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Airbus A320/321 Quick Change Market Analysis - A Case Study

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AIRBUS A320/321 QUICK CHANGE MARKET ANALYSIS

- A CASE STUDY

by

Till Christian Mommsen

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This thesis was prepared under the direction of the candidate's thesis committee chairman, Professor Boris Trnavskis, Aviation Business Administration Department, and has been approved by the members of his thesis committee. It was submitted to the Office of Graduate Programs and was accepted in partial fulfillment of the requirements for the degree of Master of Business Administration in Aviation.

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ABSTRACT

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The purpose of this thesis is to evaluate and compare the Boeing B737 QC to the Airbus A320/321 QC aircraft, and to determine their relative market within a sample airline. The technical design of the two Airbus aircraft in a mixed QC operation were considered with respect to the requirements of a particular airline. Direct operating costs and payload range data for all three aircraft were calculated.

To evaluate the competitiveness of the A320/321 QC under actual conditions, a linear programming fleet planning model was developed that considers more than the direct operating costs of a particular aircraft. The cost components included were direct operating costs, costs of insufficient capacity, additional costs of daytime operation, capital costs of the conversion, costs of positioning flights at low load factors, conversion station costs, costs of ferry flights, and costs of idle aircraft.

The model was then applied to an actual network and potential new routes. The results are presented and analyzed. The outcome is considered the potential market for A320/321 QC aircraft within the hypothetical airline used in the study.

TABLE OF CONTENTS

TABLE OF CONTENTS - CONTINUED

TABLE OF CONTENTS - CONTINUED

LIST OF ABBREVIATIONS

CLS:	Cargo Loading System
DOC:	Direct operating costs
MCD:	Main Cargo door
MEW:	Manufacturers Empty Weight
MLW/MLAW:	Maximum Landing Weight
MTOW:	Maximum Takeoff Weight
MTXW:	Maximum Taxi Weight
MZFW:	Maximum Zero Fuel Weight
OEW:	Operating Empty Weight
SKO:	Seat-kilometer offered
TKO:	Ton-kilometer offered
USD:	US Dollars

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

The quick change (QC) aircraft concept was originally developed by the Boeing Company in the early 1970's. The "quick change aircraft" is a rebuilt passenger aircraft. Within about 45 minutes, it can be converted from an all passenger aircraft with only belly cargo space, to an all cargo aircraft with no passenger seats available and the possibility of main deck container loading.

To date, only the B737 and B727 can be rebuilt to QC versions. Airbus Industrie, however, is developing a QC version of its Airbus A320 and A321 aircraft. Now, airlines that wish to convert some of their passenger aircraft will have a choice between Airbus and Boeing QC products. Therefore, it is interesting to compare the B737 QC to the A320/321 QC and to determine the market of the A320/321 QC for a sample airline.

A-Air[1] is presently operating the B737 QC and is planning to expand QC operations. This may include a substitution of wide-body aircraft on night mail routes by QC aircraft. The present cargo/mail traffic volumes on some wide-body routes exceed the capacity of the B737 QC aircraft and would require parallel operation of two or more aircraft. Converting some of the A320/321 passenger aircraft to QC versions may be advantageous for the airline, because the A320/321 QC has a higher capacity than the B737 QC.

[1] A-Air is a hypothetical airline modeled on a major European airline.

1.1 Problem Statement

This thesis examines the technical feasibility and market for the Airbus A320/321 Quick Change aircraft compared to the Boeing B737 QC aircraft in the present and planned European cargo and night-mail network of A-Air. A time horizon of twelve years starting from 1994 has been used.

The analysis involves assessing the economic feasibility which is defined as the degree to which converting and operating A320/321 aircraft would produce cost savings compared to converting and operating B737 aircraft. The economic feasibility considers the costs of the conversion but does not include an analysis of financing alternatives. Technical feasibility involves an analysis of whether a converted A320/312 will better meet A-Air's cargo/mail requirements and a brief evaluation of a A320/321 QC operation.

European cargo and night-mail network is defined as all flight itineraries for which A-Air schedules narrow body cargo aircraft (quick change or cargo aircraft), as well as positioning flights with passengers on board. This also includes destinations outside Europe, if a narrow body aircraft is scheduled. .

1.2 Literature Review

1.3.1. The Airbus A320/321 QC

Literature about the planned A320/321 QC is limited to technical material. In 1993, Moss conducted initial research concerning an A320/321 QC.[2] In this study, he investigated broad benchmarks and requirements for a freighter and quick change aircraft. Without detailed technical solutions, a broad aircraft definition was proposed and presented.

In November 1993, Borchard further investigated an A320/321 conversion.[3] He calculated the optimum load density and maximum payload for both versions. Further, he determined and compared payload range diagrams for the B737-200 QC and the B757 package freighter, and the center of gravity movements during loading and unloading for a front and aft main cargo door position. Those calculations, however, were only of limited value to the current study. First, the calculations are based on weight estimates that were unrealistically low and on parameters that were not necessarily true for A-Air (e.g. MTOW). Therefore, the maximum payload might have been too optimistic. Second, the B737-200 aircraft is not the main competitor of the A320/321. The newer B737-300

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[2] Hermann Moos, "Zukünftige Einsatzbedingungen und Anforderungen an ein Airbus A320/321 Frachtflugzeug in der Serien- und Umrüstlösung," (Future conditions and requirements to an Airbus A320/321 freighter as a series and conversion aircraft), Diplomarbeit FH Würzburg September 1993.

[3] Walter Borchard, **A320 Feasibility Study,** Deutsche Aerospace Airbus, February 1994.

series should be considered. Third, no direct operating cost comparisons were included in the study.

In February and March 1994, Kwik and Sprenger prepared another study on the A320 QC which was mainly concerned with the cabin layout, the cargo loading system, and the required R&D effort needed for the cabin design.[4] Although the basic seat configuration of A-Air was used as a base, the study noted that the A320/321 QC had to be redesigned to make it competitive with the B737 QC. First, they modified the design to include a crash net to comply with safety regulations. This net, however, would cost a container position and leave the A320 QC with the same container capacity as the B737 QC. Therefore, a 9-g system comparable to the B737 QC system had to be implemented. Second, the height of the loading system was unacceptably high and led to an aisle width reduction of 3.6 inches which may cause passenger service problems. Third, only the A320 but not the A321 was considered in the study. Finally, some details such as seat pallet size, ramp design, and galley/lavatory configuration had to be modified.

1.2.1 The Boeing B737 QC

Literature pertaining the B737 QC was mainly supplied by A-Air. Since this thesis compares the two aircraft types, the appropriate parts of the B737 literature will be presented in the main body of the thesis. Basic economic data associated with the B737

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[4] Wilfried Sprenger and Karl Kwik, **A320 QC Cabin Layout,** Deutsche Aerospace, March 1994.

QC were taken from a study the airline prepared before acquiring the aircraft. Technical material was provided by the engineering department.

The Boeing aircraft as used by the airline were converted by Pemco Aeroplex Inc., a major supplier of cargo conversion kits. The basic aircraft considered in this analysis is the B737-300 with CFM 56 engines.

In 1965, Hiat and Plewes[5] studied potential advantages of the B737 QC and B727 QC. They mentioned the advantage of lower capital costs associated with higher aircraft utilization as one major advantage of the QC concept. The study predicts a high demand for QC aircraft, however, without showing any supporting quantitative analysis.

1.2.2 Fleet Planning Models

In the past, several mathematical models have been used to solve aircraft fleet planning problems. In 1983, Hammer[6] researched the aircraft acquisition practices of five U.S. national carriers and found as one major conclusion that these airlines do not necessarily make full use of fleet planning models during the acquisition process. Models are available and could significantly improve planning results.

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[5] M.A. Hiatt and K.C. Plewes, **The Quick-Change Convertible Cargo-Passenger Aircraft Will Aid Air Freight Development in the Next Decade,** (Seattle: Boeing Co., 1965. Document Number 650782).

[6] Robert H. Hammer, "Fleet and Airplane Acquisition Planning of Regional Airlines" (M.S. Thesis, Massachusetts Institute of Technology, 1983).

Manheim[7] gives a detailed overview of different aspects of transportation system analysis. Although he does not present a comprehensive fleet planning model, he analyzes the fundamental components and concepts to develop such models. Furthermore, he is not aviation specific but considers other transportation modes. His approach in analyzing costs of a system may be helpful in the context of aircraft comparison (A 320 QC vs. B737 QC).

To date, many different fleet planning models have been developed. Simple models may consider only one period and portray reality in simplified terms. Kirby[8] and Wyatt[9], for example, assumed a single type fleet with known demand and the constraint that all demand must be met either with the fleet vehicles or by outside hire. Other early models use linear programming algorithms to optimize fleet planning[10]. These early efforts, however, are of limited use since the lack of computer resources forced them to rely mainly upon manual computations.

In 1960, Boeing developed a freighter network analysis model.[11] This model incorporates both linear programming and heuristic algorithms. Profit maximization is

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[7] Marvin L. Manheim, **Fundamentals of Transportation Systems Analysis. Volume 1: Basic Concepts**, MIT Press Series in Transportation Studies, ed. Marvin L. Manheim, (Cambridge: The MIT Press, 1979). Especially chapters 6, 9, 13, 16.

[8] D. Kirby, "Is Your Fleet the Right Size?", **Operations Research Quarterly** 10 (1959): 252; quoted in Christopher Colin New. "Transport Fleet Planning For Multi-Period Operations," **Operations Research Quarterly** 26 (1975): 153.

[9] J. K. Wyatt, "Optimal Fleet Size", **Operations Research Quarterly** 12 (1961): 186; quoted in Christopher Colin New. "Transport Fleet Planning For Multi-Period Operations," **Operations Research Quarterly** 26 (1975): 153.

[10] AR Ferguson and GB Dantzig, "The Allocation of Aircraft to Routes-an Example of Linear Programming under Uncertain Demand," **Management Science** 3 (1956): 45-73.

the objective function of the model. It allows performing sensitivity analysis if input variables are changed.

Schick and Stroup[12] use a computer supported model developed by the Douglas Aircraft Company[13] in 1975. This multi-period model is designed to minimize costs expressed either as direct operating costs, capital costs, or a combination of these. The fleet mix is determined by several computer supported steps with a human analyst involved in each step. Carriage of passengers and cargo is considered in the model.

New[14] presented a cost minimizing fleet planning model in 1975. It is based on the assumption that cost minimization is the only true objective for fleet planning since price setting is considered beyond the control of a particular airline. This model is designed to accommodate passenger-carrying airlines only. Additionally, it takes the resale value of an aircraft into account and assumes some fixed costs with introducing a new aircraft type at an airline. All variables are considered to be time dependent.

In 1984, Silva[15] presented a fleet planning model from the manufacturer's viewpoint. He does not detail all the variables affecting fleet planning but looks at a complete route system served by several airlines. Similar routes are classified into a

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[11] James C. Goodboy and James G. Gilbertson, **Freighter Network Analysis Model,** (Seattle: Boeing Co., 1960)

[12] GJ Schick and JW Stroup, "Experience with a Multi-Year Fleet Planning Model", **The International Journal of Management Science** 9 (1981): 389-96.

[13] DP Shube and JW Stroup, **Fleet Planning Model,** (Sacramento: Douglas Aircraft Company, 1975), Paper 6440.

[14] Christopher Colin New, "Transport Fleet Planning For Multi-Period Operations", **Operational Research Quarterly** 26 (1975): 151-166.

[15] Armando C. Silva, **Cell Fleet Planning: An Industry Case Study,** (Cambridge: Massachusetts Institute of Technology, Department of Aeronautics and Astronautics, Flight Transportation Laboratory, May 1984), FTL Report R84-4.

certain number of cells which reduce the complexity of the model. These cells share common characteristics such as stage length and passenger volume. He uses his fleet planning model to forecast demand for new aircraft - not only for one airline, but for a whole aircraft market.

In 1989, Abara[16] developed a model for American Airlines using linear programming algorithms. He included optimization of fleet utilization as one important objective function.

