

How to Prepare an Airport for the Olympic Games?
- Transportation of the Olympic Family Members-

by

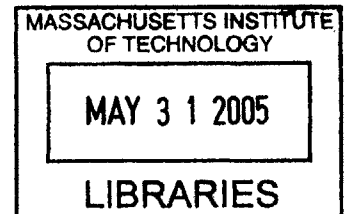
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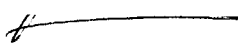
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**How to Prepare an Airport for the Olympic Games?
- Transportation of the Olympic Family Members-**

By

Eva Kassens

Submitted to the Department of Civil and Environmental Engineering on May 6th,
2005 in Partial Fulfillment of the Requirements for the Degree of Master of Science
in Transportation

ABSTRACT

This thesis describes and assesses the preparation of Athens International Airport for and its performance during the Olympic Games in 2004. The analysis includes infrastructural modifications made and organizational restructuring processes undertaken. It also describes the rationale behind some of the decisions, as well as the implementation of certain specific measures. The time-frame of the preparations stretches from the very strategic beginnings, the forecasting, to the actual management of passenger flows during the Games. The focus of the thesis is on the transportation of the Olympic Family Members, i.e. athletes, sponsors, and VIP's. Finally, the thesis incorporates lessons learned from the Athens Olympic Games.

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Chapter I: Introduction

The introduction briefly recounts the history of Athens International Airport (AIA) in parallel with the selection of Athens as the host city of the Olympic Games 2004. It outlines AIA's mission for the Olympic Games by identifying the most important organizational challenges for an Olympic airport, in general, and by relating these challenges to the very unique characteristics of AIA and the Greek mentality. A note on my personal background is included in this section. In the second section, a brief outline of the thesis is given.

1.1 The Challenge

“And the winner is Athens.” These were the words of Juan Antonio Samaranch, the former president of the International Olympic Committee (IOC), announcing the decision on September 5, 1997, that Athens would host the Olympic Games in 2004. These words set off celebrations throughout Greece and imposed a significant organizational task on the country and thus on its new airport. The decision was made: Athens International Airport would serve as the main entrance gate to Greece and be the first and last impression for hundreds of thousands of spectators visiting the XXVIII Olympiad in Athens in 2004.

The underlying hypothesis of this thesis is that every airport preparing for the Olympic Games undergoes significant changes in its organization and infrastructure. These preparations are not only crucial to the Games' success but also important in the evaluation and decision process of the IOC, when selecting a host city for Olympic Games.

Significant examples can be easily drawn from the past three Olympic Games. Atlanta (1996): Hartsfield Jackson Atlanta International Airport completed a fourth

runway and extended its third shortly before the city bid to host the Olympic Games. Sydney (2000): Six years prior to the Olympic Games, Australia was implementing a new Air Traffic Control¹ System, which was considered to be one of the most modern, efficient, and reliable control systems at that time.

Athens (2004): The city was closing down its old and building a new airport for the Olympic Games, which was ranked second-best in the world after completion (Aviation Week, 2001; Atlanta Airport, 2004; Athens International Airport, 2004).

1.1.1 Organizational Challenges of the Olympic Games

Every country considers the Olympic Games an extraordinary event that changes the life of the entire country for several weeks. Hundred of thousands of visitors populate the host city and use the existing transportation system extensively. As a part of this transportation system, the airport serves as the entrance and departure gate to the city. Therefore, it has to be carefully prepared for this task, because no commercial airport is designed to manage the very large peak demands that are part of the Olympic Games. Serving the arriving and departing passenger flows imposes challenging organizational tasks on the airport's infrastructure and its operations. Thus, additional facilities have to be built and special operational procedures have to be implemented prior to the Games. The airport operations during an Olympic Games period² are especially crucial, because any single unexpected change can jeopardize the complex operations of any heavily used airport. Clearly, there is a necessity for detailed planning for these extensive activities, which requires high-level collaboration, tight coordination, and frequent communication among several involved parties. Therefore, a central document called "Olympic Games Operations Plan" is prepared by airport officials specifying detailed airport procedures to be effective during the Olympic period.

¹ An Air Traffic Control (ATC) system supports air traffic controllers in guiding the airplanes through air space.

² The Olympic Games period, referred to in this thesis, covers the time span, during which an increase in passenger volume due to the Games is expected.

For Athens International Airport (AIA) several other factors exacerbated the pressure to master the preparation process for the Olympic Games.

- **Highest security alert:** In the aftermath of terrorist attacks in New York City and Madrid, security became the most important and crucial aspect of the preparations.
- **Risk aversion:** The opportunity to host the Olympic Games came along with a very high risk: the cost of failure for such an event is extremely large. First, this risk was imposing a huge financial burden on Greece. Second, the risk also challenged the country's reputation by being the birthplace of the Olympics. Over 2 billion people were paying close attention to Greece during the Olympic Games; the prestige of the Greek State was facing one of the biggest tests in its history.
- **New airport:** The new airport which was to serve as the entrance and departure gateway to Athens and Greece had only limited experience with exceptionally big events. As an airport that opened in 2001, it was still involved in adaptive processes common to newly-built airports; at the same time, the airport was struggling with pressing political requirements due to its partial foreign ownership and late agreements on operational procedures with the Hellenic Civil Aviation Authority³ (HCAA). On top of these obstacles, special Olympic procedures changing all normal airport operations had to be planned, communicated, and successfully implemented. Furthermore, with only two runways AIA was one of the smallest airports that had ever hosted the Olympic Games.

Nevertheless, despite bad publicity about the slow preparations for the Olympics, Greece impressively demonstrated itself to be a motivated and strong nation by

³ The Hellenic Civil Aviation Authority (HCAA) is the authority responsible for air safety regulations in Greece.

keeping up its spirit and defining clear goals. The country mobilized to meet these goals on time with a charming attitude to seek to become the best hosting country ever for the Olympic Games. Its own unique way of handling this pressure became famous as the Syrtaki principle⁴ that guided Greece to its success in meeting its defined goals.

1.1.2 Defined Goals

AIA's mission for the Olympic Games was "to provide visitors with the best arriving and departing experience possible." To achieve this goal, two main areas had to be targeted. First, the airport had to be secured against potential attacks and, second, ways to relieve congestion during the peak days had to be found.

The Games were being held amid a background of substantial concern about security. Additional security staff in and around the airport, more frequent security checks, and special procedures were implemented to protect the passengers. VIP's and athletes, as nations' representatives, were considered potential targets for terrorist attacks. Out of desire to protect the Olympic Family Members (OFM⁵) and airport users, in general, a guiding principle was adopted: to separate the flow of the Olympic Family members from that of the general public⁶. For the first time in the history of the Olympic Games, the Athens Organization Committee (ATHOC⁷) and Athens International Airport (AIA) agreed to strictly separate the flows of Olympic Family Members (OFM) from those of the general public. This decision required

⁴ The Syrtaki is a famous Greek traditional dance. It starts very slowly and increases its rhythm through the dance. The Syrtaki principle implied that the preparations for the Olympic Games started very slowly, but shortly before the Games the pace of the preparations was increased tremendously to finish them on time.

⁵ Olympic Family Members (OFM) include athletes, sponsors, VIP's, heads of state, and athletic family members.

⁶ General public in this thesis will refer to persons who have not passed a security check.

⁷ The Athens Organizing Committee (ATHOC) was responsible for organizing the Olympic Games Athens 2004 with Mrs. Gianna Angelopoulos-Daskalaki as its president.

large financial investments, tight collaboration among all involved parties, and clear organizational procedures.

The exclusive transportation procedure of the OFM solved simultaneously the second main requirement for the Games: providing a smooth arrival and departure experience for all visitors. It significantly relieved congestion on the peak days in the Main Terminal Building of the airport. This thesis focuses in its second half on the exclusive transportation of the OFM by describing, analyzing, and evaluating this process.

At the time when Athens stood alongside the other candidate cities, Rome (Italy), Cape Town (South Africa), Stockholm (Sweden), and Buenos Aires (Argentina) in September 1997, competing to host the Olympic Games, none of the above-mentioned ideas were even born. Once selected, Greece as the birth place of the Olympic Games and its new international Airport had to undergo significant changes of leadership and to master difficult organizational tasks for the preparation, in order to become ready to face the challenge of the Games.

From June 1st till September 6th, 2004, the author worked as a Golden Ambassador at the Athens International Airport. As a member of the "Olympic Games Organization Team 2004" her responsibilities involved analytical assessments for the planning processes of the Airports Olympic Games preparations, development of three models to support the Olympic Family transportation, and informational as well as security services at the airport during the Olympic Games.

1.2 Thesis Outline

This thesis will describe, analyze, and evaluate the preparations of Athens International Airport, focusing on the transportation of the Olympic Family Members. It is divided into six chapters.

The second chapter, the literature review, provides background information for the subsequent chapters. This includes a detailed description of the physical layout of Athens International Airport, a short introduction to the two main parties, ATHOC and AIA, the stakeholders involved in organizational procedures at the airport, and a brief introduction to queuing theory.

In the third chapter, Forecasting for the Olympic Games, the most important part of preparing an airport for the Olympic Games is described, because its results are the basis for all preparation plans of the airport. The forecasting analysis and the results presented range from the very first strategic approaches to the last modifications implemented shortly before the start of the Olympics. In particular, the peak arrival and departure periods, focusing on the transportation of the OFM, are discussed. Decision and consultation processes among the involved stakeholders and the rationale for decisions are also included in this chapter.

In the fourth chapter, Organizing for the Olympic Games, the capacity of the airport as of January 2004 is evaluated and needs are assessed derived from the peak demands forecasted in Chapter III. A brief description of special measures and actions taken by the airport in preparation for the Games, such as infrastructural changes and organizational procedures, is given by addressing capacity issues and constraints at specific parts of the airport. Emphasis is given to security considerations and internal reorganization processes, as well as to the interactions among all involved parties.

The fifth chapter, *Managing the Olympic Games*, provides a description of applied queuing models of the processing and transportation of OFM, preparing for their arrival, determining their time of departure from the Olympic Village, and preparing the space within the terminals. Actual data gathered during the Olympic Games is compared to the forecasts in Chapter III. Finally, the use of the models and their accuracy are discussed.

In the sixth chapter, *Conclusions*, a final evaluation of AIA's preparation efforts is presented, and a brief look ahead to the next hosting city of the Olympic Games in 2008, Beijing, is given. This chapter will incorporate the lessons learned from the Games in Athens and answer the question, whether anything can be applied to the airport in Beijing.

Chapter II: Literature Review

This Chapter provides a detailed description of the physical layout of Athens International Airport, a short presentation of the organizational structure involving two main parties, ATHOC and AIA, and a brief introduction to queuing theory.

2.1 Athens International Airport

This section outlines the history of Athens International Airport along with the application process of Athens to host the Olympic Games 2004. A detailed overview of the airport's infrastructure, its terminal buildings and its capacity are also presented.

2.1.1 History

In July 1995 the Airport Development Agreement (ADA)⁸ for a new airport, called Athens International Airport Eleftherios Venizelos (AIA), was signed by the Government of the Hellenic Republic and a private consortium to replace the existing facilities at Hellenikon, satisfying the need to accommodate the increasing air traffic volume. Six months later the Plenary Session of the Hellenic Olympic Committee decided that Athens would officially bid along with 10 other countries for the 2004 Olympic Games. After qualifying to be one of the five finalist candidate cities, Greece successfully mastered the critical evaluation by the Olympic Evaluation Committee in October 1996 (Hellenic Resource Network, 2004) and won the right to host the Olympic Games in September 1997. The airport finished its construction work three years later and was officially opened in March 2001. (Athens International Airport, 2004)

⁸ The Airport Development Agreement (ADA) establishes a 30-year concession ratified by Greek Law 2338/95 granting the Airport Company the exclusive right to occupy and use the site for the purpose of the "design, financing, construction, completion, commissioning, maintenance, operation, management and development of the airport".(Athens International Airport, 2004)

The airport, capable of handling 16 million passengers and 220,000 tons of cargo per year, promised to meet the challenge to serve as the main entrance gateway for the Olympic Games. Located 30km east of Athens, the airport had a declared capacity of 52 operations per hour up to the Winter season of 2004. The concessionaire of the new airport is Athens International Airport SA, with 55% of shares held by the Greek state, and the rest owned by a private consortium. The build-own-operate-transfer contract was awarded to AIA and the construction was led by the principal member of the private consortium, the German construction company Hochtief. The construction cost for the airport totaled €2.5 billion.

2.1.2 Layout

With this development cost, Athens International Airport represents Greece's biggest-ever infrastructure project. (Athens International Airport, 2004)

In the 2003 survey of the "IATA Global Airport Monitor"⁹ Athens International Airport was ranked as the best European Airport in the competitive airport size category of 5 – 15 million passengers per year regarding "Overall Passenger Satisfaction" and second best worldwide. In the overall IATA ranking the airport maintained its second position -regardless of airport size- behind the "state of the art" airport in Copenhagen. Overall, AIA has been selected as a European leader for a wide range of service categories like security inspections, comfortable waiting areas and gates etc. (IATA, 2004; Athens International Airport, 2003). Olympic Airways is the home-based carrier at the new airport.

⁹ Yearly survey conducted by IATA to rank airports worldwide regarding various service categories.

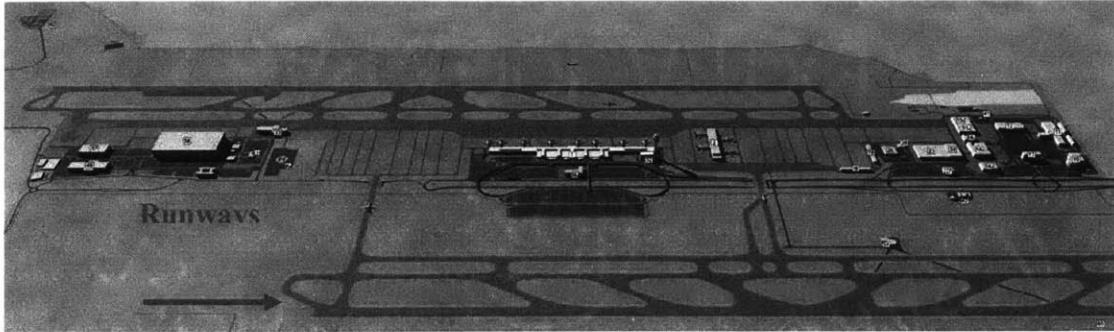


Figure 1: Layout Athens International Airport; source: Athens International Airport, 2004

The airport design with two parallel runways (length 4,000m and 3,800m) theoretically enables the airport to perform simultaneous landings and take-offs of up to 65 movements per hour. As can be seen in Figure 1 the two runways are connected via a double taxiway system leading over the six lane access road from the south, Attiki Odos. The airport had 73 aircraft stands and increased the number throughout the past years to 89 parking positions, 20 positions for General Aviation and 17 positions for helicopters. Those are divided into southern (called A-stands) and northern stands (called B-stands), while 24 passenger boarding bridges service the Main terminal and Satellite building. (Athens International Airport, 2004)

The air traffic management system of AIA is one of the most advanced air navigation systems in Europe as of summer 2004. Approved by the Greek Civil Aviation Authority, it now performs all air traffic control and backbone communications.

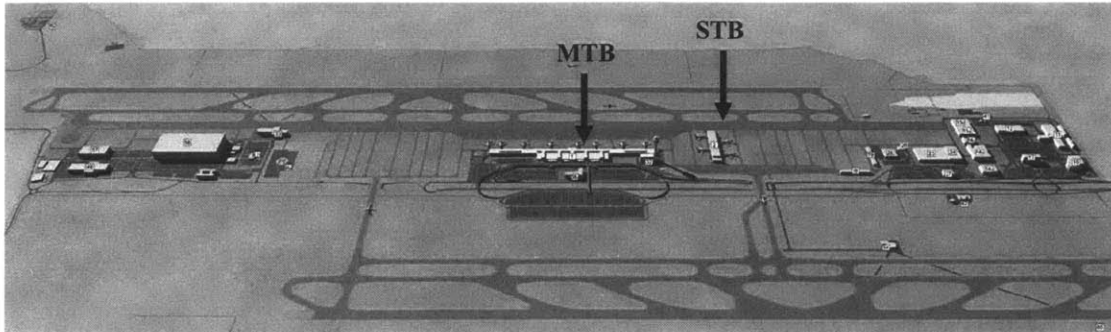


Figure 2: Layout Athens International Airport; source: Athens International Airport, 2004

The two Terminal buildings, a four-level Main Terminal Building (MTB) with a total floor surface of 150,000m², which can service around 10 million passengers a year, and a three-floor Satellite Terminal Building (STB), which can accommodate another 6 million passengers a year, are connected through an underground walkway (Figure 2). The departure/arrival gates are odd numbered starting from the south with A13 to the north B09.

The arrivals level (ground level) is divided into an Extra- and Intra-Schengen area¹⁰ (dotted line in Figure 3). Fourteen Passport control desks are located at the south end of the terminal for Extra-Schengen arrivals. Distributed through the Main Terminal building there are three transfer flight desks and entering from the apron five bus gates for passengers arriving from remote stands. In total, eleven conveyor belts, which are split into four Extra-Schengen and seven Intra-Schengen, deliver the luggage to arriving passengers. According to the two separate passenger flows, there are two exits out of the baggage reclaim area into the general public area. From the “meeters and greeters” area five exits lead to the outside and thus to connecting travel modes like the newly built train station, busses and taxis. (Athens International Airport, 2004)

¹⁰ The Schengen Agreement is a treaty signed by countries of the European Union to allow passengers to cross the internal borders of the implementing countries at any point without checks. Countries that signed the treaty are: Austria, Belgium, Denmark, France, Finland, Germany, Greece, Iceland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain and Sweden.

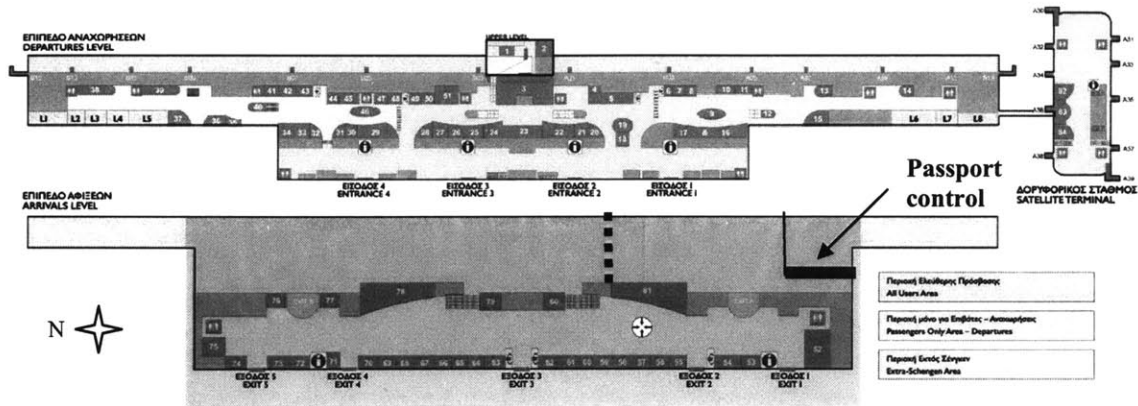


Figure 3: Terminal plans Athens International Airport, source: Athens International Airport, 2004

At the departure level four entrances lead to the public area with 144 check-in counters and five boarding card control stations (Figure 3). Generally, the check-in counters are serviced by airlines. Each airline has a contract with a baggage handling provider that services the luggage through the terminals to the airplanes. At Athens International Airport there are three providers: Swissport, Goldair and Olympic. (Hill Leonard, 2002)

The construction of Athens International Airport further included a parking facility with capacity for approximately 4,700 vehicles, located in front of the terminal building, across Attiki Odos.

After a construction period of five years and three years of smooth operations and excellent performance, AIA was selected as one of the 35 Athens Olympic venues¹¹. This sent the message to the airport community that it had to cope with its Olympic challenge: handling two million passengers arriving and departing within three weeks. (Olympic Games, 2004)

¹¹ A venue is a dedicated facility providing official services for the Olympic Games.

2.2 Stakeholders

This section introduces the organizational structure of the two most important parties operating at Athens International Airport during the Olympic Games. First, it describes principal stakeholders of the airport and their general responsibilities and tasks. Additionally, it introduces the structure of the Athens Olympic Organization Committee (ATHOC). Finally, it shows the various interfaces between the stakeholders and points out potential coordination efforts necessary to allow safe and efficient airport operations during the Olympic Games.

2.2.1 Athens International Airport (AIA)

Athens International Airport is one of the principal sites of employment in Greece with more than 14,000 people working at the airport compound. Over 200 enterprises directly related to the airport's operation are based at the airport. The airport has six main stakeholders: the airlines, ground handlers, immigration and emigration, police, customs, medical services and the media. These stakeholders interact frequently with the airport's company "Athens International Airport SA" in short "AIA".

AIA

AIA is structured into four main departments: "airport operations", "business development", "corporate services" and "finance & procurement" that have several smaller sub departments (please refer to Figure 4).

