A BEHAVIOURAL APPROACH TO SOME ASPECTS OF LEISURE TRAVEL PLANNING.

by
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1. INTRODUCTION

Transport planning during the last 30 years has understandably been primarily concerned with urban peak hour problems. From origins where it was designed to simply describe present movement and then extrapolate that description to forecast future demand, it progressed to more sophisticated techniques which not only described the act of travel but also the motivation. Trips being studied were predominantly work, commercial or domestic-oriented and the constraints implicit in trip choice mechanisms gradually became identified and incorporated in the planning process. Whilst the existence of leisure-motivated trips was acknowledged, they were generally of secondary importance. The methods which evolved placed little, if any, importance on the different trip-motivating factors when leisure was the prime, or exclusive, trip purpose.

In recent years planners have become increasingly aware of the need to plan for growing amounts of leisure time. The reasons are readily apparent including such factors as the shorter working week, longer annual holidays and greater disposable incomes. The contemporary attitude towards tourism was summarised in the 1979 OECD Report (1) on the European Conference of Ministers of Transport:-

> "... holidays and leisure have now become an increasingly deeply felt aspiration and need, resulting in a deeply rooted social requirement."

Figures compiled by the World Tourism Organisation (2) show that, world-wide , more than 500 million workers are entitled to paid holidays and that:-

> "... taking into account the average size of family, the total number of people associated with that number of workers, who go on holiday by virtue of the entitlement to holidays with pay, amounts to more than 2 000 million."

Many leisure activities either directly or indirectly, involve travel, and concentration of these activites requires the transport planner to place a greater emphasis (and therefore understanding) on this trip purpose. Some of the constraints inherent in conventional transport planning will be relaxed in this different context. For example, the journey to work or to school has to be made whatever the weather. Once the location of the home is chosen, such trips have to be made, at least in the short and medium terms, no-matter how the cost of travel, or the quality of services provided may change. Clearly there is a far greater element of choice in the decisions involved in the making of leisure trips. It is also apparent that whilst travel has a disutility in conventional transport planning applications, when a leisure activity is the reason for making the journey, the trip itself may have a net positive value to the trip-maker.

The trip may no longer be constrained by the choice of "quickest" or "shortest" or "cheapest"; such factors as comfort, quality of service and terminal facilities may assume increased importance.

Perhaps of even greater importance than the phenomenological changes implied by such considerations is a recognition of the role of socio-economic, political and demographic changes and their incorporation in the modelling process. This appears to be particularly important in planning for more than, say, 5-10 years hence where changed circumstances may be dictated by random and unpredictable events. Plans must therefore incorporate sufficient flexibility to allow revision and/or updating over this time scale. This can be achieved by analysing a range of longer-term possibilities. Short-term decisions must not be allowed to prejudice long-term requirements. Transport planning can no longer remain a purely traffic-functional process but must be organised as an integral part of a much broader context. In the past, particularly in relation to growing urbanisation, the pace of technological and social progress has outstripped the speed with which planning, in general, has been able to respond, partly because no such variables were incorporated in the planning models. In the context of tourism and leisure travel such an approach has clear implications for the influence of transport on regional development (and vice-versa), in the same way that the major urban transport plans of the 1960's aimed to provide information to assist overall planning. An optimum overall social return on investment is now the sought-after criterion based on society's total requirements and expectations rather than mechanistically optimising the operational characteristics of the system. Such an approach requires the incorporation of values which attempt to describe the economics of consumer behaviour (in relation to travel), psychology of choice, and identification of the decision variables in travel choice situations. Whether, or not, models produced in this way are behaviourally sound or policy-relevant, their conceptual framework is more flexible thus permitting examination of a wider range of issues than conventional sequential models. A more flexible "modular" structure allowing easy partitioning of the model, so that individual elements can be amended without an overall reformulation, may produce a less satisfactory initial version but prove to be more useful over a period of time.

To capitalise on this approach the most relevant parameters must be identified. For instance, the different requirements and aspirations of the generations reaching adult-hood in the postwar era distinguish them (especially in relation to leisure and travel, in the present context) from their forefathers. Until the most recent years, continuous economic growth has produced an expanding "middle class", a group in which sharp inter-generation differences in value priorities are particularly apparent (3), yet one which previously had steadfastly upheld traditional values. Whilst more modest economic growth rates are probable in the foreseeable future they may still produce aspirations to new life styles and are unlikely to bring a halt to technical innovation in either transport systems or the associated infrastructure. The recognition of such developments must therefore be incorporated in behavioural models since indications are that they will have a significant impact on mobility and the motivating factors of travel. This type of approach may well give rise to a range of projections rather than the prediction of a single, most probable state. To some extent the air transport industry already adopts a dual approach - the "conventional" and the "modern marketting" outlooks (4).

