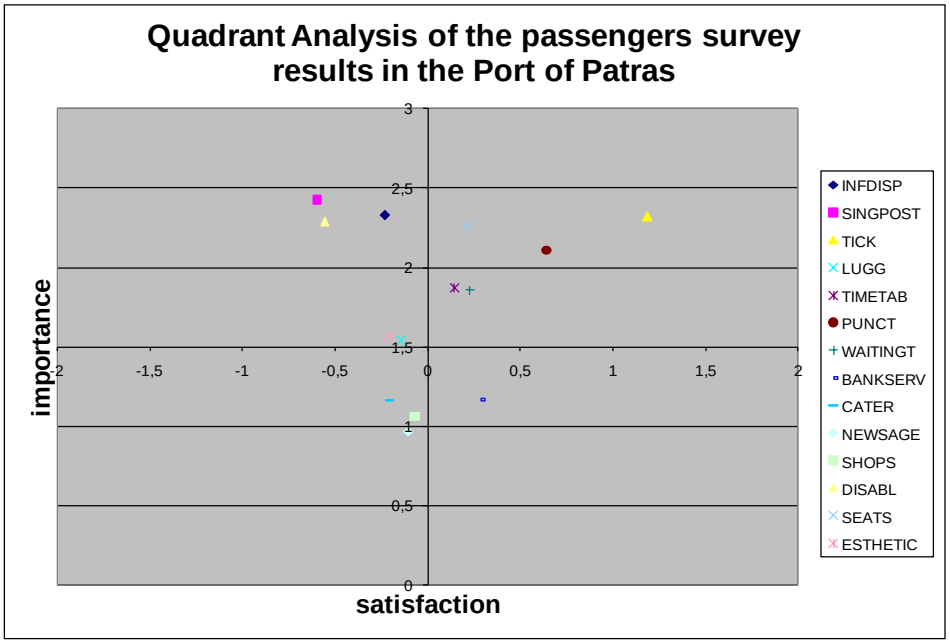

**Figure 11. Number of legs**

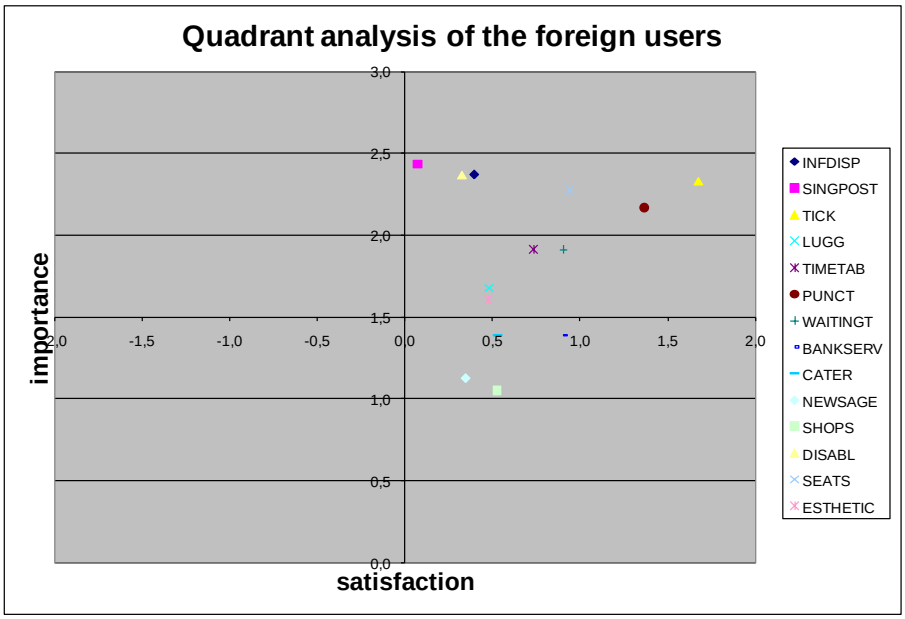



Parallel conclusions from the customer survey give us the motive to examine additional or alternative possibilities of continuation or modification of the trip for the passengers who accept and prefer a number of changes or interruptions of their travel. These passengers who consist the target group of the above process, according to the customer survey represent 45% of the total sample (trip consisted of more than 4 legs)

## 5. IDENTIFICATION OF CRITICAL PARAMETERS

The identification of the critical parameters is based on the rate that the passengers gave to the importance of every service and to their level of satisfaction with them. According to that, for the total of the respondents the most importand factors and their satisfaction with them is presented in the following quadrant diagram.