Lockheed Co. takes a more macroscopic view by analyzing total cargo systems.[17] Certain aspects such as identification of major cost elements were helpful to identify major variables in the fleet planning model under study.

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[16] Jeph Abara, "Applying Integer Linear Programming to the Fleet Assignment Problem", **Interfaces** 19 (July/August 1989): 20-28.

[17] R.B. Ormsby, **Development of Total Airline Profit Model Program to Permit Simulation and Evaluation of Total Air Cargo System,** (Georgia: Lockheed-Georgia Co., 1969), SAE TRANS 690413.

2 RESEARCH METHOD

A two step analysis was employed to determine the market for A320/321 QC aircraft within A-Air and evaluate the competitiveness of the Airbus aircraft compared to the B737 QC. In the first step (chapters 3-5) the characteristics of the new aircraft types were analyzed and compared to the existing B737 QC. This refers to a technical, operational, and economical comparison of the three aircraft types.

In the second step (chapters 6-8), results from the first step and airline data were used to simulate the impact of the availability of three aircraft types in the network on the minimum cost fleet mix. This was accomplished by formulating and solving a linear programming fleet planning model. The two steps are further explained in the two sections below.

2.1 Aircraft Comparison and Evaluation

Initially, the technical differences between the three aircraft were outlined. This was accomplished by comparing technical papers and documents obtained from the airlines and airframe manufacturers and discussing the technical layout with Airbus and airline engineers. Since the technical layout of the two Airbus aircraft was still in the preplanning phase, the layout of the Airbus aircraft was adapted to the specific requirements of A-Air to the maximum possible extent. An inductive approach was used with the purpose of identifying and quantifying technical benchmarks of the Airbus aircraft that will determine their operational characteristics and economic performance.

Operational characteristics of a mixed QC operation were analyzed by participating in a B737 QC rotation; interviewing station personnel and network managers; and presenting them information about the A320/321 QC in the form of technical drawings and data. The Airbus layout and its technical design were discussed with respect to the characteristics of the daily operation within A-Air. This procedure identified the aspects of a mixed QC operation which might be different from a single type operation.

The economic comparison was performed independent of the route structure but employed a standard method of aircraft cost comparison. Three configurations for each of the three aircraft (B737, A320, A321) were compared: the aircraft as a normal passenger aircraft, as a quick change aircraft in passenger configuration, and as a quick change aircraft in cargo configuration. The method used for economic analysis consists of three steps. Initially, the operating empty weight (OEW) of the aircraft, the structural weight limitations, and the aircraft configuration was specified referring to the technical specification. In the second step, payload range data were calculated. The performance information of step two was then combined with analytical (e.g. fuel) and empirical (e.g. handling fees) cost data from an A-Air DOC-calculation software to determine costs per seat-km (SKO) or ton-km (TKO) for an aircraft that is operated at full payload over a 500

NM segment at standard conditions[18] and at a standard utilization. Cost reductions such as reduced capital costs due to higher utilization were not considered.

2.2 Fleet Planning

To determine the optimum fleet mix and thus the potential market for A320/321 QC aircraft, a linear programming model (LP) was formulated and applied to a QC network using network cost minimization as the objective function. The major cost components, for different mixes of aircraft types, for each leg of the network were identified and quantified. Development of these cost components over time was then forecast using assumed growth rates for the input parameters that determine these costs. Rates and parameters were taken from the results of chapter 5, supplied by the airline, or estimated.

The LP was designed so that it draws up an aircraft rotation schedule with a suggested fleet mix, for each year of the planning horizon. The schedule complies with aircraft scheduling constraints which are imposed by general aircraft scheduling and QC specific requirements. Optionally, initial stock of a specific aircraft type, and aircraft acquisition and selling practices, could be included to further constrain aircraft availability.

[18] ISA atmosphere, 150 NM alternate, 30 min. holding, 5% contingency fuel.

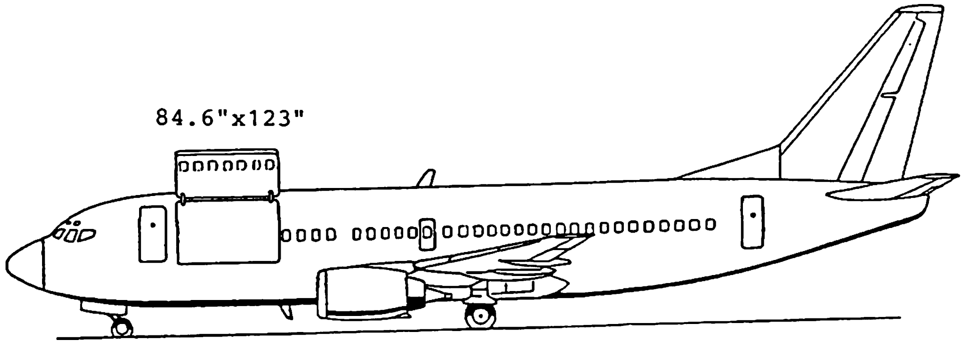
The LP model was then developed and processed using SAS/OR software. The solution to the LP was critically evaluated and the results were considered the potential market for A320/321 QC aircraft within the airline.

3 TECHNICAL EVALUATION OF THE A320/321 QC AND COMPARISON TO THE B737 QC

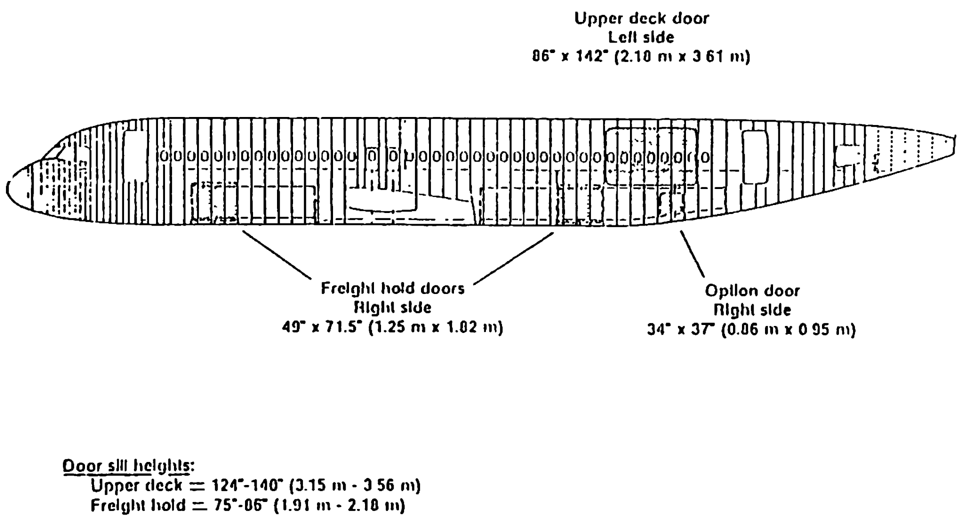
3.1 The Main Cargo Door

All aircraft are equipped with a cargo door for main deck container loading. The door of the B737 QC is located in the front section of the fuselage, whereas the A320/321 QC will have the door in the aft section. Figure 1 shows the location of the cargo doors. The A320/321 QC main cargo door (MCD) will have a dimension of 86"x142" compared to 84.6" x 123" for the B737 QC. The larger cargo door gives more flexibility in sizing the seat pallets. It will be possible to design the seat pallets with four instead of three rows per pallet. This reduces the problem of loose carpet borders at the pallet edges, because the number of pallets is reduced by one compared to the B737 QC. The seat pallets will be further discussed in section 3.3. Also, larger seat pallets reduce the conversion time because the ground crew has fewer bolts to unscrew.

In the B737 QC there is no choice of cargo door locations because the aircraft is only available with a front cargo door. Also, an aft door location would not be possible, because the fuselage is too short and the loading equipment would interfere with the wing tips. The Airbus aircraft have different fuselage dimensions and are still in the design phase. Therefore, the cargo door location can still be changed. Advantages and



B737 QC



A320 QC

Figure 1 Location and size of the main cargo door.
Source: B737 QC: A-Air, 1991. A320 QC: Deutsche Aerospace Airbus, March 1994.

disadvantages of the different door locations for the Airbus aircraft are summarized in Table 1

From a Deutsche Aerospace Airbus (who will be responsible for the QC retrofit) design standpoint, a front door location is disadvantageous. Each of the main fuselage sections is designed and completed by the respective manufacturer before they are joined together in the final assembly line. If design changes (such as a cargo door) on aircraft sections are needed after an aircraft has been completed (e.g. a QC retrofit), each company involved in manufacturing the affected section has to be involved in the design change. The front door would be partially located in the fuselage section that is manufactured by Aerospatial (AS). Therefore, AS would have to be included in all steps of the design such as door design, relocation of affected aircraft systems (wiring, etc.), production process planning, time planning and cost planning. This additional coordination effort could be avoided if the door is located in the aft, because in this case it would be located completely in the Deutsche Aerospace Airbus section. However, if the door is located in the aft, it will be partially located in the noncylindric section of the fuselage. This will make the door design more complicated plus the aft door location makes the relocation of affected aircraft systems more difficult (e.g. hydraulic lines). Also, the aft fuselage encounters higher aerodynamical and structural forces which makes the door about 100-200 kg heavier and the design more expensive.

The B737 QC does not have these problems, because the retrofit is performed by a single company (Pemco) which is licensed by Boeing and has sole responsibility for the

Table 1. --A320/321 QC Advantages and Disadvantages of Different Main Cargo Door Locations.

Criteria	Front Location Advantage	Front Location Disadvantage	Aft Location Advantage	Aft Location Disadvantage
Technical:				
Design		Door partially located in Aerospatial (AS) sections; therefore additional coordination required with AS. Door and frame in two main fuselage sections.	Door located completely in the Deutsche Aerospace section.	Door partially located in the noncylindric section.
Load on structure	Located in an area of little mechanical stress.			Located in an area of high mechanical stress; therefore heavier and more expensive.
Impact on aircraft systems		Coordination with AS necessary		Relocation of systems difficult
Operational				
Center of gravity considerations during loading/ unloading		Insufficient load on the front wheel; tail support may be required.	No threat of tail skipping.	
Accessibility		Threat of engine damage due to little spacing between loader and engine		Loading of seat pallets into seat van may be difficult depending upon van layout.
Passenger comfort		More air noise	First/Business class not in the door area.	
Weight and balance			Center of gravity within take-off limits for an empty aircraft (A321).	
Cabin configuration		Combi layout difficult.		
Economy				
Weight				100-200 kg additional weight.
Aerodynamics		Higher drag.	Backward CG location reduces fuel consumption.	

Source: Deutsche Aerospace Airbus, HAM TK 131-077/94, Feb. 2, 1994, edited and translated by the author.

conversion. Also, the aircraft is not composed of sections that were designed, completed and equipped, with all aircraft systems beforehand, by independent companies as it is the case with Airbus.

From an operational standpoint, the aft location is preferred. First, the center of gravity will not be within take-off limits if the door is located in the front. That means on ferry flights, weight would be required. Second, during loading and unloading only an aft location will provide sufficient load on the front wheel, which is especially critical for the longer A321 QC. This assumes a standard loading procedure where each container is moved to the frontmost position before the next container is loaded into the aircraft (further discussed in section 4.2). The B737 QC has no threat of tail skipping due to the different fuselage size. Third, the threat of engine damage during loading and unloading is reduced with an aft door location, because the loader does not have to move in front of the engine inlets. Interference with the wing tips is not critical.

A major problem associated with any cargo door is the aversion of passengers to sit next to it. In case the door is located in the front (as is in case of the B737 QC) mainly first and business class passengers are sitting next to it. This can be avoided if the door is moved to the back which would also reduce the air noise caused by the door. Additionally, an aft door would offer the prospect of offering the A320/321 as a combi aircraft comparable to the principle of the B747 combi. With a front door, a combi operation will not be possible.[19]

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[19] Although technically possible, the required cabin layout for combi operation with a front door location is not accepted by A-Air.

From an economic standpoint, the higher weight of the aft door will increase the fuel consumption and make the aircraft less fuel efficient as it could be. This effect, however, will be partially offset because a more aft location of the center of gravity (weight of the door in the back) is aerodynamically advantageous (lower angle of attack; less downdraft required by the stabilizer to control stability of the aircraft) and the additional aerodynamical drag caused by the door will be lower.