There can be no doubt that tourism will remain an expression of individuality in terms of choice and availability of destination, transport and accommodation. Todays world witnesses far-reaching socio-economic, political and demographic change. It is important that the modelling process should incorporate some assessment of these factors, and be readily adaptable to changing values and situations. Such considerations lead one to question whether transport planning methods developed in the more conventionally accepted framework will be the most appropriate tools in a leisure-dominated market, or whether such circumstances require the development of new techniques for their effective description and prediction.

2. CHOICE OF STUDY AREA

Whilst the transport system in virtually any area includes an element of recreational trips, generally these are a small proportion of the total trips being studied. Not only may there be difficulties in isolating them, but there may also be a wide variety of recreational activities possible in the area, and their individual attractions will need to be unravelled if the study is particularly interested in this group of trip-makers. If the purpose is specifically to examine one or more aspects of recreational travel then clearly it is logical to seek an area where this trip purpose dominates the market. Some earlier work (5, 6) has been undertaken on one such area, the Southern Aegean region of Greece, and this was considered a suitable study area for the present project.

The Aegean islands are served by a fleet of approximately 60 passenger vessels which carried some 4 million passengers in 1979 (7). All are privately owned or belong to small companies based on the islands. Most are old with low standards of accommodation. The passenger and car ferry network offers a low-price service (compared to international standards) with a varied level of service. The latter ranges from seven services per day to some islands, to one every other day in the case of those islands remote from Piraeus, the port of Athens. In addition a fleet of high speed hydrofoil vessels was introduced in the mid-1970's connecting Piraeus with some of the more popular islands in the vicinity of Athens. There are now more than a dozen such vessels operating providing passenger-only services. On inter-island services some areas of the Aegean are served very well while other connections are difficult and require long indirect itineraries. During the peak summer period services to the most popular islands are fully utilised with congestion building up to a peak in early August. Throughout the area, winter frequencies are substantially lower with smaller islands becoming practically isolated and, in some cases, even services to bigger islands being discontinued. Also services become unreliable due to very bad weather conditions, the Aegean experiencing some of the roughest sea conditions in the Mediterranean.

Air transport consists of a network of services strongly centred on Athens with very few inter-island services. In general, main services are frequent and regular, although aircraft availability is dependent on the needs of the international routes which they also serve. All services are fully utilised during the peak summer period, again with congestion problems appearing in August. Services, however, are substantially reduced during winter months.

The level of service (air plus ship) which any tourist-attracting island receives during summer, primarily depends on the impact of tourism and not on geographical or social characteristics of the islands. Some of the islands have poor accessibility because of a low frequency of air/sea services, especially during winter time. Another problem is that of high traffic volumes resulting from tourism seasonality and creating peak summer congestion. This has an adverse effect on tourism in stopping potential trips from being made. In addition to the age of the vessels, other problems specific to sea transport include too many en-route stops, inadequate port facilities and few inter-island services.

The study region was finally defined as the central Aegean area, including Athens/Piraeus as the most important mainland zone. Five mainland resort centres located on the Peloponnese coast were also included due to the NSSG data on Shipping Statistics (8) classifying them together with the islands. These mainland centres have been defined as zones in the same way as the islands. The present paper deals exclusively with trip distribution within this region.

3. MODELLING OF TRIP DISTRIBUTION

Because of the importance of trip motivation in a leisure context, considerations led towards the group generally known as synthetic models. Such models attempt to incorporate causal relationships behind patterns of movement by postulating similarities to laws of physical behaviour basically the gravity and opportunities models. Whilst possibly having a stronger behavioural basis than aggregate models, the more recently developed disaggregate forms could not be considered since no disaggregate data base exists for the area. In contrast to growth factor methods, both the gravity and opportunities models incorporate network effects. Also, they can be calibrated on a single characteristic such as distance. They have a conceptually stronger basis than the growth factor models and, in that respect, the intervening opportunities model has been considered (9) superior since it is the only one which attempts to model a physical process by finding cause and effect, and simulating the interaction between them.