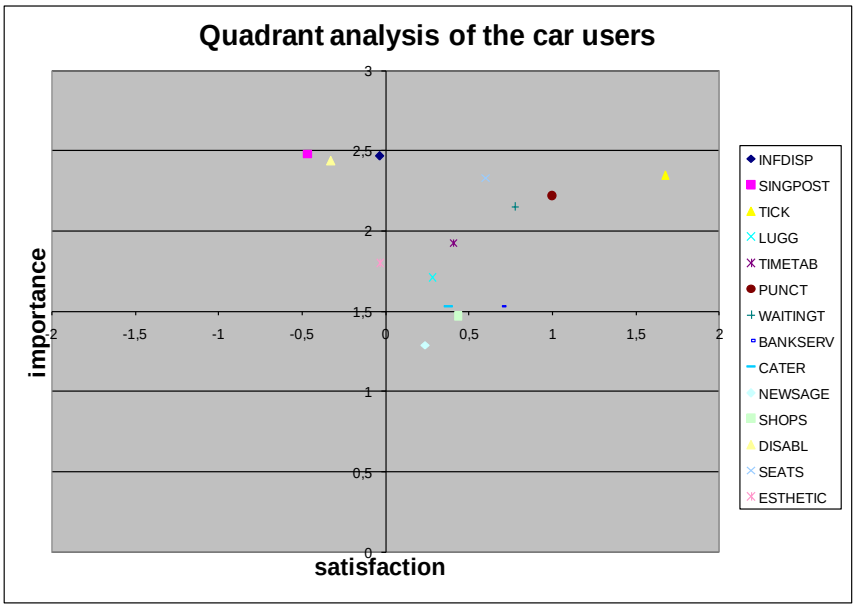


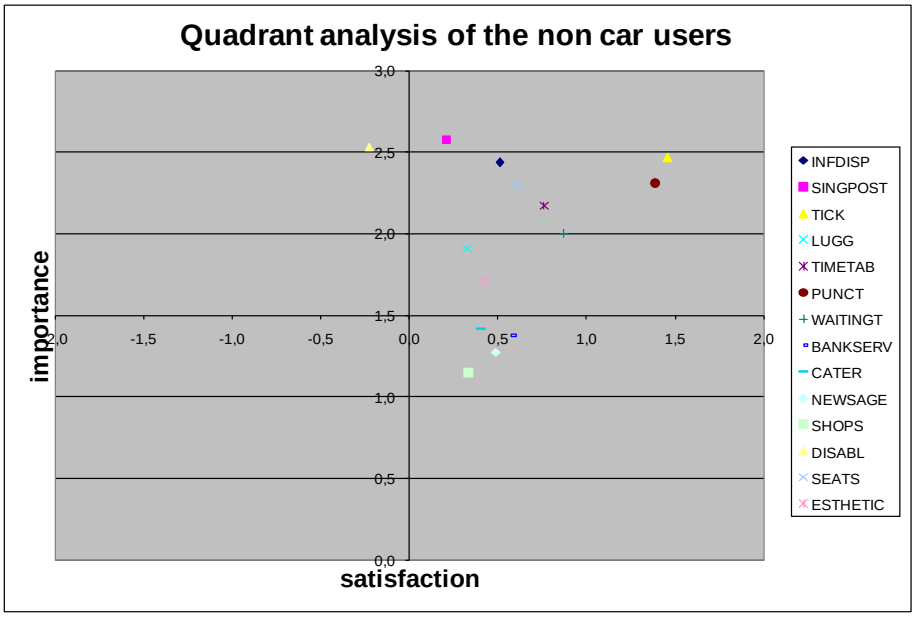




According to that, the most importand services of the port are the Information displays, the Signposting & directions, the tickets/booking and the facilities for disabled people. For three of these factors their satisfaction is to low and special attention must be given on those issues from the administrative authority of the port. These are mainly the results of the Greek interviewees as the foreigners believe that the same parameters are very important but they are quite satisfied by them.