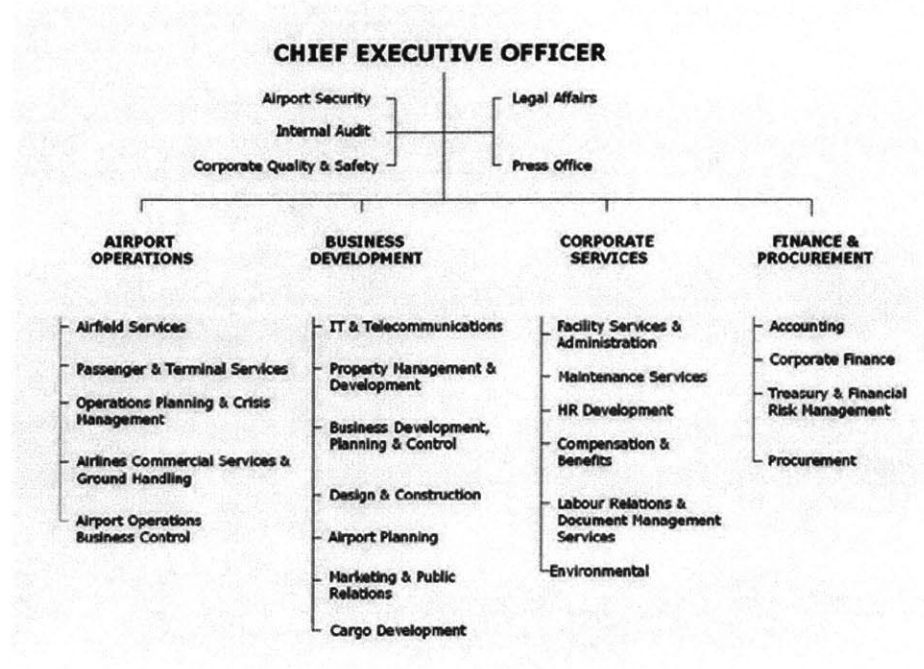


Figure 4: Organizational chart of AIA; source: Athens International Airport, 2004

In preparation for the Olympic Games three years prior to their start, an “Olympic Games Team 2004” was established under the airport operations department. This team was built in a joint effort by the Department of Passenger Terminal Services (PTS), responsible for informational and safety services within the terminals, and by the Department of Operations Planning and Crisis Management (OPCM), responsible for contingency and security planning. This multi-disciplinary team was given the task to address, plan and organize necessary organizational and infrastructural modifications in preparation for the Games by integrating all corporate airport stakeholders. The guiding document called the “Olympic Games Operations Plan” summarized the results of this process.

This plan incorporated contributions to Olympic procedures by 57 airlines, by three Ground Handling Companies, responsible for the transportation and storage of the luggage and for the servicing of aircraft, by Customs Control, responsible for the execution of all activities related to the control of goods imported to Greece, by medical services, responsible for health services for passengers, and by the media center, responsible to broadcast all important information relating to the airport.

Integrated into the normal operations of an airport are the responsibilities that the **police** shares with AIA: immigration and emigration and security. These two tasks took on a very important role during the Olympics.

- *Immigration and Emigration* conducts passport control for Extra-Schengen passengers. Fifteen countries have signed the “Schengen Agreement” permitting the free travel of persons between and within the partner countries. This means that these persons are no longer subject to routine immigration and customs control (passport control).
- *Security*: All departing passengers, the ground staff, private and civil servants, and the flying crews undergo security screenings before they are permitted access to controlled areas. Similar screenings are carried out on all transit passengers, as well as on those people working at the airport or visiting the airport for professional reasons. The controls are conducted each time people pass from a public area leading to controlled areas, i.e., the waiting lounges. The responsibility of the police also includes *boarding pass controls* to the duty free shopping areas.

A very important contribution to a secure airport was added through the establishment of an Airport Services Operations Center (ASOC). This center is one of the few facilities in the world that integrates airport operations control and security into one supervising authority to match excellence at the level of

operational efficiency and safety of the airfield. At ASOC, AIA works closely with the Hellenic Civil Aviation Authority (HCAA), the Hellenic Fire Corps, the Hellenic Police and several other public entities. This center ensures orderly, expeditious, and safe airport operations, in compliance with ICAO standards and recommended practices, as well as national regulations. The center supervises the airfield, the terminals and the landside of the airport by monitoring public and non-public areas.

2.2.2 Athens Olympic Organization Committee (ATHOC)

Every nation that hosts the Olympic Games establishes a National Organization Committee. The committee is responsible for the planning and implementation of organizational procedures effective during the Games. It also serves as the coordination center between all involved parties. The participants to the committee for the Athens Olympics were set in place in a joint effort of the International Olympic Committee (IOC) and the Greek State. The president of the Athens Olympic Organization Committee (ATHOC), Gianna Angelopoulos, took on her position in late 2001 to lead Greece into the preparations of the Games. Her supporting committee was facing the task to prepare the set up for the Olympic Games, 201 nations with 301 competitions in 28 different sports.

As can be seen in Figure 5, the responsibilities were generally split between the managing (red sections), technical (blue sections) and operating executive directors (green and yellow sections). The interfaces to the airport were under the responsibilities of the chief and the deputy chief of operations.

ATHENS 2004 Organisational Chart

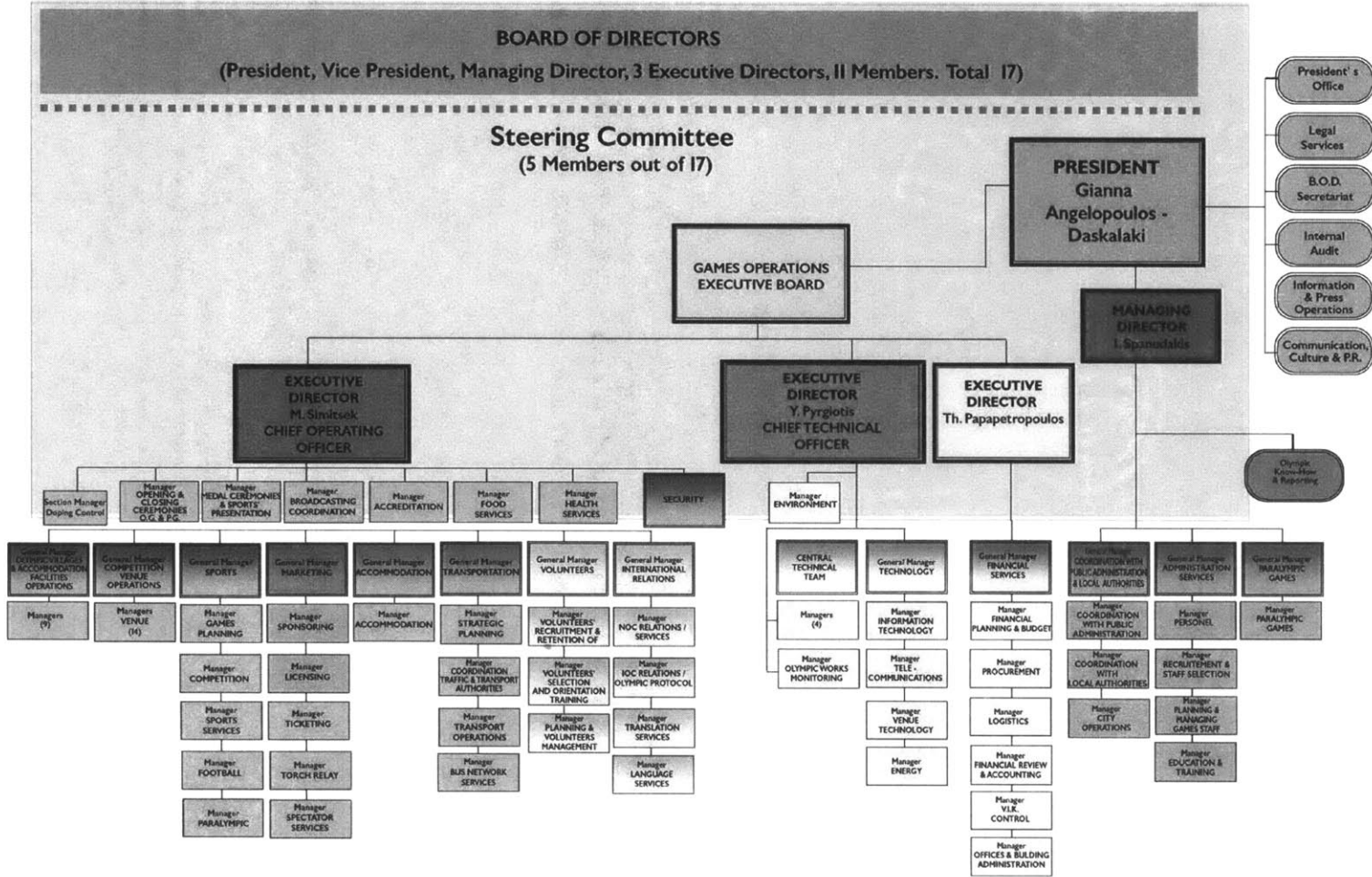


Figure 5: Organizational chart of ATHOC; source: Olympic Games, 2004

2.2.3 Coordination Challenges

The responsibility for overlapping interactions between the airport and ATHOC were split within the Athens Olympic Organization Committee. A non-competition manager (under the executive director of operations) had the oversight of the airport as a non-competition venue. In addition, a dedicated “Athens 2004 Transportation Manager” was appointed under the deputy chief of operations in order to coordinate the transportation within the city, as well as from and to the airport. And finally, a dedicated “Olympic Family manager” was responsible for the security, comfort and support of the Olympic Family.

All interfaces had to be coordinated within ATHOC to interact with the corresponding Athens International Airport representatives. In a top down approach the coordination efforts had to be clearly communicated to all ATHOC volunteers and AIA staff.

In summary, the greatest challenge for the airport and its internal stakeholders was to successfully integrate diverse processes and coordinate between all involved parties for the delivery of excellent services to the arriving and departing visitors for the Olympic Games. Huge efforts and extensive planning were required in order to come to an agreement on security procedures, customs regulations and to prepare all members of the airport community for the challenging task of handling the arrival and departure of up to two million visitors.

2.3 Queuing Theory and Models

This section introduces some basic background on queuing theory. It will give a brief introduction to models and their application and discusses basic assumptions made for three models developed for and used during the Olympic Games in Athens. The models are presented in detail in Chapter V.

2.3.1 Queuing Theory

Queuing theory is a branch of Operations Research. Operations Research in general is the search for optimal decisions subject to constraints. Queuing theory itself is concerned with service for customers within a queuing system and analyzes queuing processes. A queuing system consists of a user source, a queue and a service facility (Figure 6).

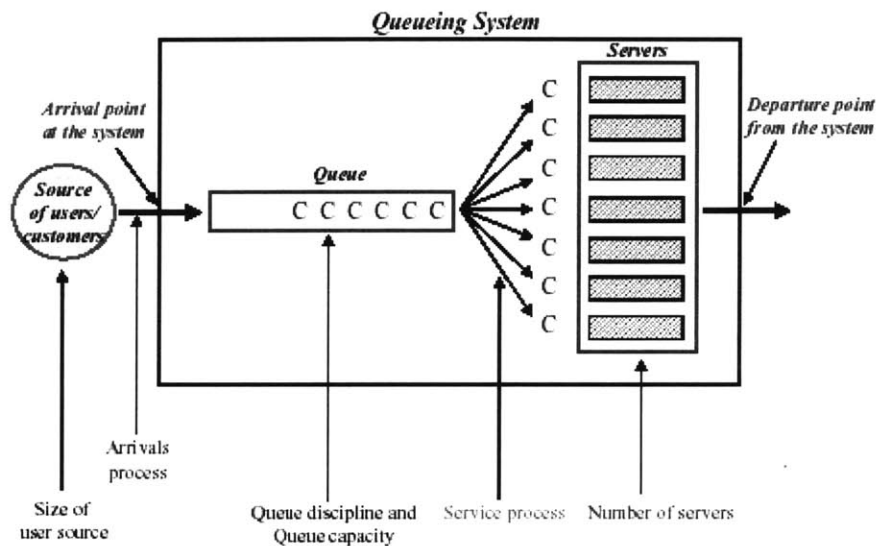


Figure 6: A generic queuing system; source: Odoni, 2004

Fundamental parameters for a queuing system are the *demand rate*, i.e. the expected number of users arriving per unit of time, the *service rate*, i.e. the expected number of users leaving per unit of time, the *queue capacity* and the *queue discipline*.

A queuing system as mentioned before is a conceptually simple system only consisting of a user source, a queue and a service facility. This system can be broadened in complexity to a queuing network, which is a set of interconnected queuing systems (Figure 7).

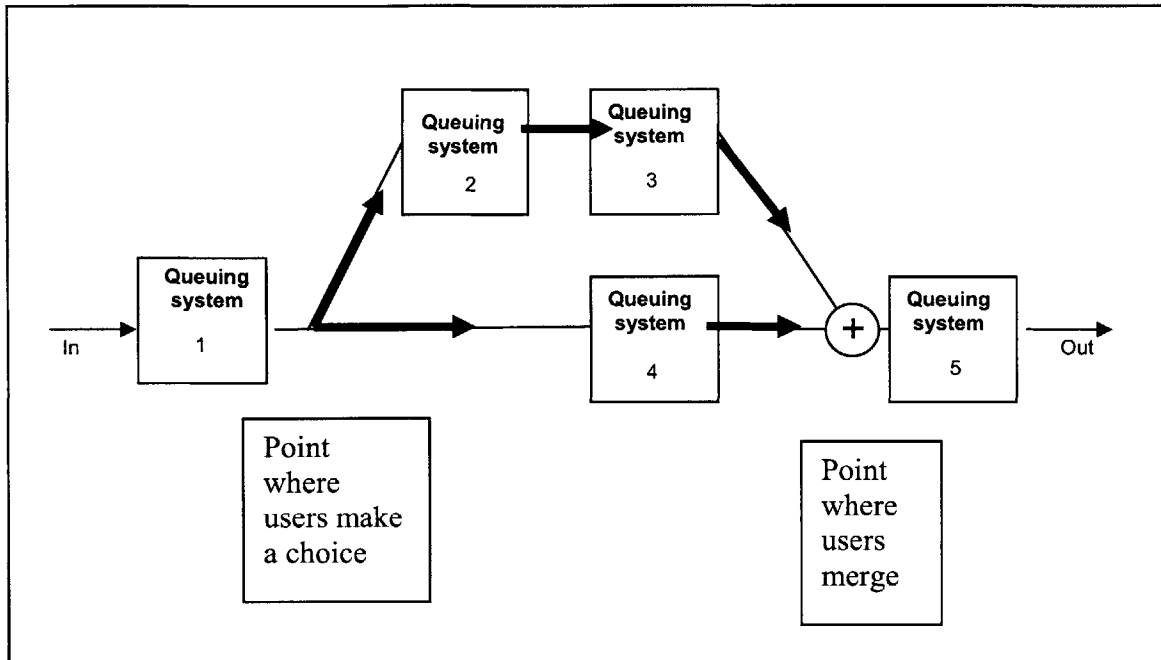


Figure 7: Queuing network consisting of 5 queuing systems; source: the author

At Athens International Airport the analysis was based on similar types of queuing networks. The queuing systems within the AIA-network have their own characteristics based on different fundamental parameters. As an example (Figure 8), one queuing network consisted of six queuing stations, five possible paths and three merging points. In the queuing network of Athens International Airport, none of the customers, the arriving passengers, did actually make a probabilistic choice. Due to airport regulations the distinctive passenger paths through the airport were already defined and thus accurately predictable.

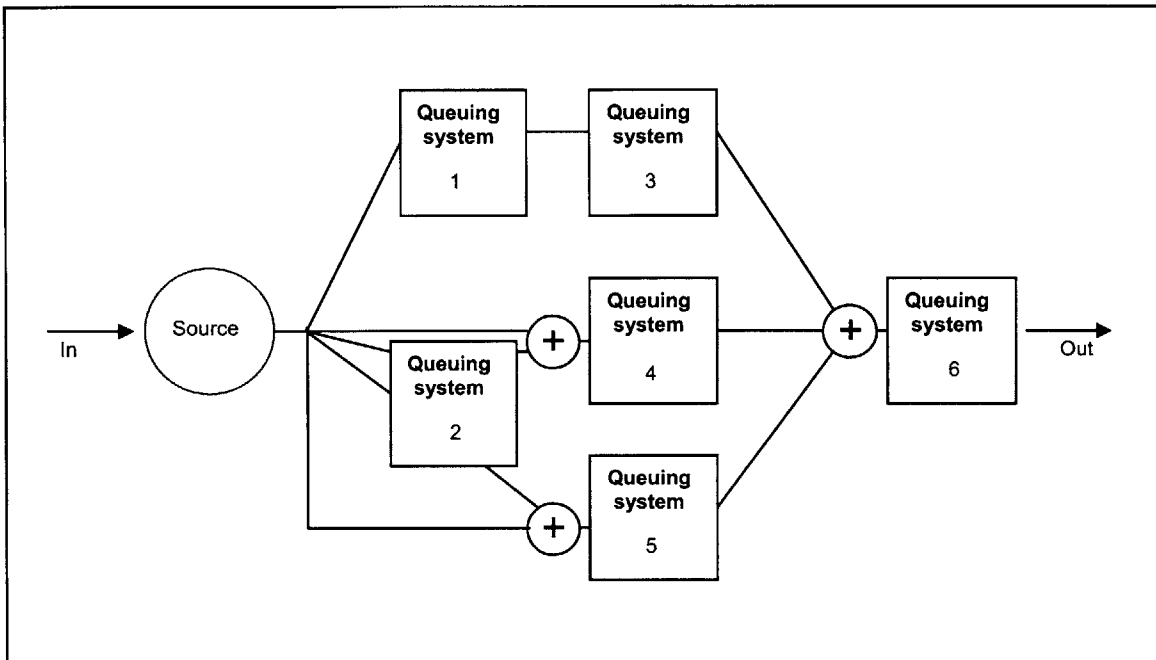


Figure 8: Example queuing network of Athens International Airport; source: the author

The “source” in Figure 8 represents arriving airplanes, whereas the network’s output consists of passengers departing from airport facilities. The indicated queuing systems represent necessary procedural stations for the Olympic Family on the airport’s compound, e.g. passport control. Each station has its unique characteristics; different demand rates and different service rates, but the same queuing capacity and the same queuing discipline. The queuing capacity was virtually infinite: there was enough queuing capacity available to ensure that every arriving Olympic Family Member would go through the procedures that are legally required. Only in the very rare case of heavy congestion and unbearably long waiting times, would the airport consider processing the OFM off-site. The queuing discipline was first come, first served and the time units in the queuing analysis were chosen as 5-minute intervals.

Usually queuing analyses are performed with the objective of understanding tradeoffs between operating costs and level of service for customers. The level of service and the security of the athletes were of highest value for the airport during the Games. At the same time, the volunteers worked for free, thus ATHOC could appoint as many volunteers as necessary to provide a high level of service.

2.3.2 Models

The queuing network models used during the Olympic Games were programmed using Excel software to take advantage of fast applicability and to enable a real-time updating process. This turned out to be essential due to unexpected short-term changes. The results were evaluated with the help of cumulative diagrams (please refer to section 2.3.3).

For the Olympic Games models, the real world system “Athens International Airport” with its unique characteristics was simplified. The unique characteristics shall refer to the physical system layout, e.g. the dedicated paths for passengers. Simplification shall refer to the specific assumptions made in order to implement the model into Microsoft Excel. These assumptions are listed below:

- deplaning an aircraft takes 15 minutes
- the number of deplaning Olympic Family Members is evenly distributed throughout this time period
- constant service times at stations
- first come first served order of service
- dedicated walking paths through the airport take a fixed amount of time e.g. from the Satellite Terminal Building to the Main Terminal Building takes 15 minutes

During the programming process the models were modified based on observations. The refined models assumed, instead of an even 15-minute deplaning process, instantaneous deplaning within a 5-minute interval. Olympic Family Members waited for their team members after deplaning in order to traverse in a group their path through the airport. The programmed models needed several input data to predict the peak passenger flows during the Olympic Games such as the aircraft arrival time.

As a final remark, the models did not offer answers to all problems. For example, one model predicted, that on the 11th of August 120 members of the Olympic Family coming from Asia would clear passport control within 35 minutes. In reality, due to visa issues, the process lasted over 1 ½ hours. The wrong predictions here were, of course, due to wrong input data and not caused by the model itself.

2.3.3 Cumulative Diagrams

To analyze the passenger flow through several bottlenecks at the airport such as passport controls, cumulative diagrams were used. The model drew these diagrams in order to make the results transparent through visual interpretation. Cumulative diagrams are very useful tools for predicting approximately delays under overload conditions. (de Neufville and Odoni, 2003). Cumulative diagrams are graphs consisting of two curves (Figure 9). The upper one indicates the cumulative expected demand for use of a facility, the lower one the cumulative expected number of units (passengers or other entities) served by that facility. When the two curves are overlapping, no queue is present; i.e. between midnight and 6 am in Figure 9. If the curves split, the demand is higher than the service; e.g., between 6 am and 1 pm. From cumulative diagrams one obtains estimates of the total number of people at any given time in the queue (vertical distance between the split curves), the approximate waiting time of the passengers

(horizontal distance between the split curves) and the total waiting time of the passengers (area between the two curves).