Considering the advantages and disadvantages of available model types, it was evident that the choice rested between the gravity and intervening opportunities models as the most suitable and conceptually based. The competing opportunities model was excluded because its structure is less suitable with regard to the peculiarities of the region, namely that the characteristics of Piraeus as a "zone" are quite dissimilar to those of other zones. All trips regardless of mode are distributed to the zones from Athens/Piraeus contained within both sub-regions. Tourists must necessarily stop there in order to choose their end-destination within the study region and between the available modes. An exception are cruise- and charter-flight passengers as well as others using private means, none of which are considered in this study. Thus Athens/Piraeus will be regarded as a "dummy" zone, for those trips originating outside the study area (other countries or elsewhere in Greece) and having a final destination within the region. It is evident that those tourists are bound to return to Athens/Piraeus after completing their holidays before leaving the region.

Several factors justify the final selection of the intervening opportunities model as the most appropriate.

i) The peculiarity about the region in as much as Piraeus is concerned does not allow any socio-economic factors of the origin to enter the model form. Such factors would introduce a strong bias in the calibration process as Piraeus attracts tourists from the zones, mainly due to the unavoidable "return" part of their journey through Piraeus/Athens. Socio-economic factors related to Piraeus, if used, clearly would not reflect its attracting power as a tourist receiving centre so much as its importance as a commercial attracting pole. Furthermore, it would be difficult, if not impossible, to isolate the minor recreational infrastructure component of Piraeus and relate it to a socio-economic factor, the value of which would also be quantifiable on a scale common with that of the zones in question. In that respect the simple probabilistic structure of the intervening opportunities model has appeal as it does not require a knowledge of socio-economic factors for its calibration.

ii) The intervening opportunities model has a strong conceptual basis in attempting to address the problem of individual behaviour, thus offering potential as a mechanism of deriving behavioural results.

iii) The intervening opportunities model is sensitive only to the ordering of zones according to a measure such as time or distance and not to the value of time or distance involved. This appears to provide a promising basis in the case of a tourism-dominated area because it allows the construction of a special parameter defining the ordering of zones. In the process of choosing a holiday resort, tourists are not only sensitive to such factors as travel time or service offered but are also seeking to satisfy their needs in relation to leisure activities (demand) and thus are sensitive to the facilities available at potential destinations (supply).

iv) A base year origin/destination trip matrix is not available for the study area, so it is desirable to use a model which can be calibrated in some other way. The intervening opportunities model offers this capability.

The first application of the model in urban transportation planning was in the Chicago Area Transportation Study (10). The concepts of the model are, to a large extent, based on assumptions about individual behaviour in choosing possible destinations for a specific trip. Two hypotheses offer the basis on which it is built:

a) minimisation of total travel time from a point, subject to the condition that, if a destination is considered, a stated probability exists for its acceptance;

b) the probability of acceptance of a considered destination, is constant and does not depend on the ordering of potential destinations.

The number of trips, T_{ij}, between specific origin and destination zones will be equal to the total trips emanating from the origin, O_i, multiplied by the probability, $P(D_j)$, that each trip from origin i will find an acceptable terminal at destination, j. This can be expressed as:

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$$T_{ij} = O_i P(D_j) \qquad [1]$$

D_j (total destinations at j) is used because it is the model's assumption that two zonal characteristics determine the probability of acceptance of a destination. They are the size and the order in which the destination is encountered as trips proceed away from the origin. $P(D_j)$ may also be expressed as the difference between the probability, $P(V_{j+1})$, that the trips originating at i will find a suitable terminal in one of all destinations, ordered by closeness to i, up to and including j, and the probability, $P(V_j)$, that they will find a suitable terminal in all destinations, up to but excluding j. This is expressed as:

$$T_{ij} = O_i[P(V_{j+1}) - P(V_j)] \qquad [2]$$

A formulation of the function P is then possible. The probability that a trip will terminate within some volume of destination trip ends equals the product of two probabilities:

a) the probability that, within this volume, there is an acceptable destination;

b) the probability that an acceptable destination closer to the trip origin has not already been found.