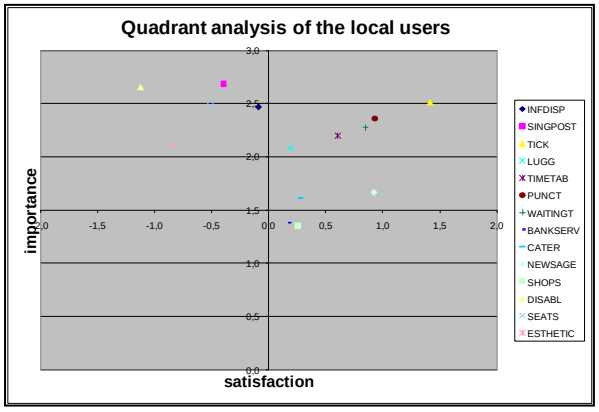
In the following diagrams it is explored how the market segmentation influences the evaluation of the transport system parameters. According to the mode that the passengers had used to reach the port one can see that the users of private cars are in accordance with the results that were presented

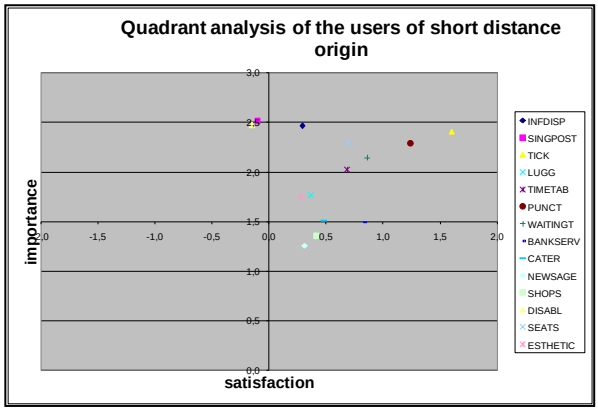
before. The non car users seems to be more positive with the port services as they gave better satisfaction scores to most of them. They also agree that the Information Displays, Signposting & directions, tickets/booking and facilities for disabled people are the most important services of the port.

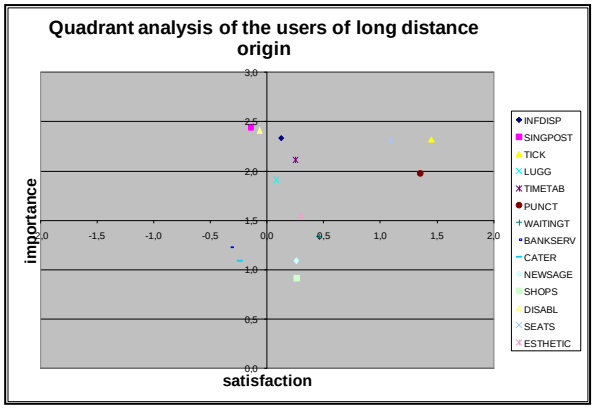



According to the distance of the passengers' origin from the port of Patras the results of the quadrant analysis are showing some interesting differences.