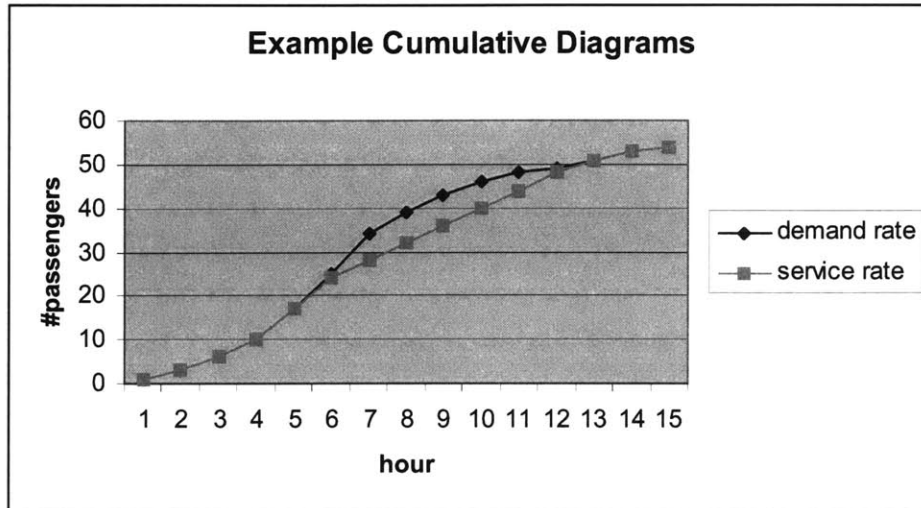


Figure 9: Example of cumulative diagrams; source: the author

Chapter III: Forecasting for the Olympic Games

Forecasting for a major event such as the Olympics is one of the most challenging and most important tasks in preparing an airport, because the results are the basis for all preparations. The forecast determines where capacity is lacking so that actions can be taken to accommodate all passengers. For an airport it is far more important to predict the arrival and departure peaks than to forecast the total number of visitors, because the peak results indicate the maximum congestion level. These reflect an approximation of the airport's required capacity when working close to its operational limits under maximum utilization. This chapter begins by describing the difficulties of forecasting demand for the Olympic Games. It then discusses briefly the approaches taken in 2002 to forecast the number of passengers and evaluates the forecasts in comparison to the actual traffic demand during the 2004 Olympics.

3.1 Early Forecasts 2002

In general, the difficulties in forecasting passenger traffic for the Olympic Games stems mainly from three facts. First, there is rarely any reliable historical information available, because the Games only take place every 4 years as a one-time event in a different city. Athens is the only city to host the Olympics twice. Nevertheless, the Athens of 1896 is scarcely the same as Athens 2004. Comparisons drawn to other major events like soccer world championships do not seem to be appropriate, because of different arrival and peak patterns. Second, each host city has unique characteristics such as the country's culture, the country's location on a continent, and the location of the city within the country. These characteristics greatly determine the country's access possibilities and thus the number of passengers traveling through the airport.

Third, hardly any local information useful for the Athens Olympic Games, two years prior to its start, was available.

In conclusion, the only information available were data gathered at former Olympic Games, information about country-specific travel patterns gathered since the opening of Athens International Airport in 2001, and the very limited data already available specifically about Athens 2004, e.g. the number of athletes permitted per event. These information sources had to be carefully evaluated and applied to AIA's airport characteristics. Nevertheless, it was clear that the nature of this forecasting effort would be subject to a high level of uncertainty.

3.1.1 Information Sources

The 2002 forecast utilized the following general approach:

First, comparisons to the three most recent cities for the Summer Olympic Games, Sydney (Australia 2000), Atlanta (USA 1996) and Barcelona (Spain 1992) were made to seek similarities to Athens and its airport. Only Sydney and Barcelona were selected as the closest analogies to the Athens Games. Atlanta, as a major American hub, did not seem to have anything in common with AIA.

Sydney was selected on the assumption that the expected number of visitors arriving by air to the Olympic Games could be considered to provide an upper bound for Athens, because of the facts that (a) Australia is accessible, almost exclusively, only by air and (b) Sydney's airport is considerably busier than AIA. Specifically, Athens International Airport handled roughly 12 million passengers in 2003 while Sydney had almost 18 million passengers in 1999. (Sydney Airport, 2004)

Barcelona, as a European Mediterranean City with good sea access possibilities, seemed to also show some similarities to Athens.

From these comparisons, assumptions about passenger volumes for the Olympic Games were made.

Second, data gathered at Athens International Airport revealed that the usual summer peak in Greece coincided with the Olympics and Paralympic Games. Thus, the summer months of 2001 were used as the baseline for estimated passenger volumes in the forecasts made in 2002.

Third, information already available was very limited. No tickets had been sold, nor any hotel reservations made through which one could estimate the number of visitors for the Games. Essentially only the key dates were known: the Olympic Games opening ceremony was scheduled for the 13th of August and the closing ceremony for the 29th of August. These dates suggested that the peak waves would occur on the 12th of August for arrivals and the 30th of August for departures.

3.1.2 Approach for Passenger Forecasts

Based on the available information, the following approach was taken by Athens International Airport to estimate the total number of passengers arriving and departing between July and September 2004. This description is based on documentation provided by participants in the “Olympic Games Team 2004”. The discussion of the forecasts for the expected peak days concentrates on the initial assessment of traffic demand in 2002.

The early forecast of the number of passengers and movements during the peak days incorporated all useful information available under a “**worst case assumption**” by using an upper bound for the traffic increase.

- 1) The increase of movements and passengers was mainly derived from data obtained from Sydney Airport. The daily increase of aircraft movements from the year 1999 to 2000 (Olympic Year) observed at Sydney was used as the basis for the estimate of the daily traffic increase

from year 2003 to 2004 (Olympic year) for Athens. The correspondence of the days was based on the most important dates that affected traffic, i.e. Olympic Village Opening, Opening Ceremony, and Closing Ceremony. The increase in traffic at Sydney was measured in *total number of movements*. When applied to Athens International Airport these numbers resulted in an approximately 15% increase in movements and 18% increase in passengers in 2004, compared to its usual traffic during the summer of 2003. This estimate was used as an **upper bound** for the expected number of visitors to be handled by Athens International Airport.

- 2) To compute the daily summer-peak traffic increase at Athens International Airport in 2004 the *percentage increase (8%)* that was observed in 2002 during the summer months compared to the yearly average was applied to the summer months in the year 2004. This estimate was based on days of the week rather than dates, e.g. the Mondays of former months were compared.
- 3) The average hourly distribution and split of flights between arrivals and departures for each day of the week during August 2002 was applied to the forecasted results for August 2004.
- 4) The estimated daily number of passengers was modified as follows to take into account special conditions expected to apply during the Olympic Games:
 - the total number of daily flights in 2004 was reduced by the percentage of non-passenger flights during August 2002
 - the average seating capacity per flight during August 2002 was assumed to be the same as during August 2004
 - average load factor will be 80% for the “normal”¹² peak days

¹² “Normal” peak days are days with a high number of aircraft movements, but exclude the peaks of the opening and closing dates.

- a load factor of 85% for inbound flights was assumed during the arrival waves related to the opening of the Olympic Village and the opening ceremony
 - a load factor of 90% for outbound flights was assumed during the outbound wave related to the closing ceremony
 - a load factor of 70% for arrivals was assumed during the above-mentioned outbound wave
- 5) The average hourly distribution and split of passengers for each day of the week during August 2002 is applied. The split concerns Intra-Schengen versus Extra-Schengen as well as domestic versus international flights for arrivals and departures. (Stamatopoulos and Odoni, 2002)

In short, the predicted number of aircraft movements and passengers was computed by adding the number of extra flights during the Olympic Games period in Sydney to the predicted summer peak flight numbers in 2003 at Athens International Airport. This scenario was assumed to be a “**worst case scenario**” - the maximum possible increase in traffic for the Olympic Games in 2004 (Miltos Stamatopoulos).

The results of the initial assessment and the main conclusions drawn from this early analysis had very important implications for planning procedures and preparation assessments. The assessment projected:

- 5,420,000 passengers for July through September 2004. The increase, compared to the same time period in 2003, amounted to 1,150,000 passengers.
- 61,400 number of aircraft movements for July till September 2004. The increase, compared to the same time period in 2003, amounted to 9300 movements.

- The peak daily passenger traffic was expected to occur on August 30th, “Big Monday”, with 78,600 passengers; the peak arrival day was expected to be August 12th with 37,100 arriving passengers and the peak departure day was expected to be August 30th with 45,300 departing passengers.
- The peak daily aircraft movements totaled 890 movements with 432 arrivals and 458 departures on August 30th. (Athens International Airport, 2004)

Based on these results a detailed hypothetical flight schedule was prepared for 2004 by applying the day-to-day percentage increase to all days starting from July 20th to September 30th, 2001.

3.2 Forecasts 2004

This schedule was updated during the final year of preparations, in order to “be on the safe side” and account for the high level of uncertainty caused by Heads-of-State aircraft and General Aviation¹³ demand. Thus, the number of expected flights was raised so that the forecasts now predicted a 30% increase in traffic compared to the same period in August 2003. (Olympic Games Operations Plan, 2004)

¹³ General Aviation is typically described as all aviation other than scheduled commercial flights and military aviation. General aviation aircraft span a broad range, from two-seat training airplanes to the most advanced long-range business jets; its operations include personal and recreational flying, traffic observation and news reporting, crop dusting, emergency medical evacuation, and business air travel.

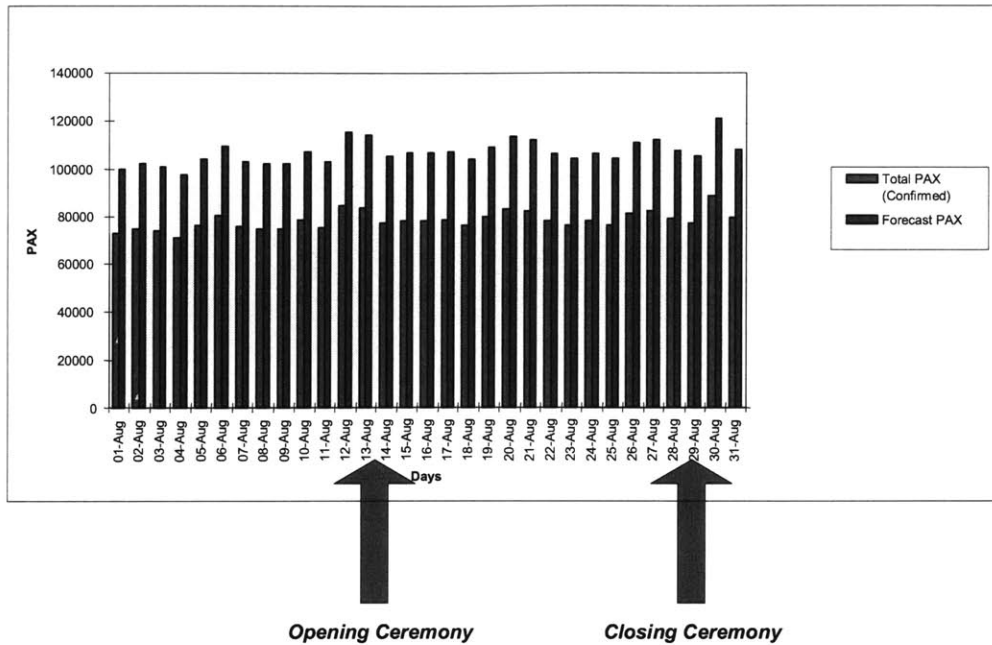


Figure 10: August passenger profile; source: Olympic Games Operations Plan, 2004

The red bars indicate the total confirmed number of passengers as of February 2004, whereas the blue bars indicate the expected numbers of passengers during August 2004 (Figure 10). As can be seen, the peak arrival day is forecasted to occur on the 12th and the peak departure day on the 30th of August.

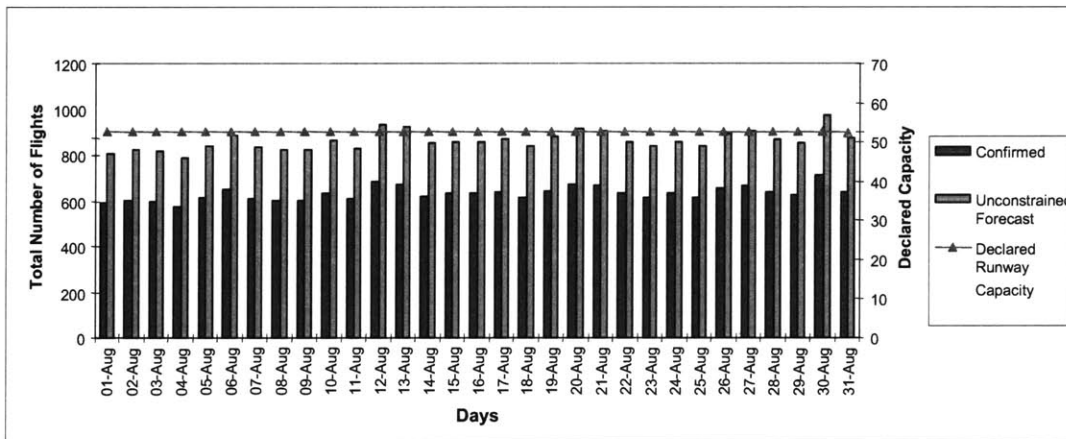


Figure 11: August flight profile; source: Olympic Games Operations Plan, 2004

Figure 11 shows the predicted air traffic movements. As can be seen, in a very few cases, the forecasted runway demand (blue lines) would be higher than the runway capacity. These are, of course, the peak days.

3.3 Actual Traffic

The actual traffic statistics for 2004 showed some surprising travel patterns. The month that shows the smallest increase in traffic compared to 2003 is August (Figure 12), the very month that was originally expected to show the largest increase in traffic!

Passenger Traffic	Domestic			International			Total		
	2004	2003	% 2004/2003	2004	2003	% 2004/2003	2004	2003	% 2004/2003
January	314,522	277,348	13.4%	489,070	470,932	3.9%	803,592	748,280	7.4%
February	303,243	273,203	11.0%	438,424	412,633	6.3%	741,667	685,836	8.1%
March	417,029	313,707	32.9%	574,277	507,368	13.2%	991,299	821,075	20.7%
April	473,175	342,153	27.8%	728,238	588,876	23.7%	1,165,413	931,029	25.2%
May	454,534	362,564	25.4%	716,090	667,268	7.3%	1,170,624	1,029,832	13.7%
June	476,793	408,248	16.8%	778,981	752,991	3.5%	1,255,774	1,161,239	8.1%
July	524,138	445,205	17.7%	898,751	856,385	4.9%	1,422,889	1,301,590	9.3%
August	527,118	497,211	6.0%	1,054,565	988,160	6.7%	1,581,683	1,485,371	6.5%
September	491,288	433,756	13.3%	910,313	849,270	7.2%	1,401,601	1,283,026	9.2%
October	453,465	379,013	19.6%	818,491	741,076	10.4%	1,271,956	1,120,089	13.5%
November	363,441	313,561	15.9%	552,950	507,716	8.9%	916,391	821,277	11.6%
Year-to-date	4,762,746	4,045,969	17.7%	7,960,150	7,342,675	8.4%	12,722,896	11,388,644	11.7%

Figure 12: Monthly passenger traffic in 2004; source: Athens International Airport, 2004

In conclusion, most of the preparations were based on the early forecasts in 2002. This forecast identified the significant peak days and passenger numbers and thus important implications for planning and organizational procedures were derived. Comparing this forecast to the one made in 2004 and the actual travel data, the early forecast was the most accurate one.

Nevertheless, the revised 2004 forecast, which was the most optimistic one regarding passenger volumes and air traffic movements, was very helpful in heightening the motivation and fostering the spirit of the AIA staff. Even more important, this most risk-averse forecast prepared the airport community for a possible worst-case scenario.

In summary, forecasting is a tool to assist in preparations. Though “all forecasts are wrong”, they are essential to planning processes. (de Neufville and Odoni, 2002)

3.4 Olympic Family Forecasts

The forecast for the Olympic Family Members was much easier to prepare than that for the overall passenger increase, because the relevant information was already available, more reliable, and provided a higher level of detail: the number of participating athletes was known, because the International Olympic Committee¹⁴ (IOC) specifies a maximum contingent of participating athletes for every competition. The team officials and family members accompanying the athletes could be easily estimated. Sponsors had already declared their participation and were able to predict the numbers of participating people quite accurately. Furthermore, the media had to declare their broadcasting plans well in advance of the Games and thus the number of participating media was known. This information was gathered by ATHOC and given to AIA (Figure 13).

¹⁴ The International Olympic Committee is an international non-governmental non-profit organization and the creator of the Olympic Movement. The IOC exists to serve as an umbrella organization of the Olympic Movement.

Olympic Family Group	Olympic	Paralympic
Athletes	10,500	4,000
Team Officials	5,000	2,000
VIP (Special)	500	100
VIP	2,000	400
Media	21,000	3,000
Sponsors	35,600	2,000
Observers	700	300
Totals	75,300	11,600

Figure 13: Distribution of Olympic Family groups; source: Olympic Games Operations Plan, 2004

After collecting all available information, the estimate added up to about 75,000 Olympic Family Members who would participate in events related to the Games. Compared to former years this estimate was the highest in the history of the Olympic Games (Figure 14). The trend of participating Olympic Family Members has been continuously increasing. In Barcelona roughly 30,000 Olympic Family Members participated in the Games. Atlanta and Sydney hosted about 50,000 Olympic Family Members. Athens 2004 hosted about 75,000 Olympic Family Members.

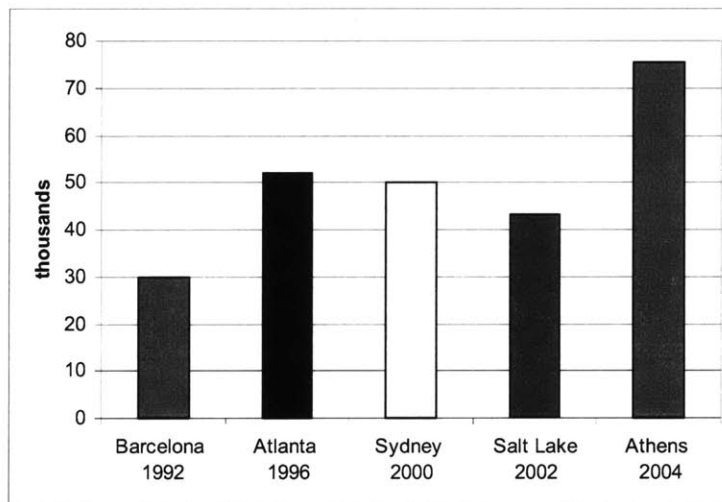


Figure 14: Number of OFM during former Olympic Games; source: Olympic Games Operations Plan, 2000

The peak days for Olympic Family Members were expected to coincide with the peak arrival dates of the airport (Figure 15). After forecasting the demand patterns for the various participating parties, further peak arrival key dates had to be added: the opening of the Olympic Village on July 30th and the opening of the Media Village on August 3rd.

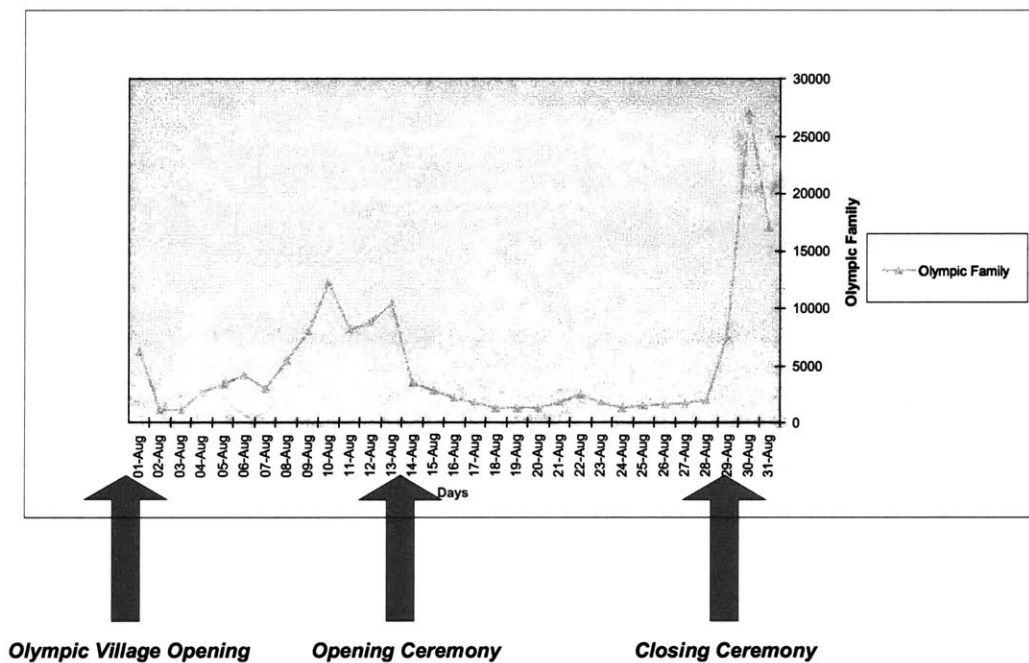


Figure 15: Forecasts of Olympic Family Members for August 2004; source: Olympic Games Operations Plan, 2004

In summary, the arrivals of the Olympic Family Members were distributed over a 14-day period. After the evaluation of the data given by ATHOC, the arrival peak period for the Olympic Family Members was projected to occur between August 9th and August 13th. The departure peak day would clearly be on August 30th, when about 27,000 Olympic Family Members would leave Greece through Athens International Airport.

Chapter IV: Organizing for the Olympic Games

This chapter draws planning implications from a comparison between the forecasted passenger volume (Chapter III) and the design capacity of the airport (Chapter II). The organizational and infrastructural changes to accommodate the large passenger volumes were based on the peak arrival and departure days, when the airport had to operate at or above the design capacity of existing facilities. The first section of this chapter analyzes specific parts of the airport and then describes the special measures used and actions taken by the airport in preparation for the Olympic Games for general passenger volumes. The second section focuses on the preparation for the Olympic Family Members.

