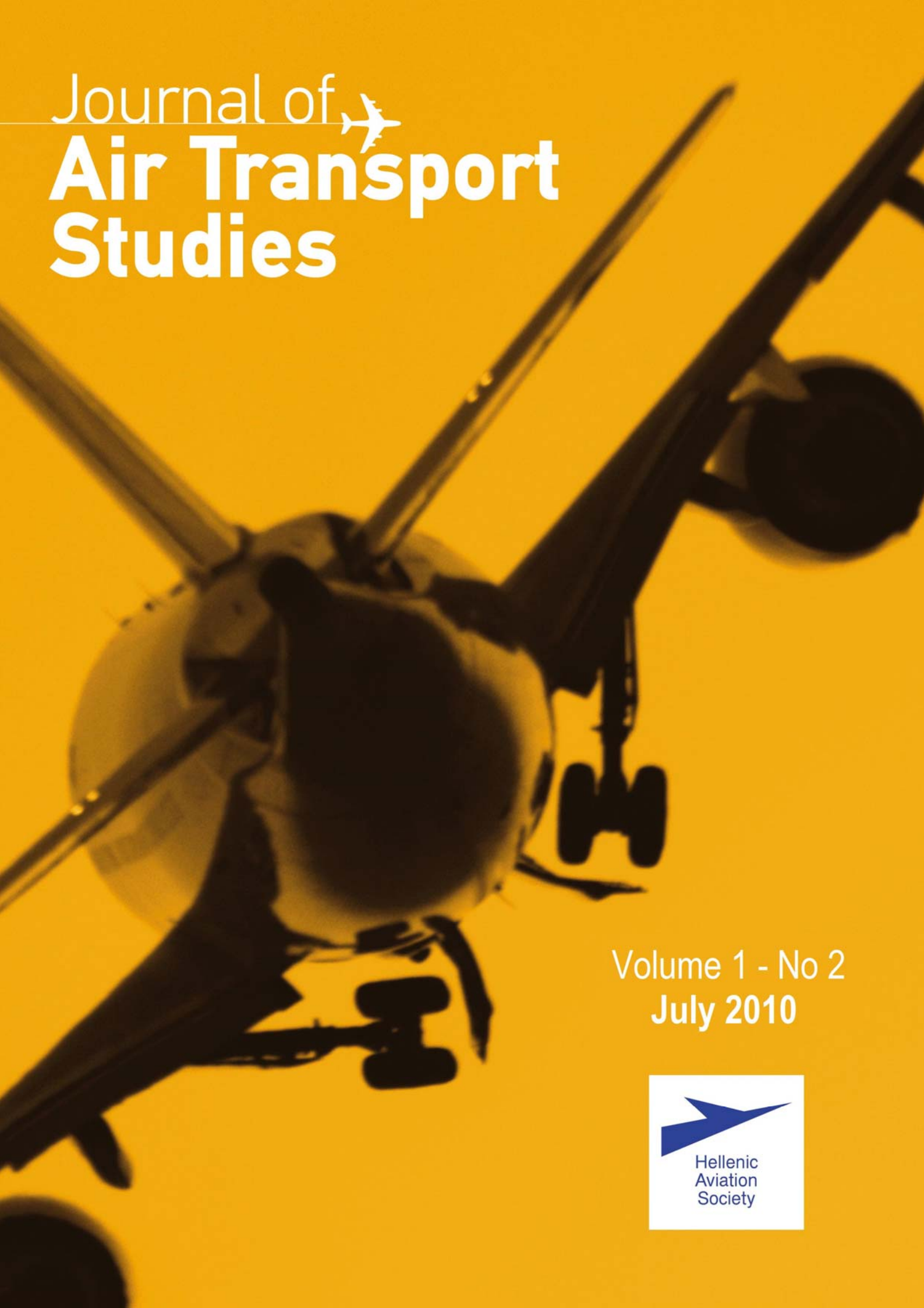
Journal of Air Transport Studies



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The *Journal of Air Transport Studies* (JATS – ISSN: 1791-6771) is a peer reviewed journal aiming at publishing high quality research related to air transport. JATS is interested in publishing papers primarily focusing on economics, geography, policymaking, management, marketing, operations, technology, logistics/supply chain management and modelling.

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Journal of Air Transport Studies (JATS)

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Full Research Papers should contain original research not previously published elsewhere. They should normally be between 4,000 and 7,000 words although shorter or lengthier articles could be considered for publication if they are of merit. The first page of the papers should contain the title and the authors' affiliations, contact details and brief vitae (of about 50 words). Regarding the following pages, papers should generally have the following structure: a) title, abstract (of about 150 words) and six keywords, b) introduction, c) literature review, d) theoretical and/or empirical contribution, e) summary and conclusions, f) acknowledgements, g) references and h) appendices. Tables, figures and illustrations should be included within the text (not at the end), bear a title and be numbered consecutively. Regarding the referencing style, standard academic format should be consistently followed. Examples are given below:

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Book Reviews should be between 1,000 and 1,500 words. They should provide factual information (e.g. book publisher, number of pages and ISBN, price on the publisher's website) and critically discuss the contents of a book mainly in terms of its strengths and weaknesses.

Industry Perspectives should be up to 1,000 words and provide a practitioner's point of view on contemporary developments in the air transport industry. Contributors should explicitly specify whether their views are espoused by their organization or not.

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company, the preferable destination, and their alternations in travelling behaviour. The technique undertaken in order to reach the objectives is personal – structured interviewing, and a random starting method was also selected in order to reach the respondents. For better comprehension of the perspectives' formulation there was an analysis of five socio-demographic characteristics (gender, age, level of education, marital status, and travel frequency). The results provide interesting outcomes concerning the degree of the perceived risk factors that tourists take under consideration for their decisions. Furthermore the paper suggests for decision makers further policies that can be undertaken in airlines and destinations.

Editorial

This second issue of the *Journal of Air Transport Studies* includes five carefully selected papers covering various topics. **Pavlovic** proposes a model of airline schedule optimization to minimize the negative effects of disruptions. The model considers a number of constraints and also undertakes sensitivity tests. It may prove useful for network planning especially in the context of the current economic crisis.

Subsequently, **Lee, Jeon and Lee** focus on communication effectiveness improvements regarding air traffic controllers. Mutual trust proves to be very important in this job in conjunction with job satisfaction and remuneration. Issues of human resources management such as team building and the creation of high performance teams can improve effectiveness and reduce unit costs of air traffic management.

In the following contribution, **Mao** studies competition between air and rail on the Beijing – Shanghai route, one of the thickest in China. The case study somewhat resembles a similar situation experienced between London and Paris in Europe and has important commercial implications also regarding consumer welfare.

In the fourth paper **da Rocha** and **de Araujo Junior** adopt a legal approach to highlight issues of civil responsibility in air transport with respect to disaster management and liability. The various stakeholders may prove to be jointly held responsible in a legal conundrum given the international character of the airline industry.

Finally, **Pappas** focuses on the implications of terrorism for airline and tourism destination choice. The paper highlights the important risk factors considered by the potential tourists and suggests suitable policy measures to effectively deal with crises.

May we take this opportunity to thank all our authors and referees for their support in publishing this second issue of our Journal. Enjoy reading!

Dr Andreas Papatheodorou, Editor-in-Chief

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Sensitivity analysis of airline schedule optimization (ASO) advanced model

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ABSTRACT

The ASO model provides a proposal for a new flight schedule, in situations when a carrier's flight scheduled is disrupted, and which would minimize the negative effects of the disruption. The objective function of the model is a mathematical formulation of the company's goals and preferences, where all assumptions and operational constraints must be satisfied. The disruption costs are given in weighted coefficients which present the penalties that can be changed by the dispatcher. One of the goals was to test to what degree the generated solutions are sensitive to changes in penalty values.

Keywords: sensitivity analysis, model, penalties, flight schedule, perturbation, airline profit

1 INTRODUCTION

The daily schedule, handed to the dispatchers at the airline operations control centre in charge of observing its realization, is a set of aircraft and crew routings for a one-day time period. In addition to observing the daily schedule realization, dispatchers must deal with disruptions that may jeopardize the execution of airline's planned operations and cause flight delays and

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cancellations, which may further incur direct and indirect operational costs to the company[1]. Taking all this into account, the successful running of the daily schedule is a very complex and demanding task for dispatchers.

Depending on the airline's policy, dispatchers at the operations control centre react to disruptions in different ways, but with the same goal: to minimize the negative effects on the realization of airline's planned operations. In order to minimize the negative effects of disruptions, the dispatcher is expected to create a solution and take appropriate action to implement the solution within a very short time period, i.e. in real time, such as flight delays, flight cancellations, substitution of aircraft in realization of certain flights, using spare aircraft from the fleet for realization of planned operations, etc. The complexity of the disruption problem increases when dispatcher has to deal with a larger number of flights and rotations.
This is why the need for computational methods and techniques arises. The implementation of these methods and techniques in the decision-making process should facilitate the creation of permissible and economical solutions within an acceptable period of time. This helps dispatchers in their work by accelerating the decision-making process and increasing the quality of decisions made.

An example of such software is the Airline Schedule Optimization (ASO) Advanced software which has been developed at The Faculty of Transport and Traffic Engineering, University of Belgrade (Institute of Faculty of Transport and Traffic Engineering, July 2002 - January 2005). The software is based on a model, and both (software and model) have the same goal: to provide a solution within a short period of time to create a new flight schedule in situations when the carrier's scheduled activities are disrupted, which would minimize the negative effects of the given disruptions.

1.1 ASO ADVANCED SOFTWARE

The ASO Advanced software is based on a mathematical model and heuristic procedure (Nedeljković, 2004). The proposed mathematical model and heuristic procedure are defined to calculate the objective function (the airline's profit of a new flight schedule) which is a

[1] Technical breakdown of aircraft, crew shortage, tardiness of crew and passengers, ATC constraints and restrictions, bad meteorological conditions, etc.

mathematical formulation of the company's goals and preferences, where all assumptions and operational constraints must be satisfied. The aim of the objective function, and the number of assumptions and constraints taken into consideration in the model's process of creating solutions, depends on the user's preferences, hence it is possible to alter them, depending on the exact goal that is to be achieved.

The current version of the ASO Advanced software is based on the objective function of a mathematical model which maximizes the airline's profit and needs, and where all assumptions and operational constraints must be satisfied. The defined assumptions and operational constraints are based on different resources such as: number of aircraft, number of passenger seats, airport working hours, maximum allowed delay time, etc.

The objective function of the ASO Advanced model is determined in such a way that in the case of disruption, it maximizes the difference between revenues from sold passenger tickets on all flights and pondered costs that include: direct and indirect operational costs of assigning aircraft to flights, priority flight cancellation costs, flight delay costs, non-priority flight cancellation costs, aircraft maintenance disruption costs and aircraft balance disturbance costs (if at the end of day the aircraft are not at the planned airports).

Airline Profit = Revenue – (Total Operational Costs + Priority Flight Cancellation Cost
+ Non-Priority Flight Cancellation Cost + Flight Delay Cost +
Maintenance Disturbance Cost + Aircraft Balance Disturbance Cost)

The assumptions and constraints significant for this particular research, among others, are: the airline has different types of aircraft in its fleet (different seat capacities), ferry flights (flights without passengers) are not allowed, crew constraints are not considered, all flights have to be executed within the period when the airports are open, etc.

To attain solutions related to the company's interests by using the ASO Advanced model, i.e. to avoid unacceptable solutions, there are several penalties introduced in the model's objective function, and values and relations between them can also be changed, according to defined goals. Those penalties are:

- k_1 – penalty for flight delay (cost per minute of delay)
- k_2 - penalty for non-priority flight cancellation (cost per flight)
- k_3 - penalty for aircraft maintenance disturbance (cost per flight)
- k(i) - penalty for priority flight cancellation (cost per flight)
- kaz(l,k) - penalty for aircraft balance disturbance (cost per flight)

The value of these penalties is very difficult to measure and quantify, but their values and relationships have an important influence on what the final solutions will be. According to these, the most important task is to carefully determine the values of penalties so the proposed solutions by the ASO Advanced model are in accordance with the company's goals and preferences. Changing their values could lead to a change in the solutions generated by the ASO Advanced model.

It is important to notice that the value of the objective function (the airline's profit) is not significantly representative when validating the quality of the generated solution. The quality of the generated solution is measured by the number of cancelled flights, total delays, single flight delay, etc. To improve the software to present the real profit of an airline for the proposed solution (new flight schedule) it is necessary to provide software with complete and precise data.

The main task in this paper is to analyze how the values of the penalties influence the solutions generated by the ASO Advanced model i.e. how sensitive the generated solutions are to changing the penalties values. Also, it was possible to determine the range of penalty intervals within the solution is the same. Because of the nature of the problem, the entire analysis and all the solutions and conclusions are based on a concrete example and should be viewed in that way. In another words, every flight brings different profit to an airline so the penalty value will have different influence on them i.e. on generated solutions proposed by the model. In any case, this analysis can help attain at least approximate values of the penalties which can further help achieving the compliance of the proposed solutions with the company goals and preferences.

2 SENSITIVITY ANALYSIS

The sensitivity analysis is usually conducted after the determination of optimal solution, but if all the inputs are defined in advance it is possible to do it beforehand. The ASO Advanced model sensitivity analysis is tested on the flight schedule of a middle size European airline and all the flight data is known, with the exception of the values of the penalties which were estimated according to the policy of this particular airline.

For the purpose of sensitivity analysis, the basic solution was determined and accepted basic values of penalties were:

- $k_1=1$
- $k_2=10000$
- $k_3=5000$
- k(i)=20000
- kaz(l,k)=3000

Furthermore, it is defined that the maximum allowed flight delay is 300 minutes, according to the rules of the observed airline. This paper does no not consider how changing this value would influence the generated solutions.

For better understanding the model it is important to note that the first step in the algorithm is common for all solutions. In this step the model checks what kind of perturbation is in question, how many flights are affected and what type of flights they are (priority or non-priority). At the end of the first step, the model compares the maximum allowed flight delay with the delay of each affected flight, if those flights are going to be executed by the planned aircraft after the perturbation is removed. If the delay is longer then the maximum allowed delay for a given flight, that flight will be temporary cancelled. In the given example the delays of all affected flights are longer than the maximum allowed delay i.e. 300 minutes, so all the affected flights will be temporary cancelled. According to this, the penalties values have no influence on affected flights, in this first step. The only influence that they have is how the perturbation can be solved i.e. what the proposed solutions will look like.

In further steps, the model is checks whether the temporary cancelled flights can be assigned to some other aircraft in the fleet, complying with all defined assumptions and operational constraints. For each provided solution the airline's profit is calculated and all solutions are then ranked in descending order. The list of the feasible solutions is then presented to the user.
Further in the paper it will be presented how the airline's profit and proposed solutions vary by varying the value only one penalty while the rest of the penalties keep their basic values, the range of penalty intervals within the solution is the same and finally, limited values for each of the penalties which should not be exceeded to avoid an unacceptable solutions, in this case the solutions which do not comply with the policy of the observed airline. After the one-penalty variation sensitivity analysis, some of the results gained from the two-penalty variation sensitivity analysis will be presented, where now two of five penalties are varyed while the rest of the penalties keep their basic values.

2.1 EXAMPLE

The data used in this research is the real data from realized operations in the daily schedule of the observed airline during a one-week time interval (April 17-30, 2006). The data required for testing was made available thanks to the Information Technology Department of observed airline. The daily flight schedule is presented on the Figure 1.

Example. Technical breakdown on the aircraft B737-G, registration OELNO, from 5:00 AM till 5:00 PM, at Vienna airport:

- Disruption duration equals to 12 h, i.e. 720 min.
- Affected flights by disruption:
  - Priority flights: OS301 (VIE-CPH) and OS302 (CPH-VIE),
  - Non-priority flights: OS313 (VIE-ARN) and OS314 (ARN-VIE).

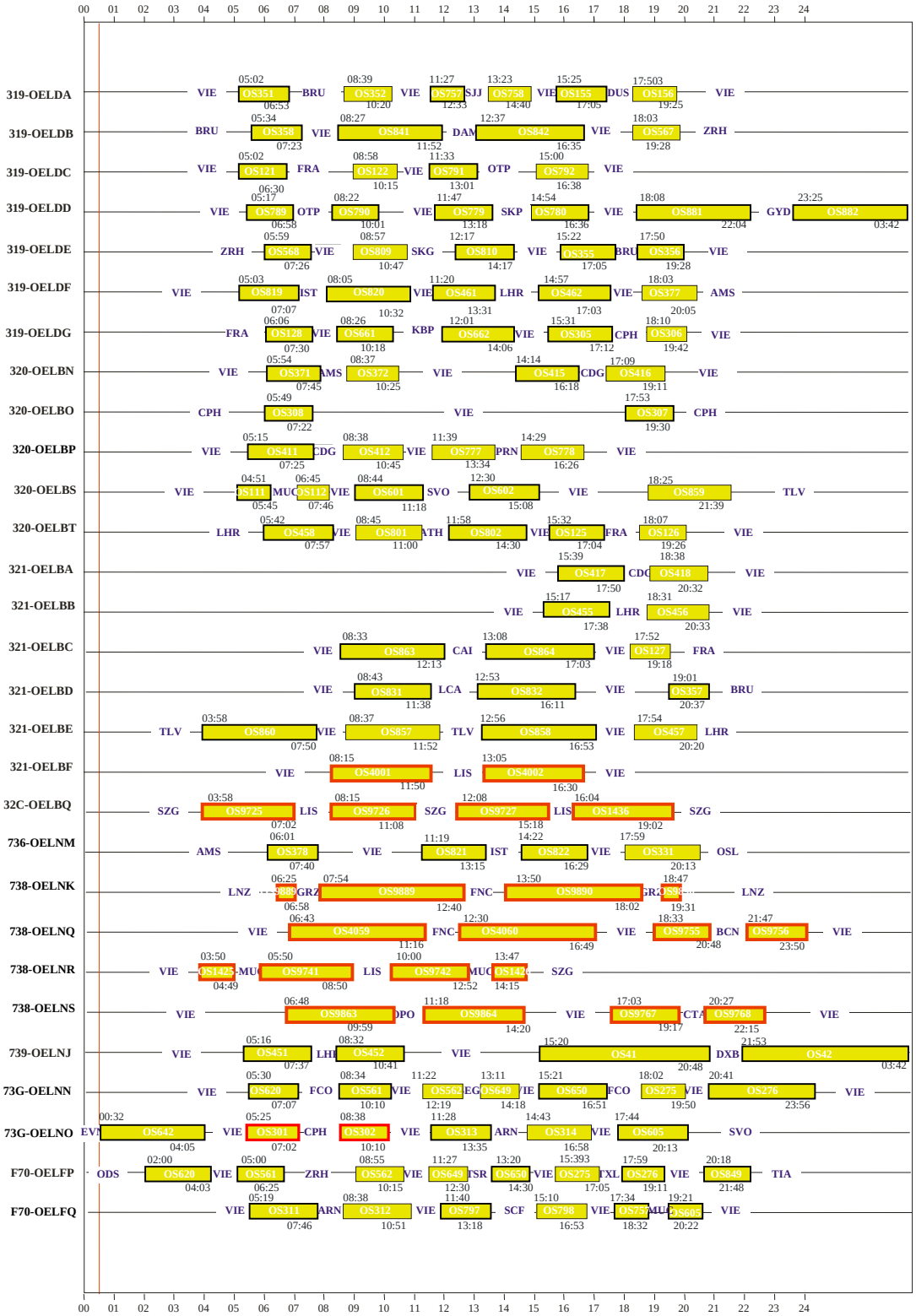


Figure 1. Daily flight schedule

Basic solution:

- Priority flights, OS301 (VIE-CPH) and OS301 (CPH-VIE), are reassigned to aircraft A319 - OELDB and are executed with delay (delay on flight OS301 is 163 min and 112 min on flight OS302)
- Non-priority flights originally assigned to aircraft OELDB (OS841, OS842 and OS567), are executed with delay (delay on flight OS841 is 260 min, delay on flight OS842 is 260 min and delay on flight OS567 is 217 min)
- Non-priority flights OS313 (VIE-ARN) and OS314 (ARN-VIE) are reassigned to the aircraft A320- OELBO and executed on time.
- No cancelled flights.
- The airline's profit is **F=139632.63**

2.2 ONE-PENALTY VARIATION SENSITIVITY ANALYSIS

2.2.1 PENALTY FOR PRIORITY FLIGHT CANCELLATION, k(i)

After the basic solution where k(i)=20000, the model was tested for a solution if this penalty is equal to zero i.e. if there is no penalty for cancelling the priority flight. Further, the analysis of the number of different solutions by varying the value of *k(i)* was carried out and also, the values when the solution is changed were determined. The values of *k(i)* used in the analysis and the airline's profit gained from the solutions as well as the solution reviews are presented in the following Table 1.