This leads to a differential expression which when integrated becomes:

$$-\ln(1 - P) = LV + k \qquad [3],$$

for constant L and k, and the solution of which is:

$$P = 1 - Ke^{-LV} \qquad [4]$$

where $K = e^{-k}$

Hence from [2]:-

$$T_{ij} = KO_i(e^{-LV_j} - e^{-LV_{j+1}}) \qquad [5]$$

The constant K, can be evaluated by using the first trip conservation rule (i.e. $\Sigma_j T_{ij} = O_i$). If there is a total of n zones, then application of the rule leads to:

$$\sum_j T_{ij} = KO_i(1 - e^{-LV_n}) = O_i$$

and

$$K = \frac{1}{1 - e^{-LV_n}} \qquad [6].$$

It is clear when considering equation [6] that it only becomes internally consistent when n and therefore, V_n, become very large. Although this condition may rarely be encountered in practical situations it implies that, the larger the number of zones and opportunities in the study area, then the more valid will be the model's application. Whilst the model has been constrained to satisfy the first of the trip conservation rules, it does not satisfy the second (i.e. $\Sigma_i T_{ij} = D_j$). If necessary an iterative balancing process can be applied to approximate this constraint. In applying the model to an actual study area, V_j is commonly equated to the number of destination trip ends in each of the zones passed before arrival at the jth zone.

The model form finally selected is that of equation [5] relying on a calibration procedure that allows the determination of L and the specific value of K for a finite number of zones, whilst acknowledging that this implies a relaxation of a theoretical constraint of the model.

4. CALIBRATION OF THE MODEL

Equation [3] incorporates the two hypotheses inherent in the derivation of the intervening opportunities model and provides a linear relationship when $-\ln(1 - P)$ is plotted against V. This line will have slope L and an intercept k. The estimation of P and V permits values of L and k to be found by regression analysis. Such an approach provides a simple calibration method that does not require an iterative procedure. What is necessary, however, is to define values of P. Data included in (8) has been used for the calibration. This data is classified in the form of 13 major "lines", representing different shipping services assembled into 13 major categories rather than into conventional shipping lines. Monthly figures of passengers embarked and disembarked at each port are provided as well as totals for the year. Of the 13 "lines", 7 contain the movements within the Aegean island area and, of those, 6 (subsequently listed in Table 3) have been used for the calibration process. Data for the seventh (Piraeus-Crete), already exists in a trip origin-destination form.

In the linear regression analyses P has been taken as the ratio of arrivals at destination ports (classified in the Shipping Statistics as "Disembarked"), to total leaving the origin (classified as "Embarked") and V as the number of arrivals at each port representing the number of destinations in each zone. Total traffic volumes during the peak-summer period, June-September, have been used for calibration. This is the period when all tourist and transport facilities are operating thus providing the widest range of choice and the most suitable conditions for a study involving behavioural values. Also irregularities in travel patterns (such as special fare contracts) are more likely to be levelled out over the whole peak summer period.

The trip distribution process focusses on flows originating exclusively from Piraeus. For the ordering of zones required in the model's evaluation, time (originally assumed to be the ranking measure) has been replaced by COMP, a composite parameter consisting of two factors, each considered to exert an influence on the tourists' trip choice. These have been called the "tourist infrastructure factor", TIF, and the "access impedance factor", AIF.

In considering an appropriate composition of TIF, a range of tourist-related variables were examined. Some of these, (e.g. number of shops, number of tavernas) proved unsatisfactory mainly because the local-customer element could not be separated. However, hotels on the islands do cater almost entirely for tourist demand and the best correlation with arrivals in each zone during the peak summer period was obtained with number of hotel beds, (correlation coefficient 0.79, see Table 1) and this was subsequently used as the single variable determing the TIF.

The formulation of AIF is somewhat more involved; it is a function of "time-level of service" characterising the accessibility of a zone from Piraeus. Low values of AIF indicate a reduced impedance, i.e. improved accessibility. Zones in a "line" have been classified into two categories, those served by the leading shipping service in that "line" (operated by better ships, and preferred by the majority of travellers as being more reliable and quicker), and the few remaining zones served by less important shipping services. The AIF of each "leading" service island is assessed by:-

(i) It's time sequence from Piraeus (number of stops, S, en-route to the zone) weighted according to the total number, N, of stops in the shipping service and summed over all services, G.

$$\left(\sum_{1}^{G} S/N\right)$$

(It is evident that the more stops made en route to the zone, the less important it becomes as traffic will have been distributed over more zones).