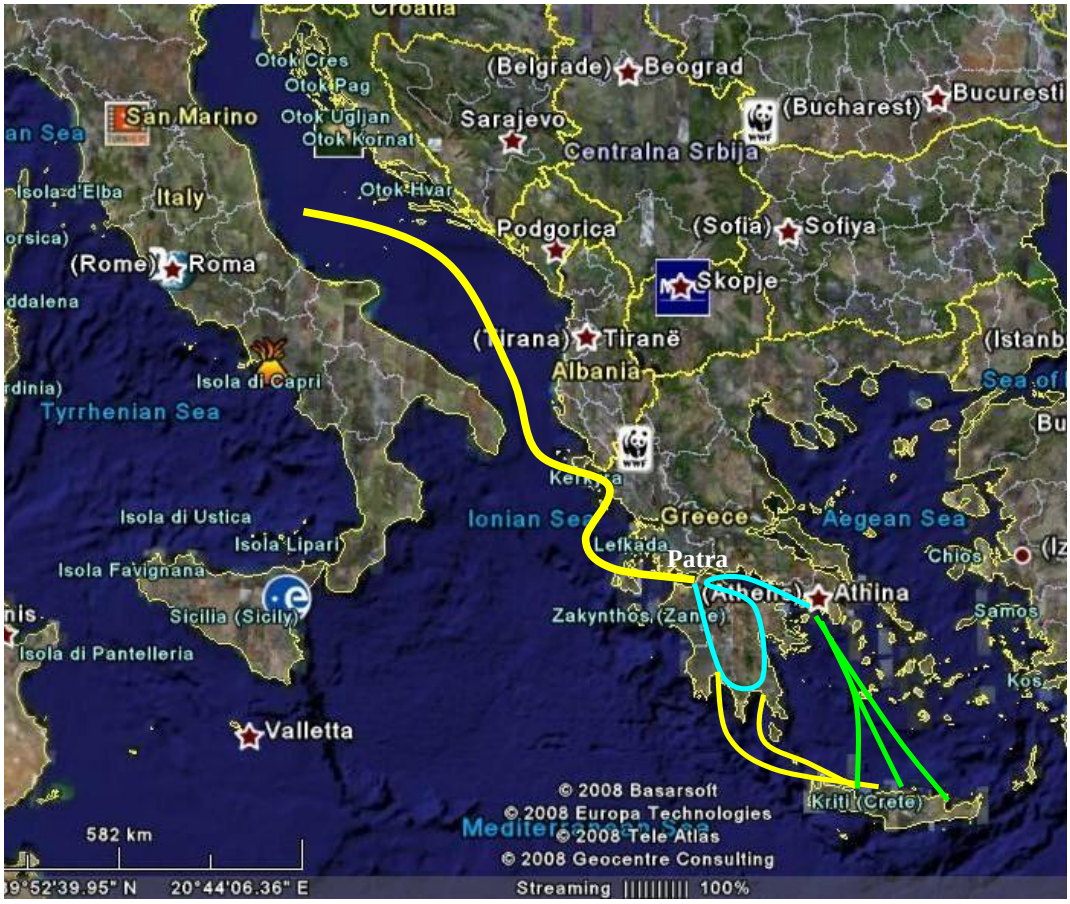

It seems that the local people are more dissatisfied with the important services as they believe that the quality level of the Information system, the signposting & directions service the ticketing system, the luggage handling and the esthetics of the port is too low. The short and long distance users are in accordance with the results that were presented above. Another issue to mention is the catering and banking services that the long distance users find quite poor in relation to the short distance users.

## 6. ASSESSMENT OF A NEW INTERMODAL SERVICE AND IDENTIDIFICATION OF CUSTOMER SEGMENTS

As already mentioned, the present research work also investigates the role of passenger interchange poles in view of the promotion of new transport services based on intermodal concepts. The pilot case of the research is the assessment of an alternative integrated intermodal passenger service from Adriatic- Ionian corridor to Crete through Peloponnese.

More concretely, the integrated chain is composed from a) the long distance ferry transport between Italy and the port of Patras, b) the inland leg connecting the port of Patras to the southern Peloponnese and c) the medium distance ferry transport from southern Peloponnese to Crete. However the main focus of the study is the currently “missing link” i.e. the inland leg

between Patras and Southern Peloponnese which needs to be integrated to the network. The corridor configuration is presented in the following map.




Extension of the Adriatic – Ionian Corridor to Crete

The proposed service is further specified, offering two sub-alternatives of service package:
a) a direct intermodal transport chain with coordination of timetables of the various modes used (for “non-stop travelers”) and

b) a more extended service associating transportation with other touristic activities such as accommodation and sightseeing tours while crossing the western Peloponnese corridor in an integrated service package (for “travelers with stops”). The second alternative can be stimulated by the opportunity to visit numerous sites of high cultural and natural interest such as ancient Olympia, ancient Pylos etc.

Based on a priori assumptions, as well as on the descriptive analysis of the data, it was decided to segment the sample based on the number of stops variable. Thus two market segments were created as follows:

- Non-Stop Travellers: all the individuals that conducted less than/equal to three stops during their reported journey; and
- Travellers with Stops: all the individuals that conducted more than 3 stops during their reported journey.

The model specification for both models (Non-Stop Travellers and Travellers with Stops) is the same. The dependent variable of the Mixed Multinomial Logit Model consists of four alternative choices: (1) Car and Ferry through Patra-Piraeus-Crete Corridor, (2) Car and Ferry through Patra-Kalamata-Crete Corridor, (3) Bus and Ferry through Patra-Kalamata-Crete Corridor and (4) Rail and Ferry through Patra-Kalamata-Crete Corridor.