So far, from the perspective of A-Air and Airbus, an aft door location is preferable and its advantages outweigh the disadvantages. Therefore, an aft cargo door location as shown in Figure 1 represents the current planning status (the A321 QC will have a similar door configuration to the A320 QC).

The MCD of the B737 QC is powered by a hydraulic system. Problems associated with occasional fluid leaks causing cabin and passenger soiling led to a retrofit with an electromechanical system. The A320/321 QC will have a comparable system.

3.2 The Main Deck Cargo Loading System

Airbus will offer several options for a cargo loading system (CLS) that will be comparable to the 9-g[20] system currently installed in the B737 QC. Customers will have a choice between 1¼", 1¾", and 2" system height above the seat rails. Currently, the B737 QC system has a height of 1¾". Therefore, the Airbus aircraft offer the option of a ½" system height reduction. The seat pallets add an additional 1" height similar to the

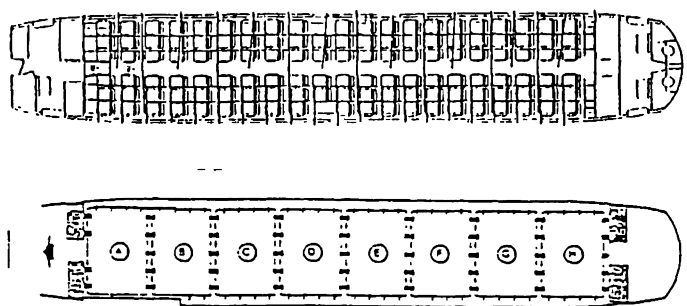
[20] "9-g" refers to the requirement that a CLS has to withstand horizontal forward accelerations of 9 g if no crash net is installed.

B737 QC. Single and double row CLSs will be available. The double row system is necessary for night mail operation. If desired, power drive units can be installed in the cabin. However, they will add additional weight to the conversion with marginal benefit. The B737 QC was initially equipped with electrical systems. They proved to be very delicate and failed several times causing the electrical drive to block the rolls and making manual loading almost impossible.

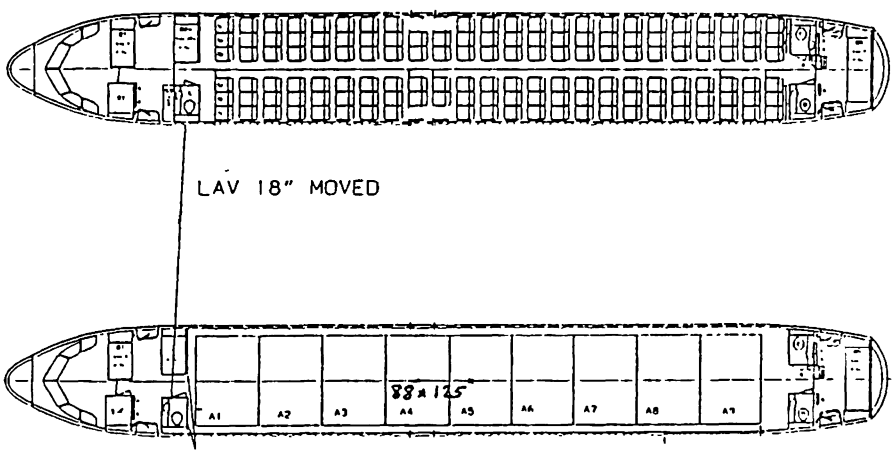
To avoid the disadvantages of the higher cabin floor, Airbus is presently reviewing the possibility of integrating the CLS into the seat rails. This would reduce the system height (including seat pallet height) to 1¼" and significantly reduce the slope of the ramp in the cabin. If this reduced height system can not be installed, there will be no significant difference between the systems of the Boeing and Airbus aircraft.

3.3 The Cabin Configuration

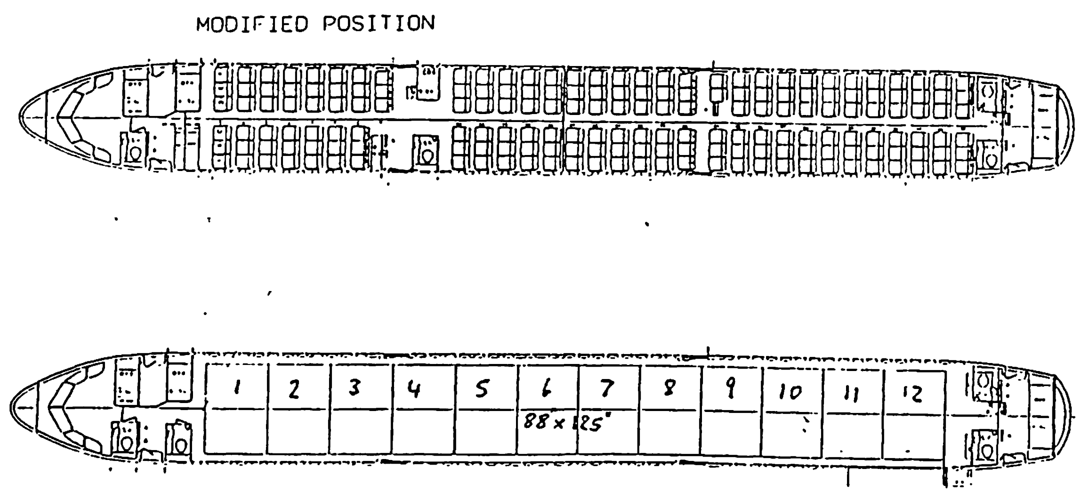
The cabin layouts of the aircraft under study are shown in Figure 2. Due to the increased floor height, the seats next to the overwing emergency exits have to be removed. This reduces the seating capacity by four seats in the A320 and two in the B737. This does not affect the A321 because it has a different design for the emergency exits. The front lavatory of the A320 has to be moved forward by 18", because otherwise it would not be possible to load the ninth container. The middle lavatory of the A321 has to be removed. It will switch position with the front stowage closet.



B737 QC



A320 QC



A321 QC

Figure 2 B737-300 QC, A320-200 QC, A321-100 QC cabin layout.
Source: A-Air ground operations manual 1992, Deutsche Aerospace Airbus, March 1994

Figure 3 shows the cross section of the Airbus cabin. The cabin isle width depends upon the height of the CLS. The isle width of the unconverted aircraft is 21". With a system height of 3'' isle width is reduced to 17.4'' which will impose service problems during daytime operation, although still within legal limits. In case of the B737 QC, the floor height increase does not cause a reduction in isle width because even with higher seats there is still enough spacing between the sides of the back rests and the cabin wall. The vertical clearance for the standard 125" x 88" 9-g container is sufficient.

The seat pallets will have a width of 125" similar to the B737 QC to fit into the seat vans. To accommodate the full width of the cabin floor, 3" wide rails will serve as side guidance for the seat pallets and container. It will be surfaced with rubber or plastic matching the carpet design. The length of the seat pallets can be variable and will be optimized depending upon the layout of the seat vans.

3.4 Systems Integration

Integrating the conversion into the aircraft systems affects mainly Aerospatial components in the cockpit. This aspect was not yet reviewed, but differs considerably from the integration of the conversion in the case of the B737. The systems software has to be adapted (different weight, door warning, etc.) to integrate the new configuration into the electronic centralized aircraft monitoring system (ECAM). This is not necessary in the case of the B737, which is not does not have a comparable system. Further analysis of this aspect of the conversion is not practical because it is very technical and involves to be resolved design issues.

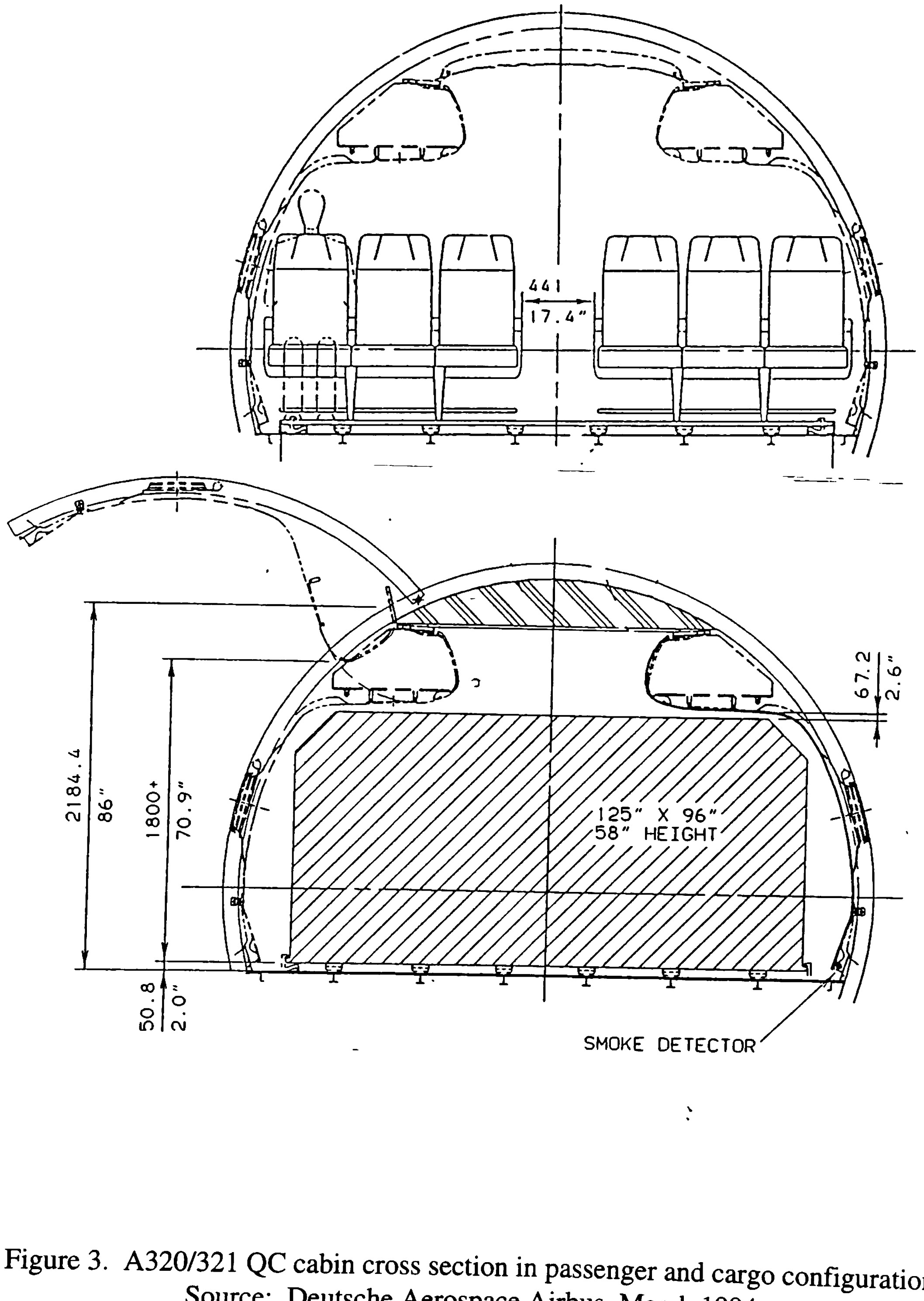


Figure 3. A320/321 QC cabin cross section in passenger and cargo configuration.
Source: Deutsche Aerospace Airbus, March 1994.