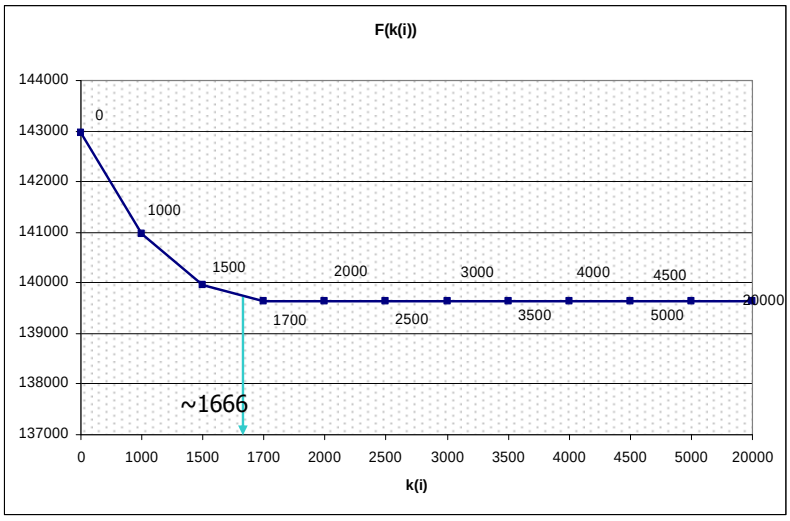
Table 1 The airline's profit and solution reviews for different values of *k(i)*

Penalty k(i)	Airline's profit F	Proposed solution	
0	142964,03	▪ Priority flights OS301 and OS302 are cancelled. ▪ Non-priority flights OS313 and OS314 are reassigned to the aircraft A320-OELBO and are executed on time.	I solution
1700	139632,63	Basic solution	

The results of analysis show that varying the value of the *k(i)* the airline's profit is also varying, but only until the airline's profit reaches the value of F=139632.63. After that the airline's profit remains constant despite that the value of the *k(i)* continues to vary. The results also show that varying the value of the *k(i)* there could be only two types of solutions for this particular example. The difference between them is in the number of cancelled flights, which exists in the first solution but not in the second one. Table 1 shows that while the penalty value increases, the airline's profit decreases, which was expectable considering that the penalty cost for each cancelled flight was increasing. The airline's profit decreases down to its minimum i.e. until *k(i)* reaches the value when the penalty cost for cancelled flights is higher then total delay cost for all flights that aircraft A319 (OELDB) should execute in accordance with the proposed solution.
The value of *k(i)* when the solution changing occurs (from solution I to basic solution) is k(i)=1666. This is also the lower limit of the *k(i)* and if a user wants to avoid unacceptable solutions i.e. the solutions with cancelled priority flights, the values for *k(i)* should not be below this limit.

Figure 2 shows that the airline's profit is very sensitive to varying the value of *k(i)* but only in the first segment, until the *k(i)* reaches the value of k(i)=1666. After this value the airline's profit is totally insensitive to varying the value of *k(i).*

Figure 2. The airline's profit in regard to the value of *k(i)* and the point of solution replacement



2.2.2 PENALTY FOR NON-PRIORITY FLIGHT CANCELLATION, k_2

The basic solution is based on the value of k_2=10000, so as in the previous case, the solutions were generated first for the k_2=0 and then for the higher values. The solution reviews are presented in Table 2.

The results from Table 2 show that if this penalty would not exist or k_2=0, the airline's profit would be F=167042.96 and this value is considerably higher than the value of the airline's profit when there is no perturbation in the observed flight schedule (F=140350.91).

Table 2 The airline's profit and solution reviews for different values of k_2

Penalty k_2	Airline's profit F	Proposed solution	
0	167042,96	▪ Priority flights OS301 and OS302 are reassigned to aircraft A319 (OELDD) and are executed on time. ▪ Non-priority flights OS313 and OS314 are reassigned to aircraft A319 (OELDF) and are executed on time. ▪ Non-priority flights originally assigned to aircraft OELDD (OS789, OS790, OS779, OS780, OS881 and OS882) and OELDF (OS819, OS820, OS461, OS462 and OS377) are cancelled.	**II solution**
1000	158109,02	▪ Priority flights OS301 and OS302 are reassigned to aircraft A319 (OELDD) and are executed on time. ▪ Non-priority flights OS313 and OS314 are cancelled. ▪ Non-priority flights originally assigned to aircraft OELDD (OS789, OS790, OS779, OS780, OS881 and OS882) are cancelled.	**III solution**
3000	143252,07	▪ Priority flights OS301 and OS302 are reassigned to the aircraft A319 (OELDB) and are executed with delay (delay on flight OS301 is 163 min, and 112 min on flight OS302). ▪ Non-priority flights originally assigned to aircraft OELDB (OS841, OS842 and OS567), are executed with delay (delay on flight OS841 is 260 min, delay on flight OS842 is 260 min and delay on flight OS567 is 217 min). ▪ Non-priority flights OS313 and OS314 are cancelled.	**IV solution**
5000	139632,63	Basic solution	

However, if this penalty would not exist, the main problem would not be in the value of the airline's profit but in the proposed solution. Namely, all the flights that are originally assigned to the aircraft with registration OELDD and OELDF are cancelled after the perturbation occurs and

after the affected flights are reassigned to these aircraft. The total number of cancelled flights is 11 (see Table 2 above).

Additionally, the balance in aircraft numbers at individual airports at the end of the day is disturbed because the aircraft OELDF finished its last rotation at the Vienna airport instead at the Amsterdam airport. The rotation VIE-OTP-VIE, originally assigned to the aircraft OELDD, is justifiable cancelled because the maximum allowed delay constrain is not satisfied. The rest of the cancelled flights could be executed on time or with acceptable delay, but still they were cancelled. The explanation of the reason why the software offered such a solution and what criteria were decisive lie in the way how the solutions are generated through the steps of algorithm.

Namely, when in perturbation, the affected flights are the priority flights and delay is longer then maximum allowed delay, the first solution is generated by reassigning the affected priority flights to some other aircraft, if the given conditions are satisfied (the aircraft is at the same airport as broken one or it is going to arrive at the same airport, the aircraft capacity is larger or equal to the number of passengers from affected flights, etc). Additionally, that aircraft has to be possible to execute the affected priority flights and the rest of the flights from their mini rotation and after that, to continue to execute the flights that are originally assigned to it. If there is more then one aircraft that can execute the affected priority flights, the one with least cancelled flights caused by the execution of priority flights will be selected. If there is more aircraft with the same, minimum number of cancelled flights, the one with minimum overall delay will be selected. If there is more aircraft with the same overall delay, the one, first found, will be selected.

When the first solution is determined, the next step is to reassign the rest of the temporary cancelled flights to the aircraft that can execute them on time or with an allowed delay. Otherwise, those flights stay cancelled till the end of the day.

The above describe procedure for solving the flight schedule perturbation was also applied in the case when the value of k_2 was 0. In that case, when the affected priority flights were

reassigned to the aircraft OELDD, the rest of the flights, originally assigned to this aircraft, were temporary cancelled because each flight would exceed the allowed delay if they were executed after the priority flights. In the next step these temporary cancelled flights were returned to flight schedule and then it appeared that because there was no penalty for cancelling the non-priority flights (k_2=0), the airline's profit would be higher if these flights were cancelled. The main reason was that the direct operational costs of that aircraft was higher then the realized revenue from these flights.

However, the airline policy is that all planned flights must be executed no matter if they are profitable or not, so the solution where the flights are cancelled just because they are not profitable is unacceptable. According to this, all the values of k_2 greater then 4810 would help to avoid the unacceptable solution.

To avoid the similar situations in other perturbations, the model should be improved by adding one more constraint that would protect the unprofitable flights.

Figure 3 The airline's profit in regard to the value of k_2 and the points of solution replacement

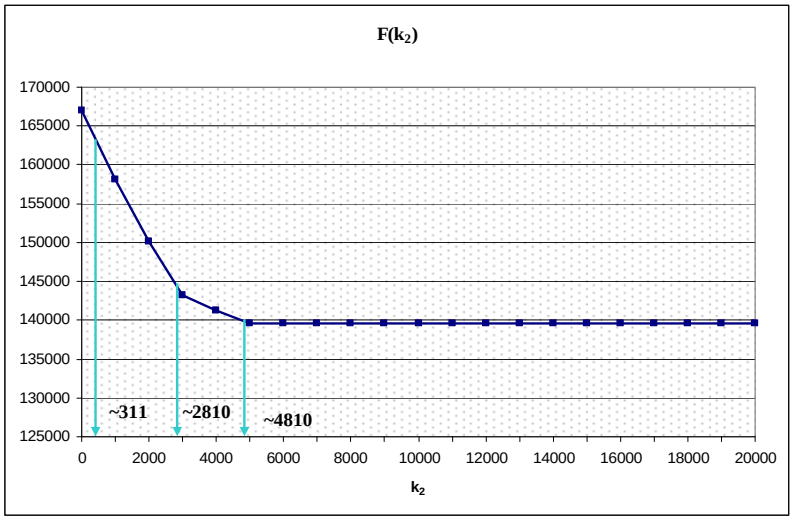


Figure 3 shows that the greater sensitivity of the airline's profit by varying the value of k_2 is in the first segment when the value of k_2 is smaller then 4810, after that the airline's profit is totally insensitive to varying the value of k_2. Also, in the first segment the airline's profit is not sensitive in the same way for all the values of k_2. In the first interval from 0 to 2810, the

function slope is inclined i.e. the function value decreases rapidly for small changes in the k_2 value. In the second interval from 2810 to 4810 the airline's profit sensitivity is smaller and the slope is less inclined.

2.2.3 PENALTY FOR FLIGHT DELAY, k_1

In the basic solution, this penalty has the value $k_1=1$, so the first analysis is done for the case when this penalty is not considered i.e. $k_1=0$, and then its value is increasing. The next Table 3 shows the generated solutions for different values of k_1 and it can be noticed that overall delay is reduced as well as the number of delayed flights with increasing the value of k_1.

Table 3 The airline's profit and solution reviews for different values of k_1

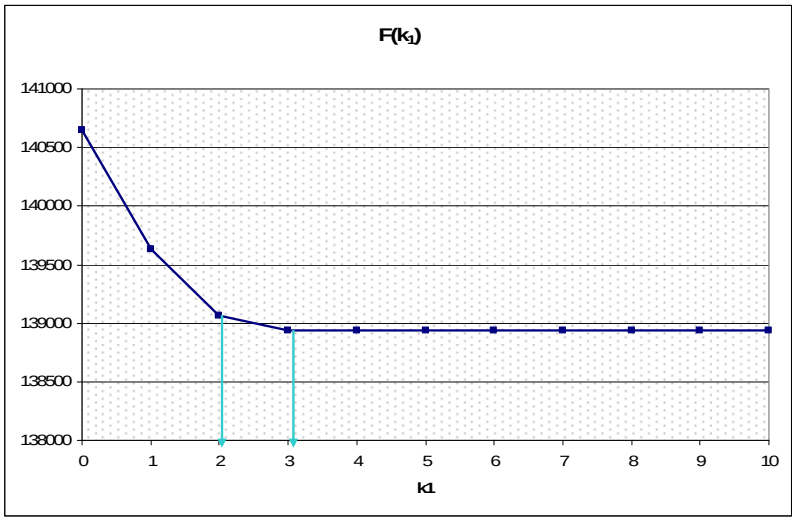
Penalty k_1	Airline's profit F	Proposed solution	
0	140644,63	Basic solution	
2	139068,31	▪ Flights OS301, OS302, OS313 and OS314 are reassigned to aircraft A320 - OELBO and are executed with delay (delay on flight OS301 is 162 min, delay on flight OS302 is 111 min, delay on flight OS313 is 78 min and delay on flight OS314 is 55 min). ▪ Non-priority flight OS307 is reassigned from OELBO to aircraft A320 - OELBP and is executed on time.	V solution
3	138939,51	▪ Priority flights OS301 and OS302 are reassigned to aircraft A321 - OELBA and are executed on time. ▪ Non-priority flights OS313 and OS314 are reassigned to aircraft A320 - OELBO and are executed on time.	VI solution

Further, for $k_1=3$ the model proposed a new solution where all affected flights are executed on time. The proposed flight distribution to available aircraft can be considered as "optimal" from the aspect of delay and cancellation cause in the situation, where one aircraft is out of order 12 hours and where the possibility of cancelling certain flights exists, still there is a solution where all planned flights can be executed on time with the available fleet. On the other side, it has to be taken into consideration that for execution of the priority flights, OS301 and OS302, the

aircraft with higher direct operational costs is used, so it now depends on airline policy if the generated solution for k_1=3 is going to be acceptable or not.

As expected, further increasing the k_1 value does not have any influence on the airline's profit or on generated solutions, because any k_1 value equal or higher then 3 would exceed the costs of using the more expensive aircraft then the broken one.

Figure 4 The airline's profit in regard to the value of k_1 and the points of solution replacement



The Figure 4 shows that the airline's profit is very sensitive to varying the value of k_1 in the segment where the $k_1 \leq 3$, after this value the airline's profit is totally insensitive to varying the value of k_1.

2.2.4 PENALTY FOR AIRCRAFT BALANCE DISTURBANCE, kaz(l,k)

The airline has some additional costs if the balance in aircraft numbers at individual airports at the end of the day is disturbed. For that reason in this model the penalty for aircraft balance disturbance, *kaz(l,k)*, is introduced and because this cost is very hard to measure the sensitivity analysis for this penalty is also done.

The starting value in the basic solution is kaz(l,k)=3000 but the results from the sensitivity analysis shows that the value of *kaz(l,k)* has no influence on the airline's profit and generated solution for the observed example. One of the reasons is that the affected flights are early in the morning so the possibility that the perturbation is going to be extended until the end of the day is very low. Also, the reason why this penalty has no greater influence on the generated solutions in this example is that the entire analysis is done according to basic solution i.e. according to basic penalty values where the situation in which the penalty *kaz(l,k)* would be considered does not appear. In another words, there is no aircraft balance disturbance in the observed example.

That is why the additional test was done which proved that penalty *kaz(l,k)* has influence on generated solutions. According to this results with the values higher then kaz(l,k)=3700 the unacceptable solutions can be avoided.

2.2.5 PENALTY FOR AIRCRAFT MAINTENANCE DISRUPTION k_3

Finally, the last parameter k_3 is the penalty for aircraft maintenance disruption i.e. the additional airline cost if aircraft is not at the airport where its maintenance is planned. The starting value of this penalty was also estimated according to the policy of the observed airline, but k_3 was not the subject of sensitivity analysis.

First of all, there were some difficulties in getting the information on scheduled maintenance of aircraft from the observed airline's fleet. Later it transpired that aircraft maintenance demands are very flexible so that they do not represent a constraint of major importance to the dispatchers' solution creating process. That is: dispatchers easily make arrangements with the personnel in the Maintenance Department related to moving scheduled aircraft checks, in cases where they need particular aircraft for the realization of scheduled operations.

Based on this, one could conclude that the penalty k_3 has no great importance in the ASO Advanced model usage. However, the importance of this penalty should not be underestimated overall or when applying it to the flight schedule of another airline with different airline' policy.

2.3 TWO-PENALTY VARIATION SENSITIVITY ANALYSIS

Based on analysis so far, it can be concluded that the solutions generated by the ASO Advanced model depends on certain factors such as: penalty values, number of passengers on flights, passenger ticket price, maximum allowed flight delay, etc. All these factors, except the passenger ticket price, are variables whose values are very difficult to estimate, but the most significant influence on the model's solutions and the most difficult to determine are the penalty values. The previous sensitivity analysis was useful for gaining the recommended value for each penalty that would lead to solutions that are logical and expectable.

Even without precise determination of penalties values, important questions that need answers are whether varying the value of one penalty will this influence on the value of another penalty, in what way and to what extent. Based on this, the following analysis was done where the values of two penalties were varying simultaneously. Two-penalty variation sensitivity analysis covered all combinations of penalties but in this paper only the one with most important results will be presented.

2.3.1 PENALTY FOR PRIORITY FLIGHT CANCELLATION k(i) AND PENALTY FOR FLIGHT DELAY k_1

The results from the analysis where the values of two penalties are varied, the penalty for priority flight cancellation value (k(i)) and penalty for flight delay value (k_1), show:

- how the solutions change
- how the point of solution replacement changes
- how the airline's profit changes

In the two-penalty variation sensitivity analysis of the ASO Advanced model, the first result is the solution where both penalties have values zero, and after that the value of *k(i)* increases while the value of k_1 remain zero. This is phase 1 and for this phase the following results are determined: changing of airline's profit as well as the solution changing until airline's profit

reaches the final value[2] for given parameters. The same procedure was repeated as many times as it was needed and in each next phase the value of k_1 was increased by 1.

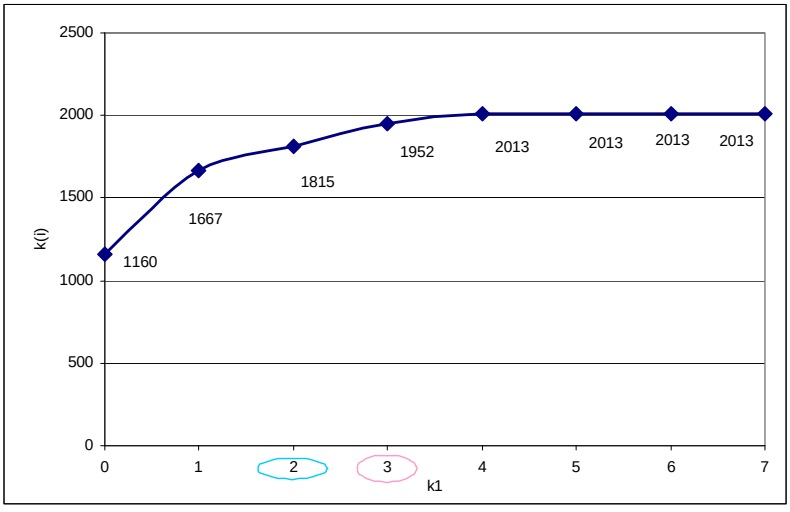
The common element for all phases is that when k(i)=0 the solution is always the same regardless of the value of penalty k_1. The structure of that solution is:

- priority flights OS301 and OS302 are cancelled;
- non-priority flights OS313 and OS314 are reassigned to the aircraft A320 - OELBO and are executed on time.

Also, the common element for all phases is that each phase has an equal number of solutions during the variation of *k(i)*, and that number is 2. The first one, as mentioned above, is common for all phases and the second one depends on the phase.

Figure 5 presents the point where it comes to solution changing (when the ASO Advanced software starts to propose the second instead of first solution) and how the value of this point (*k(i)*) is changing in regards to changing the value of penalty k_1.

Figure 5 Changing the point of solution replacement in regards to changing the value of penalty k_1



[2] When airline's profit reaches this value it stays constant despite the further penalty value changing.

Figure 5 shows that by increasing the value of penalties, *k(i)* and k_1, the point of solution replacement takes a higher value. Also, it can be noticed that the value of this point is increasing until the airline's profit reached the value of 2013, but for higher values it is constant. The marked values of k_1 on Figure 5 represent the values when the second solution differs from the second solution in previous phase. This happens for $k_1=2$ and $k_1=3$ and according to this there are 3 types of second solutions that appear in the analysis where the values of two penalties, *k(i)* and k_1, vary. These 3 types of solutions are presented in Table 4.

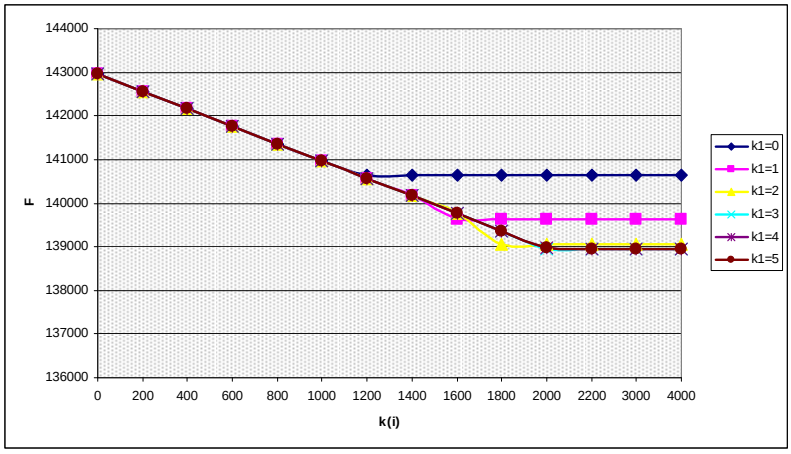
Table 4 The presentation of II solution

Penalty k_1	II solution
0	Basic solution
2	V solution
3	VI solution

By increasing the value of k_1, the number of delayed flights decreases, until the proposed solution has no delayed or cancelled flights i.e. until the delay cost exceeds the costs of using the more expensive aircraft then the broken one. Figure 5 and Table 4, also, show that for gaining the "optimal" solution the k_1 value should not be less then 3, and the *k(i)* value should not be less then 1952, which is by 286 a higher value than the one determined in previous analysis (1666).