(ii) It's service frequency obtained by dividing the above value by the number of weekly services.

Hence:-

$$\mathrm{AIF} = \left[\sum_{1}^{G} (S/N)\right]/G \qquad [7]$$

The AIF values for the second category of zones (served by the less important shipping lines) have been determined simply on the basis of the number of weekly services, i.e.

$$\mathrm{AIF} = 1/G. \qquad [8]$$

Whilst this appears to be a coarse estimation it has to be borne in mind that these zones attract relatively few tourists from those "lines".

Having evaluated TIF and AIF, each zone can now be given an integer ranking number (H for TIF, and M for AIF). H is determined simply on the basis of decreasing number of hotel beds: M is determined first for the leading-service islands on the basis of increasing AIF calculated from [7], then for the remaining islands on the same basis but calculated from [8]. Evaluation of COMP, the composite parameter determining the final overall ranked order of each zone, can now be approached by applying as-yet undetermined weighting factors, W1, W2 to the H and M values previously determined. Thus:-

$$(\mathrm{COMP}) = (W1 \times H)+(W2 \times M) \qquad [9],$$

the final ranking depending on the specific values of W1 and W2 chosen, which reflect the relative importance of tourist infrastructure and level of service for each "line". This ranking will determine the sequence from the origin in which zones are successively considered by the model, that with the lowest COMP being considered first, the second lowest next, and so on. The question arising now is:

> "What values of W1 and W2 assign the appropriate influence of the TIF and the AIF in a "line" and allow for the evaluation of the final calibrated zonal order and end results?"

There is no origin-destination matrix available for the calibration year (1978) nor for any year in the past. However earlier work on the region (5, 6) and a number of other considerations provide some assistance. Those considerations are:

i) the most rational sequence of zones according to their importance as tourist attracting centres and their location on a "leading" shipping service. The order of the first and second zone in all "line" cases is clearly predefined due to their special attributes as holiday resorts.

ii) the ratio of trips attracted to the first zone to the number of trips between Piraeus and that zone, [D(1)/T(P1)]. In most cases the first zone attracts virtually all its tourist volumes from Piraeus (11). Accordingly this ratio should be close to unity;

iii) a comparison of volumes attracted to the zones and the estimated origin-destination numbers. The sequence of the former provides an estimate of the sequence of the latter.

The combination of W1 and W2 that produces end results matching the above set of conditions will provide estimates of the varying influence in "lines" of the TIF and AIF.

Another requirement was to isolate the non-recreational traffic during the four month summer calibration period from the main bulk of recreational traffic. To do this the "surplus traffic" hypothesis proposed by Duffield (12) was applied. It states that levels of non-leisure summer traffic represent mainly "utility" traffic which can be expected to maintain a relatively constant level throughout the year. This suggests that the average monthly traffic in the winter period can be viewed as a background level of "utility" traffic on which the summer tourist and recreational traffic is superimposed. The theory appears suitable and applicable in the study region where there is no recreational travel occurring during the November to February period, which would otherwise enter the "utility" flows and disrupt the results. Hence the average monthly traffic for each zone for those four winter months has been subtracted from the corresponding monthly summer figures. The calibration procedure has used the remaining recreational volumes.

In most cases not all available origins were accounted for by the model. This is a consequence of the assumption that the total number of destinations should be very large. However, as this is not the case in most practical situations, some 10-20% (13) of the origins from a zone may remain undetermined. Also a higher proportion of trips to the first zone has been observed, something not uncommon to find when using the intervening opportunities model (9), due to the (often unjustified) assumption of a uniform trip-end density. This, however, has tended to compensate what would otherwise be the models underestimation in the case of the most important zones.