4 OPERATIONAL EVALUATION OF THE A320/321 QC AND COMPARISON TO THE B737 QC

4.1 The Conversion Procedure

Although the A320/321 QC will have the MCD in the aft section of the fuselage, there will be no major differences in the conversion procedure. A standard ground crew of four to five people, specified in the ground handling agreement, will perform the conversion. It takes about 20 minutes for the B737 QC to convert the aircraft after the last passenger has left the aircraft. Initially, catering removes all trolleys and containers from the galleys. Simultaneously, two people open the seat pallet locks, unplug the wiring for the floor path marking system, and stow the movable class divider. As soon as the 1L stairway can be removed, one loader opens the cargo door and the seat van is brought into position. Two door seal protection devices are put in place before the loading/unloading begins. The seat pallets are removed through the main cargo door and are stowed in two seat vans. The maximum seat pallet width that can be stowed in the seat vans and that can be handled with the container loader is 125". In the case of the A320/321 QC, a third seat van will be necessary to stow all the seat pallets. The vans are heated to keep the seats at a comfortable temperature. After the seat pallets are removed, the aircraft is ready for loading. In the case of the A320/321 it will be necessary to install protection walls between the main deck cargo compartment and the front and aft galley.

The conversion back to the passenger version is done in reverse order. At the end, however, the floor path marking has to be checked and signed in the technical logbook.

4.2 Loading/Unloading

The B737 QC is loaded from the front. One container at a time is lifted into the aircraft and then moved manually by one loader into the rear position where it is secured by YZ-locks. The next container can not be loaded into the aircraft until the loader has secured the rear container and returned to the front position of the aircraft. There is not enough space between the container used by A-Air and the aircraft sidewalls to pass a container in the cabin. The same will be true for the A320/321 QC. Only one container at a time can be loaded into the aircraft, but into the frontmost position of the main deck. This avoids the threat of tail tipping for the Airbus.

Since the Airbus will have an aft MCD location, the risk of engine damage especially during winter operation is reduced, and the stairway 1L does not interfere with the container loading equipment and can remain at the aircraft. However, the seat vans will need a second door in the backside of the truck because they can no longer approach the aircraft parallel to the longitudinal axis but have to approach the fuselage at a 90 degree angle. This problem might be avoided if a container loader is positioned between the aircraft and the seat van. Figure 4 illustrates the position of the loading equipment during cargo operation for the A320/321 QC. Please note that the seats are not necessarily stowed on a pallet train and that some airports do not allow pallet train operation as shown in Figure 4. There, the pallet train is located outside the aircraft area and a special transporter picks up one container at a time and carries it to the container loader at the aircraft.

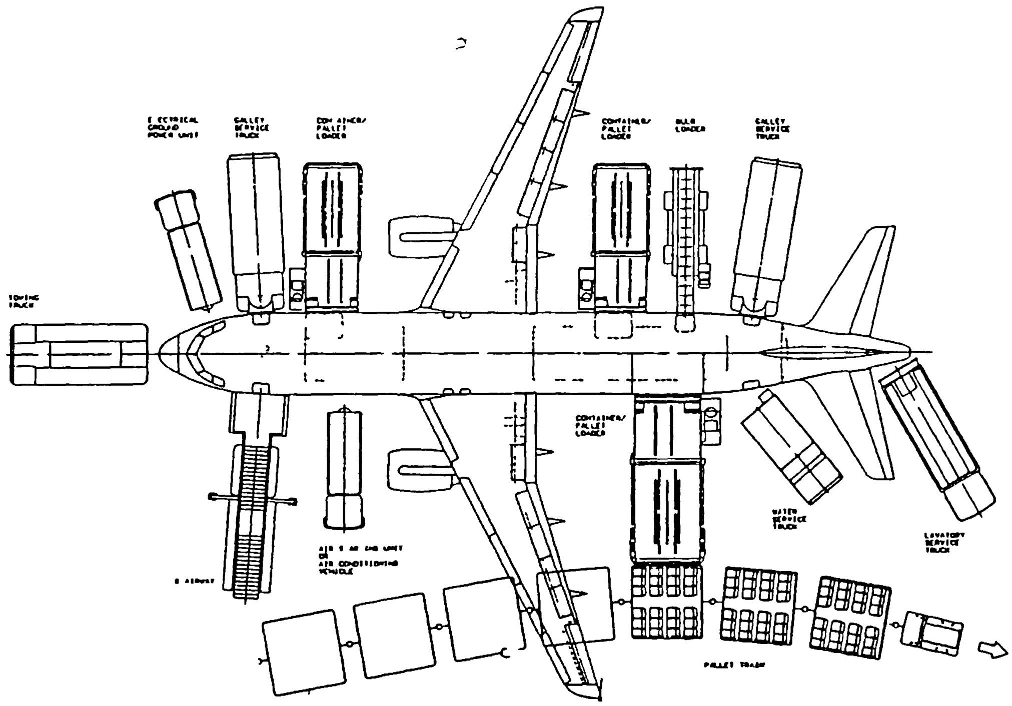


Figure 4. Position of the loading equipment for an A320/321 QC
Source. Deutsche Aerospace, March 1994

4.3 Aircraft Handling

Most European airports are currently able to fully handle B737 and A320/321 aircraft. Handling ability here refers to the availability of appropriate loading equipment, certified ground personal, and whether the airport may be used by the respective aircraft type. The aircraft under study meet Stage 3standards. Therefore, noise restrictions would affect them in the same way if night curfews become an operational problem.

The A320/321 require two additional lower deck container loaders compared to the B737 which does not have lower deck containers and is therefore loaded manually. Other than that, if the Airbus aircraft were added to A-Air's QC fleet, no significant handling problems are anticipated.

4.4 Scheduling

The aircraft schedule has to be balanced.[21] This means that the first flight in the evening after the conversion to a cargo airplane, has to be the same aircraft type as the last flight before the conversion back to a passenger aircraft in the morning. For example, from a practical operational standpoint, if the first cargo leg outbound from a conversion station (after the conversion to cargo configuration) is operated by a B737 QC, then the last inbound cargo leg (before the conversion back to a passenger aircraft) to the same station must be a B737 QC. It cannot be served by an A320 QC for example. Also, the

[21] Refer to chapters 6.3 and 6.4 for further discussion about aircraft balance.

number of aircraft of a specific type departing from a particular station has to be the same as the number of aircraft arriving at this station. Otherwise the schedule will result in the accumulation of aircraft at one or more stations.

If the aircraft type that flies on a certain route varies over time, the number of available 9-g containers at each station has to be adjusted according to the aircraft capacity, because the number of container positions is different for each aircraft type. Therefore, if the B737 QC is replaced by a larger aircraft such as the A321 QC, the number of containers at each station has to be adjusted accordingly. Otherwise, there might be a problem of container imbalances or accumulations. If this happened then the aircraft will have to carry empty containers or the empty containers will have to be carried by truck.

5 ECONOMIC EVALUATION OF THE A320/321 QC AND COMPARISON TO THE B737 QC

5.1 The Input Parameters

The economic performance of a quick change aircraft is mainly determined by the characteristics of the basic aircraft, the B737-300 or A320/321 in this case, the additional weight of the conversion, the capacity in cargo and passenger configuration, and the costs of the conversion including additional costs for structural weight increases (MTOW, MLAW, MZFW). Characteristics such as an improved cargo loading system, an aft cargo door position, and other technical design features, where the A320/321 may offer potential advantages, were not valued in the direct operating cost (DOC) calculations below.

5.1.1 Basic Aircraft Characteristics

The main characteristics include structural weight limitations, aerodynamic performance, and basis aircraft price. Table 2 shows the structural weights that were used throughout the analysis. It has to be noted that the weight limits shown for the Airbus aircraft are not yet available to airlines. Airbus Industrie, however, is reviewing the

Table 2.--Structural Weight Limitations of the Analyzed Aircraft Types

	B737-300	B737 -300 QC	A320-200	A320-200 QC	A321-100	A321-100 QC
Maximum Ramp Weight	56,700 kg	59,100 kg	73,900 kg	75,900 kg	83,400 kg	85,400 kg
Maximum Take-Off Weight	56,450 kg	59,000 kg	73,500 kg	75,500 kg	83,000 kg	85,000 kg
Maximum Landing Weight	51,700 kg	52,500 kg	64,500 kg	66,000 kg	74,500 kg	76,500 kg
Maximum Zero Fuel Weight	48,300 kg	49,714 kg	61,000 kg	62,500 kg	70,500 kg	72,500 kg

technical feasibility of these new structural weight limitations. Since preliminary analysis showed that both aircraft would only be competitive with higher limits, it was assumed that the weight increase would be included in the conversion. In the case of the A320, the weight limit increase will probably be achieved by service life reductions, which can not yet be specified. Additionally, the take-off rating was increased to 26,500 lb. The A321 will require technical design changes. It was assumed that the aerodynamic performance is not affected by the conversion except for the impact of the higher OEW. The aerodynamic performance such as speed and fuel consumption were taken from Airbus[22] and Boeing[23] manuals and will not be presented in further detail at this point. The B737 QC performance data were increased by 1% to account for the difference beween the Boeing manual and actual A-Air operational experience with the aircraft. The corresponding adjustment for the Airbus aircraft is 3%. Both of these adjustments reflect

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[22] Airbus Industrie, **Performance Doc. P2210** Rev. 2, June 93 and **Performance Doc. P21131** Rev.1, May 92.

[23] Boeing Commercial Aircraft Company, **Performance Doc. D6-37042-4,** Nov. 14 1984.

the experiences of A-Air with the reliability of performance data supplied by the manufacturers.

Basic aircraft prices are USD 37 million for the B737, USD 47 million for the A320 (both with CFM 56 engines) and USD 55 million for the A321 (with IAE engines), all in A-Air specification. These prices are guidelines only because exact prices are confidential and negotiable, and will vary depending on how the aircraft is equipped. Also, the actual price may vary considerably depending upon the number of concessions granted by the manufacturer to a particular airline. The aircraft price, however, will not affect the cash costs as presented later in the analysis. The conversion costs are not included in the basic price.

5.1.2 The Impact of the Conversion on the Aircraft Weight

The conversion to a quick change aircraft adds additional weight to the OEW. Two cases have to be considered: the new OEW of the quick change aircraft in passenger mode and the new OEW of the quick change aircraft in cargo mode. To date, Deutsche Aerospace Airbus can not provide weight estimates for the quick change conversion. Therefore, the additional weight was estimated by extrapolating the additional weight of the B737 PEMCO conversion. The weight of the individual components was subdivided into variable weight components (weight varies with the aircraft size; e.g. seat pallets) and fixed weight components (weight does not vary with aircraft size; e.g. cargo door). It was assumed that the weight of the variable components would vary in a linear manner with the number of container positions. In the case of the A320 QC, there is an additional fixed weight increase of 200 kg due to MTOW limit increase. The A321 QC will require an additional 350 kg. Table 3 documents the calculation.

Table 3.-- Weight Calculation of the Conversion

	No. of Pallets	Multiplication Factor	Variable Weight	Fixed Weight*	Total Add. Weight (Pass. Mode)	Total Add. Weight** (Cargo Mode)
B737 QC	8	1	1,687 kg	736 kg	2,423 kg	1,343 kg
A320 QC	9	9/8	1,898 kg	936 kg	2,834 kg	1,619 kg
A321 QC	12	12/8	2,531 kg	1,086 kg	3,617 kg	1,997 kg

* Includes 200 kg for structural weight limit increase in case of the A320 QC and 350 kg for the A321 QC.
** Total additional weight passenger mode minus weight of seat pallets (est. 135 kg per pallet).

The above calculated weights have to be included in an OEW calculation to determine the maximum structural payload. In the case of the cargo configuration, the OEW has to be corrected by removable cabin interior and the cabin crew. Additionally, weight conservatism is included in the calculation. The amount used in the calculations is standard A-Air conservatism. It counts for weight increases during operation due to repairs, dirt, etc. Additionally, the Manufacturer's Empty Weight has to be corrected in the case of the A321, because the aircraft was actually lighter than stated by the manufacturer. Table 4 gives a detailed weight break-down.