Figure 6 presents the airline's profit for different values of penalties, *k(i)* and k_1. According to these results, while the values of *k(i)* and k_1 increases, the value of airline's profit decreases down to its minimum and after that is constant. It can be concluded that airline's profit is very sensitive between 0 and 4 for k_1 value and between 0 and 2000 for *k(i)* value. For higher values then this one the airline's profit is insensitive. The Figure 6 best describes how the value changing of k_1 influence on the ASO Advanced model sensitivity. Meaning, that increasing the value of k_1 will increasingly decrease the airline's profit, i.e. the airline's profit will have lower minimum and it will reach that minimum at higher values of *k(i)*. The penalty values of k_1 have no influence on airline's profit at the values of k(i)<1200 because of the solution structure where the flights are executed on time or cancelled. There are no delayed flights.

Figure 6 The airline's profit regarding to penalties values, *k(i)* and k_1



2.3.2 PENALTY FOR NON-PRIORITY FLIGHT CANCELLATION k_2 AND PENALTY FOR FLIGHT DELAY k_1

As in previous case, the same procedure was applied on the second pair of penalties k_1 and k_2. The common for all phases is that in each phase the overall number of different solutions is 4. Also, in each phase when k_2 is 0 the solution is always the same regardless of the value of penalty k_1 and the model keeps this solution until penalty k_2 reaches the value of 312. After this value the model is proposing the second solution and this solution is also common for all phases. The structures of mentioned solutions are:

I solution:

- Priority flights OS301 and OS302 are reassigned to aircraft A319 (OELDD) and are executed on time.
- Non-priority flights OS313 and OS314 are reassigned to aircraft A319 (OELDF) and are executed on time.
- Non-priority flights originally assigned to aircraft OELDD (OS789, OS790, OS779, OS780, OS881 and OS882) and OELDF (OS819, OS820, OS461, OS462 and OS377) are cancelled.

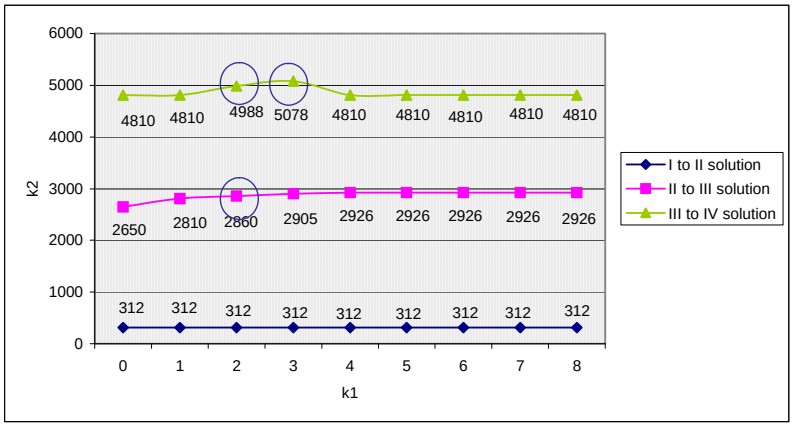
II solution:

- Priority flights OS301 and OS302 are reassigned to aircraft A319 (OELDD) and are executed on time.
- Non-priority flights OS313 and OS314 are cancelled.

- Non-priority flights originally assigned to aircraft OELDD (OS789, OS790, OS779, OS780, OS881 and OS882) are cancelled.

Figure 7 below shows the point where the solution change occurs and how the value of this point (k_2) changes in regards to the change of the value of penalty k_1. According to the fact that each phase has 4 solutions, Figure 7 presents the value of penalty k_2 when the change occurs in the solution from I to II, from solution II to III solution and, finally, from III to IV solution. Additionally, it is marked when the structure of solutions III and IV changes while increasing the value of k_1.

Figure 7 Changing the point of solution replacement regards to changing the value of penalty k_1



There are 2 types of third solution and 3 types of fourth solution that appear in the analysis when the values of two penalties k_1 and k_2 are varying and it is presented in Table 5 and Table 6.

The structures of solutions III and IV are changed because the penalty cost for each minute of delay (k_1) increased sufficiently to justify the use of the larger aircraft (aircraft with higher operational costs) to execute the affected flights.

Table 5 The presentation of III solution

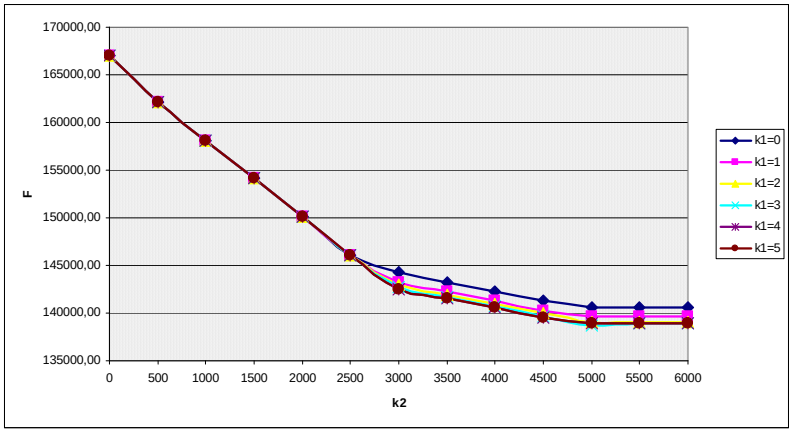
Penalty k_1	III solution
0	IV solution
2	▪ Priority flights OS301 and OS302 are reassigned to aircraft A320 (OELBO) and are executed with delay (delay on flight OS301 is 162 min and 111 min on flight OS302). ▪ Non-priority flights OS313 and OS314 are cancelled. **VII solution**

Table 6 The presentation of IV solution

Penalty k_1	IV solution
0	Basic solution
2	V solution
3	VI solution

The last proposed IV solution is equal to the previously attained "optimal" solution for k(i)=1952 and k_1=3. Based on this, the previous statement of gaining the "optimal" solution can be improved and is worded like this: for gaining the "optimal" solution the k_1 value should not be less then 3, the *k(i)* value should not be less then 1952 and k_2 should not be less then 5078 (or k_1>4 and k_2>4810).

Figure 8 The airline's profit regarding to penalties values, k_1 and k_2



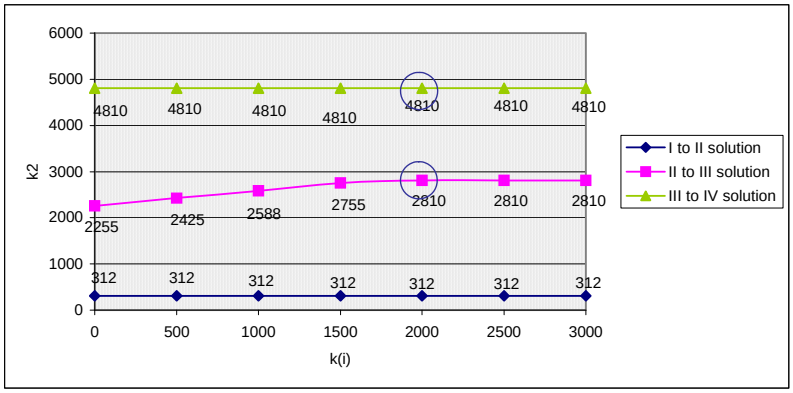
In Figure 8 it can be seen that while the values of k_1 and k_2 increase, the value of airline's profit decreases down to its minimum (until the value that has in IV solution) and after that is constant. Figure 8 also shows the airline's profit sensitivity to penalty value changes of k_1 and k_2 and it can be noted that the value of k_2 has influence on the slope of the function till the value of 5000, but the value of k_1 determined its value. Meaning, that increasing the value of k_1 will decrease the airline's profit more and more i.e. the airline's profit will have lower minimum and it will reach that minimum at higher values of k_2.

2.3.3 PENALTY FOR PRIORITY FLIGHT CANCELLATION k(i) AND PENALTY FOR NON-PRIORITY FLIGHT CANCELLATION k_2

The same procedure was applied on the last pair of penalties *k(i)* and k_2. The common element for all phases is that in each phase the overall number of different solutions is 4, regardless of the value of *k(i).* Also, the first and the second solution are the same in all phases as well as the value where the solution change occurs from the first to the second. The structure of the third and the fourth solution vary through phases, but the value where the solution change occur from III to IV is always the same.

The structures of the first and the second solutions are equal to I and II solution in the previous analysis (pair of penalties k_1 and k_2). Figure 9 shows the point where solution change occurs and how the value of this point (k_2) changes in regards to changing the value of penalty *k(i)*. According to the fact that each phase has 4 solutions, Figure 9 presents the value of penalty k_2 where solution change occurs from I to II solution, from II to III solution and, finally, from III to IV solution.

Figure 9 Changing the point of solution replacement regards to changing the value of penalty *k(i)*



Also indicated is where the structure of solutions III and IV changes, for an increasing value of *k(i)*. There are 2 types of third solutions and 2 types of fourth solutions that appear in the analysis where the values of two penalties, *k(i)* and k_2, vary. These solutions are presented in Table 7 and Table 8.

Table 7 The presentation of III solution

Penalty k(i)	III solution	
0	▪ Flights OS301, OS302, OS313 and OS314 are cancelled.	VIII solution
2000	IV solution	▪

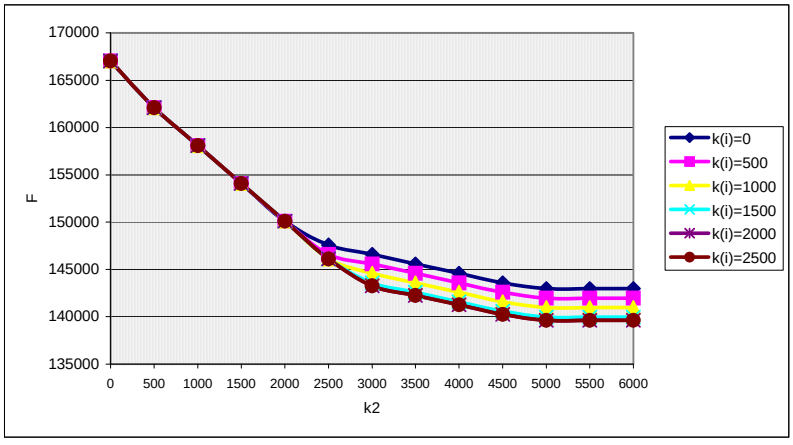
Table 8 The presentation of IV solution

Penalty k(i)	IV solution
0	I solution
2000	Basic solution

The structures of III and IV solutions are changed because the penalty cost for priority flight cancellation, k(i), increased enough to justify the use of another aircraft to execute the affected priority flights, as well as moving the departure time of certain flights for a later time. As a result, instead of 4 cancelled flights, all flights are executed on time or with allowed delay.

The results from Figure 10 show that while the values of *k(i)* and k_2 increase, the value of airline's profit decreases down to its minimum (until the value that has in the IV solution) and after that is constant. It also shows the airline's profit sensitivity to penalty value changing of *k(i)* and k_2. For k_2 values lower then 2000 the airline's profit is very sensitive, then between the values 2000 and 5000 the sensitivity is lower and for the values higher then 5000 the airline's profit is insensitive. Also, increasing the value of *k(i)* will increasingly decrease the airline's profit. The penalty values of *k(i)* have no influence on the airline's profit for values of k_2<2000 because all flights in solution are executed on time or cancelled. There are no delayed flights.

Figure 10 The objective function values in regard to penalty values, *k(i)* and k_2



3 CONCLUSION

The ASO Advanced model has been developed as a decision support system and its goal is, in situations when a carrier's scheduled activities are disturbed, to provide a solution within a short period of time, which would minimize the negative effects of these disruptions. This problem is very complex and requires precise definition of all criteria, assumptions and operational constraints so that the proposed solution is compliant with the airline's goals and preferences.

Since certain parameters (penalties) used in this model are difficult to measure, the sensitivity analysis of the ASO Advanced model to these penalties is one way that can help in their determination. The presented sensitivity analysis is also useful for determining the "optimal" solution or set of "optimal" solutions which best represent the carrier's interests and also to determine the range of penalty intervals within the solution is the same.

The results from the first sensitivity analysis, where only one penalty value is changed while the rest of the penalties have fixed, assumed values, are useful for gaining the values which will lead to logical and expectable solutions. All the considered penalties have lower limits than the assumed one, except the penalty k_1 which can have any value depending on current airline's policy. This conclusion is based on solutions proposed by the ASO Advanced model where for each assumed value of k_1 the generated solution is acceptable. The only difference is that in some solutions the affected flights are executed with a delay by an aircraft with lower or equal operational costs, then broken one and in some solutions the affected flights are executed on time by aircraft with higher operational costs then broken one.

The results from the second sensitivity analysis, where two penalties values are changed while the rest of the penalties have fixed, assumed values, are useful for gaining the values which will lead to "optimal" solution i.e. to the best solution from the aspect of delay and cancellation. The values for gaining the "optimal" solution are: the k_1 value should not be less then 3, the $k(i)$ value should not be less then 1952 and k_2 should not be less then 5078 (or $k_1<4$ and $k_2<4810$). This solution can be considered as the best one from the aspect of delay and cancellation cause in the situation where one aircraft is out of order 12 hours and there is a possibility of cancelling certain flights, still exists a solution where all planned flights can be executed on time with the available fleet.

ACKNOWLEDGEMENTS

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A study on how to improve communication effectiveness of air traffic controllers

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ABSTRACT

As the objective of air traffic control (ATC) services is to achieve flight safety and efficient aircraft operations, the role of air traffic controllers is vital in the aviation system as a result. In this paper, the controller's interactions were explored in terms of communications. The study was conducted through survey on the Republic of Korea Air Force (ROKAF) ATC controllers to identify any discrepancies in their viewpoints on the role of communication in their profession. In order to diminish differing points of view and ensure effective communication, the experienced controllers should commit to creating the desired work environment and every controller must keep in mind that mutual trust is a vital part of a successful organization. Instructions in accordance with the regulations, improvements in job satisfaction and self esteem, communication training, and individual endeavors fostering effective communication are all measures which will go a long way toward improving effective communications between the ATC specialists.

Keywords: Air Traffic Control, Flight Safety, Aircraft Operation, Aviation System, Controller Interaction, Communication Effectiveness

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1. INTRODUCTION

Since 1929 when the 1st air traffic controller, Archie League, used colored flags to provide ATC services at St. Louis' Lambert Field airport, they have continuously evolved along with technical improvements in aircraft.

In accordance with Federal Aviation Administration Order (FAAO) 7110.65 'Air Traffic Control' and ICAO Doc 4444 'Rules of the Air and Air Traffic Services', ATC services are provided to prevent aircraft collisions and manage air traffic efficiently (FAA, 2000; ICAO, 1996). In other words, they are supposed to improve efficiency of air traffic management by preventing aircraft collisions and reducing unnecessary delays.

In reviewing commercial aircraft accident statistics issued by Boeing in 2001, approximately 70% of all commercial aircraft accidents occurred during take-off/cruising climb and final approach/landing stages, whereas accidents involving airport and ATC comprised only 3% of total accidents (Boeing, 2001). Human error, rather than technical failure, now represents the greatest threat to system reliability and safety in socio-technical systems such as aviation. The ratio of accidents caused by human error increased from 10% in the 1960s to 80% in the 1990s. Its main reason was complexity of the new systems which improved reliability in technical components but increased the potential for human error by designers, decision makers, maintenance personnel, and so on (Airservices, 1996). The following statement illustrates how prone humans are to making mistakes: "To err is human and unfortunately, to err repeatedly is also human" (FAA, 1999).

An ATC specialist provides ATC services as a member of a team which is composed of pilots, other controllers, maintenance technicians and managers (D'Arcy and Pamela, 2001). Ineffective communications among the players adversely affect the individual controller's performance as well as team performance. As Heine Caesar insisted at Flight Safety Foundation Conference in 1990, communications should be trained in a community where order and obedience are a part of life (McCreary et al., 1998). The matter of communications should not be simply overlooked. As the performance model of flight crew, which was

developed by 'Helmreich and Foushee' to optimize individual and team performance, shows, all inputs and components affecting outputs regarding aviation activities should be optimized. In this paper, by reviewing the interactions of ROKAF military ATC controllers in communication through surveys, we will determine the existence of any discrepancies in communication and the impediments to effective communication. Based upon the results, measures for more effective communication will be suggested to reduce verified shortfalls.

Accordingly, the related literature is reviewed to describe general ATC services. They explain what the team tasks in aviation and human factors are, how the human factors are applied in aviation, which communication process is involved in a human factors study, what relationships of power are formed in a small team consisting of personnel from the cockpit and the ATC facility, and what communications are like under stress. In order to identify the potential problems of communication between ATC controllers, empirical verifications will be implemented through survey data which incorporates data on information requests for assistance, comments on other's mistakes, personal preferences, and mutual trusts. Based on the data collected, statistical analysis including descriptive analysis, crosstabs and independent samples T-test will be conducted.

2. LITERATURE REVIEW

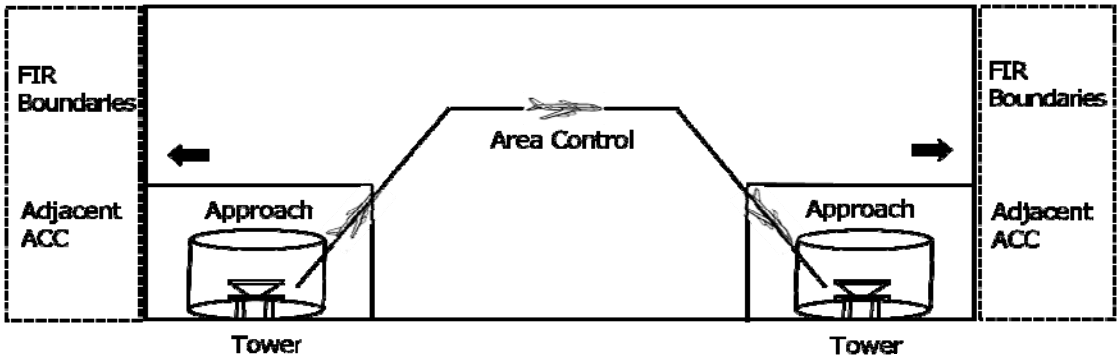
2.1. ATC SERVICERS AND TEAMWORK IN ATC SYSTEMS

ATC services are provided to prevent aircrafts from colliding each other and obstacles in the air and on the ground, and thus to maintain orderly, efficient and expeditious flow of air traffic. ATC services are divided into Aerodrome Control, Approach Control and Area Control Services in accordance with ICAO Annex 11 and Document 4444.

Figure 1 illustrates the flight flows of an aircraft and the ATC services provided for each flight stage by different ATC agencies. Aerodrome control services include issuing clearances for aircraft taking-off and landing, managing movement of aircraft and vehicles in the maneuvering area and delivering en route flight clearances to departing aircraft. Approach control facilities provide vectors for aircraft to enter into airways and to permit aircraft

approaches to the airport. The area control center deals with the en route part of flights by assigning airways and altitudes to enable safe and expeditious flights, maintaining proper spacing between aircrafts, and providing information, such as NAVAIDs status, weather and airport status.