4.1 Evaluation of Capacity

Organizational procedures implemented and infrastructural changes made in preparation for the Olympic Games are described here. The implications for planning are divided into three parts: the internal reorganization involving all stakeholders and important parties introduced in Section 2.2, air traffic management, and landside management. The last section reviews the implemented modifications and evaluates possible shortfalls. Security concerns are also central to this discussion.

4.1.1 Internal Reorganization

Since 2001 the Hellenic Civil Aviation Authority (HCAA), ATHOC, and AIA had been coordinating their efforts in preparing the airport for the Games. All participants agreed from the very beginning that the integration of all stakeholders, the airlines, immigration and emigration, security, customs, medical, and media center was essential to the Game's success (Figure 16).

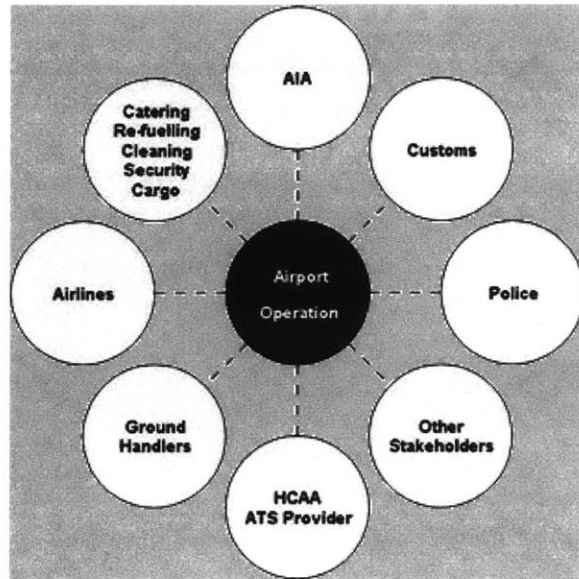


Figure 16: Airport community; source: advisory board presentation, 2004

Long-term planning efforts and early agreements with state entities, airlines, and ground handlers led to successful operations during the Games. For example, Greece is signatory to the EU's Schengen treaty that allows "Schengen passengers" to enter Greece like domestic passengers without passport or customs control. To raise the security standards, the Ministry of Public Order initially proposed to temporarily revoke the Schengen provisions for July and August of 2004, meaning that all passengers would be treated as Extra-Schengen passengers. This proposal was rejected, because of the increased entry waiting times of the passengers and the legitimate doubt that the airport would be able to process that many arriving passengers through passport control. At the same time, this rejection imposed the task on all stakeholders to conduct additional screening controls to fulfill the proposal's intention for higher security standards. Therefore, additional security equipment was leased or purchased and new security procedures were implemented.

As noted in section 2.2, the organizational AIA structure had to be carefully modified to assign responsibilities to all involved parties. This conclusion was reached by a review committee that analyzed the ongoing preparations for the Olympic Games. This committee made a few additional recommendations, which were implemented immediately in May 2004. As a result, the organizational processes within AIA were reorganized as shown in Figure 17.

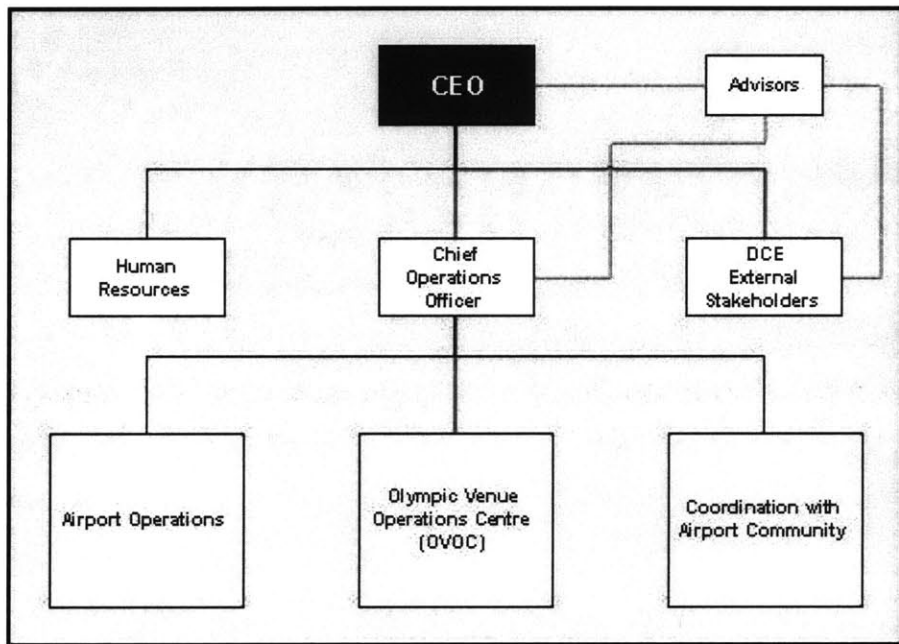


Figure 17: Airport management structure during the Olympic Games; source: advisory board presentation, 2004

Leadership

The CEO, Mr. van der Meer, replaced the Chief Operations Officer as the head of the Olympic Games operations. This step contributed to a centralized coordination and clear chain of command.

Olympic Venue Operations Center (OVOC)

This center was established as a coordination center between AIA, the police, the airlines, the ground handlers, and ATHOC. Every party was represented by three officials on a 24-hour per day basis during the Olympic airport operations (Figure 18).

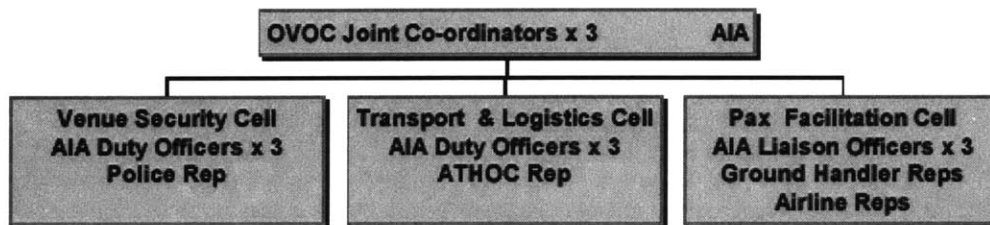


Figure 18: OVOC organizational structure; source: Olympic Games Operations Plan, 2004

All actions taken in and around the airport during the Olympic Games period were reported to this center, in order to ensure coordination between all stakeholders and employees working at that time.

Crisis management center

A crisis management center was established by AIA for contingency planning. This center was responsible for reacting to threats immediately and coordinating with the police, the media, ATHOC, and AIA in case of an emergency.

Operations manual for the Olympics

The “Olympic Games Team 2004”, consisting of employees from the Department of Passenger Terminal Services (PTS) and the Department of Operations Planning and Crisis Management (OPCM), planned and wrote the “Olympic Games Operations Plan” (see section 2.2). The members of this team were involved in the preparations for the Olympic Games from the very beginning. In 2004, they received support from several transportation consultants and

advisors, who had previously worked for the Sydney Games or were transportation experts.

Stronger integration of all stakeholders

The integration of all stakeholders was fostered through early agreements. Nevertheless, ATHOC volunteers and AIA employees were also essential to the operations and had to be prepared thoroughly for the Games. Therefore, OVOC called several meetings with the police, airlines, and the handlers to train their staff. During the Games, AIA volunteers employed as Golden Ambassadors worked closely with ATHOC volunteers and applied their special informational and security training in exemplary fashion during the Games.

Security

Security concerns were the most difficult and sensitive problem in the preparations. High public visibility of ongoing preparations, and flexible security procedures demanded by public entities, complicated the planning efforts. Therefore, a unique solution had to be found. This solution will be discussed in the last part of this section.

4.1.2 Air Traffic Management

Based on the forecasts, changes in the normal airport operation procedures had to be implemented in order to serve the high peak demands during the Olympics. Many of the new operation procedures were also put into practice to secure the visitors from terrorist attacks. A summary of the physical modifications can be found in Figure 19.

Slot Coordination

For the slot¹⁵ coordination procedure the “Sydney policy” was replicated. This policy was proven to be very efficient in securing all aircraft an assigned parking space upon arrival. The regulations required that all slot requests during the period of the Olympic Games should include a written Ground Handling Confirmation Number. Airlines were threatened with large fines for non-adherence to slots. For the implementation and coordination of these procedures, a slot performance committee had been established, chaired by AIA and consisting of representatives from the HCAA and the airlines.

Runway System Capacity

The most pressing capacity modification, as can be seen in Figure 11, was to raise the declared capacity of 52 movements per hour during the summer season of 2004. The airport had a theoretical capacity of 65 take-offs and landings per hour stated in the airport development agreement. In comparison, the upper bound forecast for 2004 called for peak hour demand on the 30th of August of 58-60 movements. If the airport could operate at its theoretical capacity level of 65 movements per hour, it could easily handle these peak demands during the Olympics. Nevertheless, the HCAA and the unions constrained the theoretical capacity and claimed 52 operations per hour were an appropriate workload. Clearly this capacity limit was too low to serve the peak demands of the Olympics. After intensive negotiation between the Hellenic Civil Aviation Authority and the unions, the declared capacity was finally raised to 60 movements per hour for the summer of 2004. In practice, during the Olympic Games, one runway was used only for landings and the other one only for take-offs, with some exceptions during certain peak hours.

¹⁵ A slot is a time interval reserved by an airline to perform a landing or a takeoff.

General Aviation Traffic

After the closing of the old airport the greater Athens region had no airport to accommodate high-end¹⁶ general aviation traffic. AIA decided to serve these flights on an ad hoc basis during the Games, as long as capacity was available. Therefore, a new General Aviation facility was built to the north of the terminal facilities (Figure 19). This new building was meant to accommodate all state entities, general aviation traffic, and VIP movements that required cooperation with the Ministry of Foreign Affairs.

Apron capacity

To resolve the shortfall in aircraft parking stands the taxiways Bravo, Charlie, and Zulu were dedicated to serve as aircraft stands during the Olympic Games. In Figure 19 these taxiways are called Taxiway B, close to the western runway; Taxiway Z, connecting the taxiway to the terminals; and Taxiway C, close to the eastern runway north of the terminal facilities.

¹⁶ High-end general aviation traffic refers to larger general aviation aircraft.

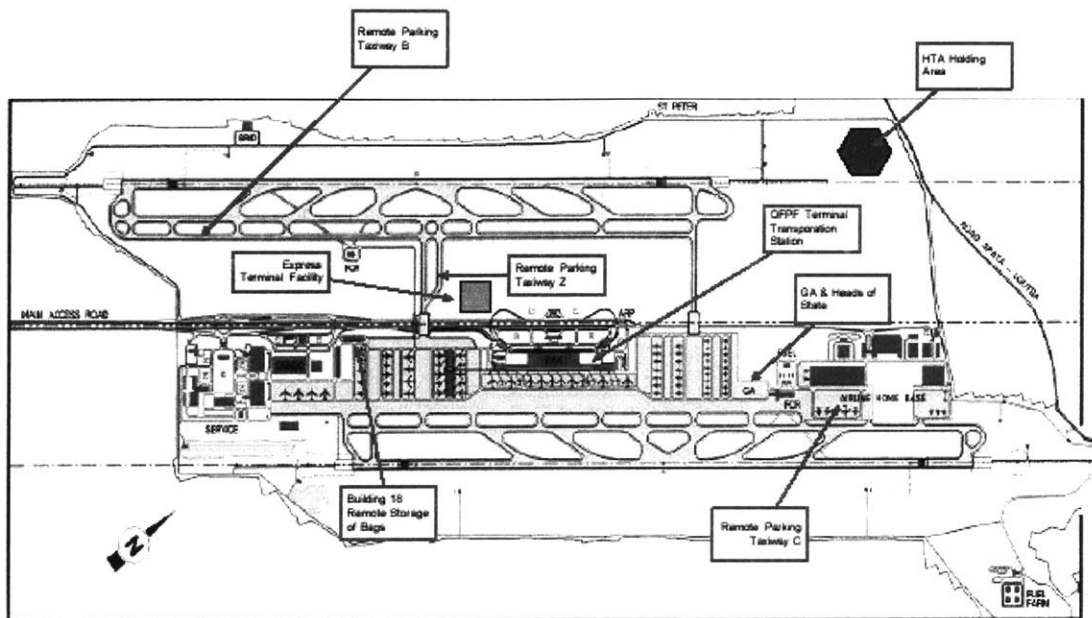


Figure 19: Key infrastructure changes; source: Olympic Games Operations Plan, 2004

4.1.3 Landside Management

Based on the forecasts AIA carefully assessed its needs to serve the increased passenger volumes during the Olympic Games period and took the following landside actions. (Please also refer to Figure 19.)

Terminal Buildings

Based on the forecasts AIA anticipated a shortage of check-in counters during the departure peaks. There were 134 check-in counters in place and 10 more available for contingency purposes, but which did not have baggage belts. Furthermore, the queuing space in front of these check-in counters and the available space in the waiting lounges was too limited to serve the anticipated passenger numbers.

To resolve the shortfalls in check-in counters and queuing capacity six more check-in counters were established in the Satellite Terminal building. Passengers

who were departing on flights from the STB were given a ticket valid only to pass through the underground link from the MTB to the STB. The underground link through which the passengers had to transport their luggage was very well equipped with escalators, baggage trolleys and supportive assistance by AIA staff. The tickets were handed out at one of the 10 contingency check-in counters mentioned above. The check-in operations policy assigned check-in counters to an airline according to the seat capacity of the aircraft type. Thirty minutes prior to the flight departure, the check-in procedure would be terminated. Nevertheless, these policies were assumed to be insufficient in relieving the shortfall of check-in counters to a satisfactory degree. Furthermore, capacity shortages were also assumed to occur in the baggage handling system, the baggage-reclaim area, and (as mentioned before) the passenger-hold rooms. Therefore, a unique solution, which is described in Section 4.1.4, had to be found.

Bus Gates

Additional Intra-Schengen bus gates were built along the northwest side of the MTB to transport passengers between the remote stands and the MTB.

4.1.4 Security Concerns and Capacity Shortfalls – a Unique Solution

The preparation plans regarding the airside management, landside management, and the internal reorganization for the arrivals seemed to be adequate, but this was not the case for the departures procedure. The main departure wave was concentrated on 3 days predicted to exceed the airport's current capacity. Additionally, the need for protection against terrorist attacks was a central concern.

Even though security improvements taken to protect the public and the Olympic Family Members alike were established in every single process of the airport's operations, Olympic Family Members and national officials were still asking for

more protection in the light of the terrorist attacks in the USA and Spain. These officials insisted on additional security procedures such as establishing their own security sites with staff allowed to conduct random bag inspections. Another security concern raised was the public visibility of security actions.

Even though the airport tried to reduce pressure during the peak days, the actions taken in the internal reorganization and on the layout did not seem to bring sufficient relief to the airport. Valid doubts were raised as to whether the airport would be able to handle the huge passenger wave especially on the 30th of August, when hundreds of thousands of passengers would pass through the airport.

For these two concerns a unique solution had to be found. Looking back into sections 3.1 and 3.2 and overlaying Figure 10 and Figure 15 clearly shows that the departure peak of the general public would coincide with the departure peak of the Olympic Family Members (Figure 20).

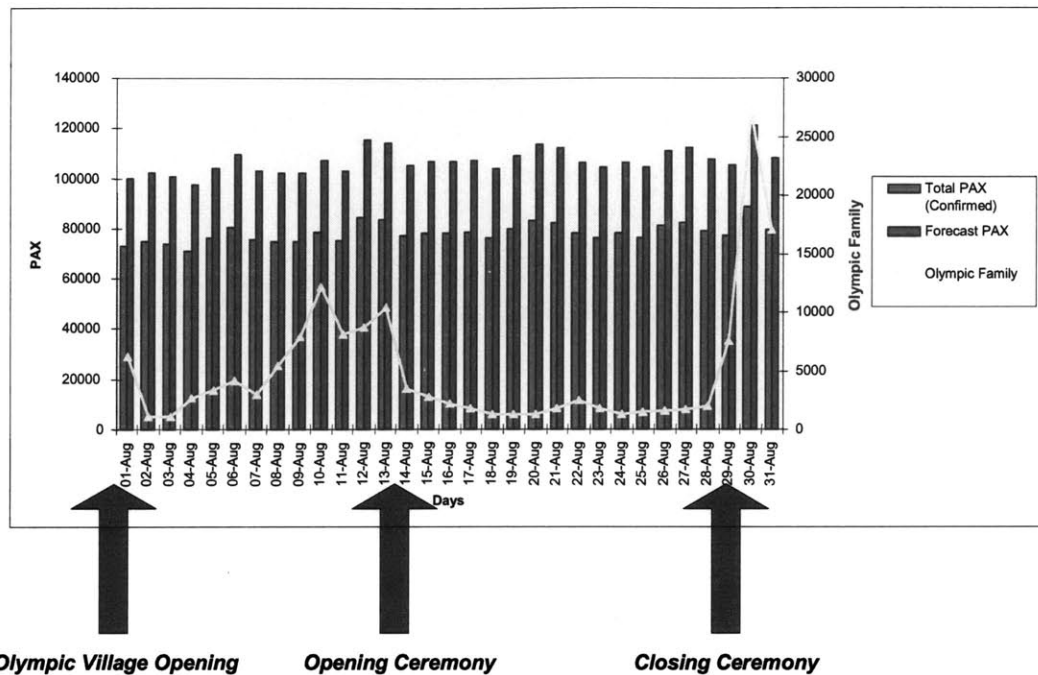


Figure 20: Departure peak, 30th of August 2004; source: Olympic Games Operations Plan, 2004

Security concerns and capacity shortages required a clean and fast solution, which would also expedite the processing of the Olympic Family. Realizing the need to protect the Olympic Family members (OFM), and their sizable numbers, a unique idea was born: to separate the departure flow of the Olympic Family members from the public's by building a separate terminal facility.

This not only offered a robust security solution for both the Olympic Family and the public, but also solved several other congestion issues the airport was struggling with. This solution

- relieved congestion in the MTB during the main departure days;
- resolved the shortfall of check-in counters;
- relieved stress on the baggage system (OFM baggage was separately screened during non-congested hours in the new terminal facility)

- provided the police with a secure facility for processing and protecting the OFM;
- ensured a smooth departure experience for OFM;
- and offered the airport a robust solution for processing and segregating the OFM.

The solution solved the capacity shortfall of the MTB during the main departure days, offered the highest possible security level by eliminating any possible contact between the general public and the OFM and its separation requirement reduced the risk of jeopardizing effective airport operations caused by last minute security policy changes. (Olympic Games Operations Plan, 2004)

4.2 Olympic Family Transportation

In preparation for this unique solution several actions had to be taken regarding the arrival and departure processes at the airport. This section assesses the special needs of the Olympic Family and describes infrastructural modifications and procedures implemented to process arriving and departing OFM.

4.2.1 Arrival of the Olympic Family

The goal to separate the Olympic Family from the general public imposed the task on the Olympic Planning Committee to route all Olympic Family Members within screened airport areas. In Figure 21 the separation between the screened and public areas is shown on the arrivals level in the Main Terminal Building. The screened areas are the arrival gates, baggage reclaim areas, and the corridors in-between. The screened area includes the arrival gates and the baggage belts. The public area includes the “meeters and greeters” areas, retail space and public exits to other transportation modes.

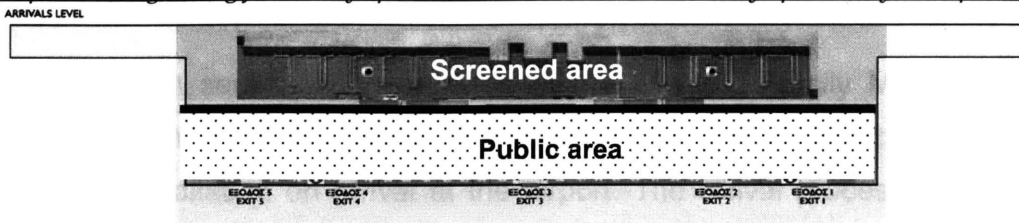


Figure 21: Screened area vs. public area; source: the author

ATHOC and AIA had planned to operate the airport as an Olympic Venue by giving accreditation¹⁷ to as many Olympic Family Members as possible. Only in case of heavy congestion, would OFM be designated to receive accreditation at the Olympic Village. This backup plan never came into effect due to excellent processing efforts (see the crossed path in Figure 22). Other dedicated accreditation places were established at the Olympic Village, the port, and selected hotels.

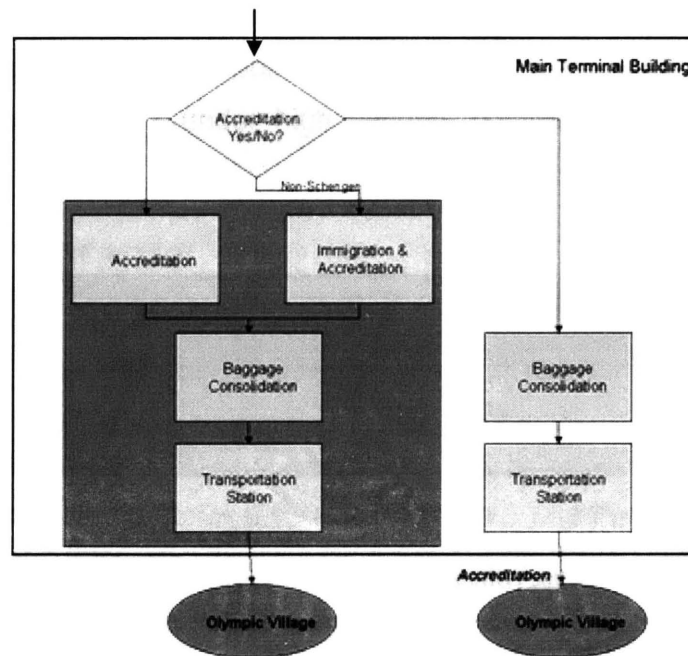


Figure 22: Olympic Family arrival process; source: Olympic Games Operations Plan, 2004

¹⁷ Olympic Family Members have to prove their identity and receive an access card to their Olympic venues.