An example of the calibration stage is given in Table 2 for the Piraeus-Chios-Mytilini "line". Determination of H and M is as described previously. It is convenient to keep one of the two weighting factors constant (in this case W2 is kept equal to 1) whilst allowing the other to fluctuate between zero and infinity until the value is found producing values of COMP in agreement with the islands' 'order-of-importance" established from qualitative and/or empirical considerations. (It is important that all values of COMP in a "line" are different; otherwise the ordering of zones would remain undetermined). In this "line" there are two predominant considerations. Chios is known to be the most important tourist-attracting island in the "line" followed by Mytilini. Third and fourth come Tinos and Limnos, both served by less important services. Tinos is recognised as being a more important tourist centre than Limnos due to the fame and festivities of the local church. This ranking order has been achieved for $[W1/W2] \leq 0.91$ providing only an upper limit for that ratio, and indicating that the AIF's influence in the ranking procedure is at least 1.1 times higher than that of the TIF. (The values included in Table 2 correspond to $W1 = 0.6$). Clearly in these circumstances it is only possible to determine a range in which W1/W2 must lie. This is due to the unavailability of a base-year data set which would otherwise define a unique value. In general terms the range of possible values becomes smaller as the number of zones in a line increases, this being due to the additional constraints imposed by the necessarily more detailed qualitative assessment in establishing the desired ranking. Thus, for example, the possible range established in the case of the Piraeus-Dodecanese "line" (11 island zones) was 1.7-2.9 and, for the Piraeus-Mykonos-Samos "line" (8 island zones), 1.1-1.9 (see Table 3). In practice these ranges were determined by repeatedly re-running a computer program with different relative values of W1 and W2 inserted until the required ordering was produced. Any ratio within the defined range leads to the same ordering of zones and hence to the same output from the model.

5. VALIDATION AND DISCUSSION

Validation of the calibrated model is limited by data availability. At the time of this study the 1978 data used in the calibration was the latest available. Similar annual data was obtained for 1974 onwards. However both 1974 and 1975 were marked by political instability and economic crises in Greece and these factors undoubtedly affected tourism in the region. The most suitable data, therefore, on which to validate the model was from 1976. It must be acknowledged from the outset that only one intervening year between calibration and validation is far from being an ideal basis for such a comparison. Nevertheless some useful indications, if not conclusions, can be drawn.

The results of recalibrating the model with 1976 data are presented in the last two columns of Table 3. Not surprisingly, over the 2-year period there were no changes in any of the zones sufficiently significant to alter the ordering within a "line", although in the case of the Piraeus-Cnios-Mytilini "line", there was no 1976 shipping service data available for

Limnos so this zone had to be excluded. There were similar "quirks" in the Piraeus-Mykonos-Samos and Piraeus-Dodecanese "lines" necessarily causing reductions in the number of zones which could be considered.

In general the 1976 results are very similar to those derived in the original calibration year and this is encouraging, if not conclusive! A number of specific points are worthy of comment. The most apparent is the changing relative importance of TIF and AIF from "line" to "line". The way in which (W1/W2) changes between "lines" indicates a larger influence of AIF (over TIF) for values less than 1 and of TIF (over AIF) for values greater than 1. In "lines" where, through the weighting procedure, the AIF parameter becomes more important than the TIF, no lower boundary exists for (W1/W2) indicating that this value provides only a lower limit of the real influence of AIF. The fact that (W1/W2) is not constrained between two values can be explained by the theoretically unlimited range of possible improvements in technology over time. Thus the value of the lower limit of AIF's influence provides only an indication of existing patterns in the particular "line" where improving conditions are indicated in increasing order of (W1/W2) values. Thus the distribution of trips on the Piraeus-Peloponnese "line", low (W1/W2), is most affected by the large distances and unsettled shipping services coupled with a relatively undeveloped tourist infrastructure. The same factors are probably also responsible for the least satisfactory [D(1)/T(P1)] ratios, the lowest of any "line" examined. The low value for this "line" suggests that there would be little point in developing the tourist infrastructure of the region without improving access by improving the transport network.

Lines on which (W1/W2) > 1 generally have ranges bounded by upper and lower limits. This is interpreted as offering further validation of the models behavioural basis since there will always be capacity limitations to the potential development of tourist-related facilities in any area. Increasing tourist infrastructure development produces increased (W1/W2) values. In the case of the Argosaronikos "line" however a single value (of 1.4) has been obtained in both years. This is considered as indicating that the tourist infrastructure of those zones close to Athens has already reached a "saturation" state, an indication empirically validated. On this basis further proposed development should be seriously questioned since it would lead to a degradation of the state which tourists may currently be regarding as optimum, i.e. the upper limit of influence of the TIF parameter in the model has been reached. Following that line of thought, it is rational to assume for all other "lines" where the TIF parameter has a higher influence than the AIF, with [W1/W2] taking values between an upper and lower limit, that the exact value assigning the true influence of the TIF parameter in the particular "line", could either be the lower limit or some value between the two limits. In that case there is still potential for tourist infrastructure development on islands belonging to such "lines". The model also appears to exhibit rational behaviour when comparing two such "lines", the lower limit always taking a smaller value for the "line" with the less touristically developed islands. In the case of the Dodecanese "line" the exclusion of Sifnos and the non-availability of beds in Symi explain the wider range of [W1/W2] values in 1976 because of an increased potential for further development in that year than two years later (in 1978 a part of Symi had begun to undertake the development of tourist-related facilities). Also in the Piraeus-Mykonos-Samos and Eastern Cyclades "lines" the [W1/W2] ratios between 1.1-1.9 can be explained by the modest state of development of the tourist sector in both of them.