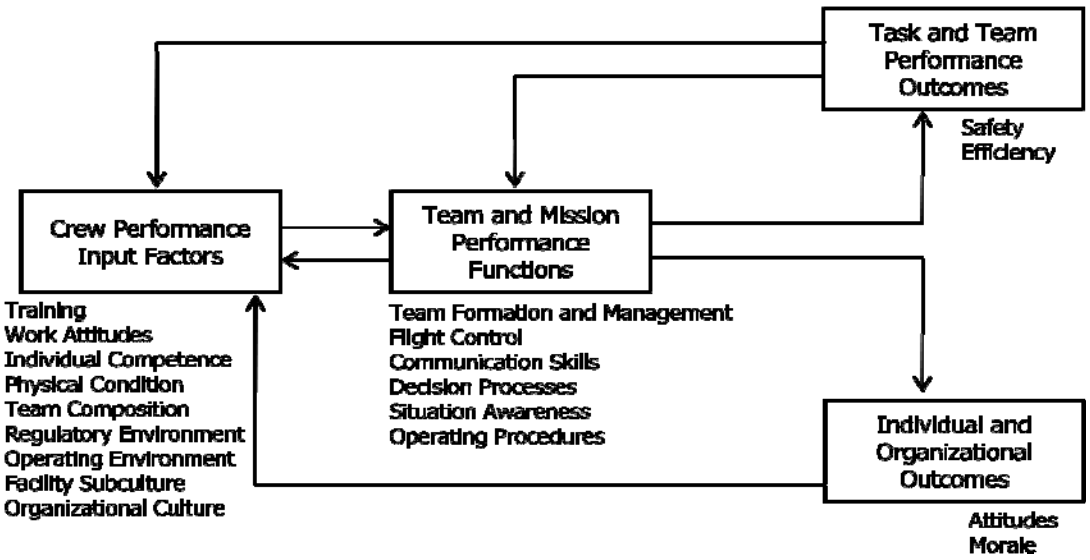
Figure 1: flight flows of an aircraft



Due to ever increasing air traffic demands, it is expected that the capacity of the current ATC system will be saturated shortly (Air Transport Association, 1999). To cope with this capacity saturation in an effective and safe manner, ATC structures should see improvements with automation, satellite navigational systems and the application of data links, etc. But the options provided with these technical improvements should account for compatibilities with safety, efficiency, cost-effectiveness and human capabilities and limitations (Wickens et al., 1997). Safety should never be overlooked and any modifications or installations to the current systems must enhance flight safety.

Teamwork between ATC controllers is very important for safe and efficient air traffic management, because ATC has various team configurations and includes many actors, such as additional controllers who share functions in the same sector, supervisors and instructors, etc. Figure 2, which has been adapted from a performance model of flight crew, developed by 'Helmreich and Foushee', shows inputs, functions and outcomes in ATC. It shows how inputs, such as training, work attitudes and team composition, affect the functions and outcomes of an individual as well as a team, and how the outcomes influence the inputs and processing factors through proper feedback (Helmreich and Foushee', 1998).

Figure 2: team performance model in ATC



2.2. HUMAN FACTORS IN ATC

Currently, various definitions have been employed in attempts to describe the subject matter of human factors and one such definition can be as follows:

"Human factors may be defined as the technology concerned to optimize the relationships between people and their activities by the systematic application of the human sciences, integrated within the framework of system engineering." (Wiener and David, 1988)

In other words, understanding human factors is to understand human nature, such as the body as an organism, physiology, psychology, abilities and limitations, and to optimize human interactions with the surrounding environment for efficiency and safety from the related activities. Because human factors include all aspects of ergonomics, along with the events happening around humans, the extent and depth of this area is very broad and highly specialized. The SHEL model developed by Frank H. Hawkins in 1975 became the theoretical background for the human factors study in aviation by supporting the causes revealed in aircraft accident investigations (Korea Civil Aviation Development Association, 1996). Since many factors surrounding the centered human relate directly to aircraft operations, all the

relevant factors inclusive of operators, equipment and work environments should be optimized in order to guarantee task efficiency and safety.

Humans and interactions between humans and systems are at the center of the human factors study in ATC, since humans influence systems in terms of safety, efficiency, capacity and treatment of uncertain conditions and the systems have an impact on human roles, functions, job satisfaction, health and morale, etc.

As an example of unwanted conditions between the centered human and the components in the SHEL model, we will see what can happen at the communication domain between controllers. A late decision to split a sector or the fear of 'losing face' in front of other controllers may cause undesired decision making so as to induce incident prone situations (EUROCONTROL, 1998).

In order to avoid these situations, ATC controllers must understand that ATC services are a team task and consider other controllers as available resources from whom they can get valuable information. It is strongly recommended to encourage controllers to interact actively in a systematic way (FAA, 1999).

2.3. COMMUNICATION IN A SMALL GROUP

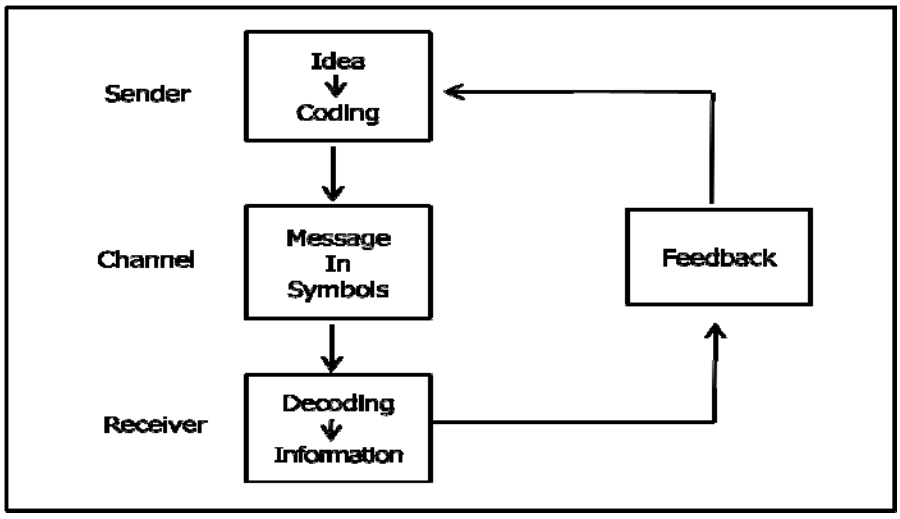
What is communication? Due to the broad range of communications, the general definitions of communication are too one-sided, complex or fractional. One way of defining communication is to explain the process associated with it. The reason for using the term 'process' for communication is that it is a progressing event (EUROCONTROL, 1997). Daily communications are usually composed of writing (word processing: 12%), reading (letters, memos, etc.: 13%), speaking (30%) and listening (45%) (Parson, 1982).

Communication starts with an idea, a thought or an emotion and the sender translates the idea into symbols and sends a message to a receiver who decodes the message into information. As shown in figure 3, communication looks like a very simple process, but the receiver does not always understand your intentions and does not process your communications in the way you

are expecting. Therefore, proper feedback is required to ensure the exact receipt of information as intended (EUROCONTROL, 1997).

Human communication takes place at two levels (Watzlawick et al., 1985). At level one, called the 'rational level', information is exchanged using words. Meanwhile, more meaning is embedded at level two, called the 'emotional level', where a general understanding of the situation is reached.

Figure 3: communication process



Each person possesses certain characteristics or properties which carry value for other people, and naturally, the greater number of highly valued properties a group member has, the more potential influence the person may have over the group. Five bases, namely reward, coerciveness, legitimacy, expertise and reference are suggested as power exercises to others (French and Bertram, 1968). As for military ATC facilities, military ranks form natural relationships for the controllers and thus the appropriate use of organic power is important for successful ATC operations.

For the groups, such as cockpits or ATC facilities which are prone to stress or crisis and depend highly on machinery, 't Hart et al conducted a survey of organizational behavior studies on crisis decision making and found three different communication patterns ('t Hart et al, 1993):

- Instead of the group's normal decision making, the patterns of decision making become highly centralized.
- Because the decision maker should concentrate on the crisis situation, criticism, dissent and mutual recrimination must literally wait until the crisis is over.
- Inexperienced participants are often shut out of the centralized decision making process.

One thing we have to note is that while appropriate and legitimate decisions made by superiors in a crisis situation enables a swift and appropriate handling of problems, the exclusion of others with simple coercive power or dependence on prior experiences may result in shortfalls to aviation safety.

Each individual has various communication channels and the more channels a person has, the better he can communicate with others. Inevitably, there is always a leader in an ATC team and because the leader forms the culture of the team and influences the work environment and performance of other controllers, he should never neglect to make desirable work conditions for the team.

Successful communication relies on understanding communication processes and the methods for sending and receiving messages effectively and thus all ATC members must make other controllers understand clearly the messages they are sending and minimize mistakes the receivers may have, if any, through appropriate feedback. Leadership and communication style of superiors have a great impact on successful communication in a group. Although all members should try to have successful communication, superiors must actively lead others to form desirable organizational cultures and work environments, because subordinates usually have limited powers of influence on others. For superiors, the following tips will be helpful for improving interpersonal communication (EUROCONTROL, 1997):

- In selecting and treating the contents of a message, communication skill, attitude, knowledge, social status and culture of subordinates should be considered.
- To be the most effective, more than one communication channel has to be used.
- Superiors should try to make sure of the exact receipt of their messages from subordinates.

- Superiors need to maintain proper feedback so as to reduce communication errors to determine the exactness of meaning and evaluate their influences.
- Superiors need to be reliable and objective and must have expertise.

3. EMPIRICAL STUDY

In most industries, including the aviation industry, human factor studies and the application of them are becoming the main method for protecting people and property from disasters and for increasing productivity through efficiency of performance. In this study, a survey was conducted through ROKAF military ATC (tower and radar facilities) specialists to verify whether effective communication is taking place between controllers and whether there are any impediments to communication and to provide appropriate measures to ensure successful communication.

In the questionnaires, a five-Point Likert Scale is used to collect answers to the questions regarding degree of requesting help, commenting on other's mistakes and accepting attitudes, views on corrections and problems, considering other controller's situations, personal preferences, communication training and mutual trusts, and so on. There are two subjective questions in which controllers could freely express their opinion on obstacles to effective communication and the ways to improve communication between controllers.

The base for division of the two groups is a 10-year working career and careers of the superiors range from a minimum of 10 years to a maximum of 32 years and 6 months with standard deviations of 7 years and 4 months, while the subordinates have worked from 2 months to 9 years and 6 months with standard deviations of 2 years and 6 months. Data collection was conducted by mail. While 176 controllers participated in the study, only 105 responses (54 superiors and 51 subordinates) were determined to be useful samples with 59.6% response rate. SPSS 10.0 was used to analyze the data. In order to identify any discrepancies on communication viewpoints between controllers, descriptive analysis, crosstabs and T-test were conducted.

4. RESULTS

The following table shows the items which have statistical importance at $p<.05$ in discrepancies in communication viewpoints between the two groups.

Table 1: Descriptive statistics and results of t-test

Items	Groups	Means	SDs	T-Values
Requesting for helps	Subordinates	3.27	.90	-3.176
	Superiors	3.83	.91	
Commenting on other's mistakes	Subordinates	3.12	.71	-2.151
	Superiors	3.48	1.00	
Views on corrections and problems	Subordinates	3.16	.70	-2.211
	Superiors	3.48	.79	
Considering others situations	Subordinates	2.88	.74	-2.102
	Superiors	3.22	.90	
Influences of personal relationships, such as regional origins	Subordinates	3.49	.70	-2.719
	Superiors	3.89	.79	
Personal dislike of others	Subordinates	2.94	.81	-2.144
	Superiors	3.30	.88	
Coping with problems	Subordinates	3.02	.79	-2.187
	Superiors	3.39	.94	

Regarding 'requesting for helps from other controllers when there are many aircrafts to deal with', discrepancies have been found between the two groups which show that superiors tend to ask for help from other controllers more easily than subordinates do, but one thing should be noted that this could happen as a result of the power that superiors have. As for commenting on other's mistakes, superiors addressed those matters more freely, while, to some degree, the two groups tended not to mention others' mistakes. This could mean that superiors are usually more responsible for ATC services. When corrections were required or

problems were found in ATC operations, superiors tried more to resolve these challenges. Differences in considering other's situations existed and superiors tried to pay more attention to the subordinate's actions. School or regional ties was one factor in creating discrepancies of viewpoints between the two groups. Superiors responded to the question that it did not have a large impact on providing ATC services. Also, subordinates who are prone to be influenced easily by other controllers responded that there were some controllers whom they didn't like. When problems happened during ATC operations, superiors communicated more actively and positively with other controllers to resolve them. Even though mutual trust was a very important aspect for ATC operations, the results showed no statistical importance.

4.1 IMPEDIMENTS TO COMMUNICATION AND ADVICE FOR COMMUNICATION EFFECTIVENESS

Through two subjective questions, impediments to communication and methods to improve communications between controllers were collected and for these questions, 70% of superiors and 25% of subordinates responded.

Table 2: Impediments to Communication

Impediments	Number of responses
Unconditional Obedience	17
Lack of Mutual Trusts	10
Generation Gaps	6
Illegitimate Orders	5
Lack of Places and Time for Communication	5
Selfishness	4
Differences in Personalities	4
Lack of Communication Skills	3

As shown in Table 2, the main impediment to communication was unconditional obedience caused by military ranking structures. Lack of mutual trusts, generation gaps and illegitimate orders were included in this category. One thing that needed attention was the controllers' lack of communication skills, which required communication training to guarantee effective communication.

Table 3: Advices for Effective Communication

Advices	Number of responses
Mutual Trusts	15
Forming of Interrelationships through Group Activities	10
Considering Other's Viewpoints	8
Providing ATC IAW Regulations	5
Increasing Job Satisfaction	5
Inducing the Feeling of Accomplishment	3
Active Efforts of Superiors	2

Table 3 presents the advices for effective communication. It was found that effective communication depended on mutual trust and proper group activities provided a means for members to maintain favorable relationships. Maintaining consistency through the application of appropriate regulations improved communication effectiveness. It was also apparent that job satisfaction and accomplishment were important factors and in improving the communication process, superiors should make every effort to maximize both of these factors for their subordinates. Reviewing the responses by subordinates shows that as effort was required by superiors, the passive postures of subordinates caused by ranking structures could be guessed at.

5. CONCLUSIONS

In accordance with the results of this study which pursued to find any discrepancies on the communication viewpoints of military ATC controllers, superiors tended to address more freely than subordinates in requesting for helps and commenting on other's mistakes and dealt with corrections and problems more easily. Also, there was a difference in considering others' situations and personal preference influenced subordinates a lot.

Although the two groups did not have a specific plan for communication improvements, superiors faced little difficulty in initiating communication to cope with any problems they were facing. No statistical differences were found for mutual trust but superiors stated that they tried to communicate with others frankly.

As for impediments to effective communication, unconditional obedience caused by military ranking structures, lack of mutual trusts, generation gaps and lack of communication skills were identified as the main causes of miscommunication. To overcome these problems, mutual trusts, the forming of sound interrelationships through group activities, providing ATC IAW regulations and active efforts of superiors are required. But as mentioned above, ensuring effective communication depends upon understanding of the communication process by each individual and the active involvement of superiors to form sound structural cultures.

6. LIMITATIONS AND RECOMMENDATIONS

Because most studies of human factors in aviation have been related to pilots in the cockpit, it was difficult to collect any accident data for accidents caused by ATC controller communication problems. As human factors study for ATC has generally been conducted individually, identification of interrelationships between communication and performance was not convenient.

Because this study was based on a survey conducted through the postal service, it was not possible to get rid of the participant's errors in interpreting the questionnaire, which didn't permit refined analysis.

It is recommended that based on the results of this study, in-depth studies should be conducted to find any relationships between communication and ATC controller's personal reliability, training and work attitudes, and so forth. Also structural and organized analysis is required for ATC team functions.

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Air vs rail competition towards the Beijing-Shanghai high-speed railway project in China

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ABSTRACT

China's railway has launched an ambitious speed-up program, the Beijing-Shanghai High-speed Railway project, which challenges the civil aviation industry aggressively. This paper studies the current air-rail competition pattern considering passenger throughput, transport time, ticket fare and economic growth, and furthermore, uses the Logit Model to forecast the future competition situation between civil aviation and railway along the Beijing-Shanghai High-speed Railway areas. The study also offers proposals for civil aviation industry towards the challenges of the new railway project.

Key words: air-rail competition, civil aviation, high-speed railway, logit model, fare, time.

1. INTRODUCTION

With its rapid development in civil aviation, China had become the second largest country in civil aviation in the world by 2005 and civil aviation is playing a more and more important role in China's national economy. In China's integrated transportation system involving railway,

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highway, water carriage and civil aviation, passenger turnover of Chinese civil aviation had increased to 13% in 2007 from 1.8% in 1979 and will increase to 20% in 2020 according to the goal of the Civil Aviation Administration of China (CAAC). Compared with it, the railway passenger turnover dropped from 61.7% in 1979 to 33.5% in 2007.

Typically, airlines carry more passengers traveling between Beijing and Shanghai than railway service providers in the competitions between them. The major problems for the railway administration are the deficient transportation capacity of railway service providers and the rising time effectiveness by passengers. That is why the Beijing-Shanghai high speed railway project, which claims up to US$30 billion investment, with approval of Chinese government in 2007. The railway administration hopes that this ambitious project can improve the capacity of its transportation and that will pose a real challenge to the civil aviation. Therefore, the future competitive situation of passenger transportation between Beijing and Shanghai after the project receives a high concern for both administrations of the civil aviation and railway.

Firstly, this paper will analyze the current situation of passenger transportation for cities along the Beijing-Shanghai high-speed railway, and focus on the differences between the civil aviation and the railway services in passenger throughput, transport time and fares. Secondly, it will set up a competition model between civil aviation and railway in order to analyze the impact on their competitive situation if the high-speed railway is put into service. At last, it will put forward some workable countermeasures for the civil aviation to meet the challenges from the high-speed railway project.

2. CURRENT COMPETTITION BETWEEN THE CIVIL AVIATION AND RAILWAY SERVICE

2. 1. OVERALL SITUATION

On April 18, 2007, China put the sixth speed up of railways into effect, that it raised national train speeds from 160 km per hour to 200 km per hour. The former speed-up projects had been launched by the Ministry of Railways in 1996, 1998, 2000, 2001 and 2004. This ambitious speed up of railway poses a great challenge to the civil aviation along with improving services. Ever so

the macro data still shows that, in passenger transportation service, the development in civil aviation is far beyond the railway service, which means that the civil aviation is on the rise while the railway service is reducing the shares in the integrated transportation system. The air passenger volume and turnover volume saw an average increase of 16.7% and 17.1% respectively between 2000 and 2007, while the rail passenger volume and turnover volume saw an average increase of only 5.2% and 7.7% respectively in the same period (See Table 1). According to the statistical data in China, it can be concluded that the former speed-up programs of railways had little impact on the rapid development of the civil aviation, especially in its passenger transportation service (See Fu 2005). It is noteworthy that the railway speed raising has some impact on the civil aviation transportation service in some specific routes, particularly for those short ones. Data also shows a rising trend in the average transportation distance of railway passengers and it proves that more mid-long range passengers are carried by railway. This lead to the growth of the average transportation distance of the civil aviation is less than the growth of the railway.

Table 1: Macro-analysis on passenger transportation volume in the railway service and the civil aviation

Railway Service					
Year	Passenger volume (million)	Increase %	Passenger Turnover (1 billion passenger km)	increase %	Average distance (km)
2000	1018	-	449	-	441
2001	1052	0.1	478	5.2	454
2002	1056	0.4	497	4.2	471
2003	973	-7.9	479	-3.6	492
2004	1118	14.9	571	19.3	511
2005	1160	3.4	606	6.1	523
2006	1260	8.7	662	9.2	526
2007	1360	8.0	721	9.0	531
Average Increase		5.2		7.7	

Civil Aviation					
Year	Passenger volume (million)	Increase %	Passenger Turnover (1 billion passenger km)	increase %	Average distance (km)
2000	67	-	100	-	1477
2001	75	10.9	109	12.5	1447
2002	86	15.4	127	16.2	1477
2003	88	1.9	126	-0.4	1442
2004	121	38.4	178	41.1	1470
2005	138	14.1	207	14.7	1479
2006	160	15.4	237	15.9	1485
2007	186	16.3	279	17.8	1503
Average Increase		16.7		17.1	

Source: National Statistics Bureau Website

2.2. SITUATION OF PASSENGER TRANSPORTATION IN CITIES ALONG BEIJING-SHANGHAI HIGH-SPEED RAILWAY

Existed Beijing-Shanghai railway locates in eastern China, which is the most social-economic developed region with the most potential development. It runs through Beijing, Tianjin, Shanghai municipalities and four provinces of which are Hebei, Shandong, Anhui and Jiangsu. This region occupies only 6.5% of China's land area, but with 26.4% of the total population and 43.2% of China's GDP in 2005. The per capita GDP of the region is 1.75 times of the national level.

Existed Beijing-Shanghai railway is the busiest railway trunk line in China, even in the world, which reaches 11.3% of the passenger turnover volume and 6% of the freight volume by only 2% of China's commercial railway mileage. And its transportation density is 4 times of the average in China.