Table 4. -- OEW Calculation

	A320-200	A320 QC (Pass.)	A320 QC (Cargo)	A321-100	A321 QC (Pass.)	A321 QC (Cargo)
MEW	36,808 kg	36,808 kg	36,808 kg	42,217 kg	42,217 kg	42,217 kg
QC Door+ Struct. weight incr.	0 kg	936 kg	936 kg	0 kg	1,086 kg	1,086 kg
QC Equipment	0 kg	1,898 kg	683 kg	0 kg	2,531 kg	911 kg
A-Air Specs.	1,533 kg	1,533 kg	1,533 kg	1,072 kg	1,072 kg	1,072 kg
Corrected MEW	38,341 kg	40,975 kg	39,760 kg	43,289 kg	46,906 kg	45,286 kg
MEW Correction	0 kg	0 kg	0 kg	-469 kg	-469 kg	-469 kg
Empty Weight	**38,341 kg**	**41,175 kg**	**39,960 kg**	**42,820 kg**	**46,437 kg**	**44,817 kg**
Additional Equipment:						
Passenger Seats	1,795 kg	1,752 kg	0 kg	2,319 kg	2,319 kg	0 kg
Basic Emergency	241 kg	241 kg	239 kg	352 kg	352 kg	349 kg
Life Vests	109 kg	109 kg	0 kg	131 kg	131 kg	0 kg
Galley Structure	624 kg	624 kg	624 kg	728 kg	728 kg	728 kg
Catering, SUs & Trolleys	1,080 kg	1,080 kg	0 kg	1,350 kg	1,350 kg	0 kg
Crews	450 kg	450 kg	180 kg	540 kg	540 kg	180 kg
Cockpit Equipment	19 kg	19 kg	19 kg	19 kg	19 kg	19 kg
Water	200 kg	200 kg	50 kg	300 kg	300 kg	50 kg
Toilet Fluid	13 kg	13 kg	13 kg	13 kg	13 kg	13 kg
Unusable Fuel	65 kg	65 kg	65 kg	65 kg	65 kg	65 kg
Lubrication Oil	53 kg	53 kg	53 kg	63 kg	63 kg	63 kg
Tare weight MD	0 kg	0 kg	2,187 kg	0 kg	0 kg	2,916 kg
Tare weight LD	560 kg	560 kg	560 kg	800 kg	800 kg	800 kg
Nominal Operating Empty Weight	**43,550 kg**	**46,341 kg**	**43,950 kg**	**49,500 kg**	**53,117 kg**	**50,000 kg**
Conservatism	650 kg	650 kg	650 kg	750 kg	750 kg	750 kg
Operating Empty Weight (OEW)	**44,200 kg**	**46,991 kg**	**44,600 kg**	**50,250 kg**	**53,867 kg**	**50,750 kg**

5.1.3 Cargo Capacity

The B737 QC offers a capacity of eight 88" x 125" 9-g containers plus additional bulk space in the belly. The A320 QC has nine, and the A321 QC twelve 88" x 125" container positions (refer to Figure 2 on page 20). The Airbus aircraft offer seven (A320) and ten (A321) AKH container positions for the lower deck. The B737 has bulk capacity only. It was assumed that the Airbus aircraft can not be bulk loaded, because bulk loading is an option for Airbus aircraft but is not available to A-Air. The main disadvantages of the containers for cargo operation are their weight and their size. The containers are included in the OEW and therefore reduce the maximum net payload by 560 kg for the A320 and 800 kg for the A321.

The AKH container is smaller than the wide-body LD-3 container which is the respective lower deck container for wide body aircraft. Therefore, A320/321 lower deck containerized cargo has to be reloaded into LD-3's to optimize space utilization if the cargo continues in wide body aircraft.[24] Additionally, the volume utilization of LD-3 containers is low because much space is lost due to bulky freight.

To determine the payload, the structural payload has to be compared to the volume limited payload as shown in Table 5. The structural payload is defined as the difference between the MZFW and the OEW.[25] The volume limited payload is calculated by multiplying the available cargo volume with the average cargo density (or by adding the

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[24] Technically, AKH's can be carried in wide body aircraft. However, the containers do not fit into the cargo compartment in an optimum manner.

[25] In case the difference of the MLAW minus MZFW is less than standard reserves, the structural payload may be less (landing weight limited). In the case of the A320/321, however, this is not the case

Table 5.-- Maximum Payloads for Different Aircraft Types and Configurations

	Max. Payload	Max. Payload (MZFW limit)	Max.Palyoad (Vol. limit)
B737-300	14,626 kg	14,726 kg	14,626 kg
A320-200	16,565 kg	16,800 kg	16,565 kg
A321-100	20,251 kg	20,251 kg	21,242 kg
B737-300QC Pass Mode	13,558 kg	13,558 kg	14,458 kg
A320-200QC Pass Mode	15,509 kg	15,509 kg	16,189 kg
A321-100QC Pass Mode	18,634 kg	18,634 kg	21,242 kg
B737-300QC Cargo Mode	15,645 kg	15,645 kg	22,339 kg
A320-200QC Cargo Mode	17,900 kg	17,900 kg	19,814 kg
A321-100QC Cargo Mode	21,750 kg	21,750 kg	26,414 kg

*Net payload; that is tare weight of the container included in OEW

average weight of the container and passengers). A standard weight of 1,700 kg for the main deck container, 500 kg for the lower deck container, 84 kg per passenger, and 14 kg baggage per passenger was used. Every 35.7 passengers utilize one lower deck container (rounded up to the next container).

5.1.4 Passenger Capacity

Due to the higher cabin floor in passenger configuration, passenger seats beside the overwing emergency exits have to be removed. The seat structure may not project into the emergency exit. Therefore, the B737 seating capacity is reduced by two, and the A320 seating capacity is reduced by four seats. The A321 has a different emergency exit layout and will not lose any seats.

5.1.5 Conversion Costs

Deutsche Aerospace has not yet published any prices for a quick change conversion. Initial internal cost calculations (based on full costs) have also not provided a solid basis for price estimates. Therefore, it was assumed that the conversion could be offered at market prices which were estimated by the Deutsche Aerospace sales department. The prices were determined by comparing existing conversion prices of different aircraft types. The conversion price for an A320 was fixed at USD 3.5 million and the one for the A321 at USD 4.0 million. This includes also the costs for structural weight increases. If the Airbus aircraft are not competitive with the B737, a reduction of the basic aircraft price to reduce the capital costs might be considered by Airbus Industrie. Final study prices are USD 40 million for the B737 QC, USD 50.5 million for the A320 QC, and USD 59.0 million for the A321 QC.

5.2 Output Data Calculation and Analysis

5.2.1 Payload Range Data

The payload range data for all aircraft were calculated using the same method. Figures 5 to 10 inclusive show payload range diagrams for the studied aircraft types and configurations. Refer to Table 2 and Table 4 for associated aircraft weights. The

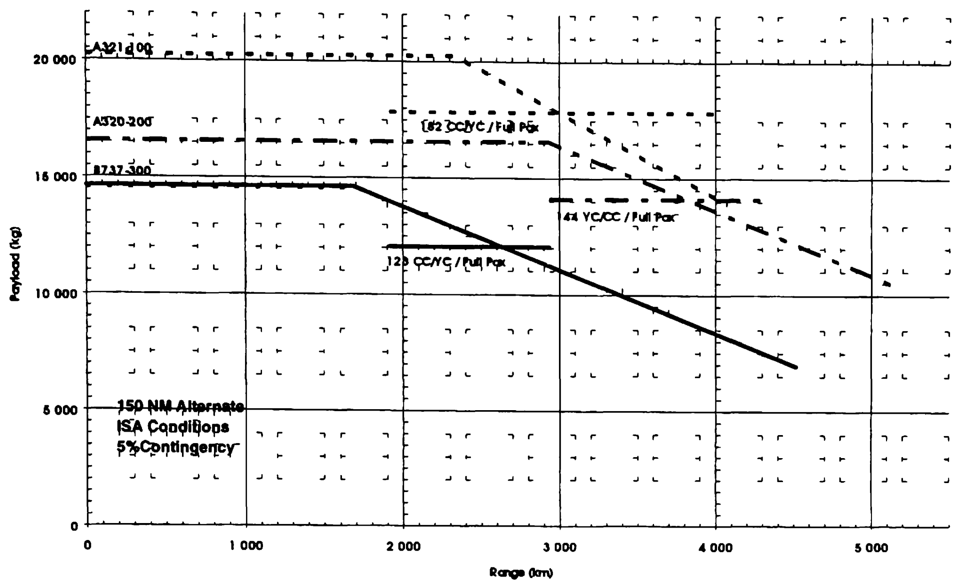

Figure 5. B737-300, A320-200, and A321-100 payload range diagram

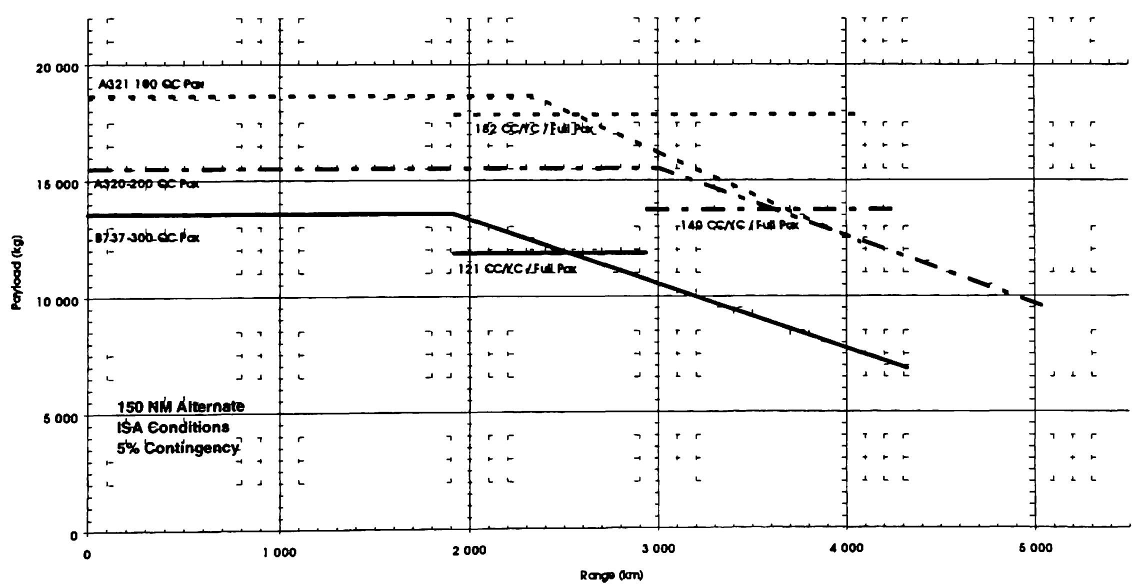

Figure 6. B737-300 QC, A320-200 QC, and A321-100 QC payload range diagram in passenger configuration

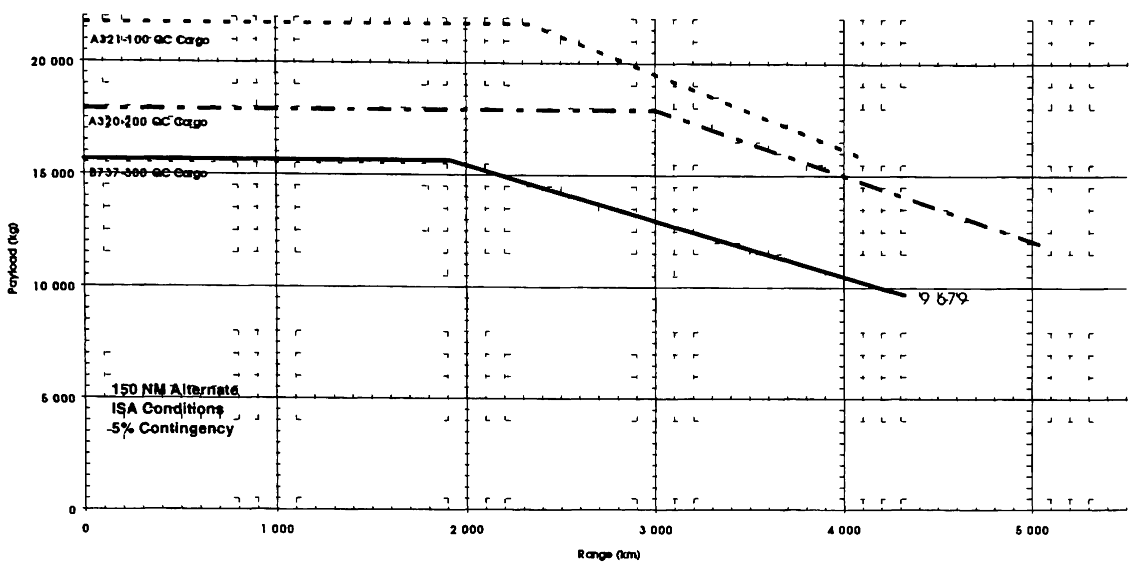

Figure 7. B737-300 QC, A320-200 QC, and A321-100 QC payload range diagram in cargo configuration.