As indicated in section 9, the arrivals of the Olympic Family Members were distributed over a 14-day period. Throughout this period about 47,500 OFM received accreditation on arrival at the airport. The arrival process is shown in Figure 22. Upon arrival each Olympic Family Member could decide whether to receive accreditation at the airport. If they decided against it, which was seldom the case, they passed immigration, proceeded to pick up their baggage, and entered their dedicated buses to the Olympic Village. There they received accreditation. If the Olympic Family Members decided to receive accreditation at the airport, they passed immigration, received accreditation, picked up their luggage, and proceeded to the Olympic bus gates. This arrival procedure required two modifications at the Main Terminal Building: new Olympic bus gates and Accreditation Areas. (Figure 22)

Bus Gates

An additional bus terminal was built at the north exit of the airport to transport the Olympic Family Members under high security controls to the Olympic Village (Figure 23).

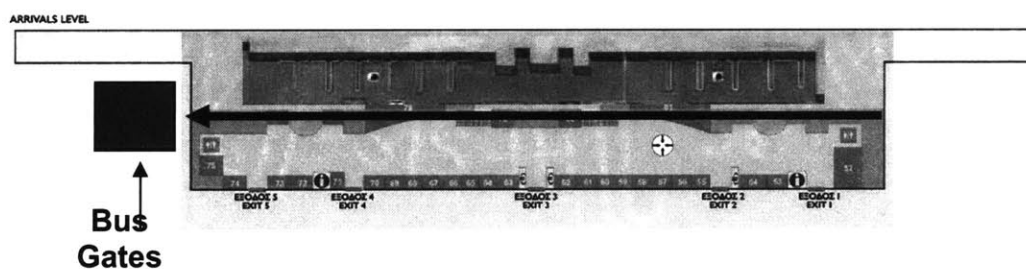


Figure 23: Arrival bus gates for Olympic Family; source: the author

The bus gates were located in the screened area, following up on the idea of processing the OFM separately. The arrow indicates the travel path of the OFM, which will be described in the following paragraphs.

Accreditation Areas

Accreditation Areas describe designated spaces in the Main Terminal where Olympic Family Members receive validation and an access card to their Olympic venues (Figure 24). In total, three official Accreditation Areas were placed in the MTB. ATHOC operated the accreditation desks and guided the OFM to and from these stations in cooperation with the police and AIA staff.

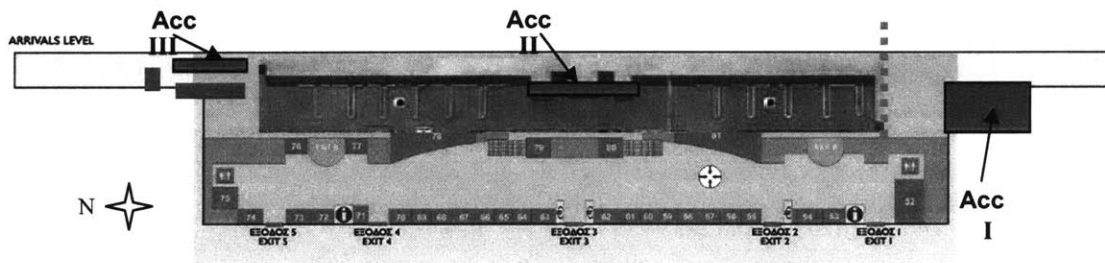


Figure 24: Layout of Athens International Airport; source: the author; Athens International Airport, 2004

The first and largest area served the Extra-Schengen passengers on the south side of the MTB. To accommodate the arriving passenger flow, a new temporary facility was built right outside of the MTB. This tent contained fifteen accreditation desks as well as six immigration desks – exclusively used by OFM. Accreditation Areas II and III were located in the Intra-Schengen area (separated from the Extra-Schengen area by the dotted line) (Figure 24). These areas replaced existing transfer desks. The second Accreditation Area, located in front of bus gates 3 and 4, consisted of ten available positions. The third Accreditation Area was located in front of bus gate 5 and consisted of twenty desks, four existing transfer stations, and two parallel sets of eight desks. The staffing of the desks was the responsibility of ATHOC; staffing of those desks that were used for passport control was the responsibility of the police.

The accreditation for VIP Family Members and heads of state took place in a VIP lounge in the Main Terminal Building.

After the accreditation procedure, the OFM were guided to the north exit of the airport, where dedicated bus gates finalized the OFM transportation to the Olympic Village (Figure 23).

In conclusion, the high percentage of OFM who used the opportunity to get accreditation at the airport proves that those stations played a very important part in providing a smooth arrival experience for the OFM. This experience was continuously enhanced with the help of ATHOC volunteers and AIA Golden Ambassadors who guided the OFM, placed signage, and operated help desks across the terminal.

4.2.2 Departure of the Olympic Family

The departure process of the Olympic Family required a new facility, more specifically, the modification of an existing mock-up building, separate from the general public terminals. The new Express Facility was located on the opposite side of the airfield from the Main Terminal Building and close to the long-term parking area (Figure 25). The cost of constructing this building explicitly for the Olympic Family amounted to approximately 7 million Euros.

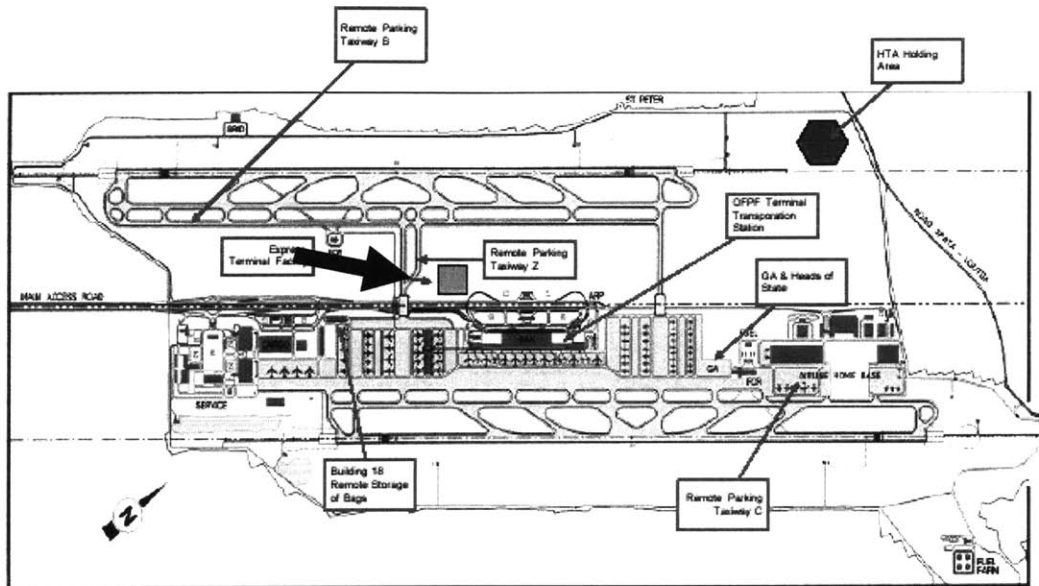


Figure 25: Key infrastructure changes; source: Olympic Games Operations Plan, 2004

Express Facility

The Express Facility was located to the south of the long-term parking facility (see Figure 25). It was connected to the airside¹⁸ and the landside, just like the MTB. The architect, Caspar Baum, designed this facility as the first and last impression of the Athens Olympic Games for the OFM. The new terminal was built to serve all departing Olympic Family passengers except the media, totaling 54,300 passengers.

The Express Facility was designed to process 1200 passengers per hour, consisting of a mix of pre-processed and full-service passengers.

¹⁸The airside of an airport is usually defined as the area of the airport and all adjacent terrain and buildings to which access is controlled. The 'airside' area in the terminal building is that area where only passengers with a valid boarding card can gain access. The 'landside' area is that part of the airport which every member of the public can visit (LCAAC, 2004).

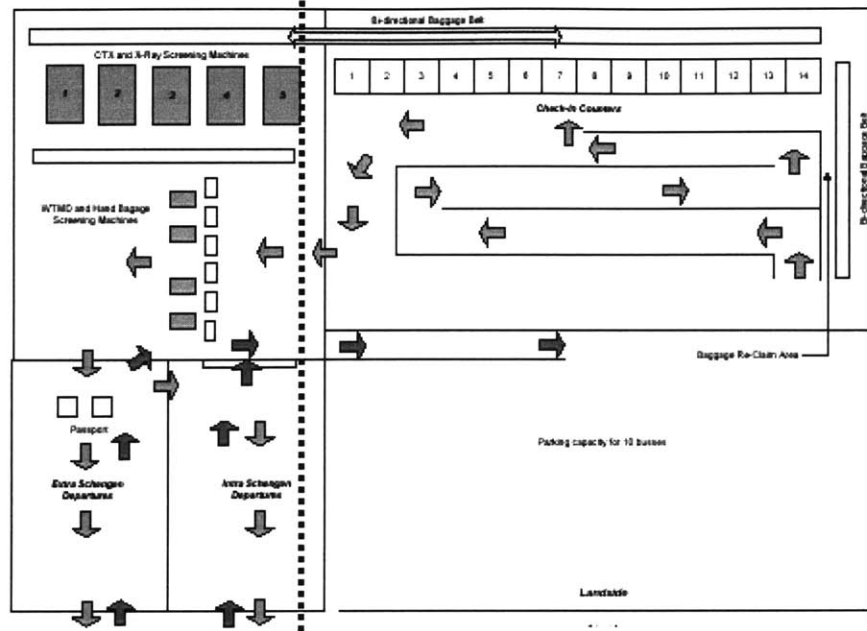


Figure 26: Express facility schematic, Source: Olympic Games Operations Plan, 2004

As mentioned earlier, the Express Facility was connected to the airside and to the landside (see Figure 26; the vertical dotted center line represents the separation).

On the landside – to the right of the center line - one can see fourteen check-in counters at the top of the figure, queuing space in front of the check-in counters, and ten bus parking spaces outside of the terminal.

On the airside, following the green departing flow of the arrows, there are six walk-through metal detectors (five baggage screening machines are on the top) followed by two passport control stations consisting of four desks. At the exit to the airside another ten bus spaces are available.

Prior to the Express Facility's actual use for the main departing days (30th of August to the 1st of September), several test runs were conducted. Throughout all of those days, the terminal building was guarded by 10 policemen and 8 Golden Ambassadors.

The operations in the Express Facility were supported by the establishment of an Off-Airport Processing operation at the Olympic Village. In order to manage the passenger peak departure days and the associated large amount of baggage, the goal was to pre-process¹⁹ as many Olympic Family Members as possible. This process was conducted successfully: in total, 72% of the OFM were pre-processed at the Olympic Village. This process proved to be very efficient. Along with the congestion relief for the baggage system, the pre-processing procedure offered a very convenient departure experience for the Olympic Family Members.

The whole departure process of the Olympic Family Members, including the Express Facility, can be subdivided into two procedures: pre-checked (Figure 27) and full-checked (Figure 28).

¹⁹ Pre-processing means to check-in the baggage and to receive the boarding passes.

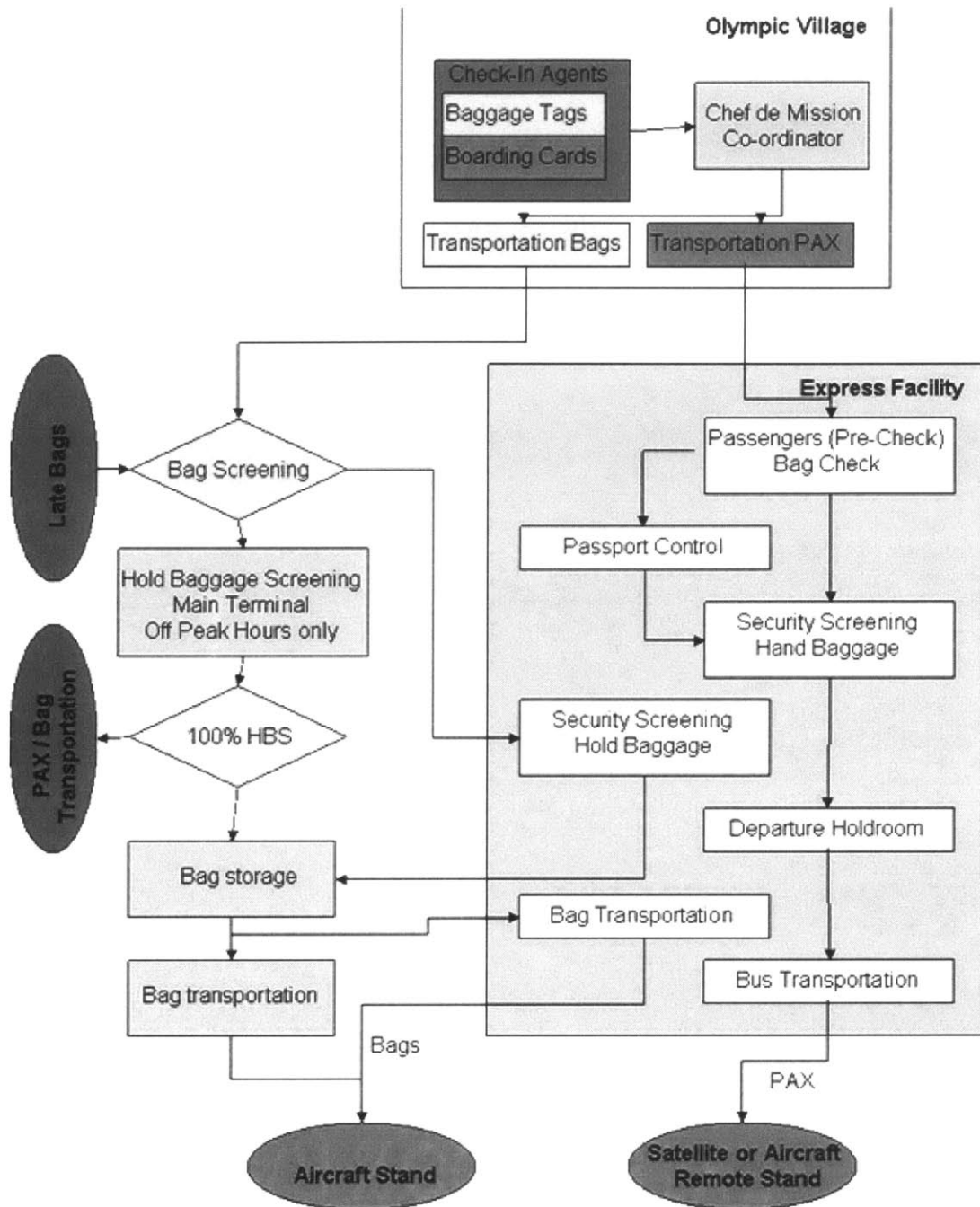


Figure 27: Departure flow of pre-checked OFM; source: Olympic Games Operations Plan, 2004

All Olympic Family Members were encouraged to pre-check at the Olympic Village. Each national Olympic Team could send a representative to fulfill all necessary duties like dropping off the luggage and receiving the boarding cards for the whole team up to 6 hours in advance of the flight departure. This service was jointly offered by the airport, ATHOC, and the ground handlers from 29 August to 1 September. During the pre-process, the baggage was collected, tagged, and delivered from the Olympic Village to the Express Facility under police escort. There the baggage was screened and sorted during off-peak baggage hours during the nights, relieving the pressure on the Main Terminal Building tremendously. Afterwards, the baggage was stored on the airside close to the Express Facility. This pre-processing of the OFM was critical to the success of the OFM departure experience. (Figure 27)

Those Olympic Family Members who did not go through the pre-check were transported to the Express Facility, where the handlers and several airlines conducted the check-in procedure on site. (Figure 28) This procedure was less convenient for the OFM than the pre-check procedure.

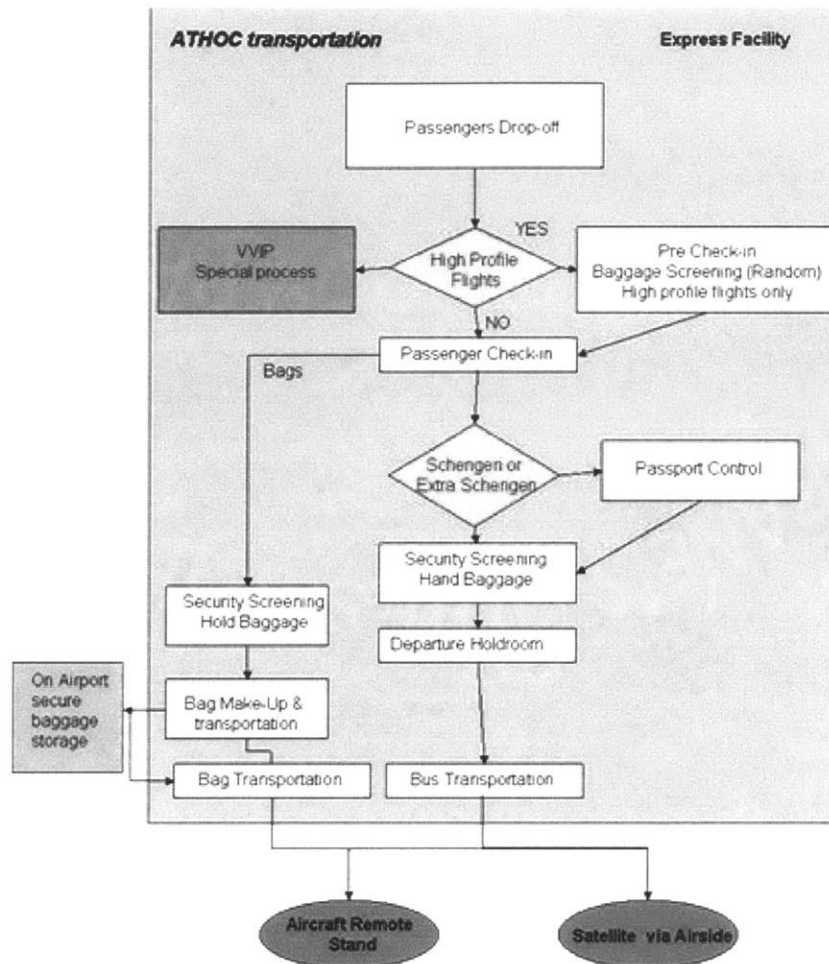


Figure 28: Departure flow of full-checked OFM; source: Olympic Games Operations Plan, 2004

In conclusion, the Express Facility building was used throughout the Olympic period for arriving and departing charter flights and for arriving and departing Olympic and Paralympic Family Members. It was only needed (and was actually built for) the 3 peak departure days to relieve congestion at the MTB and secure the OFM. Three days at a cost of 7 million Euro! But, the decision to build this facility was absolutely logical: If the OFM operation had experienced failure, the cost of this failure, would have been much higher than any other expenditure imaginable, e.g. the negative publicity it would generate, claim for damages, etc..

Chapter V: Processing the Olympic Family Members

In this chapter the focus is on the implementation and usage of three different queuing models developed to support a smooth transportation experience for the Olympic Family Members. The models predict the arrival and departing passenger flows through the Main Terminal Building and the Express Facility. The evolution and the type of the models reflect the need for their fast applicability, flexibility, and adaptability to short term changes. These changes show how policy decisions can strongly impact operational procedures. Building upon sections 2.1, 3.2 and 4.2 the application of the models is described.

5.1 Arrival Model

The first model was meant to support the Golden Ambassadors and ATHOC volunteers in organizing the flow of arriving Olympic Family Members. It is applied to and reflects the layout of the arrivals level at Athens International Airport. The goal of the arrival model was originally to serve as a tool in staffing stations, but its purpose was revised to identify hotspots²⁰ and critical time periods. The model was able to forecast the number of people in queues and their expected waiting time in front of Passport controls and Accreditation desks, here referred to as dynamic queuing stations. Variables to staff the operating desks at these stations were implemented to account for the necessary short-term changes. Finally, the arrivals model was also designed to estimate the number of busses needed at the northern bus gates per hour.

²⁰ Hotspots describe areas where congestion is likely to occur.

5.1.1 Theoretical Approach to the Model

To structure this task, first the stations of the queuing network had to be analyzed by identifying the number of queuing systems and their location in the Terminal Buildings. Each queuing system was either a passport control or an accreditation station. Their locations within the terminal buildings are shown in Figure 29.