There are 10 civil airports distributing in the 8 cities of Beijing, Tianjin, Jinan, Xuzhou, Nanjing, Changzhou, Wuxi and Shanghai which along the Beijing-Shanghai railways, including some very busy airports. These 10 airports launched 12 air service in 2007 between Beijing and Shanghai, Beijing and Nanjing, Beijing and Changzhou, Beijing and Wuxi, Beijing and Xuzhou, Beijing and Jinan, Nanjing and Jinan, Nanjing and Tianjin, Jinan and Shanghai, Tianjin and Shanghai, Xuzhou and Shanghai and Tianjin and Wuxi. The passenger transport volume of these 12 routes is 5.58% of the total national passenger transport volume in 2007 and only the Beijing-Shanghai route has carried 3.44% of the total national passenger volume.

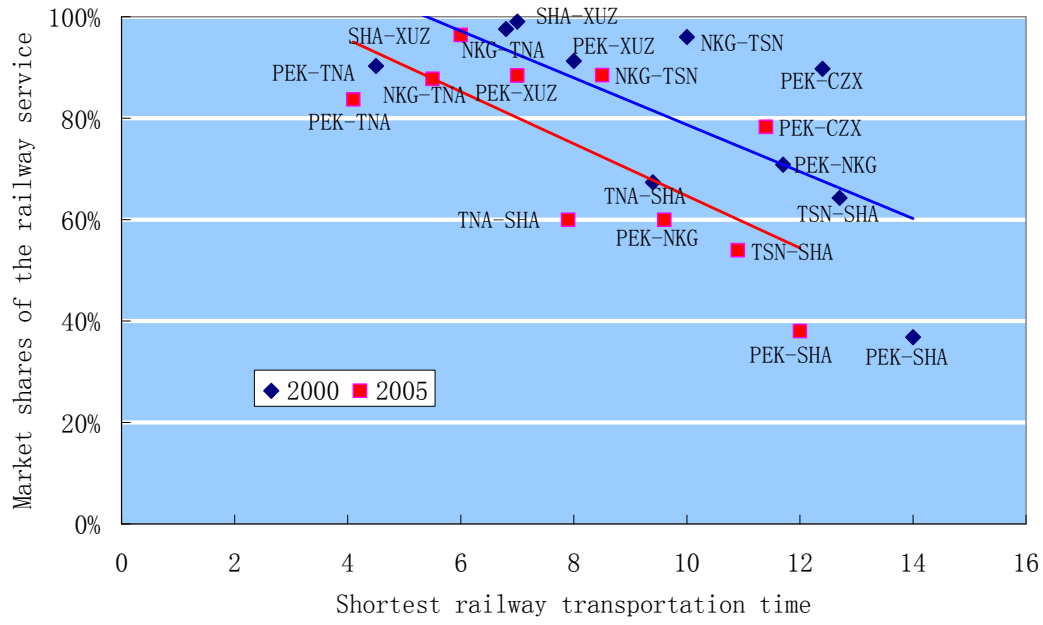
The present Beijing-Shanghai railway has been in a situation of tight transportation capacity, overload and limitations since 1990 and is unable to supply more transportation service. So the Chinese government decided to build the Beijing-Shanghai high-speed railway in order to solve these problems.

According to the master plan, the designed Beijing-Shanghai high-speed railway is 1,318 km long with 21 stations which passes through Beijing, Tianjin, Jinan, Nanjing and Shanghai. The total investment of this project is 220 billion RMB. It will be finished as early as 2010 with an initial cruise speed of 300 km/hr which is slower than its designed speed, 350 km/hr. It implies that high-speed trains will take passengers between Beijing and Shanghai in only 5 hours, which replaced the fastest trains take people at least 9 hours between Beijing and Shanghai in present. After the high-speed railway project is completed and put into service, the separation of passengers and goods transportation will be realized between high-speed railway and present Beijing-Shanghai railway, in which the new built high-speed railway will be a special line for passengers only and the ‘old’ Beijing-Shanghai railway which is in used now will mainly service for freight. When the time comes, it will lift the one-way transport capacity to 80 million passengers and more than 130 million tonnes of cargo annually. Therefore, the project will relieve the tense transportation capacity in Beijing-Shanghai corridor and meet the future transportation demand.

2.3. COMPARISON OF THE PASSENGER TRANSPORTATION IN CITIES ALONG THE LINE BETWEEN THE CIVIL AVIATION AND THE RAILWAY SERVICE

This paper has a research on passenger transport service markets of 10 city pairs that both the civil aviation and railway service operated in 2000 and 2005. Total 11.62 million passengers traveled between these 10 city pairs in 2000, of which 33.5% by air and 66.5% by train. However, total 17.85 million passengers traveled between these 10 city pairs in 2005, of which 39.8% by air and 60.2% by train. The railway did not gain more market share after the launching of the fifth speed-up, which reduced average 15% runtime of trains between those 10 city pairs. Instead, more passengers traveled by air, because the increasing concern about travel time is always accompanying with the rapid national economic growth (see Figure 1).

Figure 1: Share of railway in 10 city-pair transport markets in 2000 and 2005



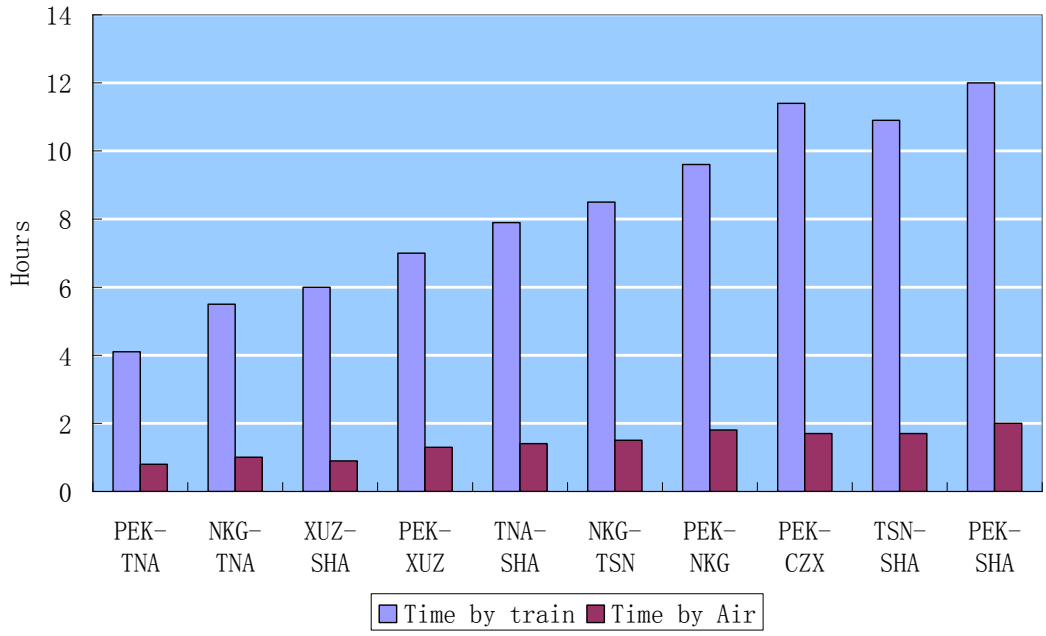
Source: CASTC.

It is mentionable that the passenger transport market of Beijing-Shanghai direct line was the only one which the civil aviation got a dominant position within these 10 city pairs, even though its market share dropped from 63% in 2000 to 62% in 2005. During the same period, in other 9 city pairs, the civil aviation gained more passenger market shares year by year. As far as in 2005, the number of passengers carried by all airlines between Tianjin-Shanghai, Beijing-Nanjing, Jinan-Shanghai increased as many as railway transportation. However, passengers

traveling between other 6 city pairs still took priority of railway service, which was less than a quarter of the total passengers traveled by air.

The main advantage of the civil aviation is its transportation time when competing with the railway service. All of the transportation time of the 10 city pairs, civil aviation were less than 0ne-fifth of that of railway service. However, more passengers trend to air travel with acceptable price due to the travel distance increasing, which implies the increase of time saved if they travel by air (see Figure 1 and Figure 2).

Figure 2: Comparison on transportation time between the civil aviation and the railway service in 10 city pairs



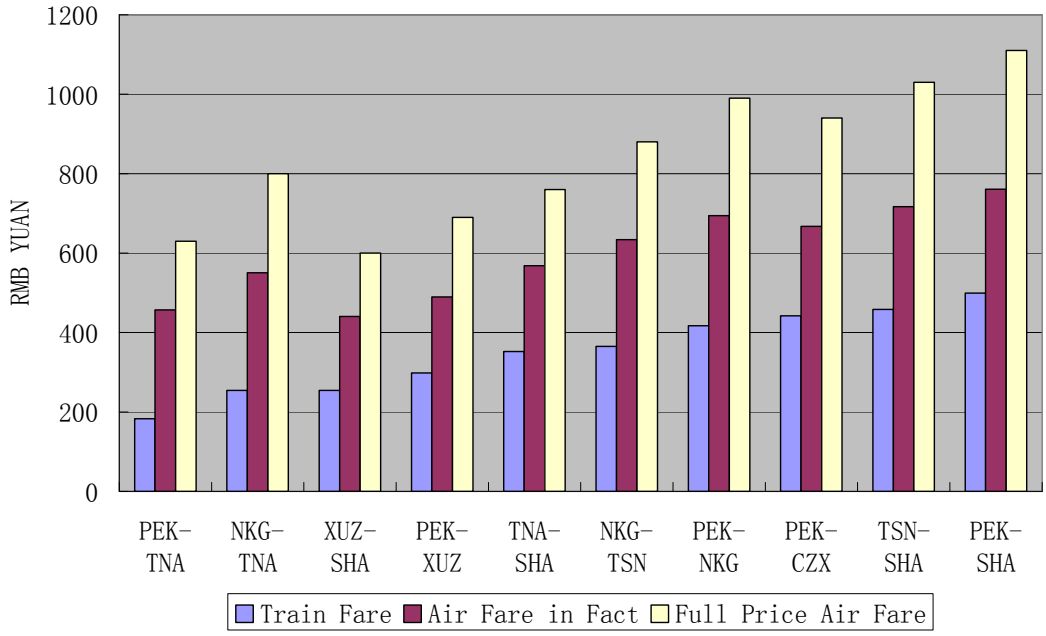
Source: CASTC.

The main disadvantage for the civil aviation is the fares when competing with the railway service. According to the benchmark airfares by the CAAC, the full price air fares are generally two times higher than that of the train tickets and even 3 times higher in Beijing-Jinan and Nanjing-Jinan routes. It deteriorates the airlines' disadvantages when competing with the railway service in short-distance transportation. But different from the fixed railway fare, airlines can offer flexible fares according to their marketing strategy goals because of the floating price

mechanism applied. By measuring, the actual airfares are considerably lower than the benchmark fares published (see Figure 3).

It must be indicated that the passenger structures and their affordability remain huge differences between each city pair, because of uneven economic development between these cities, and this produces a large difference to passengers' susceptive prices and time. Because of relatively high per capita GDP, the passengers traveling between economic developed big cities are more time sensitivity and trend to travel by air. In the counterparts, passengers traveling between big cities and small-mid cities would rather travel by trains. Also, along with the development in national economy, passengers' sensibility to prices and time is changing, which is mentioned above that more passengers would like to pay more to save their time on the way.

Figure 3: Fares comparison between the civil aviation and the railway service in 10 city pairs



Notes:
1. Short-distance railway fares for soft seats and long-distant railway fares for soft sleeping berth.
2. Actual airfares are measured by average discount.
3. Full fare tickets base on the benchmark fares announced by the CAAC.
Source: CASTC.

3. COMPETITION BETWEEN CIVIL AVIATION AND HIGH-SPEED RAILWAY

Though the fifth speed-up of railways did not affect the operation of airlines, the data implied that the sixth speed-up of railways in 2007 has obviously impacted on the passenger volume and revenue of airlines in certain routes, especially on the route of Beijing-Jinan. Benefit from the sixth speed-up in April 2007, the runtime of the train between Beijing and Jinan has shortened to 3.4 hours from 4.1 hours with an average speed of 146km/hr, so the carriage capacity of the train has increased obviously. Responding to this, the numbers of air passenger transport decreased 6% with 5.7% drop in passenger load and 16% drop in revenue per seat-km (see Table 2). It can be predicted that profound impact will occur inevitably to short-mid distance air transportation if further speed-up of railway is adopted.

Table 2: airline data on route PEK-TNA

Year	Passengers (thousand)	Seats (thousand)	Passenger load Fact	Daily Frequency	Revenue per seat-km (RMB Yuan)
2006	425	562	75.6%	10.6	1.22
2007	400	572	69.9%	10.4	1.03
Rate	-6%	2%	-5.7%	-2%	-16%

Source: CASTC.

It is reported that the runtime of trains between cities in Beijing-Shanghai railway corridor will sharp shorten after the high-speed railway being open to traffic. Beijing-Shanghai runtime will be reduced to 5 hours to meet its designed expectation while that of Beijing-Jinan and Nanjing-Jinan will be reduced to 2 hours. In addition, no soft sleeping berth but soft seats will be placed on the train and the expected fares of soft seats will be not less than the current soft seat fares of D-letter motor train set. Taking public welfare into consideration, the railway administration has no reason to raise the fares by much, and so it is expected that the train fare will possibly increase 10% of D-letter prices at most in our forecast (see Table 3).

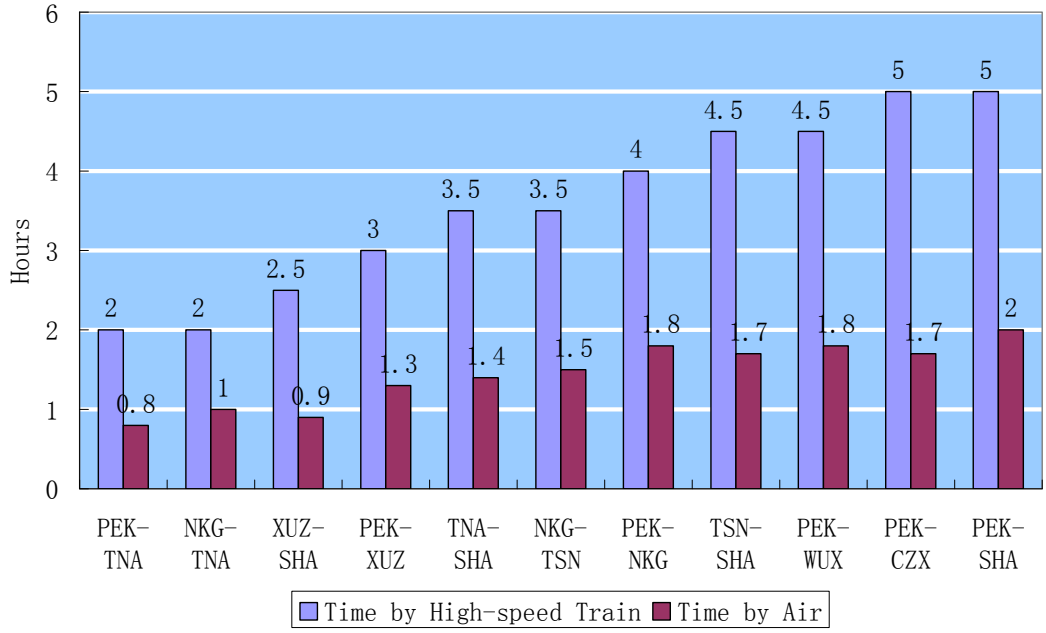
Table 3: Travel time and fares of current train and high-speed Train in forecast

	Current Travel Time By Train (Hours)	Travel Time by High-speed Train (Hours)	Current Train Fare (RMB Yuan)	High-Speed Train Fare (RMB Yuan)	
				Low	High
PEK-TNA	3.4	2	183	183	201
NKG-TNA	5.1	2	254	254	279
XUZ-SHA	4.3	2.5	254*	254	279
PEK-XUZ	6.5	3	298*	302	332
NKG-TSN	6.9	3.5	365*	379	417
TNA-SHA	7.2	3.5	352*	359	395
PEK-NKG	8	4	417*	430	473
TSN-SHA	8.9	4.5	458*	487	536
PEK-WUX	10.5	4.5	458*	495	545
PEK-CZX	11.4	5	442*	468	515
PEK-SHA	10	5	499*	542	600

Note: * refers to fares for soft sleeping berth and the others are for soft seats.

After the operation of high-speed railway, the advantage of transportation time of civil aviation is less obvious than before (see Chart 4). It takes passengers only 1 more hours to have a short-distance travel by high-speed trains than by airplanes in Beijing-Jinan, Nanjing-Jinan, Xuzhou-Shanghai and Beijing-Xuzhou routes. The saving time by air will be rather slender than by high-speed train if taking time in check-in and luggage claim after arriving. Based on the relevant researches, traveling by high-speed trains will faster than by planes in a range of 800 km distance if door-to-door travel time is taken into consideration (See Gleave 2004). Nevertheless, the civil aviation will still keep its dominance in long distance travel between cities, for instant, Beijing and Shanghai. Though it can merely save passengers 3 hours by airplanes than by high-speed trains, it is certain that many passengers would rather take the saved 3 hours for staying with family and for more rest.

Figure 4: Comparison on transportation time between the civil aviation and the railway service in 11 city pairs



On the other hand, the high-speed railway still holds a fare advantage if compared with the average current airfare discounts. No matter which fixed prices--the high one or the lower one—is taken by the high-speed railway system, the airfares will be two times or more expensive than the high-speed train fares applied to Beijing-Jinan and Nanjing-Jinan passenger service. For long-mid distance travel, there are no competitive fares with high-speed trains if higher fares were carried out by the high-speed train's administrator, the airfares will be less than 1.5 times of the train fares. Furthermore, the airlines can adjust the price flexibly to fit the market demand of the transportation. Therefore, the future price fixed by the high-speed train service will bring significant impact on relevant transportation markets and will determine the competitive pattern in which the civil aviation and the high-speed railway service are involved.

Time value is also a key factor unquestionably when the passengers make their decisions on by what they will travel. Both business passengers and leisure tourist passengers have their opportunity costs of time increased accompanying economic growth, so that they are more sensitive to travel time. It is forecasted that the per capita GDP of Beijing, Shanghai, Wuxi are higher, while that of Xuzhou, about one third of that of Shanghai, is still lower. The reason why this paper does not measure the paying ability of passengers in terms of commonly-used per

capita disposable income is that the spending on travel for business purpose is not paid by individuals. Therefore, it is more accurate to consider the average level of productivity in terms of unit-hour in the society than per capita disposable income.

4. AIR-RAIL COMPETITION MODEL

If aviation and railway are supposed to be the only two modes for transportation, then a Logit model could be adopted to analyze the competition between the railway services and the airlines, considering that randomization exists in choosing the travel tools by the passengers (See Shan 1998, and Liu 2003). The model is represented by formulas as follow:

$$P_a = \frac{\exp(-V_a)}{\exp(-V_a)+\exp(-V_r)}, \quad P_r = \frac{\exp(-V_r)}{\exp(-V_a)+\exp(-V_r)}$$

In above formulas, P_a and P_r refer to the share rates of passenger carriage by aviation and railway respectively, and V_a and V_r refer to the generalized travel expense of air passengers and railway passengers respectively.

Definition: Generalized travel expense of air passengers and railway passengers represented as:

$$V_a = f(F_a, T_a), \quad V_r = f(F_r, T_r)$$

In above formulas, F_a and F_r refer to the passengers transport costs of airlines and railways respectively, T_a and T_r refer to the door-to-door travel time by air and railway respectively.

With the difference of passenger structures and affordability among cities, the average time values for passengers are also different. And this has a close connection with the average local level of productivity in terms of unit-hour like the analysis above-mentioned, so the generalized travel expense of air passengers and railway passengers is formulated here as: .

$$V_a = \alpha_1 \lambda F_a + \alpha_2 \lambda g T_a$$

$$V_r = \alpha_1 \lambda F_r + \alpha_2 \lambda g T_r$$

In the above formulas, g refers to average local level of productivity in terms of unit-hour, α_1 and α_2 refer to a relevant phased weight coefficient in $\alpha_1 + \alpha_2 = 1$, and λ refers to the correction coefficient for transportation options with a range from 0 to 1.

Definition: average local level of productivity in terms of unit-hour represented as:

$$g = G \diagup h$$

In this formula, G refers to current year local per capita GDP and h refers to annual per capita working hours.

Simultaneous equations:

$$P_a = \frac{1}{1 + \exp\left[\alpha_1 \lambda (F_a - F_r) + \alpha_1 \lambda g (T_a - T_r)\right]}$$

$$P_r = \frac{1}{1 + \exp\left[\alpha_1 \lambda (F_r - F_a) + \alpha_1 \lambda g (T_r - T_a)\right]}$$

In regard to the difference of passenger structures in different city pairs and passenger's preference in travel time and fares, say, the difference of share coefficients α_1 and α_2, the statistic data investigation and chronological statistic data which is available are a must to obtain the share coefficients for city pairs.