Finally, the only opportunity of testing the model's predictive power in a "what if?" situation is on the Peloponnese "line". Here, in addition to the conventional steamship service, there is also a fleet of hydrofoil offering an alternative improved transport network. Three zones have been utilised (the only available on that "line") two of which already appeared in the 1976 and 1978 conventional services and a third, Leonidion, belonging to the same area covered by the Peloponnese "line", but exclusively connected with Piraeus by hydrofoil. The results for 1978, whilst still suffering from the disadvantage of being based on a very small number of zones, nevertheless indicate an upper limit of 0.90 in the ratio of [W1/W2] which correctly captures the much improved, more convenient sea transport network introduced. The higher influence of the AIF parameter over the TIF has been considerably reduced when compared with previous results (upper limits of 0.30 and 0.40 respectively for the two years) relevant to the less efficient shipping service.

6. CONCLUSIONS

This work has shown that a modified form of the intervening opportunities model can successfully be used to distribute cross-water recreational trips in the study area. The formulation of a composite parameter, replacing the traditional time or distance ranking, used in the ordering of zones has imparted an additional behavioural foundation to the model combining, as it does, measures of tourist infrastructure development (TIF) and accessibility (AIF). Both these functions have been expressed in simple terms and have been shown to produce a usable model. It is quite possible that they could be refined by incorporating additional (or alternative) variables. Nevertheless, in their present form they contribute to a model capable of providing guidance to decision-making in a range of investment, or policy-oriented, questions.

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Island	Arrivals	Hotels	Beds
Tinos	22 213	17	1 113
Chios	9 982	10	647
Aegina	24 861	42	2 198
Poros	14 781	14	1 139
Hydra	9 114	10	410
Spetses	10 240	10	705
Syros	11 259	16	592
Mykonos	25 453	28	1 382
Ikaria	1 362	13	644
Samos	17 890	28	1 472
Astypalea	293	2	58
Patmos	2 608	9	304
Leros	1 761	5	162
Kalymnos	3 011	13	406

Table 1 Peak Summer Arrivals, Number of Hotels and Number of Beds of Selected Islands.

Island	TIF	H	Service Type	AIF		M	Empirically-based ranking	W1 x H	W2 x M	COMP
Chios	647	3	Leading	(1/2 + 1/2 + 1/3)/3=	0.44	1	1	1.8	1.0	2.8
Mytilini	1048	2	Leading	(2/2 + 2/2 + 2/3)/3=	0.89	2	2	1.2	2.0	3.2
Tinos	1113	1	Other	1/4 = ..	0.25	3	3	0.6	3.0	3.6
Limnos	408	4	Other	1/1 =	1.00	4	4	2.4	4.0	6.4

Table 2 Determination of COMP and Final Ranking for Islands in the Piraeus-Chios-Mytilini "line". (W1 = 0.6, W2 = 1.0)

"Line"	1978 data			1976 data		
	No. of Zones	W1/W2	D(1)/T(P1)	No. of Zones	W1/W2	D(1)/T(P1)
Piraeus-Chios-Mytilini	4	≤ 0.91	0.868	3	≤ 0.91	0.748
Piraeus-Dodecanese	11	1.7-2.9	1.003	9	1,4-2.9	0.993
Piraeus-Mykonos-Samos	8	1.1-1.9	0.980	6	1.1-1.9	0.935
Piraeus-Eastern Cyclades	7	1.1-1.9	0.999	7	1.1-1.9	0.997
Piraeus-Peloponnese	6	≤ 0.30	0.721	6	≤ 0.40	0.930
Piraeus-Argosaronikos	6	1.4	0.924	6	1.4	0.923

Table 3 Model Calibration using 1978 and 1976 data.