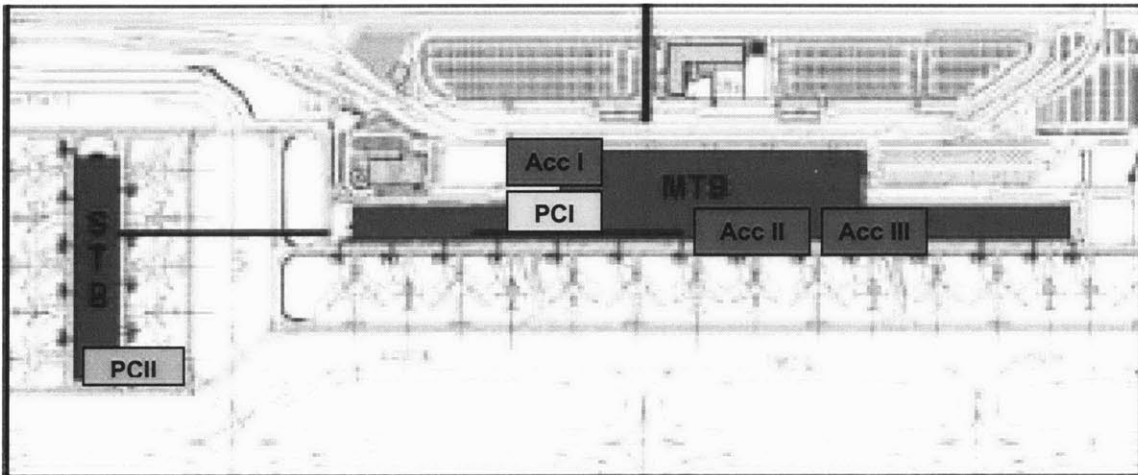


Figure 29: Dynamic queuing stations; source: the author

Second, the specific queuing network of Athens International Airport had to satisfy regulations imposed by immigration/emigration and ATHOC. These regulations, as well as the infrastructure of the airport, required splitting and merging the passenger flows at different places at the airport. These regulations had to be implemented into the model to predict the expected paths and thus travel times of the passengers through the airport. The queuing network satisfying these regulations had the structure shown in Figure 30:

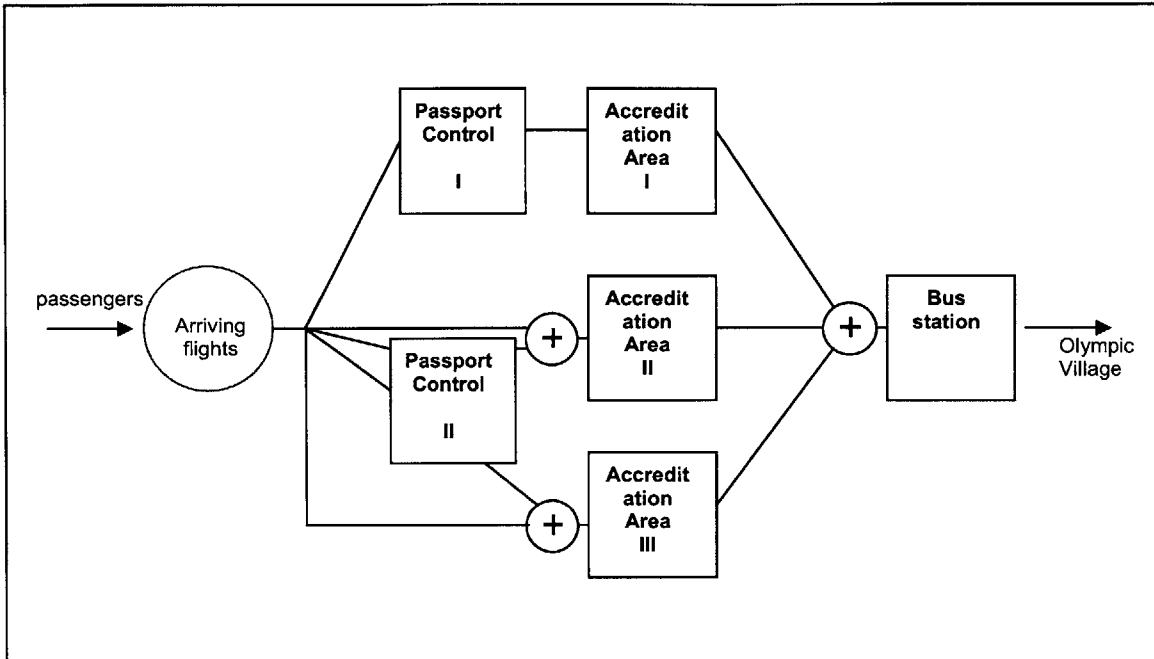


Figure 30: Queuing network of AIA; source: the author

Passengers on flights from an Extra-Schengen country had to queue for passport control; Intra-Schengen passengers could pass these stations immediately. The distribution of the flows to the Accreditation Areas depended upon the stand allocation of the arriving aircraft and the flight's origin. As can be seen in Figure 30, one possible passenger flow leads from the arriving airplane to Passport control I, then to Accreditation Area I and finally to the bus station.

Second, the aircraft allocation did not only determine the Accreditation Areas the passengers would go to, but also imposed different travel times on them. Therefore, from deplaning to entering busses at the bus gates, *eight possible passenger flows can be identified*. These are determined by the imposed EU-regulations, the aircraft stands and the origin of the flight (Figure 31). Associated with each of the flows is at least one or at most two queuing stations with different demands occurring at each station.

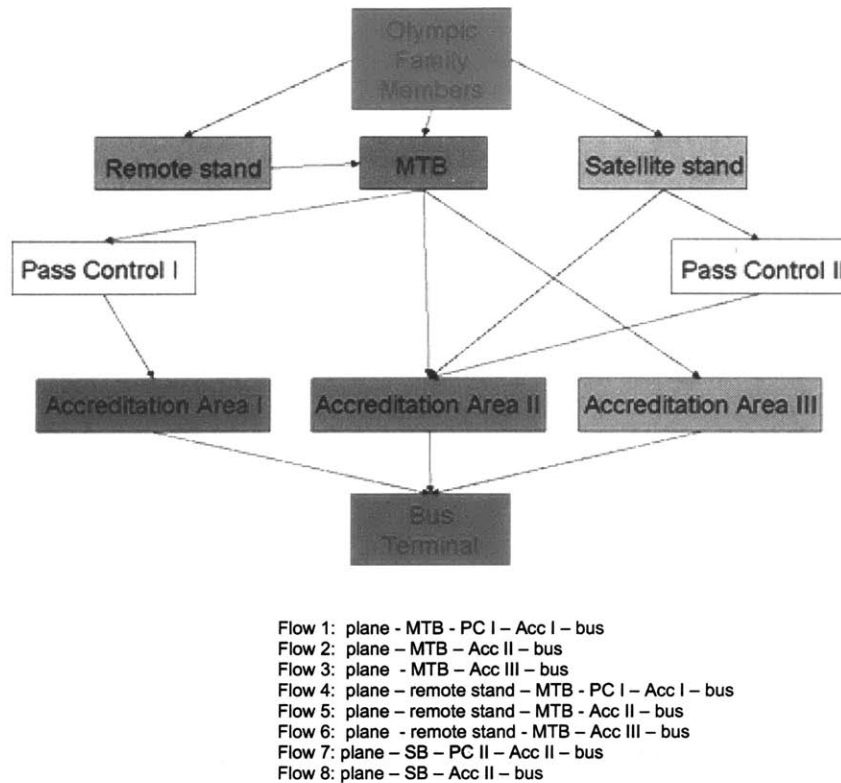


Figure 31: Presentation to AIA officials (3. August 2004); source: the author

Each flow can be identified as follows (Figure 31): There are three passenger deplaning possibilities: the Main Terminal Building, the Satellite Terminal Building and the remote stands. Then, the passengers of Extra-Schengen flights had two possibilities for passport controls. Thereafter, every OFM had to pass through one Accreditation Area before picking up his/her luggage and entering the bus terminal (last row of Figure 31). The arrows in Figure 31 point to the next possible stations at each step. For example, a passenger who arrives directly at the Main Terminal building will either go to Passport control I -in case he arrived from an Extra-Schengen country- or approach Accreditation Area II or III depending upon the aircraft arrival stand. Passengers who arrive at the remote stand will be transported to the MTB. Those passengers, who arrive at the Satellite Terminal Building, will

either go to Passport control II -in case they arrive on an Extra-Schengen flight- or move on to Accreditation Area II. From each passport control there was only one possible path; for Passport control I to Accreditation Area I and from Passport control II to Accreditation Area II.

Third, associated with each flow are different travel times through the airport. The total travel time is the sum of waiting times split into fixed and dynamic waiting times. The fixed waiting times were walking distances or transportation times. These fixed waiting times were assumed for simplification, because they were seldom depending on the passenger volume. Examples for fixed waiting times are: travel time from the remote stand or the Satellite Terminal to the Main Terminal Building, which was assumed to take 15 minutes; and waiting time for the luggage, which was assumed to take 40 minutes. The dynamic waiting times can be interpreted as the waiting times at the queuing stations, which depended on the splitting or merging flows. For example, Accreditation Area II served 4 different flows: all passengers from the Satellite Terminal Building (two flows), and Intra-Schengen passengers arriving at the MTB and at a remote stand (please refer to Figure 31). In comparison, Accreditation Area I only served 2 flows, Extra-Schengen passengers who either arrived at the MTB or at a remote stand.

In conclusion, the distribution of the OFM to the eight flows was necessary to identify the peak times at Accreditation Areas and passport controls. The interdependencies of the queuing network and thus the different waiting times for each flow were influenced by the stand allocation of an arriving aircraft and the flight origin.

5.1.2 Flow Modeling

The model using the Excel software was programmed to identify these eight flows and thus to estimate the demand at each queuing station at specific times. Being

able to calculate in real time, this model had implemented variables to change the staffing and thus the service times of the queuing stations. Therefore, it could predict the queue length and approximate waiting times in response to changes in the staffing of the various service facilities. With these abilities it fulfilled its original purpose to evaluate the trade-off between the number of volunteers working at these stations and the waiting time of the athletes. Thus, it could have served as a service prediction and evaluation tool. Since ATHOC and AIA decided to staff all available desks to provide excellent service to the athletes, this trade-off did not have to be evaluated. Now, the model was used to identify hotspots and critical time periods during the Olympic Games at the queuing stations. To explain the model in more detail the data provided for the peak day of arrivals will be used as an example. This day was the 12th of August, one day prior to the Opening Ceremony.

First, as mentioned before, the model distributed the arriving passengers to eight different flows (Figure 32):

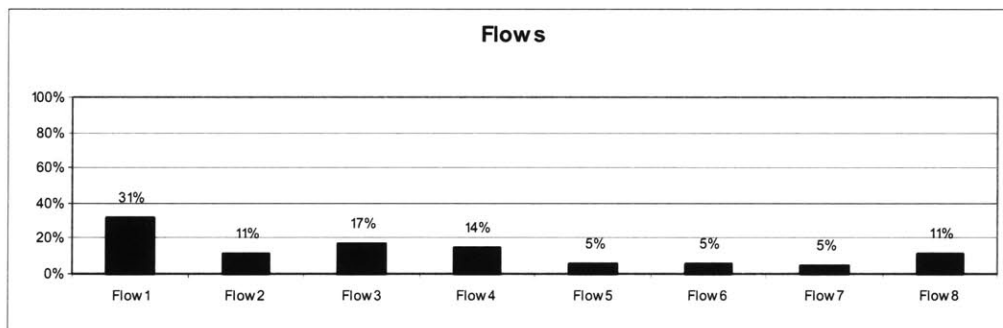


Figure 32: Distribution of OFM on the 12th of August-model results; source: the author

This distribution depended upon the first two inputs:

1. *origin of the flight (Extra-Schengen or Intra-Schengen in Figure 33)*

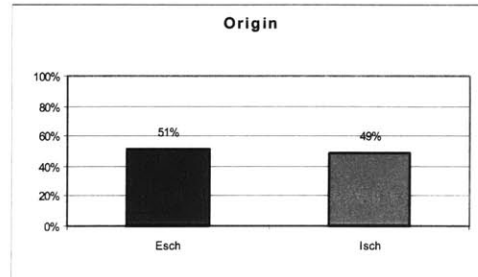


Figure 33: Origin of the flights on 12th of August – model results; source: the author

2. *aircraft stand (MTB, STB or remote stand in Figure 34)*

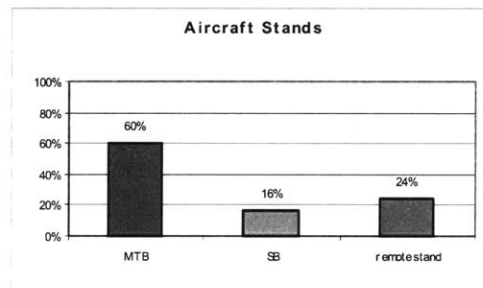


Figure 34: Arrival stands of OFM on the 12th of August-model results; source: the author

3. *number of Olympic Family Members on that flight*
4. *expected arrival time*

The latter two inputs mentioned above were necessary to identify the peak periods at the queuing stations. Given this *input*, the model furthermore randomly imposed time delays on the arriving aircraft to account for the uncertainty in these processes. The aircraft arrivals were initially modelled as deterministic²¹. The model sorted the arriving passengers into a corresponding 5-minute interval, e.g., in the time interval

²¹ “A function or algorithm is deterministic if the output is uniquely determined by the input.”

of 1 pm-1:05 pm, 2 airplanes arrived transporting 60 OFM. Nevertheless, this approach had to be slightly modified, because it predicted, that every airplane arrives exactly at the time it was scheduled, which is unrealistic. Therefore, a dynamic element was incorporated into this process, reflecting the unpredictability of passenger behaviour and the possibility of aircraft delays. This dynamic element was a uniformly distributed random variable which imposed a delay on the arrival time of passengers ranging from five minutes to one hour.

As a further simplification of the real world, it was assumed that all OFM deplane instantaneously. Even though a “normal” deplaning process takes approximately 15 minutes, this approach used in the model was valid: observations showed that the arriving team members usually assembled after exiting the airplane in order to approach the queuing stations as a group. Figure 35 shows the distribution of the OFM to the Accreditation areas on the 12th of August.

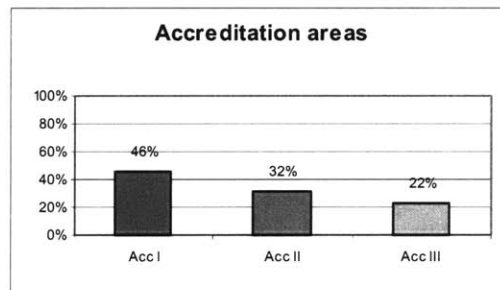


Figure 35: Distribution of OFM on the 12th of August to Accreditation Areas; source: the author

To predict the waiting times at the queuing stations, the model merges and splits the passenger flows according to Figure 31 before, in-between, and after the queuing stations. A detailed description of this process is as follows: after deplaning the model imposes a fixed time delay on passengers depending upon the travel time to their first station. There, it adds OFM from all arriving flows to the waiting OFM at that station (in case there is a queue) within 5 minute time slots. This

demand calculation is done for each queuing station. Then, it compares for each of those time slots the incoming demand with the provided service. This service is expressed through the following two **variables** of the model:

1. *Number of service desks operating*
2. *Service times at the desks*

The service rates at each station were different, but it was assumed that all available servers for a station were parallel and identical; specifically all servers would have the same service rate for each passenger. The model determined, whether there will be a queue (demand rate is higher than the service rate) and if so, it calculates the number of people in it, estimates the expected time a queue will be present at that station and draws cumulative diagrams (please refer to section 2.3).

Finally, the model computes the maximum queue length and the maximum waiting time of a passenger. One can also modify the **percentage of OFM**, who will get accreditation at the airport and insert a specific **day** and **time** to analyze a 24-hour period, in addition to all the other aforementioned variables.

5.1.3 Application and Results of the Model

In preparation for the Olympics, the model was used to identify congestion hotspots in the Terminals. In addition to the model results, observations and personal experience identified further hotspots. During the Olympic Games the model was run on each of the main arrival days (10th – 15th August) to forecast the peak periods at different queuing stations throughout the day.

Model predictions for the main arrival days

As identified in Figure 33, Intra-Schengen- and Extra-Schengen passengers were almost evenly distributed during the arrival days. The hotspots analysis for the main

arrival days was evaluated by running different staffing scenarios. The model identified two hotspots at the following queuing stations (see Figure 36):

- Because AIA rarely assigned any aircraft to STB-stands to minimize walking distances, long queues in front of the Passport control I formed. (Hotspot 1)
- By running different scenarios of the model, it turned out that Accreditation Desk II would serve 32% of all arriving passengers (Figure 35). This combined the passenger flows arriving from the Satellite Terminal, from several arrival gates at the MTB and approximately 2/3 of all passengers arriving from the remote stands. At the same time, this Accreditation Station had only 10 Accreditation desks available. Furthermore, its location in the center of several arrival flows guiding the general public passengers to the baggage reclaim areas offered limited queuing space. (Hotspot 2)

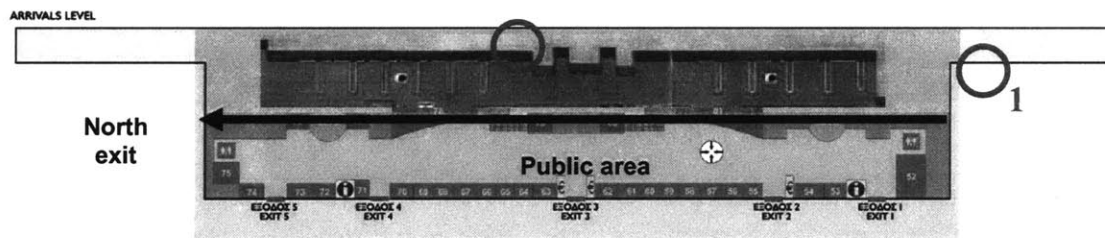


Figure 36: Hotspots of arriving Olympic Family Members I; source: the author

Having identified these two hotspots (Figure 36), AIA took the following actions: The airport employees advised the police to fully staff the desks at Passport control 1. ATHOC decided to fully staff all Accreditation Areas as well. For Accreditation Area II, AIA implemented a contingency plan to reroute the passengers through the underground link to Accreditation Area III in case congestion would block the public passenger flows to the baggage reclaim areas.

Based on discussions with AIA staff and observations three further hotspots on the arrival paths of the OFM were identified (Figure 37):

- The lost baggage area: In case OFM baggage was lost all team members would gather in front of the baggage reclaim station. This place was centrally located in-between arrival flows and thus this group would increase the congestion in this area tremendously. (Hotspot 3)
- The two exits to the “meeters and greeters” areas: Here the flow of the OFM, which was guided along the west wall of the terminal building to the bus terminal at the north exit, intersected with the general public heading to the public areas. (Hotspots 4 and 5)

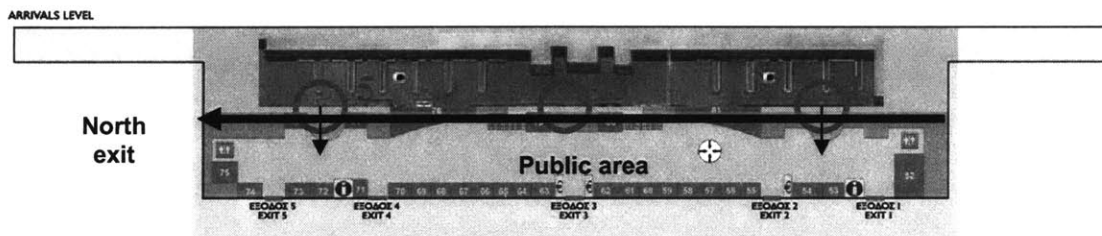


Figure 37: Hotspots of arriving Olympic Family Members II; source: the author

In general the baggage reclaim area was congested. There were two factors caused by the OFM, which increased the congestion in this area. The first one was the longer waiting time for OFM luggage. Usually, passengers carry two pieces of luggage, but many OFM, like media and athletes, had three or even four bags. The second factor was the team spirit. OFM from one team would wait until the last person had picked up his/her luggage and then proceed to their bus gates.

Main arrival days

The task to provide excellent service to OFM required detailed planning, coordinated procedures and frequent communication of three parties: ATHOC (volunteers of the venue), the police and Passenger Terminal Services (Golden Ambassadors). While ATHOC volunteers were responsible for accrediting and guiding the OFM, the police secured the area and conducted passport control while

the Golden Ambassadors were responsible for providing informational services and a smooth passenger flow through the terminals.

In total, 75,300 OFM including athletes, team officials, VIP's, media, sponsors and observers were expected to arrive throughout the Olympic Games period (ATHOC, June 2004). Between the 10th and the 15th of August 50,000 OFM arrived and almost all of them received accreditation at the airport. All involved parties (ATHOC, police and AIA) were prepared to welcome OFM by the 15th of July.

Until the 10th of August, the accreditation desks were staffed by ATHOC to 50%. The number of operating desks was raised only between the main arrival days (10th – 15th August) to maximum capacity at all Accreditation Areas. Even though, the accreditation desks were overstaffed during many hours of the day, the volunteers were desperately needed when an incoming wave of OFM arrived at the queuing stations. As a result, the waiting time at those Accreditation Areas never exceeded 30 minutes on average. Through staffing the Accreditation Areas to their full extent ATHOC provided excellent service for the OFM.

In conclusion, the model identified the hotspots correctly and predicted the peak periods for each arrival day accurately. Through robust contingency plans the airport relieved congestion efficiently.

5.2 Departure Model

The goal of the second model was to determine the departure times of the Olympic teams from the Olympic Village²² in order to minimize their waiting time at the airport and avoid overcrowded waiting lounges. In total, 75,300 OFM were expected to depart through the Express Facility. (ATHOC, June 2004) This approach goes along with the principle through which the airport was trying to handle the huge

²² The Olympic Village hosted all teams and is located approximately 30 miles away from the airport, to the northwest of Athens.

number of departing passengers: “push in and push out”. As soon as passengers would arrive at the airport, they had to be processed and were planned to leave immediately thereafter. This approach aimed to provide a smooth flow through the airport. Since the airport had very limited space available to accommodate waiting passengers, it was necessary to balance the arrival time of the departing passengers. Early arrivals would lead to overcrowded areas; late arrivals would result in missed flights or airfield delays.

5.2.1 Theoretical Approach to the Model

To structure this task, the number of major travel paths of the Olympic Family Members and the corresponding queuing network at the airport’s Express Facility had to be modeled first.