This paper just estimates the competition in passenger transportation for Beijing-Shanghai and Beijing-Jinan routes if the high-speed railway will operate in 2010. In route Beijing-Shanghai, on condition of average 30% discount airfares from all airlines, 40% of passengers will take trains and the rest take planes if the train service sets a lower price for high-speed train fairs, while 30% of passengers will travel by trains and the rest by air if high price is set. Therefore,

combining the pricing of high-speed trains with responding airfare policies will have an important effect on the model of passengers' travel in this route.

In route Beijing-Jinan, on condition of average 25% discount airfares from all airlines, 86% of passengers will take trains and 14% of them take planes if the train service sets a lower price for high-speed train fairs, while 85% of passengers will travel by trains and 15% of them by air if high price is set. Therefore, combining the pricing of high-speed trains with responding airfare policies will have a weak effect on the model of passengers' travel in this route.

5. MEETING THE CHALLENGES FROM HIGH-SPEED RAILWAY

The China's civil aviation industry plans to obtain 20% of passenger transport market calculated by passenger turnover volume by 2020. To achieve this goal and to deal with the challenges which are brought by the high-speed railway, the civil aviation must take necessary actions to guarantee its market share and economic benefits. On one hand, it needs to better use its floating airfare mechanism based on subdivision of passenger groups and take flexible fare policies to guarantee its revenue and get hold of the passengers who might turn toward high-speed trains by satisfying the needs of different passenger groups. On the other hand, it needs to reduce the passengers' door-to-door travel time by optimizing the passenger flow by the combination of the airlines, airports and air control bureau (Liu 2007). Furthermore, increasing flight frequency, improving flights punctuality and services need to be concerned more carefully as they are becoming more and more important.

Better utilization of fare policies is the most important measure to acquire more markets share for all airlines. Firstly, the airlines should let the passengers understand that air travel is not an extravagant spending, because the loyal railway passengers will not care about the airfares even though they are less expensive than train fares in some intercity routes in a slack season for traveling due to their intrinsic concept that air travel is an expensive consumption. Thus, it is necessary to have the passengers, especially those who are sensitive to the fares, aware the possibility to compare the airfares with the high-speed train fares before making a decision on how to travel, particularly in the early days of high-speed railway operation. Secondly, the adoptions of different fare policies which aim at the needs of different characters of air passenger are important strategies for airlines. A current diversifying pricing management

method is used popularly by airlines which price-sensitive passengers are attracted by discount air tickets to increase the passenger load while those who care little about the fares are sold full fare tickets and business-class tickets. If there are more low-cost airlines operating in the future, it is possible to shape a pattern in which the airlines for trunk line travel provide upscale services mainly to high-end passengers and the low-cost airlines compete with the high-speed train services to scramble for the rest passengers. Most importantly, the precondition for airfare decrease is to improve the management and reduce the operation cost, and only with this the airlines can get the space to offer low fare air tickets.

Reducing the door-to-door air travel time for passengers as much as possible is another important measure to guarantee the market share for airlines. Firstly, it is important to improve airport accessibility to reduce travel time of air passengers. Secondly, to set up “Air Express” in golden routes with more passenger movements, which offer more service promises including any-time ticket endorsement convenience and less time in ticket reservation, check-in, security check and luggage claim. Promoted by the CAAC, five airlines including Air China and China Eastern Airlines worked together to set up a ‘Beijing-Shanghai Express’ in 2007 to ensure at least one flight taking off every half an hour, the check-in being stopped 15 minutes prior to flight taking off and ticket endorsement at any time. This measure effectively consolidates the dominant position of the civil aviation in intercity transportation markets in route Beijing-Shanghai. Thirdly, promoting passengers put more trust in the airlines by punctuality improvement. After the high-speed railway operating, the fact is that travel time by trains is shortened greatly. It implies that taking a delayed flight normally occupy more time than taking a high-speed train, which is a competitive pressure that the airlines have to deal with. At last, increasing more flights to help passengers decide their flight time more flexibly and reduce waiting time between every two flights in some level. The measure that all airlines increase the flight frequency will doubtlessly enhance its competitive capability to a great extent for the civil aviation, especially in the routes with less numbers of nonstop trains everyday, for example, route Beijing-Changzhou and route Beijing-Wuxi.

6. CONCLUSION

Beijing-Shanghai high-speed railway project will indeed be a severe challenge to airlines in the future. The impact that the project will have on the civil aviation is far more exceed that the six prior railway speed-ups had. In mid- long distance travel, passengers will be more difficult to decide how they travel when the high-speed railway is put into service because of the high possibility of alternative between high-speed railway service and civil aviation. Therefore, the fare policies that directly affect the passengers' choices and the competition pattern between civil aviation and high-speed railway. In short distance routes, the airlines will not lose all of their passengers. Along with the high-speed development in Chinese national economy, a subtle change will happen in the competition between the civil aviation and the high-speed railway service. The airlines will be able to take advantage of the increasing passenger concern on travel time to gain more market share or increase gradually airfares to earn more.

To meet more and more violent competition, it needs the airlines, airports and the Air Traffic Control Bureau together to ensure the competitive advantage in travel time by improving the time management in the flights arrangement. On the other hand, the airlines initiatives to apply flexible airfare mechanism will be an important factor that has an impact on the air-rail competition pattern when a fixed pricing mechanism is still adopted by the railway service.

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Civil responsibility in air transport: a perspective after the uptodate Rome 1952 international treaty

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ABSTRACT

This paper analyzes the civil responsibility of air transport carriers in accordance with the "*Unification Convention Rules for International Air Transportation*". The matter of civil responsibility is a complicated and conflicting theme for analysis due to the difficulty even greater to the additional problem of having to define responsibilities when a disaster of great proportions takes place. Contrary to other modes of transportation, in the case of air transport there is rarely partial damage (when an accident occurs), therefore it is important to remember that in an aeronautical accident, the damages (or sinister) are not partial, they are total. On the other hand, should be considered that the airline industry is global, in which parts of a whole can come from distant countries involving partners from different countries with different realities and legal liability. The existence of joint responsibility of partners involved in the airline industry is what is meant to identify with this article.

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Keywords: Air transport responsibility, Civil Law, Common Law, International Air Transportation Convention Rules, Partners, Global airline industry

1. INTRODUCTION

The aim of this text is to analyze the civil responsibility of air transport carriers in accordance with the "Unification Convention Rules for International Air Transportation" (celebrated in Montreal on 28th May 1999). The text will also consider problems related to two judicial systems, *i.e.*, **Civil Law** and **Common Law** (and their different interpretations in applying such rules to a specific existing case).

The matter of civil responsibility is a complicated and conflicting theme for analysis (this is the case for lawyers all around the world – no matter their legal system). In the specific case of air transport, the difficulty is even greater due to the additional problem of having to define responsibilities when a disaster of great proportions takes place. Contrary to other modes of transportation, in the case of air transport there is rarely *partial damage* (when an accident occurs), therefore it is important to remember that in an aeronautical accident, the damages (or sinister) are not *partial*, they are *total*. This is the case not only in the case of passengers or cargo being transported, but also in relation to third parties (with which the air company have no contractual or legal relation at all).

Nowadays a series of "actors" are present in the air transportation equation. This includes people and also cargo. It is also true that an aircraft is not a product of only one manufacturer – there are several suppliers and several organizations responsible for aircrafts as "final products". Because of the complex nature of aircraft manufacture, in the event of an accident, how can it be considered that only one of the many "actors" involved is responsible for the accident?

Imagine that a specific equipment of a certain aircraft is defected. Can only the manufacturer be blamed for that specific equipment? Should also the company that assembled the entire aircraft be blamed for that? What about the flight company (operating the aircraft) should it be blamed? Should the air traffic control or the company operating the nearest airport be

responsible? Should the aircraft maintenance team or the pilot and his crew be blamed? There are many pressing questions.

The year 2007 was particularly chaotic regarding Brazilian air traffic. Many problems with flight control and two major accidents were responsible for many deaths (more than 300 during that specific year). The paper will attempt to analyze how the families of the victims could undertake judicial demands, considering the accident which occurred in the city of São Paulo (Brazil).

Some main questions to be answered include: Can the contractual relationships between victims and air transportation companies (the carriers) be identified as a consumption relation? In the case of family members of the victims: would they be forensically legitimate in order to receive any type of compensation (patrimonial or moral)? Could the compensation be greater than what was established by the Montreal Treaty?

Considerations are now made in order to identify how can be characterized the responsibility, what should be the "size" (or amount) of compensation or indemnification? Moreover, it should be also demonstrated that the ***Lex Aquilia*** in Rome presented as indemnification criteria relating to the proportionality principle (therefore not considering fixed compensations). Accepting this mode of action, this brings to the consideration of applying Roman law to contemporary cases. It is also important to clarify that "responsibility", as it is studied nowadays, is based on Aristotle's work "Nicomachean Ethics".

2. CIVIL RESPONSIBILITY - CONSIDERATIONS REGARDING THE "ESTAGIRA" MASTER AND THE LEX AQUILIA

Aristotle was born in Estagira in 384 A.C.; his father, Nicomaco, was a medical doctor and King Amintas II´s friend (Alexander the great's grandfather). After having been a member of Plato's Academy for 20 years (and with Plato's death), Nicomaco decided not to participate in The Academy and was made preceptor of Filipe´s son (in 343 A.C.). After Filipe´s death in 336 A.C., and the rise to power of Alexander to his father's throne, Aristotle returned to Athens and created the Lyceum (Florido, 2000, pp. 7,8,29).

There is no doubt that Western thought was mainly developed by Greek Philosophy. Aristotle started the efforts in favor of the ethical investigation of the causes of human existence. Among his various works it can be observed that his "Book V" on Ethics marks the origin of several forms of reparation of illicit acts committed by unjust man.

Aristotle, in his *Book V on Ethics*, considering several forms of justice, made the case for diverse forms of reparation: not only in terms of Civil, but also in terms of Criminal law. The "Estagirita" classification dealt with voluntary and involuntary transactions. The voluntary transactions are of Civil nature, while the involuntary are Criminal (they were considered under a type of justice called "Particular"). For Aristotle, as laws considered people or opposing parts as equals, if someone was unjustly affected, it was the work of the Judge to re-establish equality (understanding that):

... the law considers only the distinctive character of the misdemeanor and considers parts as equals, asking only if one side committed and the other part suffered some injustice. If one is the author and the other is a victim of misdemeanor. Being this type of injustice an inequality, the Judge will then try to re-establish equality[3]

When presenting the so called *corrective justice*, Aristotle demonstrated that this form of justice is the "average justice" (or a half way) between losses and gains, making use of proportionality principles, as it can be taken from:

Equality is the average or half way between the upper part and lower part of any arithmetic proportion; this is the origin of the term ***díkaion*** *(just); because we are dealing with two similar parts (****dikha****), understood as* ***díkaion****; and a* ***dikastés*** *(Judge) is the person who divides parts in halves (****dikhastés****).* [4]

Aristotle however, recognized the existence of two forms of justice when considering political justice. The "Estagirita" considers a justice "by nature" and another "by convention"; considering remission to licit and illicit acts. As the acts are practiced involuntarily, the author

3 ARISTOTLE. **Nicomachean Ethics**. Brazilian version: São Paulo: Martin Claret. p. 110.
4 ARISTOTLE. Opus cit., p. 111.

does not act in a just or unjust manner. Aristotle considered as well that what determines justice or injustice of acts is its voluntary or involuntary character [5].

2.1 OF ROMAN LAW – LAW OF THE XII TABLETS – *LEX AQUILIA*

The Law of the XII Tablets, part of the judicial Roman system, was written by "*Decenviros*" and adopted in Rome between the years of 303 and 304 B.C.; it dealt with reparations of offence and misdemeanor (wrongdoing, breaking or violation of laws) suffered by victims of these crimes or injurious actions. Item 2 of this Tablet considered: ***Si injuria rupitias... (ast si casu) sarcito*** (If someone causes a premeditated injury, this same person should repair it). Item 7 of Tablet VII considered that fire should be thrown at those who had set fire to a house or to a wheat plantation near a house. The following item (Item 8) of this Tablet considered penalties (in the case of non-intentionality) such as: ***Ast si casu, noxiam sarcito: si nec idoneus escit, levius castigator***. (If acting without prudence, the person should repair damages; if the person have no means and resources for reparation, this person should be punished less severely than if he or she had acted intentionally, Autuori, 1965, p.45).

Later in time (considering Roman law), occurred the transference of corporal to patrimonial responsibility with the ***Lex Aquilia*** which considers punishment illicit acts establishing a link of causality between the procedures of the author of the fact and the respective damaging effect. It must also be observed that not only there was an end for physical punishments – this new legal instrument also inaugurates the principle of proportionality (ending in this way with fixed indemnification and therefore amplifying the anti-judicial field).

Moraes (2002) quotes in his work "Roma Antiga e o seu Direito" (*Ancient Rome and its Laws*) concerning the responsibility under the Roman point of view, after the (already cited) ***Lex Aquilia***:

In what respects the imputation of RESPONSIBILITES it must be emphasized that one which is a consequence of ***mere procedure not in accordance or contrary to friendly relationship****, and, therefore, repugnant to Law studies, object for detailed considerations in*

5 ARISTOTLE. Opus cit. p.118.

*the **tria capita** (three chapters) of the **Lex Aquilia**, which from now onwards sanctions the **danum injuria datum**, the causality nexus linking the procedure of the author to its respective damaging effect*[i].

Another innovation brought about by ***Lex Aquilia*** for Law studies and legal practice (into the Roman Law – which is supervenient up to our days), was the idea of guilt as a tributary to the practice of illicit acts and of many forms of reparation. For the Romans, after all, and also for the ancient people in a more general way, the "size" of the damage was not a main issue – as whatever the "size", the indemnification would be always the same (and when the author of the illicit act had not enough resources to deal with required reparations, he would respond physically).

Moraes (2002), when considering Pretorian obligations, brings us to consider the existing difficulties among "Romanists" in order to identify the origins of obligations before the advent of ***Lex Aquillia***:

*The partition by four of Classic Law (referring to the origins of obligations), have in the "obligations resulting from the quasi-misdemeanor" source of uncertainties and complicated terrain, dissenting area for Romanists. In the past, some tried to differentiate these laws from those "**ex delicto**" on the basis of **dolo*** present on these, and, from simple ***culpa*** in "***ex quase delicto**" – idea which was abandoned with emerging evidence contemplated by **LEX AQUILIA**, from types of simple guilt.* (Moraes, 2002, p.283).

In order to better clarify these issues, it is important to note that the obligation, according to German theories, is dual, *i.e.*, when closely observed an obligation, it is possible to verify that it is composed of debt and also responsibility. Although the existence of obligations without one of the elements quoted above is possible, it is with both elements that the obligation can be judicially ordered. If responsibility is a consequence of the obligation however, this is also a consequence of law, of contract, of quasi-contract, of misdemeanor, of quasi-misdemeanor; the quasi-misdemeanor being considered as an illicit of Civil nature and the misdemeanor as an illicit of Criminal nature. Therefore, while the responsibility is a consequence of the obligation, there are many sources for the obligations.

It is possible to identify through the Romanist text cited above, the extent of changes which were introduced when dealing with reparation of wrongdoings (or any deleterious actions), caused both voluntarily and involuntarily by someone, with the advent of the ***Lex***. Nowadays, one talks of "Aquilian" responsibility when this is extra-contractual.

3. THE FAMILIES OF *COMMOM LAW* AND OF *CIVIL LAW*

The main differences (and similarities) and the new tendency when dealing with the two "*families*" of laws, will now be presented. The purpose here is to present the difficulties that are characteristic of both judicial systems; and also to make some considerations regarding international agreements such as the Montreal Treaty (when, for example, considerations are made in order to understand different forms of judging cases).

David (1993, p.16), in his work of *comparative law*: "The Great Systems of Contemporary Law", when classifying the many judicial systems in "families", does this by showing their similarities (keeping aside – or to a secondary position – their differences).

According to David (1993, pp.16,17) by this way, the first family of Rights is the family of Roman-Germanic Law, of Continental Law or ***civil law*** - which have in its Codes its primary formal source. He presents this family as follows:

The first family of Rights – which deserves our attention – is the Roman-Germanic Law. This family groups together the countries in which the Science of Law formed itself based on Roman Law. The rules of law are conceived in these countries as rules of conduct, closely linked to ideas of Justice and of Moral. To determine which should be these rules is the essential task of Law Science; absorbed by this task, the "doctrine" is less interested in its application – which is the interest for practitioners: lawyers and administrators. From the XIX century onwards, an important role was attributed, in the Romano-Germanic family, to the Law; several countries adopting these ideas produced many "Codes"(David, 1993,p.18).

The above author (op cit, p.19) continues analyzing the "second family", informing that the Right of ***common law*** appears as a result of the analysis of a real-life case submitted to the jurisdiction of the Judge-State (as follows):

*A second family of law is that of **common law**, which comprises the Laws of England and the Rights resulting from the English legal system. The traditional characteristics of **common law** are very different from those of the Romano-Germanic family. The **common law** had its origins with Judges, who had to solve private litigation, and today still keeps this unequivocal "problem-solving" characteristic. The rule of law of **common law**, less abstract than the rule of law of the Romano-Germanic family, comprises of a typology which is meant to provide solutions to a specific process, and not to formulate a "general rule" of conduct for the future.*

As already considered, however, there is an effort by Justice staff (who operate in both types of families), to enhance the similarities amongst these families in such ways that it is possible to consider, mainly the international treaties, with similar interpretations and actions – avoiding situations which could bring about double standards and different legal interpretations. This can be seen when reading the papers published during the "International Congress of Castel Gandolfo" (in Italy), January 2004. Reading, for example, Maria Giovanna Rigatelli, it can be seen that:

The preparation of the Congress: "Law Relations: do we have space for fraternity?" was marked by some interesting moments (in January 2004, Italy), where around fifty individuals from several countries and diverse legal cultures, hoping to find, together, some words of wisdom in order to bring more unity and understanding regarding legal studies and practices. (David, 1993, p.19).

The same specialist (*op cit*) continues her comments by highlighting the existing differences between the two main legal systems of Western world. The main conclusion is that the differences should not be the focus of attention; efforts must be directed towards finding common grounds for understanding and applying laws.

*It has been observed that, for a long time, **civil law** and **common law** were seen opposing each other. During the past twenty or thirty years however, their common roots were discovered – resulting from studies of High Middle Ages Law, which originated in Europe between the fall of the Roman Empire and the XI century.*
(...)

*Today, in those countries using **civil law**, the norm is not seen as unique (as the only source for Law), and jurisprudence is acknowledged as having greater importance.*
*On the contrary, in those countries of **common law**, there is more space for legislation.* (*op.cit.*, p.17)

As it can be seen, there is a tendency (by part of those operating within a diverse range of countries), to search for "converging points" (reaching agreements, dissipating differences). By doing so, there will be greater scope for a better judicial system, observing principles of equality and universality of rights.

Considering the "Warsaw System" and also the "Montreal Treaty", the Montreal meeting brought about solutions to the severe fragmentation originated with the Warsaw system. It is possible today to try to avoid some legal insecurities – and this is a result of efforts towards bringing together different legal systems and families (solving problems of both: Continental Law and **Common Law**).

Having said that, some observations are presented by Donato (2006) (CLAC Secretary General; using material published in the "*Revista Brasileira de Direito Aeronáutico e Espacial" / "Brazilian Journal of Aeronautical and Space Law*"):

It is possible to say that we are dealing with an imperfect Agreement, a product of many efforts towards amalgamating diverse positions of Continental Law and of "Common Law" – in order to formulate a series of observations arising from the specific technical-legal conditions. Critics can point to the problems caused by the integration of the Warsaw System – Warsaw agreement of 1929, The Hague Additional Protocol of 1955, Guadalajara agreement of 1961, Guatemala Protocol of 1971, and Protocols 1, 2, 3 and 4 of Montreal, 1975. An alternative solution was reached (considering this fragmented framework just quoted – and its legal uncertainties), when the new Montreal agreement was produced in 1999, which not only substitutes different legal jurisdictions, but produces a unified system, introducing many modern elements to deal with international air transportation for passengers and cargo (Donato, 2006).

It is important to remind the reader that the integration of many different legal instruments in (only) one system, demonstrates that the Warsaw agreement of 1929 could no longer exist because of many changes in technology: not only regarding aircraft manufacture, but also because of modernization in communication and air traffic control.