The identification of the two customer segments results from the development of two discrete choice models representing the respective route and mode choices. Both models were estimated using the corresponding number of the stated preference observations collected in the sample. The following Table presents the route and mode choices, individuals made at the stated preferences scenarios for each traveler segment.

**Table 1: Mode/Route Choice based on Stated Preferences Scenarios**

| | **Non-Stop Travelers** | | **Travelers with Stops** | |
|---|---|---|---|---|
| **Travel Mode/Route** | **Number of Observations** | **Percentage (%)** | **Number of Observations** | **Percentage (%)** |
| Car Patras - Pireaus | 36 | 9.0 | 16 | 7.1 |
| Bus Patras - Kalamata | 22 | 5.5 | 16 | 7.1 |
| Car Patras - Kalamata | 197 | 49.4 | 74 | 33.0 |
| Rail Patras - Kalamata | 144 | 36.1 | 118 | 52.7 |
| **Total number of observations** | **399** | **100** | **224** | **100** |

By exploring the data set of the survey, the characteristics of the two customer segments can be further identified, as well as their share. More concretely, it resulted that the segment of “Non-Stop Travelers” relates with travellers’ that are young (under 20 years old) and/or have high incomes and prefer to use mass modes either bus or rail. The segment includes also travellers that plan their trip well in advance and prefer to use their own car. These travellers are interested for a direct trip from Patra to Kalamata, with no intermediate stops and their segment corresponds to 64% of the target population.

“Travellers with Stops” are travellers that mainly want to use their car, travel with children and/or have high incomes. Their segment corresponds to 36% of the target population.

Finally, it was possible to proceed to Mode/Route market share forecasts per customer segment. Table 2 presents the market share forecasts based

on the model estimation results for the two customer segments. As it can be seen for the “Non-Stop Travellers” segment, the probability of car through Patra-Kalamata-Crete route is the highest (0,57), followed by rail alternative through the same route (0,25). On the other hand in the “Travellers with Stops” segment, the probability of choosing rail for the Patra-Kalamata-Crete route is the highest (0.55) followed by the car alternative (0.33).

**Table 2: Market Share Forecasts**

| Modal Split | | |
|---|---|---|
| | Non-Stop Travelers’ | Travelers with Stops |
| Car Patra_Piraeus – | 10,00% | 8,00% |
| Car | 57,00% | 33,00% |
| Bus | 7,00% | 4,00% |
| Rail | 25,00% | 55,00% |

The above customer segmentation can be the tool for specifying better tailored services offers to the potential customers of the proposed extended corridor.

## 7. CONCLUSION

The survey results showed the satisfaction of the passengers with the offered port services as well as the importance of every service and in addition the different perception of quality according to the market segmentation. It is quite clear that information services at the port and integrated ticketing systems are the most important services for passengers since most of them are not satisfied with the quality offerred. These services are also considered as prerequisites of crucial importance for developing interconnectivity and new long distance intermodal chains, notably alternative routes to Crete.

With regard to the creation of optimized alternative routes from Patras to Crete, the port of Patras, in cooperation with all the stakeholders can play a very crucial role. Driving forces for the concretization of this perspective are the reduction of the total travel time to the final destination, mainly with shorter access time, transfer time and waiting time at the port and/or capitalization of the interest for touristic activities in the greater area of western Peloponnese.

Necessary conditions for a successful development of new intermodal services for transport with touristic purposes are:

- Improvement of medium distance ferry service (Peloponnese-Crete)
- Coordination of both maritime transport services involved
- Creation of a “shuttle” inland transport service (either bus or rail) connecting port of Patras to Kalamata

- Luggage handling services
- Implementation of a Platform in order to manage and monitor all services related to transportation, booking, payment, accommodation, marketing, publishing, coordination of the different operators. The appropriate platform provides the benefit of fully integration of different transports and technologies that the transport operators will probably use and the possibilities to start with some services and then add more.
- Upgraded booking system which will provide real time online reservations, secure online purchasing system, the opportunity to select, book and buy tickets directly by the travel agencies, at the ports involved.
- Implementation of a system of repair services in order to solve any kind of problem in case of a system failure.

Finally, the successful implementation of such a new service and the fulfilment of the aforementioned conditions needs the cooperation of the Interchange and Port Authorities with all stakeholders potentially involved.

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