The queuing systems in this queuing network were the check-in counters, the security screening, and passport control. Their locations in the Express Facility are shown in Figure 38.

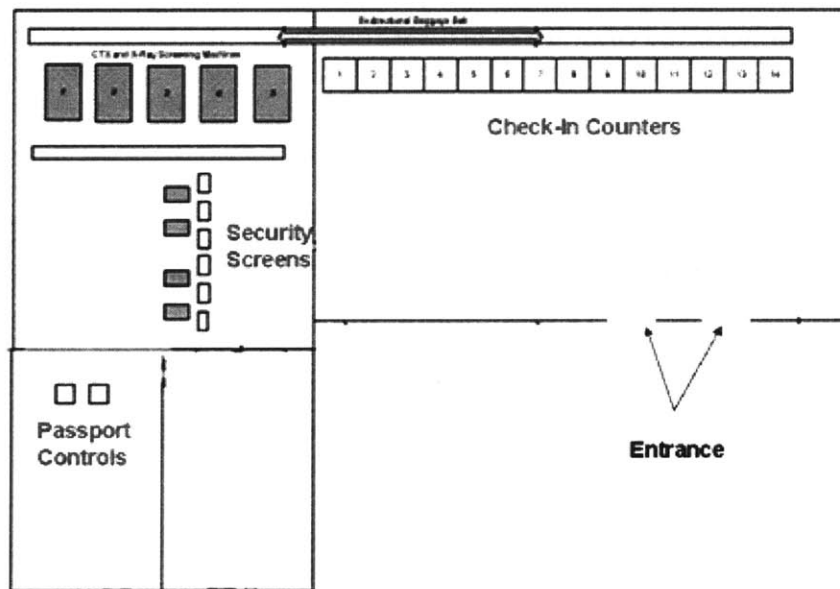


Figure 38: Express Facility; source: the author

Second, the queuing network representing the Express Facility had to be analyzed in order to estimate the time each passenger would spend at each station before boarding the airplane. As can be seen in Figure 39, there were only two flows that were merging at the airport.

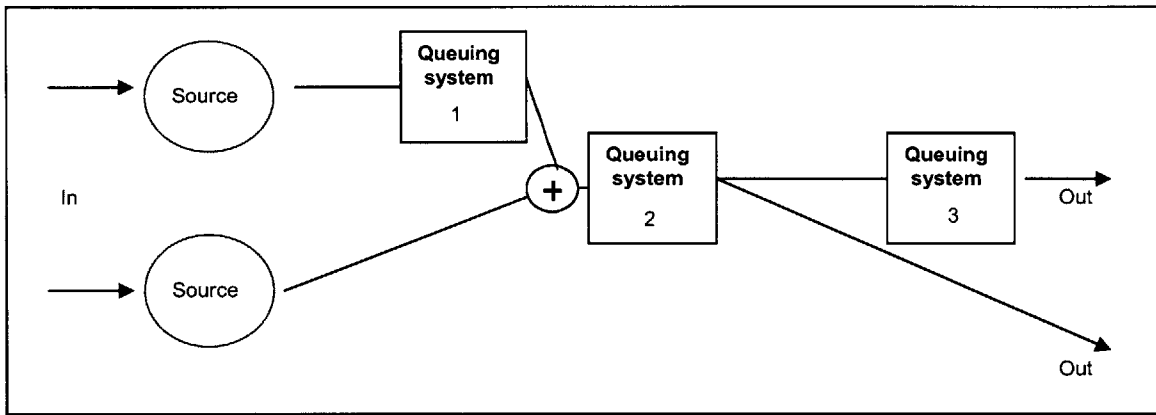


Figure 39: General queuing network of Express Facility; source: the author

There were two passenger origins: the hotels and the Olympic Village. Those passengers departing from the Olympic Village were assumed to have been pre-processed and thus would not need to check-in at the Express Facility. Regardless of their origin, every OFM had to pass through the security screening units. Thereafter, the passengers on Extra-Schengen flights had to pass through passport controls.

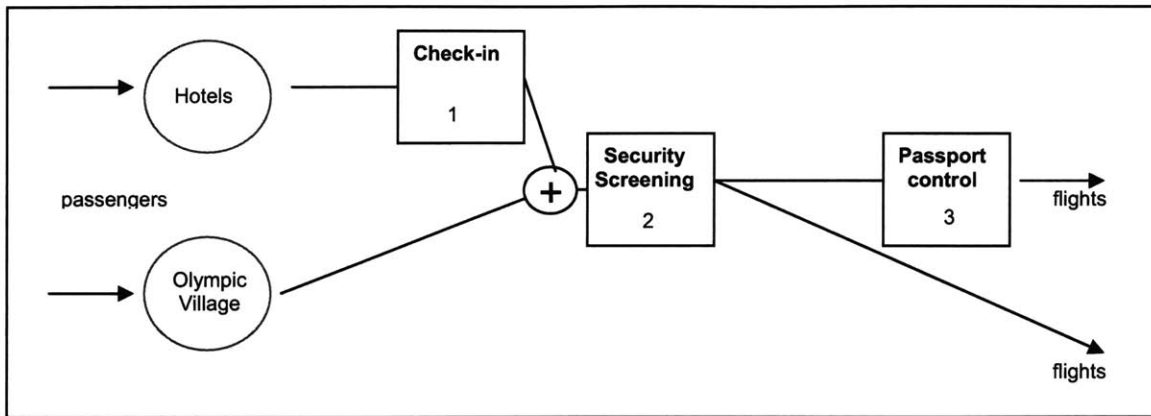


Figure 40: Queuing network of Express Facility; source: the author

Given this network, the distribution of all passengers into four types depending upon their origin (hotel or Olympic Village) and destination of their flight was necessary to determine their departure times. In Figure 41, one can see the following flows and thus identify four types of passengers:

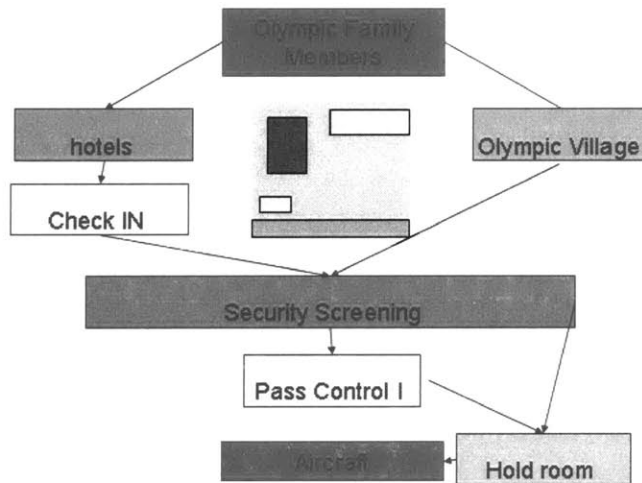


Figure 41: Presentation to AIA officials 6th of August; source: the author

The four passenger types are determined by their **origin** and their **destination**: leaving from the hotel and flying to an Extra-Schengen country; leaving from the hotel and flying to an Intra-Schengen country; leaving from the Olympic Village and flying to an Extra-Schengen country; and leaving from the Olympic Village and flying to an Intra-Schengen country.

Third, associated with each flow are different travel times through the airport. The total travel time was the sum of waiting times split into fixed and dynamic waiting times. The fixed waiting times were travel times on various transportation modes. These fixed waiting times were assumed for simplification, because they seldom depended on the passenger volume. Examples for fixed waiting times are: travel time from the Olympic Village to the Express Facility was assumed to take 45 minutes (Figure 42); transportation from the Express Facility to the waiting lounges was assumed to be 20 minutes. The dynamic waiting times can be interpreted as the waiting times at the queuing stations, which depended on splitting and merging flows. For example, the security screening served two different merging flows (Figure 41): pre-checked passengers and full-checked passengers. The waiting time in front of the security screening points for a specific individual was dependent upon the number of people already waiting in the queue (the dynamic element) and the arrival time of that individual.

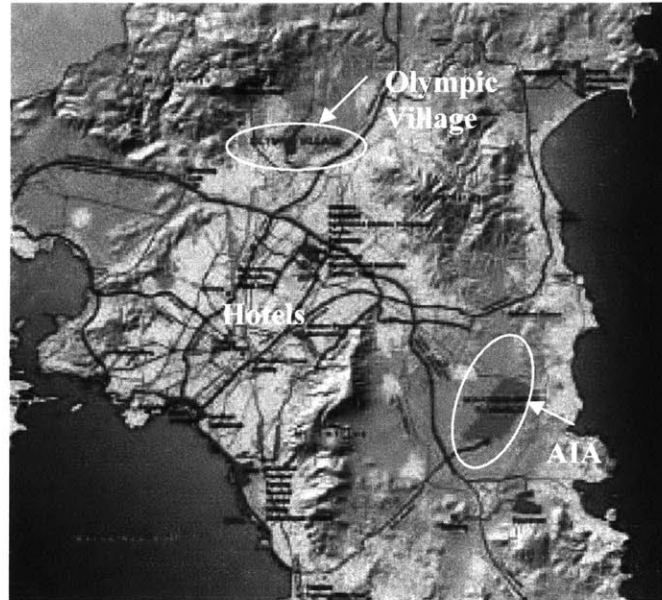


Figure 42: Athens regional map; source: the author

In conclusion, the distribution of the OFM among the four passenger types was necessary to determine their exact desired departure times from their origin. The interdependencies of the queuing network and thus the waiting times for each flow were greatly influenced by the pre-processing procedure, but also by the screening process and passport control.

5.2.2 Flow Modeling

The Excel model was programmed to identify the four passenger types and could be used as a real-time tool to explore the sensitivity of the results to different assumptions. As mentioned earlier, this process was necessary to determine the exact times, when OF passengers had to leave their origin. In contrast to the arrival model, the departure model had to be implemented in an “upside down” way (Figure 43).

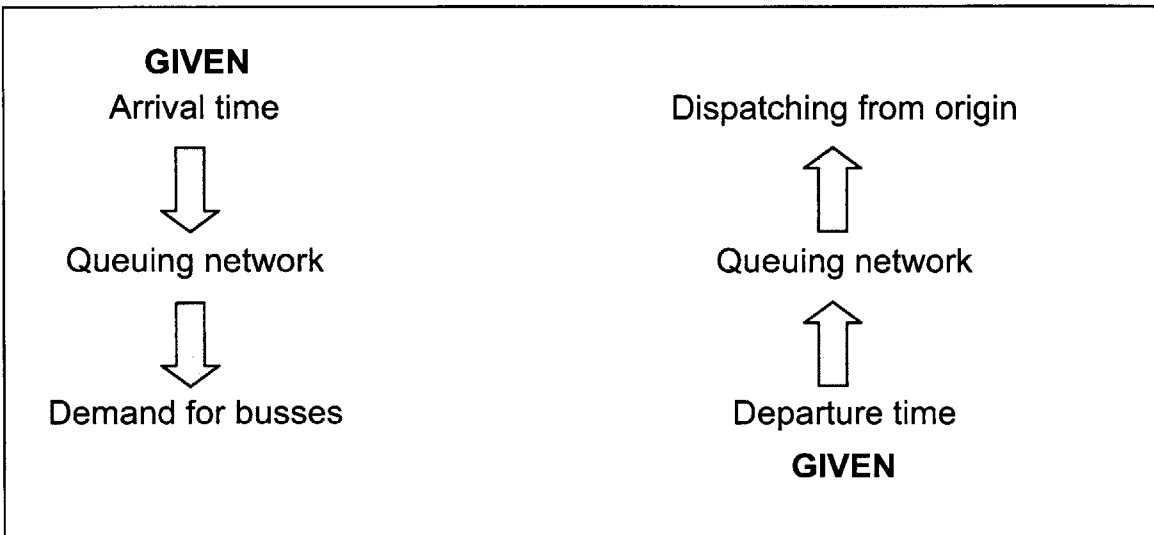


Figure 43: Arrival Model vs. Departure Model; source: the author

To explain further: for the arrival model the arrival time of passengers was given. The arrows indicate the process of forecasting to assess the bus demand. For the departure model, the aircraft departure time was given and one had to predict the time spent traveling through the queuing network in order to identify the departure time from the origin. Basically the middle step –predicting the travel time through a queuing network – was similar in both models, but one had to consider different inputs and thus program two models.

The second step, the model had to conduct, was to analyze the demand at the queuing stations during 5-minute intervals. This model had implemented variables to change the staffing of the desks and thus the service rate of each queuing station. By comparing the demand rate with the service rate during a specific 5-minute time slot, it predicted the queue length and approximate waiting times for the OFM.

The action the model took after this comparison can be described as a *backside loop*. In cases where the demand was higher than the service, it pushed those

passengers who were not serviced within a particular 5-minute time slot to the immediately preceding 5-minute slot. In practice, this meant that these passengers had to leave their origin at least 5 minutes earlier. The model repeated these comparisons described by pushing the remaining passengers to an earlier time slot, till there was no queue present anymore. Logically, this makes sense given the task at hand. The goal was to minimize the waiting time for the passengers at the airport. Each minute spent in a queue is lost time for them and causes congestion for the airport. Thus, the model forces the queue length to 0 in every 5-minute time slot.

After this second step, which determined the total number of passengers at the queuing stations, when the flows were *merged* one had to conduct a third step. This third step was necessary to *identify* the passenger types and thus to determine their specific flight departure through the flight number. This step can be described as a *foreside loop* as follows: Even though the model distinguished between the four types of passengers, it could not track each single passenger at a specific time interval within the system. So, the model could only determine the number of each specific passenger type that had to be dispatched in certain intervals. Because this model worked under the assumptions that (a) all desks at the service stations were identical servers, and (b) the queuing discipline is first come first served, the *foreside loop* was able to assign the specific flight number to the passenger. The *foreside loop* counted the number of each of the four passenger types and assigned these passengers to each of the corresponding flight types in the order of their flight departure time.

To explain the model in more detail the data provided for the peak day of departures will be used as an example. This day was the 30th of August, one day after the Closing Ceremony.

As mentioned before, the model distinguished four passenger types. The day's distribution can be seen in Figure 44:

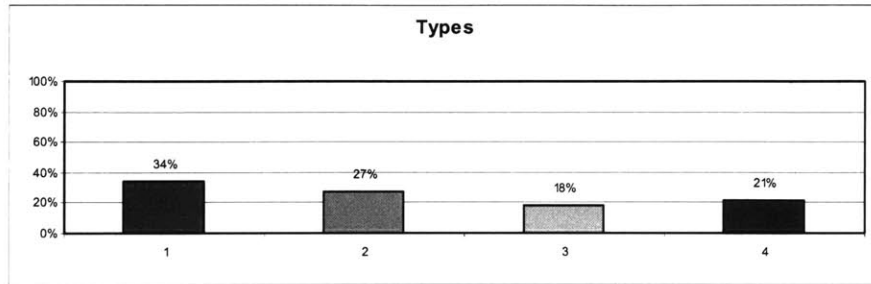


Figure 44: Distribution of OFM to the types on the 30th of August-model results; source: the author

This distinction was dependent upon the first two inputs:

1. destination of the flight (Extra-Schengen or Intra-Schengen in Figure 45)

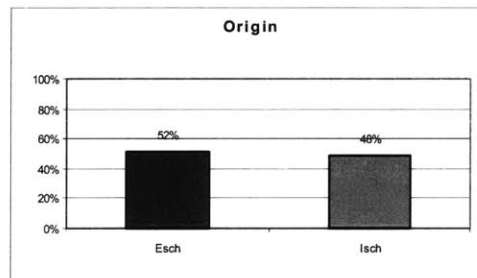


Figure 45: Destination of the flights on 30th of August – model results; source: the author

2. whether the passenger lived in OV or in a hotel (Figure 46)

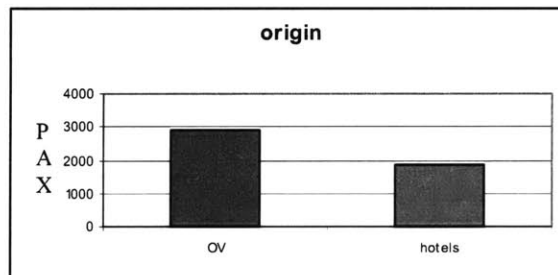


Figure 46: Origin of the OFM on the 30th of August – model results; source: the author

3. *expected flight departure time*
4. *flight number*
5. *number of Olympic Family Members on that flight*

These inputs were necessary to determine the exact departure time of each OFM from the Olympic Village. Given this **input**, the model furthermore randomly imposed small time delays on the departing aircraft, to account for the uncertainty in the transportation processes. More specifically, the passenger arrival rate was dependent upon the departing time of their airplane. The aircraft departures were deterministic. The model sorted the arriving passengers into a corresponding 5-minute interval, e.g., in the time interval of 2:20 pm-2:25 pm, 4 airplanes departed transporting 160 OFM. Nevertheless, this approach had to be slightly modified, because it predicted, that every airplane departs exactly at the time it was scheduled, which is unrealistic considering the Olympic Games passenger congestion level. Therefore, a dynamic element was incorporated into this process, reflecting the unpredictability of passenger behaviour and the possibility of aircraft delays. This dynamic element is a uniformly distributed random variable which imposed a delay on the departing aircraft ranging from five minutes to one hour.

As a simplification, the model was implemented under the assumption that travel time from the OV to EF takes 45 minutes, from the hotels to the EF 30 minutes and from the EF to the waiting lounges of the aircraft 30 minutes. Depending on their departure time, it pushes - for each queuing station - the number of passengers who could not be served in a specific 5 minute time interval to earlier time slots, by comparing for each of those time slots the incoming demand with the provided service. This service is expressed through the following two **variables** of the model:

- 1) *Number of service desks operating*
- 2) *Service times of the desks*

The service rates at each station were different, but it was assumed that all available servers for a station were parallel and identical; specifically all servers would have the same service rate for each passenger. The model now determined the departure schedules according to the flight number for the Olympic Family Members through two main actions that were introduced earlier in this section as the *backside loop* and *foreside loop*.

Finally, it shows on the output sheet a complete daily schedule, indicating when the passengers for each flight had to be dispatched from the Olympic Village or from the hotels.

5.2.3 Application and Results of the Model

In preparation for the Olympics, the model was run for each of the main departure days (30th of August till 2nd of September) assuming different staffing scenarios, in order to prepare departure schedules for the Olympic Village and hotels.

Model predictions for the main departure days

The model predicted that passengers pre-checked at the Olympic Village should leave 1½ hours before their scheduled departure time, while passengers who had to go through a complete check-in procedure had to leave 2 hours in advance. Even though this seems like a very short travel time, one has to keep in mind that the process in the Express Facility was completely separated from and independent of the large flow of regular passengers. According to the analysis, the only time period in which OFM had to be dispatched earlier than the time indicated above was during the predicted peak departure period on the 30th of August between 1pm and 2pm. Passengers scheduled to depart during this period were advised to leave their origin 2½ hours in advance. Overall, the model promised a smooth flow through the Express Facility.

During the last week of the Olympic Games, a few minor changes were made to the departure process of the Olympic Family by airport officials. For example, the decision was made, that only passengers who lived in the OV would be processed through the Express Facility. Furthermore, the assumption that only 60% of the OFM would pre-check their luggage and receive their boarding cards was revised. Based on the original departure model, these modifications could be easily implemented.

On Friday, the 27th of August, a completely new policy stated by a leading Greek official jeopardized this planning model shortly before its application. He recommended that everyone should depart from their origin at least **four hours prior to their flight departure**. This policy was dictated by the official's concern that AIA was the smallest airport that ever handled the huge peak demands of the Olympic Games and might be unable to cope with demand. Through this revised policy the officials were trying to minimize the possibility of passengers missing their flights. Nevertheless, this political decision would cause heavy congestion, because the airport could not provide enough space to hold and accommodate all waiting passengers over a four hour period. This policy decision was also made based on the assumption of heavily congested highways, missed transportation connections and delayed trains. This assumption was false, because the access to the airport was excellent. If this policy was put into practice thousands of passengers would arrive too early and cause congestion and overcrowded areas at the airport.

After further consideration, this new policy was modified: Olympic Family Members should depart their origin at least **three hours prior to their flight departure**. Even though this would relieve somewhat the pressure on the airport (compared with the 4-hour policy), it did not distinguish between the OFM who already pre-checked at the OV and those who did not. The pre-checked passengers would spend longer waiting times at the airport, even though this procedure was set in place to avoid

exactly that. In practice the consultants, responsible for the bus dispatching at the Olympic Village, followed the model's predictions by delaying the bus departures. Their judgment proved to be good, because unnecessary waiting times at the airport were avoided in this way.

In summary, the new policies adopted during the final week did not fully comply with the departure model's recommendations. However, the model did serve the purpose of warning AIA's staff about the fact that dispatching passengers too early would cause heavy congestion and supported the decision to dispatch them later.

5.3 Spacing Model

Under the new policies (dispatching the Olympic Family Members three hours in advance of their departure times and only 60% of the OFM would pre-check their luggage at the Olympic Village) the goal of the spacing model described below was to coordinate the available queuing space in front of the fourteen check-in counters in the Express Facility. Additionally, it had to determine, how to distribute the counters among the three ground handlers and various airlines.

5.3.1 Theoretical Approach to the Model

To fulfill this task, the available queuing space in the Express Facility had to be determined first and the two major travel paths for those OFM who pre-checked and those who did not had to be identified.