As changes which occurred throughout the world are fantastic and of far-reaching consequences (mainly after 1975), the main "instrument" for controlling air transportation could not stay stagnated[6] and fragmented (this including countries "non-aligned" with ***commom law*** or ***civil law***).

4. CONTEMPORARY CIVIL RESPONSIBILITY, AND THE 1999 MONTREAL TREATY

One of the most common problems presented by the Warsaw Pact was that regarding the indemnification limitations by part of air transport companies (be it for cargo or passenger transportation). Notwithstanding the changes made with the advent of the Montreal Treaty, the indemnification limitation still subsist.

This paper presents a case-study involving an aircraft accident of national transport nature (not international)[7]. Even, ***mutatis mutandi***, it is understood that this will not modify the objectives intended to be pursued. In order to better present ideas regarding civil responsibilities, it is necessary to present a brief synthesis of the evolution of responsibilities under a judicial point of view.

6 The first part of the Convention must be read, in order to understand how this modernization works as a signaling system for those participant countries: "Recognizing the need to modernize and put together the Warsaw Convention and related instruments. Recognizing the importance of safeguarding the protection of interests of users of international air transportation, and also, the need for an equitable indemnification, based on the principle of restitution. (Decree n.º 5.910, of 27 September 2006, promulgated as a consequence of the Convention for the Unification of Certain Rules Relative to International Air Transportation, celebrated in Montreal: 28th May 1999).

7 In accordance to the Montreal Convention, following directions of Item 2 (beginning of Article 1), international air transportation is considered that which the point of departure, of arrival or of connection occurs in different countries.

In the past, what prevailed in the sphere of Public Law was the "theory of irresponsibility", based on the English legal principle of ***the king does no wrong***. Later in time came a "theory of subjective responsibility". Nowadays there is the "objective responsibility", and also responsibilities based on administrative risk and responsibilities based on integral (total) risk, and also social responsibility. At present some Western legal organizations use all the theories quoted in a "techno-systematic" fashion.

Our attention will be focused in analyzing the subjective and objective responsibilities, and by which manner the enforcement of any of these responsibilities may influence judicial demands – considering contractual and also extra-contractual relations. In order to state this matter clearly, a tangible example is presented as follows: when a person takes a bus it has as an objective to occupy a determined place. When this person pays for the journey, and enters the vehicle, the passenger made a contract with the transportation company (even if nothing was objectively written and no "specific" contract was celebrated). In the event of an accident, and if the passenger suffers some kind of damage to his physical condition, there will be responsibility on the part of the bus company (of contractual nature).

If in this accident, however, a pedestrian is harmed, suffering some type of damage, the responsibility of the company is of extra-contractual nature. This is the case because the company has no judicial relation with the pedestrian (now victim); not considering damages resulting from the misdemeanor or quasi-misdemeanor, in accordance to the nature and extension of the damage which resulted.

When considering objective and subjective responsibilities, the main point to consider is the matter of guilt. In the case where responsibility is objective it is enough for the person harmed to prove his damage, the causality connection (in other words: the relation of cause and effect). However, if the responsibility is subjective, the affected person will also have to prove the guilt of the part which (supposedly) caused any type of harm or misdemeanor.

It can be seen that the subjective responsibility presents for the person affected (harmed) a greater degree of difficulty. This happens because the person will have to present valid proof to

convince the Judge that it was "that agent" who was responsible for any damage caused to the individual (who performed the illicit act).

At this point, the responsibility presented in the Montreal Treaty is of an objective nature – in accordance to Item 1 and Article 17; and of a subjective nature (regarding damages, loss, or destruction of luggage) – as can be seen by reading Item 2 of Article 17 of the Treaty (the final part of the Treaty).

If the "Brazilian Consumer Defense Code" (*Código de Defesa do Consumidor Brasileiro*) is considered this follows the tendencies of similar codes from the European Community (such as the Italian or the Portuguese Consumer Defense Codes), and all the responsibilities are objective. As the consumer is considered as a final addressee of the productive chain, this places the consumer in an unequal judicial condition in relation to the supplier, to the entrepreneur, to the manufacturer, and to the importing corporation.

Seen by this perspective, air transportation, such as any form of public transport (in the Brazilian case) is a public service, which is offered to consumers via public contract or through permission or concession, and, under these conditions it is applied a rule present in the Brazilian Constitution in its §6º of Article 37, which considers that if a person suffers some type of misdemeanor or damage from any public service provider, it is enough to prove damage or wrongdoing and its causal connection.

Therefore, when considering the Brazilian legal system, regarding the judicial relation between transporter and passenger as a consumption relation (and even if this was not the case), the public services rule (and also for passengers) would be applied in the event of any damage to its physical conditions (or to luggage). It would be enough to prove the damage and the causal connection – without having to prove the guilt of the transportation company.

The following considerations are non-removable when the responsibility is objective (both, under the Consumer Defense Code and the Brazilian Constitution): the first refers to the fact that not always the passenger himself will search for his rights (as in the case of air transportation damages are most likely followed by death and total loss). In the case of

luggage, the situation is different, as the Montreal Treaty considers that in the advent of destruction, loss or damage, the registered luggage is subjective – because it depends on proving the guilt of the transportation company (or of its responsible people), in accordance to the final part of Item 2 of Article 17 of the Treaty.

In the case of transportation and fortuitous damage of cargo, the rule of Article 18 of the Montreal Treaty is applicable. This means that the transportation company proving any of the hypothesis cited in topics a, b, c and d, of Item 2 of Article 18.

4.1 LIMITATION:

The Treaty limited the indemnification for damages for the physical integrity of passengers to a value not greater than 100.000 "*Withdrawal Special Rights*". This monetary unit will be converted under the evaluation of the International Monetary Fund (IMF).

This limitation is directly related to the economic viability of international commercial aviation. In other words, it is not applicable what was applicable in Rome: the ***restitutio in integro***. It is evident that nothing should be greater, for example, than the loss of human life. However, what justifies maintaining the limitation for indemnification? This limitation can not be considered today as restrictive to the development of air transportation enterprises. Exception is made in the cases of terrorism – as was the case in many cases worldwide.

There is no doubt, however, that the increase of passenger flow around the world, and also the growth of cargo transportation, enhances (considerably) the problems of congested airports in many countries. This may as well be a contributing factor for more accidents. However, this should not be a reason for maintaining limitations for indemnification – as determines the Montreal Treaty (to a certain extent repeating some ideas presented in the Warsaw agreement).

It is certain that each case will be considered by the Judiciary in each country (member and signatory of the Treaty). The matter may be considered under the view point of Legal Hermeneutics, or even in accordance with the tendencies of the Tribunals of each country. It is

necessary to understand that the setting up of some points of convergence (some type of agreement) must be put in place in order to allow for the possibility of applying the principle of equality and of universality of rights (no matter the judicial family of the countries involved).

5. SYMPATHETIC RESPONSIBILITY BETWEEN THE MANY ACTORS WHICH WORK DIRECTLY OR INDIRECTLY WITH AIR TRANSPORTATION

Another matter which is relevant for researching civil responsibility is that relating to solidarity. It is well-known that in Legal activities, solidarity is not presumed (but is a consequence of the Law or of the will of the parts involved in legal cases).

In day-to-day legal practice, solidarity represents an opportunity for the creditor or the damaged part to promote judicial demands over those who may, effectively, satisfy its credits or those who are able to take on condemnation when it is the case. In the case of air transportation, not only because there are many other actors involved, but also because of the fact that modernization reduced (or at least minimized) entrepreneurial risks – sharing responsibilities.

It must be also considered that aircraft supplying companies also share responsibilities using the ***leasing*** system. This makes business more attractive and favors air transportation activities (commercially speaking). This is also the view point of José Pedro Polack Varela (see article "Aeronautical Insurance Contract Perspectives", in number 1794, March 2007, of the periodical found on the web-site of SBDA):

The basic elements for air transportation are those belonging to the following actors: aircrafts, infrastructure and navegation systems, aeronautical personel and passengers of cargo which must be carried.

(...)

Without the backing of a system of division, distribution or transfer of risks, which avoids that the great impact of an accident may affect solely one actor, it is very complicated to work safely.

(...)

The insurance contract is a contract which works as a great net of solidarity – making it posible to spread any potencial risks.
(...)
The risks and the corresponding Premium will be the result of studying two main factors:
The accounting conditions, and
The recovery possibilities. (Varela, 2008)

As it can be observed, beyond the existence of other actors (in order to share eventual responsibilities), the transporter will also be obliged to hire and provide insurance. This works, as it can be seen, as a large solidarity net (making it possible to spread and share risks). This also brings a little more judicial safety to passengers. After all, even in the event of the bankruptcy of the transporting company, there are still chances for receiving indemnification (even if this could take more time to occur).

However, the matter is much more widespread. Besides the transportation company, there are also many others actors involved in air transportation such as: air traffic control, airport administrations, and also many suppliers of aircraft manufacturers. Furthermore, the constructor of an aircraft is a consumer of many inputs. An aircraft manufacturer may well be an assembling company – searching for its parts from several countries around the world.

Taking a specific accident as a case-study, and after specialist analysis (by technical investigation), it is almost certain that solidarity can be brought into the equation – among the diverse range of actors. This may neutralize the indemnification limitation, imposed by the Montreal Treaty. It may also affect (making it more complicated) that the hindered person (or his family member) is able to promote any demand targeting any of the actors involved considering the entire air transportation operation.

6. THE WHAT, HOW,WHEN AND WHERE QUESTIONS:

It is possible to understand that the final addressee of air transportation, or even the third-party which presents no judicial relation to the air transportation carrier, it should have the opportunity to choose what**,** how, and when ... and even where.

6.1. WHAT: Considers the choices that the victims (or their families) have regarding the type of legal action they will undertake. Important considerations here are those of contractual and extra-contractual responsibilities.

6.2. HOW: To produce the analysis of the diverse possibilities and of the variables which are a consequence of solidarity, it is always important to seek for the best interests of those who were victims of accidents or misdemeanor.

6.3. WHEN: The search for immediate reparation, even if there are not enough elements in hand to pursue legal demands (even in those cases related to objective responsibilities).

6.4. WHERE: Valuing solidarity, it is possible to advocate the case in more than one country (this being possible when the actors who caused the misdemeanor are not restricted to only one country).

7. CONCLUSIONS AND CLOSING REMARKS

The aim of the present text was to shed light and promote some reflections regarding the matter of solidarity in civil responsibilities relating to the air transportation sector. It was dealt here with a tragic and extreme situation of the air chaos as it occurred in Brazil in 2007. However, this type of research is also useful in cases where passengers suffer some type of disruption, and it is not always clear the main responsibilities of air transportation companies.

As mentioned previously, there are many actors in the air transportation sector. Technological development and the many forms for financing air transportation companies are increasing the complexity of these actors. As airplanes are increasingly building up mass transportation systems, there will be greater problems with air traffic congestion and increased possibilities for system failure.

To the consumer, addressee and important link of the consumption chain, there are still problems regarding the weaknesses of this "link" (it must be considered the negative and not expected results). The consumer, understanding his weakness and its importance, should pursue more knowledge related to the "what", "how", "when" and "where" questions in order to try to repair wrongdoings or misdemeanor caused by air transportation companies. And, of course, valuing the proportionality principle of the "Lex Aquilia", and also the reasonability principle, removing the limitations imposed by the Montreal Treaty.

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Terrorism and tourism: the way travellers select airlines and destinations

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ABSTRACT

Terrorism is seen as an influence factor for tourists in order to select transportation mean and destination. The Mediterranean Region is the most famous tourist destination globally, and most of its visitors use airplanes in order to be transported. The purpose of this study is to examine the perceptions of tourists traveling by air in accordance with the influence of terrorism concerning the selection of the air company, the preferable destination, and their alternations in traveling behavior. The technique undertaken in order to reach the objectives is personal – structured interviewing, and a random starting method was also selected in order to reach the respondents. For better comprehension of the perspectives' formulation there was an analysis of five socio-demographic characteristics (gender, age, level of education, marital status, and travel frequency). The results provide interesting outcomes concerning the degree of the perceived risk factors that tourists take under consideration for their decisions. Furthermore the paper suggests for decision makers further policies that can be undertaken in airlines and destinations.

Keywords: Tourism, Terrorism, Travelers Perspectives, Air Company Selection, Destination Selection.

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1.1 INTRODUCTION

The crisis created after the 9/11 terrorist strikes in the U.S. of America had a considerable influence in tourist flows from origin to host societies, especially the dependent ones from air transportation. This crisis was enlarged with other chain reactions followed the terrorist strike, as it was the wars in Afghanistan and Iraq, the strikes in Instanbul, Madrid, London, Kairo, Amman, and the increasing global mistrust due to the occurred economic changes.

Mediterranean is considered as the most famous tourist destination globally. The terrorist strikes have led to changes in tourist flows of its traditional destinations affecting not only the economy of the local societies, but the economic structure of the region. These impacts are more profound in dependent destinations on tourism.

The island of Crete is situated in the southernmost part of Greece. It hosts approximately 2.5 to three million tourists every year (N.S.S.G., 2005). Its economy is dependant on tourism, while the vast majority of tourists reach the island by air (Spertou & Pappas, 2004).

A lot of studies discuss a wide variety of matters concerning the relationship of tourism and terrorism (Aziz, 1995; Weber, 1998; Stafford et.al., 2002; Bhattarai et.al.; 2005 Coshall, 2005), but limited studies emphasize on the impacts of terrorist acts in tourism in a Mediterranean basin. In such cases, extensive preliminary work needs to be done to gain familiarity with the phenomena in the situation, and understand what is occurring (Sekaran, 2000).

The purpose of this paper is to examine the perceptions of tourists traveling by air, and visiting Crete. The aim of the paper is to seek out on the visitors' perspectives according the selection of the air company, and the impact that terrorism has in their alternations of traveling behavior and destination preferences.

1.2 TOURISM AND TERRORISM

Terrorism is defined as "the premeditated, politically motivated violence perpetrated against civilians and unarmed military personnel by sub-national groups.", and international terrorism as "involving citizens or the territory of more than one country" (U.S. Department of State, 1997:

34). The relationship between tourism and terrorism gained international notoriety during the Olympic Games in Munich. After this, the international tourists have been actually aware of this relationship (Lepp & Gibson 2003). The infrastructure and security in the tourism industry, the psychology of travel, and the way in which many people view the world have changed after the tragic events of 9/11 in America (Goodrich, 2002), and their chain reactions (Spertou & Pappas, 2004).

Many studies remark that safety and security are important concerns toward tourists travelling abroad (Poon & Adams, 2000). Tourists usually become targets of terrorist organizations (Lepp & Gibson, 2003). Tourism actually comes to represent capitalism and conspicuous consumption, and a terrorist attack on tourists signifies ideological opposition to these western values (Aziz, 1995). According to Richter and Waugh (1986), and Sonmez (1998) an attack on tourists can symbolize an attack on the government. Pizam (2002: 1) says that "every time a wave of crimes or a terrorist act is committed at a tourist destination, tourism demand declines and the industry goes through a period of economic slowdown or recession".

Lepp and Gibson (2003: 620) state that "tourism planners need to be aware of which risks might cause stress among tourists, an awareness that should also inform marketing strategies", something that is very important in the developing societies where tourism industry is being promoted as an important market sector (Burns, 1999) and is being used as a key for further development (Andriotis, 2000).

1.3 TOURISM IN CRETE

The island of Crete is the most famous tourist region of Greece, hosting more than 20% of the total tourist arrivals in the country (Pappas, 2005). The island has also recorded the largest increase on bed nights (Andriotis, 2000) all over Greece. It is considered as the wealthiest region in the country (Ministry of Economy, 2003). The local economy is based in the tertiary sector, placing tourism as the most important economic activity.

Crete is considered as a family resort. Approximately 42% of total tourist arrivals represent families with children, 38% couples and 20% singles. There is also an attraction occurred in

younger segments of the tourist market. 49% of tourists belong to the age group of 18 – 35, 22% between the age of 36 – 45, 18% to the from 46 to 60 years old and 11% to the over 60 years old age group (R.I.T.T.S., 1999).

In 2001 the majority of tourists that visited Crete were northern Europeans, especially Germans, British and Scandinavians, having an amount of approximately 65% of total foreign tourist flows (G.N.T.O., 2002). There is no doubt that the countries of Eastern Europe offer a new potential market for the island, since they have a religious relationship with Greece, the centre of Orthodox Christianity (Andriotis, 1995). Unfortunately, these markets have not been fully exploited and therefore appropriate marketing strategies are required for their attraction (Bakalis & Theodossiou, 1994; Association of Cretan Hoteliers 2003).

Air transport plays a crucial role on Cretan tourism since approximately 90% of foreign tourists arrive by charter flights. The last decade the arrivals by charter flights increased approximately 45% (G.N.T.O., 2002). It is estimated that during summertime, air traffic is so high that in the International Airport of Heraklion the arrivals are approximately 150 per day (Interkriti, 2001).

1.4 SELECTION OF VARIABLES

The variance of the expressed opinions and the statistical significances that are formulated toward the expressed perceptions are directly connected with the individual characteristics of the sample population. Many studies reveal that gender is the main factor of the perspectives' formulation in the respondents (Hess & Ferree, 1987; Swain, 1989; Picard, 1990; Britton, 1991; Fairburn-Dunlop, 1994; Kinnaird & Hall, 1996; Mason & Cheyne, 2000). Some others, such as the researches of Walmsley and Jenkins (1993), Oppermann (1995), Trakolis (2001), Collins and Tisdell (2002), Spertou and Pappas (2004), and Trethway and Mak (2005), support that the differentiations of the respondents' age create very important alternations to their perceptions.

On the other hand, the level of education of the sample population is considered as a crucial factor for the creation of significant differences in the expressed perspectives (Baloglu & McCleary, 1999; Stern & Krakover 1993; Teye et. al., 2002). Other studies' findings remark the importance of the marital status for the tourists' decision making (Arentze et.al., 2004; Cao &

Mokhtarian, 2005). Finally, the previous experience and frequency of tourists' travels is being presented as an important factor for the final preferences of tourists (Pearce, 1988, 1996; Sonmez & Graefe, 1998[a]; Aksoy et.al., 2003)

This paper takes under consideration all the above studies and researches, and examines the variation of perceptions toward gender, age, level of education, marital status, and travel frequency.

2. RESEARCH METHODOLOGY

2.1 RESEARCH CHARACTERISTICS

The research was quantitative. It was conducted in June and July 2006 in the International Airport of Heraklion, Crete. The most appropriate method considered in order to obtain the primary data, was the structured personal interview. It was undertaken the technique of personal interviewing in order to reach the objectives since it is "the most versatile and productive method of communication, it enables spontaneity, and also provides the skill of guiding the discussion back to the topic outlined when discussions are unfruitful" (Sekaran, 2000). The questions of the interview were 'close-ended', structured with a 5-point Likert Scale (1: strongly disagree, 5: strongly agree).

2.2 SAMPLING STRATEGY

In order to select a sample frame, the process adapted was the following. A random starting method (systematic sampling) was selected in order to reach the respondents. Passengers of every fifth flight reaching the International Airport were selected to participate in the sampling frame. All the respondents had to be adults, coming to Crete for tourism.

2.3 SAMPLE SIZE DETERMINATION

The way that the sampling size had to be representative was a fundamental criterion in order to determine the amount of the sample and the research time period. Of the total tourist

population over 80% visits the island during summertime (G.N.T.O. 2003). Since the proportions of population were unknown, it has taken a conservative response format 50 / 50%, meaning the assumption that 50% of the respondents have negative perceptions, and 50% have not. At least 95% confidence and 5% sampling error was selected. The sample size was:

$$N = \frac{(1.96)^2 (0.5)(0.5)}{(0.5)^2} \Rightarrow N = 384.16 \textbf{ Rounded 400}$$

The calculation of the sampling size was independent of the total population size hence the sampling size determines the error (Aaker & Day, 1990). From the 400 interviews, 273 travellers have replied. The response rate of the research was 68.25%. The final statistical error of the research was 5.9%.

2.4 DATA COLLECTION ANALYSIS

The existing literature helped for the preparation of the data collection instrument, and included questions were selected by a series of previously conducted interviews in host population concerning perspectives toward selection of Air Company, destination, and influence of terrorism in tourists' behavior (Poirier, 1997; Sonmez & Graefe, 1998[a], 1998[b]; Albuquerque & McElroy, 1999; Prideaux, 2000; George, 2003; Lepp & Gibson, 2003; Spertou & Pappas, 2004).