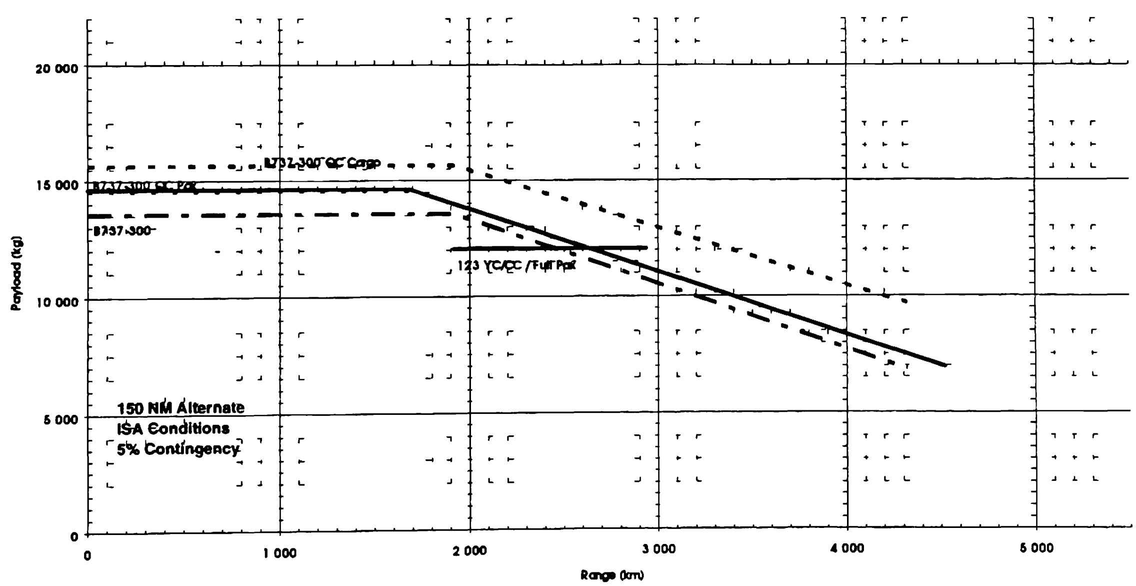

Figure 8. B737-300 payload range diagram in different configurations

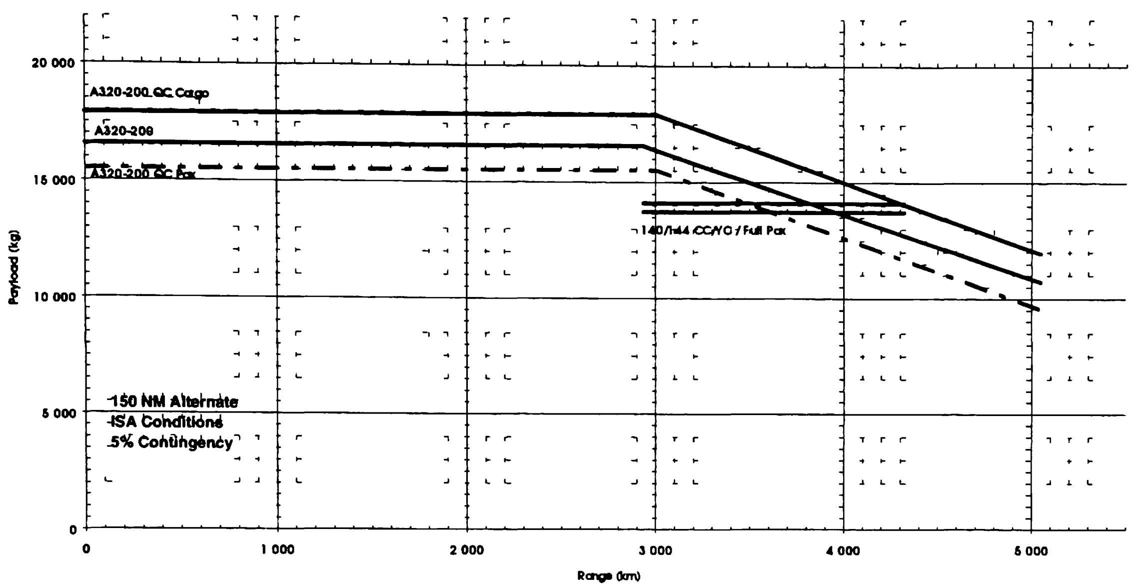

Figure 9. A320-200 payload range diagram in different configurations.

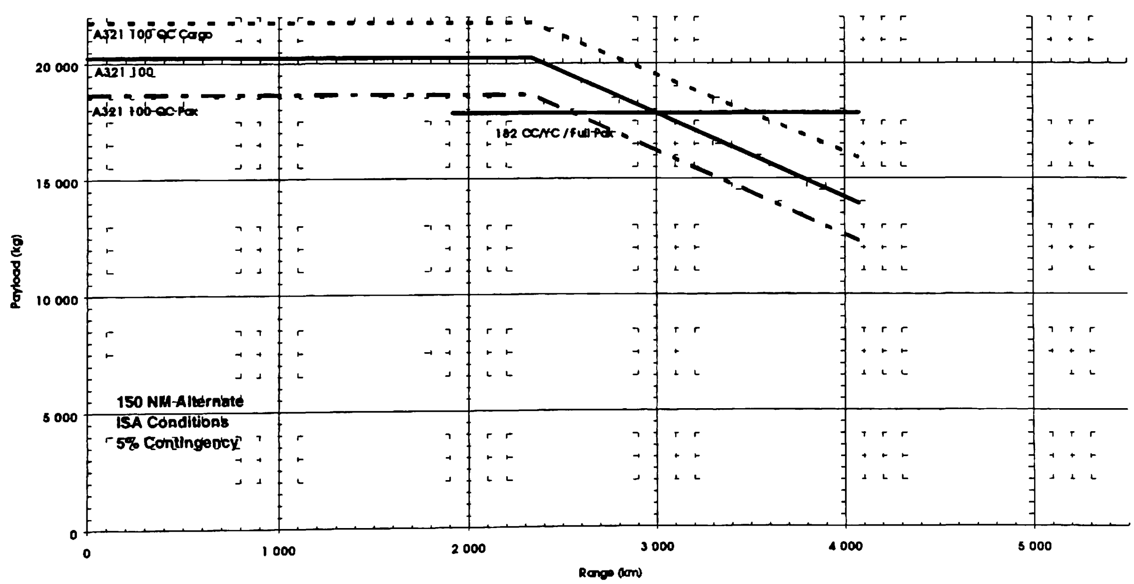

Figure 10. A321-100 payload range diagram in different configurations

diagrams in Figure 5 to Figure 7 illustrate the difference between the three aircraft types in the same configuration. It can be seen that the A320 has an advantage on routes above 2,000 km because the B737 is unable to carry the maximum payload. The A321 has comparable range characteristics to the B737 at a higher payload.

Table 6 presents the results in detail and shows the differences between the B737 and the A320/321 in different versions (passenger aircraft, QC aircraft in passenger configuration, QC aircraft in cargo configuration). Delta values in the columns show the differences between the Airbus aircraft and the B737 in the same configuration, whereas delta values in the rows show the differences with respect to the non-converted aircraft. The former is used to evaluate the additional capacity of a larger aircraft while the latter is used to evaluate the loss of capacity due to the additional weight of the conversion.

As an unconverted aircraft shown in Figure 5, the A320 offers about 2 t (13%) more payload at 1,251 km (74%) higher optimum range. If the aircraft is operated at maximum range, the difference amounts to 3.4 t (49%). Respective values for the A321 are 5.6 t (38%) at 654 km (39%) higher range and 7 t (101%) at maximum range.

In QC passenger configuration as shown in Figure 6, the A320 QC and A321 QC maintain their payload advantage relative to the B737 QC (absolute payload advantage decreases slightly). Values are 2.0 t (14%) for the A320 QC and 5.1 t (37%) for the A321 QC. Range differences shift slightly. The A320 QC increases its optimum range advantage at full payload to 1,091 km (57%) whereas the A321 advantage is reduced to 317 km (17%). At maximum range, both Airbus aircraft lose some of their payload advantage. The A320 QC offers only 2.7 t (39%) more payload and the A321 QC 5.5 t (17%). The maximum range advantage (disadvantage A321) remains almost unchanged.

Table 6.-- B737, A320, A321 Payload Range Data and Differences among the Different Versions and Types

	B737-300	A320-200	Delta B737	Delta B737 (in %)	A321-100	Delta B737	Delta B737 (in %)
Max Payload	14,626 kg	16,565 kg	1,939 kg	13 26%	20,251 kg	5,625 kg	38 46%
Range at max payload (km)	1,684	2,935	1,251	74 29%	2,338	654	38 84%
Payload at max range	6,937 kg	10,341 kg	3,404 kg	49 07%	13,920 kg	6,983 kg	100 66%
Max Range (Km)	4,519	5,181	662	14 65%	4,083	-436	-9 65%
	B737-300QC Pass Mode	A320-200QC Pass. Mode	Delta B737	Delta B737 (in %)	A321-100QC Pass. Mode	Delta B737	Delta B737 (in %)
Max Payload	13,558 kg	15,509	1,951 kg	14 39%	18,634 kg	5,076 kg	37 44%
Lost payload compared to normal version	-1,068 kg	-1,056 kg	N/A	N/A	-1,617 kg	N/A	N/A
Lost payload in % of max normal payload	-7 30%	-6 37%	N/A	N/A	-7 98%	N/A	N/A
Range at max payload (Km)	1,918	3,009	1,091	56 88%	2235	317	16 53%
Payload at max range	6,847 kg	9,549 kg	2,702 kg	39 46%	12,303 kg	5 456 kg	79 68%
Lost payload compared to normal version	-90 kg	-792 kg	N/A	N/A	-1,617 kg	N/A	N/A
Lost payload in % of max normal payload	-0 62%	-4 78%	N/A	N/A	-7 98%	N/A	N/A
Max Range (Km)	4,321	5,048	727	16 82%	4,077	-244	-5 65%
	B737-300QC Cargo	A320-200QC Cargo	Delta B737	Delta B737 (in %)	A321-100QC Cargo	Delta B737	Delta B737 (in %)
Max Payload (net)	15,645 kg	17,900 kg	2,255 kg	14 41%	21,750	6,105 kg	39 02%
Range at max payload (km)	1,918	3,009	1,091	56 88%	2235	317	16 53%
Payload at max range (net)	9,679 kg	11,940 kg	2,261 kg	23 36%	15,906 kg	6,227 kg	64 34%
Max Range (Km)	4,321	5,048	727	16 82%	4,077	-244	-5 65%

All aircraft are still able to carry maximum passenger load. Remaining cargo capacity[26] is 2.6 t (B737), 2.5 t (A320), and 0.8 t (A321).

In cargo configuration as shown in Figure 7, the A320 QC offers a payload advantage of 2.3 t (14%) at a 1,091 km (57%) higher optimum range. Values for the A321 QC are 6.1 t (39%) and 317 km (17%) respectively. At maximum range, the

[26] Difference of maximum payload minus number of passenger seats times 98 kg. May vary slightly in case the remaining volume limits the remaining capacity.

payload advantage of the A320 QC is 2.3 t (23%) and of the A321 QC 6.2 t (64%).