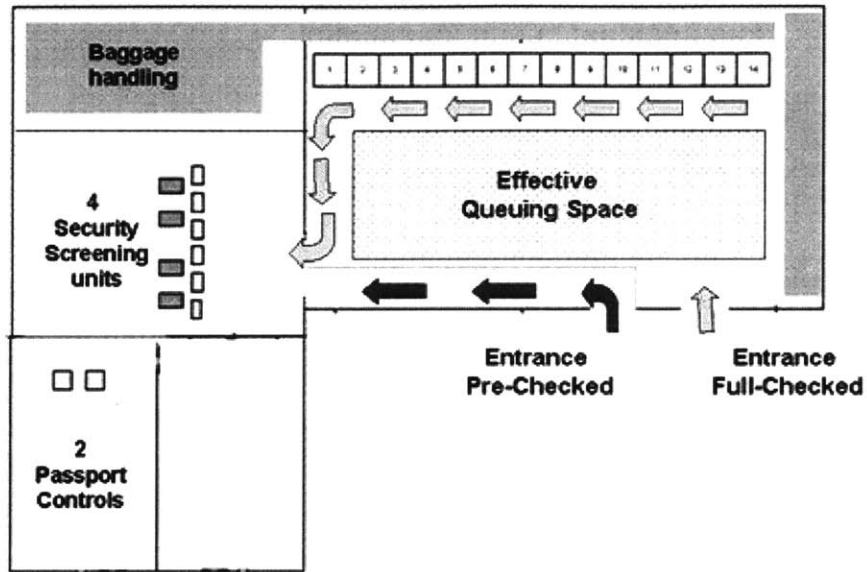


Figure 47: Effective queuing space of the Express Facility; source: the author

The dark blue arrows in Figure 47 show the travel path of the pre-checked OFM, the light blue arrows the travel paths of the full-checked OFM. The dotted area represents the available queuing space, which can accommodate approximately 120 passengers with baggage trolleys. As explained earlier, the check-in counters in the Express Facility were operated by the airlines.

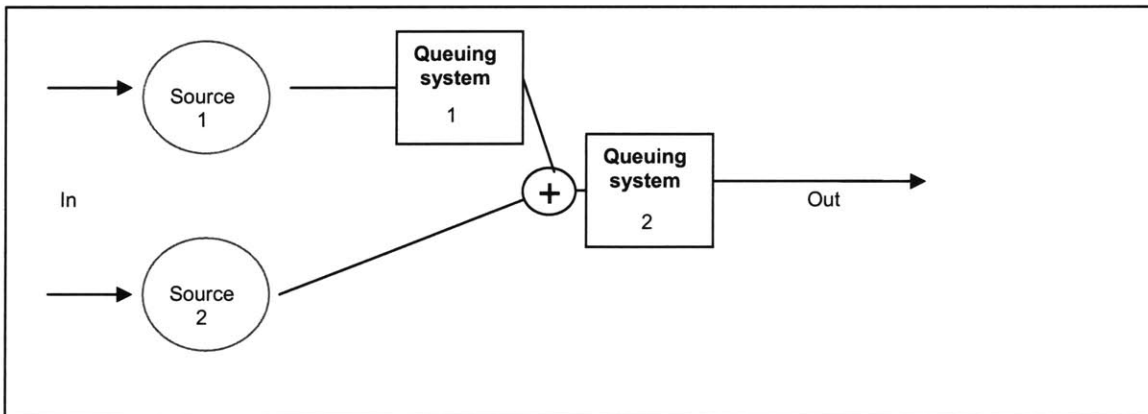


Figure 48: Relevant queuing network of the Express Facility; source: the author

Two passenger types are represented in Figure 48: those who pre-checked at the Olympic Village (Source 2) and those who did not (Source 1). Those passengers who did not pre-check-in at the Olympic village needed to check-in at the Express Facility. Regardless of the type every OFM had to pass through the security screening units (Queuing system 2, Figure 49).

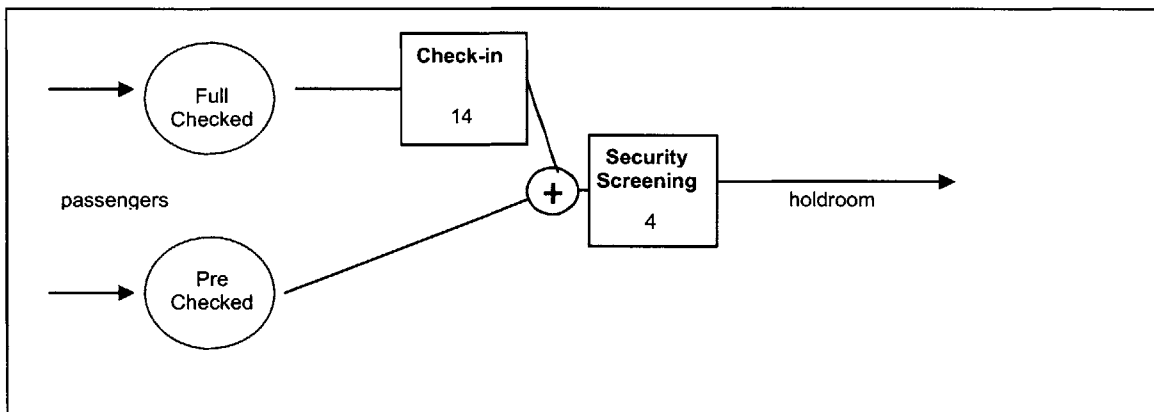


Figure 49: Queuing system in the Express Facility; source: the author

The issues the model addressed were:

- 1) How to staff the fourteen check-in counters with the handlers and airlines in a way that would optimize the trade-off between provided service and occurring demand.
- 2) How to locate the handlers at the check-in counters to ensure maximum separation between the two longest queues at any given time over the 3-day-period.
- 3) How to predict and demonstrate the queue forming processes in front of the check-in counters and the security screening points, so that necessary preparations for the incoming passengers could be taken by the Golden Ambassadors at least fifteen minutes in advance. A 24-hour schedule for these preparations was needed each day.

In conclusion, it was necessary to predict the queue forming processes in order to optimally serve the incoming Olympic Family Members and relieve congestion in the Express Facility.

5.3.2 Flow Modeling

The model using the Excel software was flexibly programmed to allocate the check-in counters among the handlers and airlines, as well as to modify the staffing of these check-in counters. Furthermore, it assigned the passengers to the appropriate handlers or airlines. As mentioned earlier, this process was necessary to predict the queue length in front of the check-in counters. The model had to forecast the time a queue would be present, the rate at which it would dissipate and the exact time it would disappear.

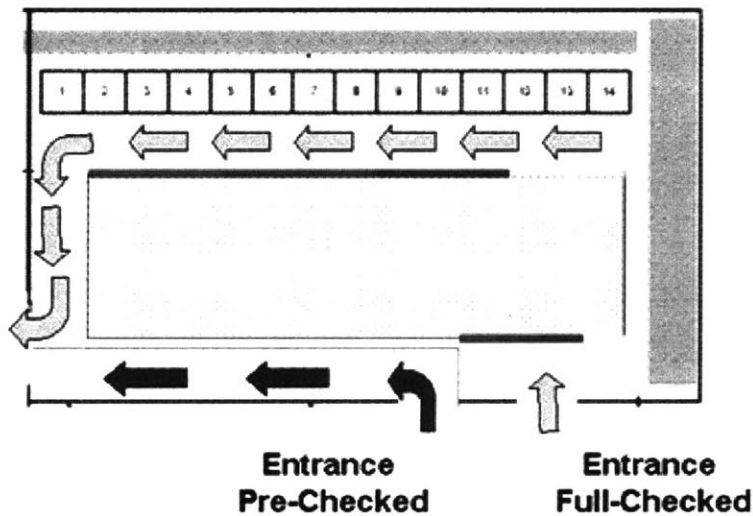


Figure 50: Queuing space in the Express Facility, source: the author

In Figure 50, the colored lines represent the entrances and exits to the queuing area. The shaded space represents the queuing space, which can be flexibly distributed among these four lanes during the 3-day period.

In preparation for the Olympics, the model was run for each of the main departure days (30th of August till 2nd of September) assuming different staffing scenarios. The results of the model suggested allocating the check-in counters for the three days as follows: Swissport counters 1-4, Goldair counters 5-8, Olympic counters 9-12 and other airline counters 13 and 14 (Figure 50). In addition, the model was applied on a day-to-day basis to distribute the queuing space among these four lanes shown in Figure 51 depending upon the predicted hourly demand for the handlers and airlines. On a daily schedule, the model showed the queue forming process with the total number of passengers in each queue.

Swissport	Lane I
Goldair	Lane II
Olympic	Lane III
Aegean	Lane IV
Alitalia	Lane IV

Figure 51: Lane distribution in the Express Facility; source: the author

To predict these processes, the model had to identify the handlers or airlines for specific flights. This distinction enabled the Golden Ambassadors to prepare the queuing space and to direct the arriving passengers to their check-in lanes. The model needed the following inputs to fulfill its tasks:

1. handler or airline responsible for the specific flight
2. indication of whether the passengers for that flight were pre-checked (Figure 52)

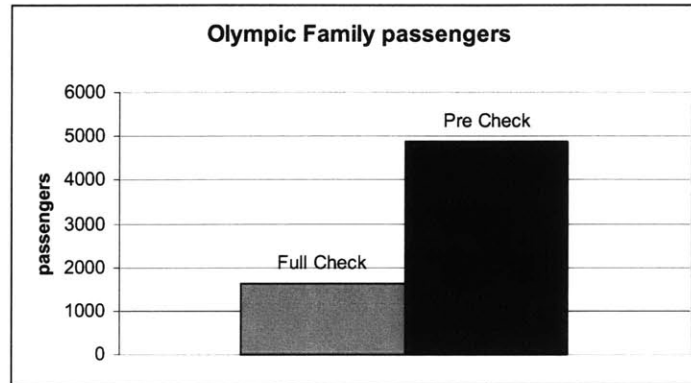


Figure 52: Pre-check vs. full-check; source: the author

3. expected departure time from the Olympic Village

Given this **input**, the model furthermore randomly imposed time delays on the departing aircraft to account for the uncertainty in the ground transportation processes from the OV to the EF as explained in section 5.2.2.

After imposing delays on the arriving passengers, the model analyzed the passenger demand at the queuing stations, the check-in counters and the security screening station, during 5-minute intervals. It compared this demand with the provided service. The service is expressed through the following three **variables** of the model:

- 1) Number of service desks operating
- 2) Service times at the desks
- 3) Maximum queue space available for each lane

This procedure is explained in more detail in section 5.2.2. By comparing the demand with the service the model predicted the queue length and approximate waiting times at any given time of the day. It determined, whether there will be a queue (demand is higher than the service) and if so, it calculated the number of people in it, estimated the expected time a queue will be present at that station and drew cumulative diagrams (please refer to section 2.3.) for each lane. With these results, it was possible to adjust the queuing space for the lanes throughout the entire day.

In an overview of all lanes (as an example please see Figure 53) the outputs of the model summarize and show the queue forming process. They indicate the times, when the queue exceeds the maximum queue space available for each lane.

5.3.3 Application and Results of the Model

The model was applied on a day to day basis. It served as a planning tool to staff the desks in the Express Facility and served during the three major departure days as a guideline for the Golden Ambassadors to modify the queuing space in front of the Check-in counters in the Express Facility.

Model predictions for the main departure days

The model predicted the queues for each day accurately as was proved during the Olympic departure days.

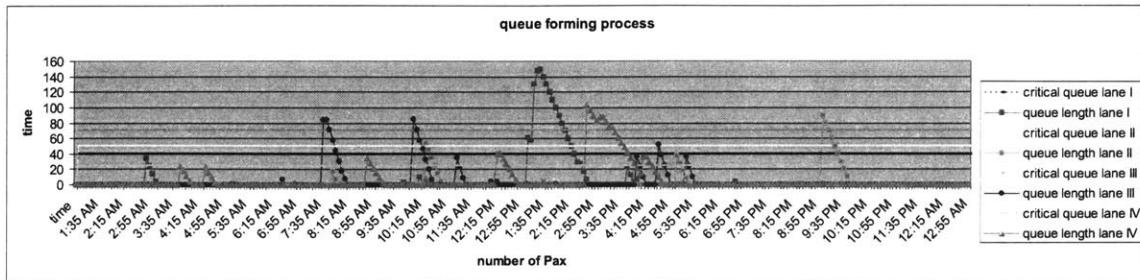


Figure 53: Lane-specific predicted queue forming process for the 30th of August; source: the author

Figure 53 shows the predicted queue forming process over a 24-hour period. The horizontal lines indicate the maximum queuing space available for the corresponding lane. The jumps indicate a forecasted arrival wave of OFM at the Express Facility. Whenever the queue was predicted to exceed the capacity of the queuing space available during that time, the Golden Ambassadors and consultants at the Olympic Village were to be advised to delay bus departures from the OV. One has to keep in mind, that during the summer months in Athens, it would have been a burden to wait outside of the Express Facility. Whenever the model predicted a fast increase of queue, the Golden Ambassadors were advised to prepare the queuing space in the Express Facility. As a further contingency, the OFM could wait in the busses in front of the Express Facility. In Figure 53, the total predicted passenger volume and their distribution over time during the 30th of August can be seen.

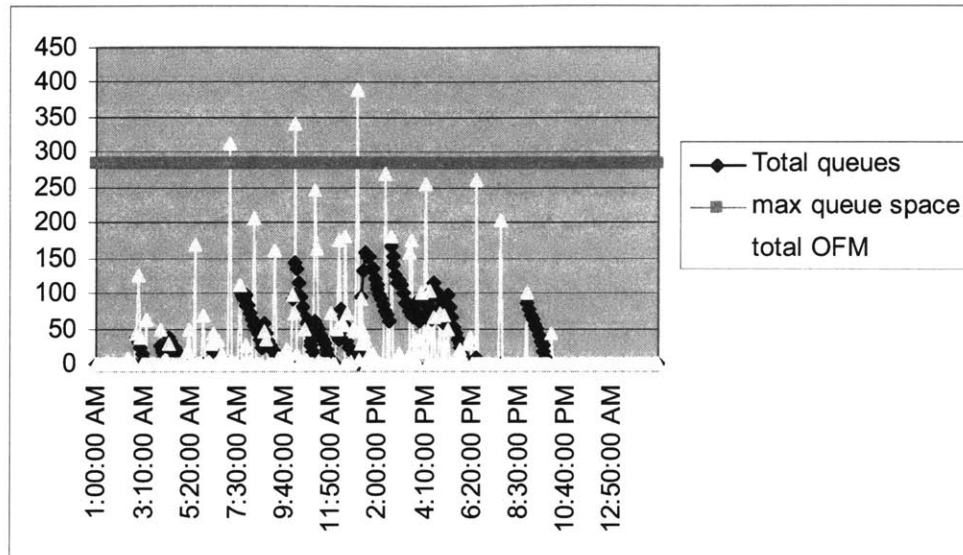


Figure 54: Overall predicted queue forming process for the 30th of August; source: the author

In Figure 54, the horizontal line indicates the total queuing space available in the Express Facility. The yellow peaks indicate the total number of passengers scheduled to depart from the Olympic Village at any specific time. The blue queue forming lines represent the accumulated queue forming processes in the Express Facility.

Peak departure days

The task to provide excellent service to OFM required detailed planning, high-level coordination and frequent communication among five parties: the airlines, the three Ground Handlers, customs, the police and Passenger Terminal Services (Golden Ambassadors). While the Ground Handlers and the airlines were responsible to check-in the OFM, the police and customs conducted passport control and randomly checked bags for weapons. The Golden Ambassadors were responsible for assisting the arriving passengers and directing the flow through the Express Facility.

In conclusion, the model identified the peak period on Monday, 30th of August between 1pm and 2pm correctly and gave accurate overviews of the occurring queue forming processes. During the departure days it served as a tool to arrange the queuing space in the Express Facility. In total, 60,800 OFM including athletes, their family and team officials departed through the Express Facility within three days. During the 3 days of operations, frequent real time changes had to be applied to the model and implemented immediately. For example, some busses that were not officially scheduled to leave from the Olympic Village, showed up at the Express Facility unscheduled. It was essential to enter these changes immediately into the model, to accurately prepare the queue space for the rest of the day. During these procedures, frequent communication was essential to provide a smooth transportation flow through the Express Facility.

The Express Facility is a perfect example where “cost of failure” far outweighs any out-of-pocket costs. It essentially relieved congestion at the MTB and offered a very secure transportation possibility for the OFM. For future planning efforts, this model should be considered, because it brought not only advantages to the airport but also to the OFM. For these passengers the processing time through the Express Facility never exceeded 30 minutes. OFM who had to conduct the full check-in procedure spent about one hour in the Express Facility. In very rare cases, whenever the responsible airlines showed up late at the Express Facility, this waiting time exceeded 1½ hours. In conclusion, IOC and NOC should encourage OFM to pre-check their luggage and pick up their boarding cards at the Olympic Village before their flight departure.

Chapter VI: Conclusions

In this final chapter some overall conclusions are summarized concerning the preparations for and airport operations during the Olympic Games. Overall, Athens International Airport (AIA) handled the passenger volume successfully. The lessons learned during this process will also be discussed in this chapter. Finally, a brief look ahead towards possible applications to the next Olympic Games in Beijing (2008) is presented.

6.1 Athens 2004

Athens International Airport was well prepared for the Olympic Games. The airport, which is by nature subject to detailed planning procedures and strict operations, made a major planning effort for the Olympic Games. Because of the heavy traffic loads during the Games, any incident, as insignificant as it might be, could have caused a chain reaction if the airport did not respond immediately. The airport designed all operations and procedures to comply with the highest security standards as suggested by IOC. Eventually it achieved its objective, as stated in the first section: “to provide the best possible service” to all passengers.

6.1.1 Athens Evaluation

The airport managed to handle the large peak demands, probably because it had planned for a “worst-case scenario” - the assumption of the highest possible passenger volume. During the Olympic Games, it turned out that the passenger traffic fell short of these expectations with the exception of three days, the three main departure days. Even though fewer passengers than expected traveled through the new Athens airport during the Olympic Games period, these three days were the benchmark the airport had planned for. Failure to provide excellent service

or a lapse in the coordination of procedures would have led to a deterioration of operating conditions during these days.

The planning process was dominated by extremely risk-averse decision-makers. On the one hand, this attitude is desirable for such events; on the other hand, it tends to resist new procedural opportunities. Therefore, it proved helpful to involve several parties outside of AIA and ATHOC, such as consultants or external transportation experts. Overall, the highly advanced and carefully coordinated planning effort worked. Given that security issues dominated the Olympic Games period, this extraordinary effort was necessary for the airport's success.

The successful operation of Athens International Airport was recognized throughout the world. AIA received many compliments from the media, IOC, ATHOC, Olympic Family Members, and the general public. For the airport, this operation meant a tremendous growth of staff experience and built a closer airport community.

The preparation of the airport to operate as an Olympic Venue proved to be a challenging project for all involved parties. This process required a well coordinated and meticulously planned effort from the earliest planning stages on. The unobtrusive yet secure accreditation procedure and distinct transportation conducted at the airport upon arrival, was praised by the OFM. The departure process was even more successful. It received rave reviews because of its high security standards and convenience.

The innovative idea to separate the passenger flows of the Olympic Family from the general public and to use the Express Facility as a separate terminal worked well and should be considered as a model in the future. Besides providing the highest protection level possible, it also significantly relieved congestion at the MTB.

Especially during the main departure days, it relieved the pressure on the baggage handling system.

In conclusion, AIA succeeded impressively in welcoming and bidding farewell to all passengers.

6.1.2 Lessons learned

What are the lessons of Athens 2004 for future airport planners?

1. For an Olympic Airport it is essential to lay value on a continuous, effective, consultative, and open planning process. “Continuous”, in the sense, that an airport should start planning for the Olympic Games as soon as its city is selected as the host. “Effective” refers to the principle AIA used in managing the passenger flows: “push in and push out.” “Consultative” describes the close involvement of transportation experts from outside AIA and ATHOC. And finally, “open” means that frequent communication from the very beginning among the management and the staff is essential for successful operations.
2. A high level of coordination and motivation of the staff in preparation for the Olympics is needed. As mentioned before, the communication efforts have to be made a priority by the management. This guideline furthermore incorporates the deeper intention of the communication efforts: understanding and motivation. The CEO scheduled personal meetings with individual staff members, was open to every suggestion, and frequently rewarded great ideas. This behavior boosted the motivation of every person.
3. The cost of failure would be much higher than any other expenditure and therefore spending on objectives should be unstinting. The Express Facility can serve as a typical example. Even though this building, prepared at a cost

of 7 million Euros, was used intensively for only 3 days, it significantly improved the security of the Olympic Family and the public.

4. Large investments in time and money devoted to thinking through as many planning scenarios as possible are essential. This extensive advance planning also requires a thorough accuracy check of available information.
5. Effective stakeholder communication is essential to the Games' success. The communication not only with AIA's employees, but also with their stakeholders, uncovered several hidden planning problems and led to successful solutions during the Games.
6. A central authority that coordinates and controls the operations during the Games is indispensable. Especially in case of emergencies a clear command chain is needed.
7. Even though the operational planning seems to be perfectly in place, one has to keep in mind that last-minute political decisions can jeopardize these plans and require flexible adjustments.

6.1.3 Outlook for Beijing

The experience gained at Athens Airport during the Olympic Games can influence and aid the Beijing preparations. The good news is that the lessons learned will be of great value to the Organizing Committee at the airport. The bad news is obvious. As explained in the introduction, one of the greatest challenges of the Games is their uniqueness; everything done has to be tailored to the country's specific characteristics. China is a country with great population density and thus it is to be expected that the participation at the coming Games will be tremendous. Furthermore, this event will give a reason to many international travelers to visit a new country and culture.

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