The questionnaire consists of by 21 questions. These questions were:

- Six questions accessing passengers' perspectives on the selection of air company.
- Four questions concerning the influence of terrorism in tourists' behavior.
- Six questions dealing with the visitors' selection of the destination.
- Five socio – demographic questions (gender, age, level of education, marital status, travel frequency).

For the analysis of the collected data, the Statistical Program for Social Sciences (SPSS, 13.0) was used. To identify the existence of statistical significances between the variables, the analysis used t-Test, Spearman's "ρ", x^2, frequency tables, and ANOVA. The indication of

statistical significance is at the 0.05 level of confidence. For the contradiction and presentation of the research findings, Cross tabulations were also used.

3. RESEARCH FINDINGS

3.1 PROFILE OF THE SAMPLE

Table 1 presents the socio-demographic characteristics of the study population. The majority of the respondents were men (51.6%). The study population between the ages of 18 – 35 represents the 44.3% of the total sample. Accordingly, the age groups between 36 – 50, and over 50 years old represent the 34.4% and 21.2% of the sample respectively. 47.3% of the respondents were primary and secondary education graduates, while 52.7% were tertiary education graduates and postgraduates. The single respondents represented 47.3% of the sample, and the married ones represented 52.7%. Finally, the interviewed population that had a frequency of air travels up to three times the previous year represented the 37% of the sample, as those who annually traveled from four up to six times. The sample population that traveled more than six times represented the 26% of the total sample

Table 1: Profile of the Sample Population

	N	**Sample (%)**
Gender		
Male	141	51.6
Female	132	48.4
Age		
18 – 35	121	44.3
36 – 50	94	34.4
Over 50	58	21.2
Level of Education		
Primary and Secondary Education Graduates	129	47.3

Tertiary Education Graduates and Postgraduates	144	52.7
Marital Status		
Single	129	47.3
Married	144	52.7
Annual Frequency of Air Travels		
0 – 3	101	37.0
4 – 6	101	37.0
Over 6	71	26.0

3.2 THE SELECTION OF AIR COMPANY FROM TOURISTS

The perspectives of the respondents revealed that the most important for their travels' air company selection was the provision of flight safety (1.82), followed by the ticket price (1.86), the air company's security measures (2.14), and finally the provided services (2.55). The majority of the sample population disagreed with the selection of an air company concerning its origin country (4.01).

Table 2: Selection of Air Company

	Flight Safety	Security Measures	Prices	Services	Flight Frequency	Origin Country
Total Mean	1.82	2.14	1.86	2.55	2.77	4.01
Stand. Deviation	.793	.909	.721	1.070	.937	.916
Gender						
Male	1.75	2.21	1.78	2.70	2.74	4.40
Female	1.89	2.07	1.94	2.39	2.80	3.59
T Ratio	-1.405	1.256	-1.842	2.342	-.509	8.037
Significance*	.161	.212	.068	**.020**	.611	**.000**
Age						

18 – 35	2.12	2.47	1.53	2.98	2.93	4.16
36 – 50	1.77	2.03	2.12	2.28	2.56	3.96
Over 50	1.26	1.62	2.12	2.09	2.74	3.78
F Ratio	28.442	20.802	26.781	21.170	4.246	3.682
Significance*	**.000**	**.000**	**.000**	**.000**	**.015**	**.026**
Education						
Primary & Second.	1.74	1.99	1.99	2.47	2.84	3.84
Tertiary & Postgr.	1.89	2.27	1.74	2.63	2.70	4.15
T Ratio	-1.591	-2.554	2.972	-1.233	1.196	-2.808
Significance*	.113	**.011**	**.003**	.218	.233	**.005**
Marital Status						
Single	1.97	2.29	1.74	2.74	2.74	4.19
Married	1.68	2.01	1.97	2.38	2.79	3.84
T Ratio	3.048	2.545	-2.638	2.765	-.481	3.240
Significance*	**.003**	**.011**	**.009**	**.006**	.628	**.001**
Travel Frequency						
Up to 3 times	1.77	2.03	1.89	2.58	2.94	3.82
4 to 6 times	1.80	2.23	1.78	2.50	2.82	4.14
Over 6 times	1.90	2.17	1.92	2.58	2.44	4.08
F Ratio	.580	1.252	.889	.207	6.573	3.425
Significance*	.561	.287	.412	.813	**.002**	**.034**

*: The values shown in bold indicate a statistical significance at the .05 level of confidence

Statistical significances toward gender appear in statements concerning the air company's provided services and origin country. Dealing with men, the overall agreements in provided services were 46.8%, and 2.1% in origin country. The proportions in women were 56.8%, and 13.6% respectively. All statements reveal statistical significances toward age. For the sample population up to 35 years old the overall agreements were 68.6% for flight safety, 60.3% for security measures, 94.2% for price influence, 33% for provided services, 34.7% for frequency of flights, and 5.8% for air company's origin country. The proportions for respondents between

36 to 50 years old were 86.2%, 76.6%, 81.9%, 61.7%, 47%, and 6.3%, while in the same statements the proportions for people over 50 years old were 100%, 87.9%, 79.3%, 74.1%, 41.4%, and 13.8% respectively.

Toward education, statistical significances appear in statements dealing with provided services and origin country. In the same statements, significances were also produced toward gender. For the primary and secondary education graduates the overall disagreements in provided services were 17.8% and 69% in origin country. The proportions for the tertiary education graduates and postgraduates were 22.2% and 78.5% respectively. Statistical significances toward air travel frequency appear in statements dealing with the flight frequency and the origin country. The overall disagreements in people that annually travel up to three times were 25.7% in flight frequency, and 67.3% in origin country. In these statements the proportions on the respondents that annually travel for four up to six times were 21.8% and 80.2%, while for people traveling over six times per year were 21.1% and 74.6% respectively.

Most of the statements reveal statistical significances toward marital status. Dealing with flight safety in singles, the overall agreements were 69.8%, 68.2% in security measures, 90.7% in provided prices, 44.2% in provided services, and 1.5% in origin country. On the other hand, the overall agreements in married respondents were 85.4%, 75%, 83.3%, 58.3%, and 13.2% respectively.

These results indicate that as people get older, they become more careful and demanding. Their level of education, their gender, and mostly their marital status play a significant role for respondents' final decisions. As people grow up, their obligations increase (occupational, family etc), and their decisions are characterized by skepticism, since they become more careful to their final preferable selections.

3.3 THE INFLUENCE OF TERRORISM IN TOURIST PREFERENCES

The informants perceive that terrorism has mostly influenced the way they travel (2.28), and the destination they select (2.32). Terrorist events and strikes have also slightly influenced the frequency of the respondents' air travels (2.54). Concerning the influence of terrorism in the sample population's interaction with the locals, the perspectives seemed to be neutral (3.00).

Table 3: Influence of Terrorism

	Way of Travel	Frequency of Travel	Destination Selection	Interaction with Locals
Total Mean	2.28	2.54	2.32	3.00
Standard Deviation	.839	1.000	.881	1.045
Gender				
Male	2.28	2.72	2.43	3.12
Female	2.29	2.35	2.20	2.86
T Ratio	-.111	3.147	2.158	2.042
Significance*	.912	**.002**	**.032**	**.042**
Age				
18 – 35	2.60	2.93	2.50	3.60
36 – 50	1.99	2.35	2.30	2.62
Over 50	2.09	2.03	1.95	2.36
F Ratio	18.237	21.242	8.257	49.966
Significance*	**.000**	**.000**	**.000**	**.000**
Education				
Primary & Secondary	2.22	2.57	2.20	2.84
Tertiary & Postgraduate	2.33	2.52	2.42	3.14
T Ratio	-1.068	.371	-2.046	-2.402
Significance*	.287	.711	**.044**	**.017**
Marital Status				
Single	2.42	2.65	2.37	3.27
Married	2.16	2.44	2.26	2.75
T Ratio	2.559	1.712	1.014	4.242
Significance*	**.011**	.088	.312	**.000**
Travel Frequency				
Up to 3 times	2.15	2.49	2.28	3.03
4 to 6 times	2.40	2.55	2.36	3.00
Over 6 times	2.31	2.61	2.31	2.94

F Ratio	2.274	.313	.205	.141
Significance*	.105	.731	.815	.868

*: The values shown in bold indicate a statistical significance at the .05 level of confidence

Statistical significances appear toward gender concerning the frequency people travel, the destination they select, and their interaction with the locals. Among men the overall agreements on travel frequency were 39%, 56.7% on the preferable destination, and 26.2% on their interaction with locals. The proportions among women were 55.3%, 63.6%, and 38.6% respectively. The statements concerning the destination selection and the interaction with the locals reveal statistical significances toward education. The overall agreements in the destination selection were 65.9% for the primary and secondary education graduates and 54.9% for the tertiary education graduates and postgraduates. Moreover, the overall disagreements dealing with the interaction with the locals were 26.3% and 38.2% respectively.

Toward marital status, statistical significances exist in the way people travel and in their interaction with the locals. The overall agreements focusing on the way people travel were 52.7% for singles and 69.4% for the married ones, while in the interaction with the locals they were 20.9% and 42.4% respectively.

Once more, statistical significances appear in all statements toward age. The overall agreements dealing with the influence of terrorism in the respondents up to 35 years old were 45.4% in the way they travel, 28.1% in the frequency they travel, 52% in the destination they select and 9.9% in their interaction with the locals. In addition, focusing on the respondents from 36 to 50 years old the overall agreements in the same statements were 73.4%, 55.3%, 58.5%, and 44.7%, while in the respondents over 50 years old these were 75.9%, 72.4%, 77.6%, and 58.6% respectively.

Most of the statistical significances appear toward gender and age, while there was no statistical significance toward the annual air travel frequency. Women and elder people have higher impact factor from terrorist incidents. Moreover, terrorism has lower influence on singles, and on tertiary education graduates.

3.4 THE SELECTION OF TOURIST DESTINATION

Dealing with destination selection, the most crucial factor among the was the terrorist strikes that happened in this territory (1.85). The criminality occurred in the host society was one more important variable (1.93) for the selection of the host destination, followed by the excising health conditions (1.94), the political stability (2.21), and the local culture (2.27).

Table 4: Selection of Destination

	Political Stability	Culture of Destination	Religion of Destination	Health Conditions	Criminality	Terrorist Strikes
Total Mean	2.21	2.27	3.04	1.94	1.93	1.85
St. Deviation	.799	.852	1.046	.809	.806	.785
Gender						
Male	2.16	2.35	3.23	2.00	1.91	1.87
Female	2.27	2.17	2.83	1.87	1.96	1.83
T Ratio	-1.055	1.754	3.158	1.316	-.556	.415
Significance*	.293	.080	**.002**	.189	.579	.679
Age						
18 – 35	2.43	2.53	3.42	2.24	2.31	2.13
36 – 50	2.13	2.20	2.89	1.74	1.77	1.78
Over 50	1.90	1.83	2.47	1.62	1.43	1.36
F Ratio	10.179	15.125	20.214	17.447	32.201	22.516
Significance*	**.000**	**.000**	**.000**	**.000**	**.000**	**.000**
Education						
Prim. & Secondary	2.09	2.16	2.91	1.84	1.84	1.78
Tertiary & Postgr.	2.32	2.37	3.15	2.02	2.02	1.91
T Ratio	-2.357	-2.090	-1.948	-1.801	-1.888	-1.417
Significance*	**.019**	**.039**	.052	.073	.060	.158

Marit. Stat.						
Single	2.32	2.45	3.30	2.15	2.13	1.97
Married	2.12	2.10	2.80	1.75	1.76	1.74
T Ratio	2.075	3.409	4.085	4.172	3.936	2.471
Significance*	**.039**	**.001**	**.000**	**.000**	**.000**	**.014**
Trav. Freq.						
Up to 3	2.09	2.24	3.14	1.92	1.81	1.80
4 to 6	2.29	2.23	2.91	1.97	2.03	1.82
Over 6	2.28	2.37	3.07	1.92	1.97	1.94
F Ratio	1.924	.647	1.249	.130	1.962	.755
Significance*	.148	.525	.288	.878	.143	.471

*: The values shown in bold indicate a statistical significance at the .05 level of confidence

The only statement that reveals statistical significance toward gender concerns the religion of people as a factor for the selection of a destination. Among men, the overall agreements were 22%, while in women they reached 37.1%. Toward level of education statistical significances appear in the statements dealing with the political stability and the culture of the destination. The overall agreements among primary and secondary education graduates were 69.8% in the influence of political stability and 66.7% in the destination's culture, while in the tertiary education graduates and postgraduates the proportions were 60.4% and 52.8% respectively.

Statistical significances appear in all statements toward age and marital status. Toward age, the respondents up to 35 years old overall agreed by 55.4% in political stability, 47.9% in destination culture, 17.3% in locals' religion, 66.1% in health conditions, 63.6% in criminality levels and 72.7% in terrorist event and strikes in the destination. In the same statements the proportions for people aged from 36 till 50 were 68.1%, 61.7%, 27.7%, 85.1%, 92,5% and 86.2%, while in people over 50 years old these were 79.3%, 79.3%, 56.9%, 86.2%, 94.8% and 96.5% respectively. Toward marital status, the singles overall agreed by 60.5% in the issue of political stability, 51.2% in the culture of the destination, 18.6% in the locals' religion, 70.5% in the destination's health conditions, 72.9% in the host society's criminality levels, and 71.3%

in terrorist incidents concerning the selected territory. For the married ones, these proportions were 68.7%, 66.7% 38.9%, 82.6%, and 86.8% in the two final ones.

Concluding, younger and single people are the main seekers for adventure and they seem to search for challenges to the destinations they choose even if these challenges might hide a high risk for their health and their life. On the antipode, the elder, married people appear to have the highest concern and influence in risk factors in order select their preferable destination.

3.5 SPEARMAN'S CORRELATION

According Spearman's "ρ", the statistical significances' occurred appear positive relationship toward age and marital status (ρ = .402, Sig. = .000), and negative relationships toward age and education (ρ = -.258, Sig. = .000), marital status and education (ρ = -.146, Sig. = .016), and marital status and frequency of air travels (ρ = -.129, Sig. = .033). The above outcomes reveal that as people get older, they get married. Marriage obligations (family affairs, children etc) reduce the frequency of peoples' travels. Moreover, the level of education usually determines the occupation people do, meaning that people with higher education usually get higher posts, and due to their jobs and their salaries they travel more often. Nowadays, the necessity of education, and the opportunities provided are higher than those in former decades. Concluding, the profile of the frequent traveler is a young, not married person with higher education.

Table 5: Cross Tabulation Analysis toward Independent Variables in the Statements with Statistical Significance

Age		Str. Agree	Agree	Not Agr. / Dis.	Dis.	Str. Dis.	**Gender**		Str. Agree	Agree	Not Agr. / Dis.	Dis.	Str. Dis.
Safety	18 – 35	30	53	31	7		Service	Male	18	48	41	27	7
	36 – 50	35	46	13				Female	29	46	36	18	3
	Over 50	43	15				Country	Male		3	13	50	75
Security	18 – 35	14	59	30	13	5		Female		18	37	58	19
	36 – 50	22	50	19	3		Freq/cy	Male	13	42	62	19	5
	Over 50	29	22	7				Female	32	41	44	11	4
Price	18 – 35	65	49	6	1		Dest/tion	Male	17	63	45	16	
	36 – 50	11	66	12	5			Female	32	52	39	8	1
	Over 50	8	38	9	3		Int/tion	Male	8	29	50	46	8
Service	18 – 35	12	28	39	34	8		Female	13	38	46	24	11
	36 – 50	20	38	27	8	1	Crim/ty	Male	7	24	49	52	9
	Over 50	15	28	11	3	1		Female	17	32	46	30	7
Freq/cy	18 – 35	9	33	42	31	6	**Education**						
	36 – 50	10	37	31	16		Service	P. & S.	23	48	35	21	2

	Over 50	1	23	24	10			T. & P.	24	46	42	24	8
Country	18 – 35		7	19	43	52	Country	P. & S.		16	24	53	36
	36 – 50		6	17	46	25		T. & P.		5	26	55	58
	Over 50		8	14	19	17	Dest/tion	P. & S.	24	61	38	6	
Way	18 – 35	8	47	51	15			T. & P.	25	54	46	18	1
	36 – 50	28	41	23	2		Int/tion	P. & S.	13	35	47	28	6
	Over 50	12	32	11	3			T. & P.	8	32	49	42	13
Freq/cy	18 – 35	10	24	60	18	9	Politics	P. & S.	33	57	33	6	
	36 – 50	18	34	33	9			T. & P.	18	69	50	7	
	Over 50	17	25	13	3		Culture	P. & S.	27	59	39	4	
Dest/tion	18 – 35	16	48	38	18	1		T. & P.	28	48	55	13	
	36 – 50	17	38	33	6		**Marital Status**						
	Over 50	16	29	13			Safety	Single	39	60	25	5	
Int/ction	18 – 35		12	43	48	18		Married	69	54	19	2	
	36 – 50	12	30	35	16	1	Security	Single	24	64	24	14	3
	Over 50	9	25	18	6			Married	41	67	32	2	2
Politics	18 – 35	11	56	45	9		Price	Single	51	66	7	5	
	36 – 50	20	44	28	2			Married	33	87	20	4	
	Over 50	20	26	10	2		Service	Single	19	38	37	28	7
Culture	18 – 35	15	43	47	16			Married	28	56	40	17	3
	36 – 50	17	41	36			Country	Single		2	27	44	56
	Over 50	23	23	11	1			Married		19	23	64	38
Religion	18 – 35	4	17	39	46	15	Way	Single	20	48	48	13	
	36 – 50	5	21	47	21			Married	28	72	37	7	
	Over 50	15	18	9	15	1	Int/tion	Single	2	25	49	42	11
Health	18 – 35	19	61	34	7			Married	19	42	47	28	8
	36 – 50	38	42	14			Politics	Single	20	58	41	10	
	Over 50	32	18	6	2			Married	31	68	42	3	
Crim/ty	18 – 35	19	58	32	12		Culture	Single	17	49	51	12	
	36 – 50	30	57	6	1			Married	38	58	43	5	
	Over 50	36	19	3			Religion	Single	7	17	46	48	11
Ter/rism	18 – 35	24	64	26	7			Married	17	39	49	34	5
	36 – 50	36	45	11	2		Health	Single	27	64	30	8	
	Over 50	39	17	2				Married	62	57	24	1	
Trav. Frequency							Crim/ty	Single	30	64	23	12	
Freq/cy	0 – 3	1	32	42	24	2		Married	55	70	18	1	
	4 – 6	3	37	39	19	3	Ter/rism	Single	39	61	23	6	
	Over 6	16	24	16	14	1		Married	60	65	16	3	
Country	0 – 3		18	15	35	33							
	4 – 6		2	18	45	36							
	Over 6		1	17	28	25							

4. CONCLUSIONS

The examined socio – demographic variables were gender, age, level of education, marital status, and annual air travel frequency of the respondents. The sample included the adult visitors in a traditional Mediterranean summertime island tourist destination. As a result, the research findings can be generalized in other Mediterranean similar host destinations. The perceptions of the individuals hold on the factors that affect their final decisions in order to select an air company and a destination. These results contribute to the better understanding on how travelers' behavior is formulated, and give useful evidence in both airlines' and destination marketers.

The decision makers can increase the image on an air company providing more flight safety and security measures with a parallel rationalization or reduction of ticket prices. Additionally, the marketers can improve the destination image if they succeed to decrease the perceptions formulated by the risk factors associated with host society.

The most crucial socio-demographic variable appears to be the respondents' age, followed by the marital status. The perceptions of married, elder people seem to be more vulnerable in terrorism incidents and other risk factors they might exist or appear. Associating with genders, women give higher concern in flight and destination risk factors than men do. Moreover, people with higher education are less influenced by terrorism incidents that the primary and secondary education graduates. Finally, the less people travel, the more they are influenced by air traveling and destinations' risk factors.

Further research needed in order to better comprehend the formulation and the evolution of perspectives. The perspectives of travelers are not standardized and unchanged during time. These perceptions in traveling and visiting tourist destinations have significantly changed after the 9/11 terrorist strikes (Goodrich, 2002; Stafford et.al., 2002; Spertou & Pappas, 2004), and are still changing. Because of this, research in travelers has to be repeated. The travelers' perceptions have to be periodically examined in order to give to the decision makers, essential evidence and information aiming to the continuous image improvement of airlines and tourist destinations, and the annihilation of terrorist incidents' influence to individuals.

As Lepp and Gibson (2003: 620) state "tourism marketers need to learn how to guard against the *generalization effect* as perceived risk can have severe economic consequences". A combined effort has to be made from airline and destination planners and decision makers in order to increase the safety image, reduce the influence of the perceived risk factors, and strengthen the public trust in order to increase the tourist flows in host societies.

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