Comparing different versions of the same aircraft type (B737 see Figure 8, A320 see Figure 9 A321 see Figure 10), the A320 QC in passenger configuration looses the least compared to the unconverted aircraft. The A320 QC looses 1 t (6.4%), the B737 QC 1 t (7.3%), and the A321 QC 1.6 t (8%). The optimum range increases slightly or remains constant due to the increases in the MTOW for all aircraft. As a rough guideline, 300 km can be subtracted from the optimum range for each ton decrease in MTOW. At maximum range, the B737 QC looses 90 kg (1%), the A320 QC 792 kg (5%), and the A321 QC 1.6t (8%).

The required take-off field length for the A321 QC at ISA, sea level, and MTOW has increased by 5.3% from 2,200 m to 2,316 m, and by 9.6% from 2,865 m to 3,139 m under ISA +20° conditions and 2,000 ft pressure altitude. Landing field length has increased by 4.8% from 1,585 m to 1,661 m. This performance is still satisfactory without a thrust increase from present levels since most runway lengths exceed these values.[27]

The respective values for the A320 QC change slightly, because the T/O rating was increased from 25,000 lb. to 26,500 lb. to avoid performance problems. Required take-off field length at ISA has decreased by 7% from 2,195 m to 2,042 m, and by 9% from 3,231 m to 2,926 m under ISA + 20° conditions. Landing field length increases slightly from 1,463 m to 1,493 m.

[27] A321 performance is currently insufficient in a few specific weather conditions at some airports in the network. This is the case for 83 t and 85 t MTOW. However, thrust increases for these exceptions are normally not considered by the airline. According to Airbus Industrie, there are airlines that operate the A321 with the higher take-off weight without a thrust rating increase

5.2.2 Direct Operating Costs (DOC) per SKO

Using the above calculated payload range data, direct operating costs were calculated using a standard A-Air computer program (all values in USD per SKO). This program utilizes the following method. For aircraft comparison, a standard stage length of 500 NM is used. The payload range data supply the appropriate input parameters such as block fuel, block time, payload, and available seats and freight for each aircraft type at this stage length. An annual yearly utilization of 1,920 flights per year (about 8.5 block hours per day) is assumed. Based on theses figures, annually offered seat-km, ton-km, block fuel, and block hours were calculated. Additional details are provided in Appendix A.

Direct operating costs per SKO are separated into variable and fixed cost components. Fuel costs were calculated using a price of USD 0.218 per liter. This costing method assumes that the aircraft consumes the whole block fuel on a trip, which is normally not true. However, for the purpose of aircraft comparison, this method is acceptable. Maintenance costs are separated into airframe and engine maintenance. These cost components are a function of the aircraft weight and type and are based on empirical studies. Landing, handling, and navigation charges are a function of the aircraft weight and the payload (handling charges) of the aircraft. The fixed cost components are technical, capital, insurance, and cockpit/cabin crew costs. The capital costs are shown as the sum of aircraft and spares interest and depreciation.

This costing method treats all aircraft as if they were flown in the same configuration during the entire year. It does not yet show the DOC of a quick change aircraft that is flown in a mixed operation. If such a mixed operation increases the annual utilization (i.e. more flights per year in either cargo or passenger configuration), the fixed costs will be spread over more flights with a subsequent reduction of the DOC per seat-km or per ton-km. This effect, however, will influence the Boeing and Airbus aircraft in the same way. The direct operating costs are shown in Figures 12 through 15.

Figure 11 shows total direct operating costs per SKO for the passenger versions of

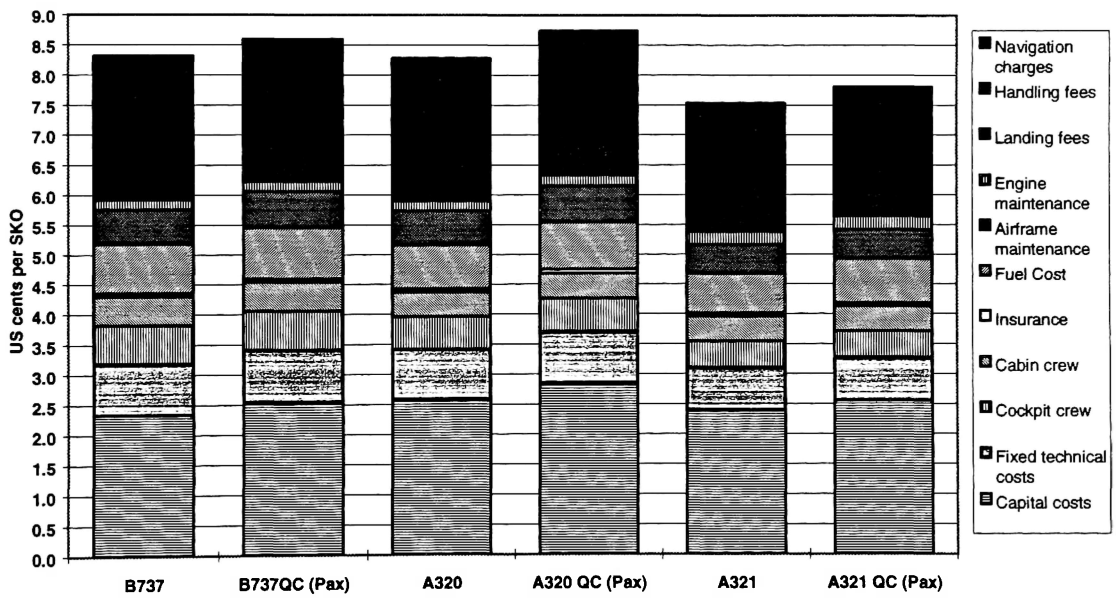

Figure 11. B737, A320, and A321 DOC per SKO in normal and quick change-passenger configuration.

the B737, A320, and A321. Respective individual values and cost differences are shown in Table 7 and Table 8. The A320 is about 11% more fuel efficient than the B737 and has about 15% lower crew costs per SKO. Respective values for the QC version are 7.5% and 14%. However, higher landing fees (11%) and capital costs (10.4%/11.8%) eliminate the DOC advantages of the A320. The A321 is significantly cheaper in fuel, handling, navigation, fixed technical, and crew costs. The high aircraft price is spread over more seats and therefore the capital costs are not significantly higher. Total DOC per SKO are about 9% less than the B737.

Table 7.--B737, A320, A321 DOC per SKO and DOC per SKO Differences
(US cents per SKO)

	B737	A320	Delta B737	Delta B737 (in %)	A321	Delta B737	Delta B737 (in %)
Fuel Cost	0.826	0.738	-0.088	-10.63%	0.662	-0.165	-19.92%
Airframe maintenance	0.573	0.567	-0.007	-1.17%	0.492	-0.081	-14.14%
Engine maintenance	0.165	0.166	0.001	0.44%	0.218	0.053	32.30%
Landing fees	0.454	0.504	0.051	11.19%	0.451	-0.003	-0.65%
Handling fees	1.244	1.194	-0.049	-3.97%	1.126	-0.118	-9.48%
Navigation charges	0.701	0.684	-0.018	-2.54%	0.575	-0.127	-18.04%
Total variable costs	**3.963**	**3.853**	**-0.110**	**-2.78%**	**3.523**	**-0.440**	**-11.09%**
Fixed technical costs	0.850	0.837	-0.013	-1.54%	0.721	-0.129	-15.21%
Capital costs	2.335	2.578	0.243	10.40%	2.386	0.051	2.17%
Aircraft depreciation	1.194	1.311	0.116	9.74%	1.214	0.019	1.62%
Spares Depreciation	0.105	0.123	0.019	17.69%	0.113	0.009	8.41%
Aircraft interest	0.953	1.046	0.093	9.75%	0.968	0.015	1.61%
Spares interest	0.083	0.098	0.015	17.93%	0.090	0.007	8.57%
Insurance	0.050	0.055	0.005	9.63%	0.051	0.001	1.55%
Cockpit crew	0.637	0.544	-0.093	-14.58%	0.430	-0.206	-32.42%
Cabin crew	0.483	0.413	-0.070	-14.58%	0.421	-0.062	-12.87%
Total fixed costs	**4.356**	**4.427**	**0.071**	**1.63%**	**4.009**	**-0.347**	**-7.96%**
Total direct costs per SKO	**8.319**	**8.280**	**-0.039**	**-0.47%**	**7.533**	**-0.786**	**-9.45%**

Table 8 -- B737 QC, A320 QC, A321 QC DOC per SKO and DOC per SKO Differences Used in Passenger Configuration.
(US cents per SKO)

	B737QC (Pass.)	A320 QC (Pass)	Delta B737	Delta B737 (in %)	A321 QC (Pass)	Delta B737	Delta B737 (in %)
Fuel Cost	0.857	0.793	-0.064	-7.50%	0.742	-0.115	-13.41%
Airframe maintenance	0.598	0.610	0.012	2.04%	0.499	-0.098	-16.47%
Engine maintenance	0.168	0.179	0.011	6.70%	0.218	0.051	30.15%
Landing fees	0.482	0.533	0.051	10.66%	0.461	-0.020	-4.16%
Handling fees	1.164	1.164	0.000	0.02%	1.126	-0.038	-3.28%
Navigation charges	0.729	0.713	-0.016	-2.23%	0.582	-0.147	-20.20%
Total variable costs	**3.997**	**3.992**	**-0.005**	**-0.14%**	**3.629**	**-0.368**	**-9.21%**
Fixed technical costs	0.864	0.861	-0.003	-0.37%	0.721	-0.143	-16.59%
Capital costs	2.543	2.843	0.300	11.78%	2.553	0.010	0.38%
Aircraft depreciation	1.304	1.449	0.146	11.18%	1.302	-0.002	-0.15%
Spares Depreciation	0.111	0.132	0.021	18.79%	0.118	0.007	6.28%
Aircraft interest	1.040	1.157	0.117	11.20%	1.039	-0.001	-0.12%
Spares interest	0.089	0.105	0.017	18.97%	0.094	0.006	6.29%
Insurance	0.055	0.061	0.006	11.49%	0.055	0.000	0.06%
Cockpit crew	0.647	0.560	-0.088	-13.57%	0.430	-0.217	-33.52%
Cabin crew	0.491	0.425	-0.067	-13.57%	0.421	-0.070	-14.29%
Total fixed costs	**4.601**	**4.749**	**0.148**	**3.22%**	**4.180**	**-0.421**	**-9.15%**
Total direct costs per SKO	**8.598**	**8.741**	**0.143**	**1.66%**	**7.809**	**-0.789**	**-9.18%**

DOC for the respective unconverted aircraft were shown to identify any improvement or deterioration of cost differences between the different aircraft types. The A320 maintains a slight cost advantage in passenger configuration. Since remaining freight capacity was not taken into consideration in the DOC calculation, the passenger configuration is less affected by the retrofit than the cargo configuration.

Figure 12 shows only cash costs which were defined as crew costs, insurance costs, handling, navigation, and landing fees, fuel costs, and maintenance costs. Capital

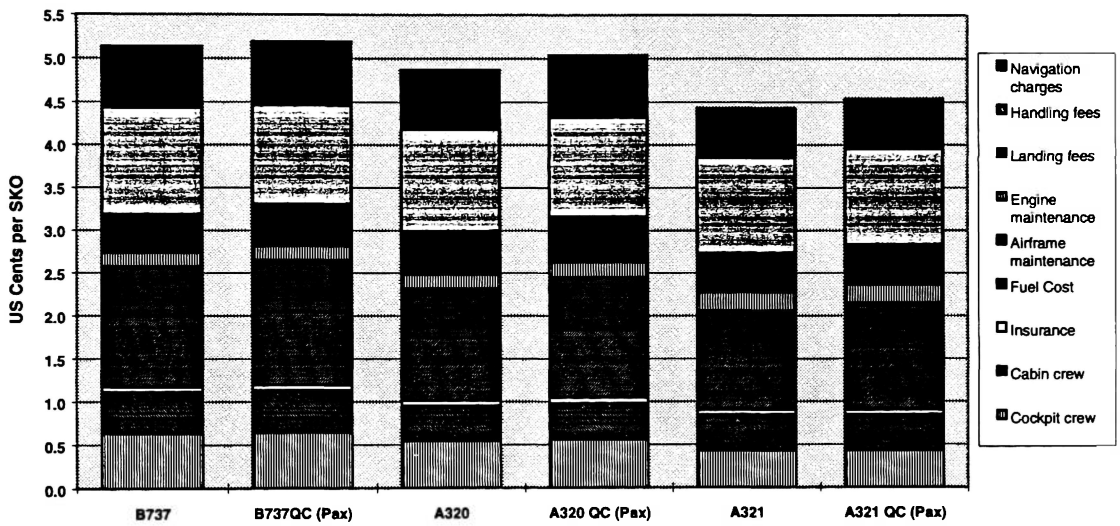

Figure 12. B737, A320, and A321 cash costs per SKO in normal and quick change-passenger configuration.

costs and fixed maintenance costs were excluded. It was assumed that the variable maintenance costs are cash costs. Cash operating costs for the B737 are 5.1 US cents per SKO and 5.2 US cents per SKO for the QC version. Respective values are 4.9 and 5.0 for the A320, and 4.4 and 4.5 for the A321. Therefore, if only cash costs are considered, the A320 aircraft offers a potential advantage. The A321 is cheaper in both cases.

The respective costs for the cargo version are shown in Figure 13, Figure 14, and Table 9. As a cargo aircraft, the A320 has 2.7% lower variable operating costs per TKO but still 1.8% higher total DOC per TKO which is mainly caused by higher capital costs. Since the capital costs of the passenger version were not affected significantly by the conversion, it can be assumed that the high basic aircraft price causes the high capital costs. In looking at cash costs only, values for the A320 QC and A321 QC are 36.3 US

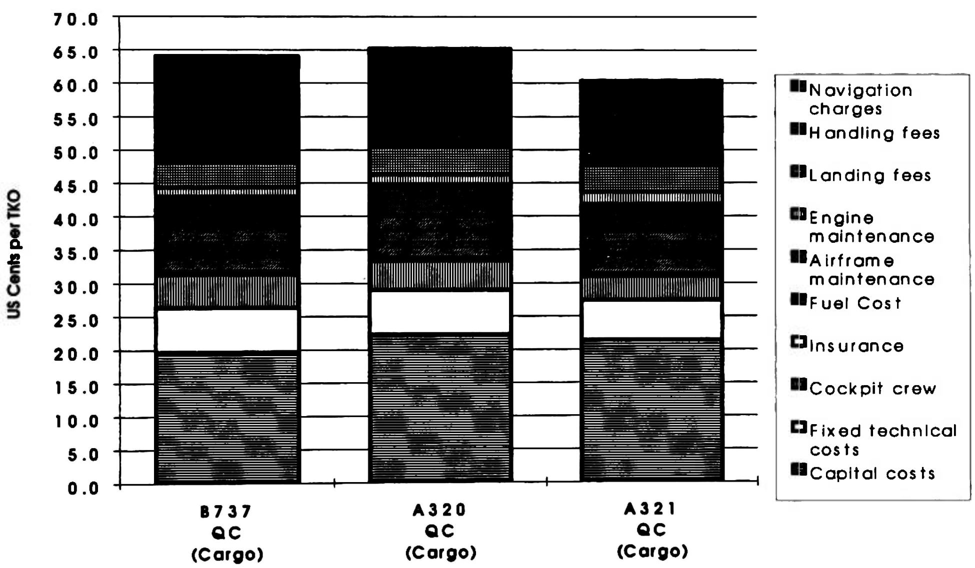

Figure 13. B737 QC, A320 QC, and A321 QC DOC per TKO in cargo configuration.

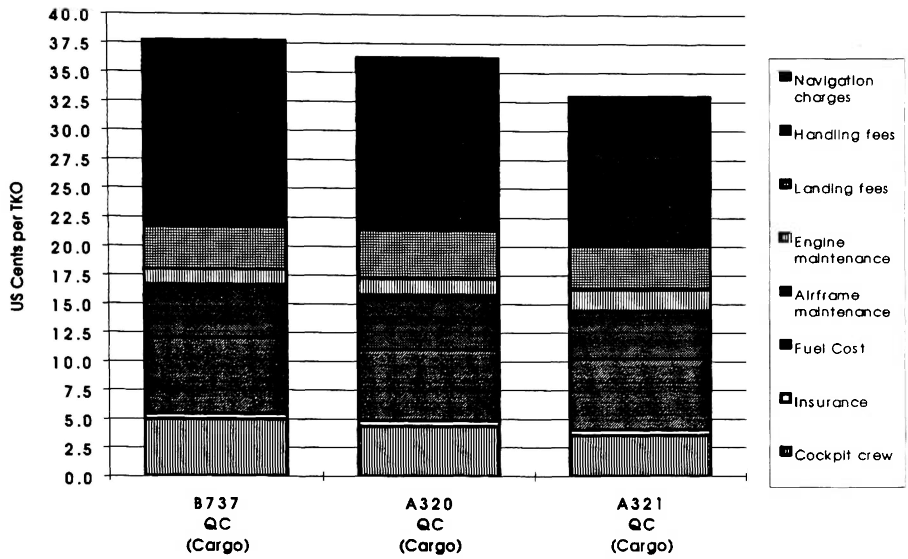

Figure 14. B737 QC, A320 QC, and A231 QC cash costs per TKO in cargo configuration.

Table 9.-- B737 QC, A320 QC, A321 QC DOC per TKO in Cargo Configuration (US Cents per TKO)

	B737 QC (Cargo)	A320 QC (Cargo)	Delta B737	Delta B737	A321 QC (Cargo)	Delta B737	Delta B737
Fuel Cost	6.629	6.201	-0.428	-6.46%	6.210	-0.419	-6.32%
Airframe maintenance	4.625	4.772	0.148	3.19%	4.179	-0.445	-9.63%
Engine maintenance	1.298	1.400	0.103	7.90%	1.827	0.530	40.82%
Landing fees	3.724	4.168	0.443	11.91%	3.862	0.137	3.69%
Handling fees	10.361	9.296	-1.065	-10.28%	7.989	-2.372	-22.89%
Navigation charges	5.637	5.573	-0.064	-1.13%	4.867	-0.770	-13.67%
Total variable costs	**32.274**	**31.410**	**-0.863**	**-2.68%**	**28.935**	**-3.339**	**-10.35%**
Fixed technical costs	6.683	6.734	0.050	0.75%	6.031	-0.652	-9.76%
Capital costs	19.669	22.235	2.565	13.04%	21.361	1.692	8.60%
Aircraft depreciation	10.082	11.335	1.253	12.43%	10.892	0.810	8.03%
Spares Depreciation	0.858	1.031	0.173	20.12%	0.987	0.129	14.98%
Aircraft interest	8.044	9.047	1.002	12.46%	8.693	0.649	8.07%
Spares intererst	0.685	0.824	0.139	20.31%	0.788	0.103	15.00%
Insurance	0.423	0.477	0.054	12.75%	0.458	0.035	8.26%
Cockpit crew	5.007	4.376	-0.631	-12.60%	3.602	-1.405	-28.07%
Cabin crew	0.000	0.000	0.000	N/A	0.000	0.000	N/A
Total fixed costs	**31.783**	**33.821**	**2.039**	**6.41%**	**31.452**	**-0.331**	**-1.04%**
Total direct costs	**64.057**	**65.232**	**1.175**	**1.83%**	**60.387**	**-3.670**	**-5.73%**

cents per TKO and 33.0 respectively, compared to 37.7 of the B737. The cash cost figures are more meaningful due to two reasons. First, the aircraft price is negotiable. Second, QC operation may be considered a joint-product operation, which means that capital costs should not be considered since the aircraft is available anyway (if the airline has the aircraft already in its fleet). Therefore, both aircraft offer a cost saving potential.

5.2.3 Sensitivity Analysis

Two cases were analyzed. First, the effect of changes in fuel prices was analyzed. This did not cause significant cost shifts. The DOC changed by less than 1% even if the fuel price was doubled. This is due to the fact that the B737-300 is already a fuel efficient aircraft compared to the older -200 series.

The second case analyzed was zero conversion costs for the A320. In this case, total DOC for the cargo version are reduced to 63.7 US cents per TKO which is 0.5% less than the B737 value. Since the A320 is a bigger aircraft, the DOC per TKO should be significantly lower than the B737 DOC due to economies of scale but that is not the case. This indicates that the basic aircraft price is too high for the A320.

6 THE FLEET PLANNING MODEL

6.1 Overview

In the previous chapter, the A320/321 QC aircraft were assessed using a standard method that does not consider the characteristics of its daily operation in A-Air. This includes varying cargo volume over time, scheduling constraints, additional cost that were not included in the standard DOC calculation, and other limitations that may affect the optimum fleet mix and thus the decision whether or not to buy an additional QC type. For example, although the A321 QC may have lower DOC as a cargo aircraft than the B737, the lower passenger load factor during the aircraft positioning flight may eliminate any cost advantage. Since an airline has to consider the network as a whole, it may prefer to operate the B737 QC and lose some cargo due to insufficient capacity, because this is still cheaper than acquiring and operating the larger A321 QC. Therefore, a model was developed that takes more than only direct operating costs differences into consideration.

First, as mentioned above, an airline does not necessarily have to accommodate all the cargo demand on a certain route. It may decide to operate a small aircraft and satisfy only that part of the freight market that has a high enough yield to make a profit. In this case, the airline looses some revenue due to insufficient capacity which is an opportunity cost to the airline. As long as these opportunity costs do not outweigh the higher total costs of operating a larger aircraft, the airline is better off using the smaller equipment.

Second, the operating costs of QC cargo aircraft may not be compared without consideration of the effect on the daytime passenger operation. A QC passenger aircraft has higher DOC than an unconverted passenger aircraft. Depending upon the daily utilization, the difference will impose additional costs to the QC cargo network. In this context, it is often argued that the QC operation increases the total utilization of the aircraft and therefore spreads the fixed costs (especially capital costs) over more flights. This, in turn, would reduce the DOC of the aircraft and outweigh the penalties of the conversion. But opinions on this aspect are inconsistent. Some argue that QC aircraft fly less during the daytime, because route scheduling tries to avoid them (higher variable cost). Therefore, fixed costs would not be reduced or spread over more hours. On the other hand, an airline has to hold some spare aircraft. Of course, it will try to hold the aircraft with the highest variable costs as spare capacity, in this case the QC aircraft. If there would be no QC aircraft, the airline would have to use unconverted aircraft as spare capacity. Therefore, there would still be some effect of reduced fixed costs. Since it was not possible to determine which of the two arguments is true, the reduction of capital costs was not considered in the model, but only higher direct operating costs due to the higher weight etc.

Capital costs of the basic aircraft were excluded from the model. First, as mentioned above, effects on capital costs are not yet analyzed in detail. Second, it can be argued that the cargo operation with QC aircraft is a by-product. The basic aircraft are available anyway and differences in capital costs should not be considered during cargo operation. Therefore, only the capital costs of the conversion were included.

A fourth cost group to be included in total network cost considerations are the costs of positioning flights at low load factors. Often, passenger service is offered on a particular route only because it is necessary that the aircraft be available for night operations at the destination. Therefore, a portion of the positioning flight costs has to be included, depending upon the load factor.

Each additional conversion station causes investment in seat vans that is not included in normal handling charges. If an additional conversion station is needed in the network, this is an additional cost above the normal handling charges that are not covered by the direct operating costs. A larger aircraft may require additional conversion stations, if the routes that were previously served by a one stop service with the smaller aircraft are now split in two rotations with an additional conversion station.

Finally, the structure of the schedule may require ferry flights, if additional aircraft types are operated. Although the night schedule is only part of a whole schedule, it must still be balanced with the same aircraft type arriving in the morning at a station as it was converted the evening before.

All these costs should be minimized as a whole under consideration of actual airline operating characteristics. To determine whether the Airbus aircraft would be competitive in such an environment, a mathematical model was developed that plans a schedule with a fleet mix that minimizes the above listed cost types. The three aircraft available to this model are the B737, the A320, and the A321 as outlined in the previous chapters. The model is an integer linear program that minimizes the objective function "total network costs" under several scheduling constraints.

Underlying concept of the mathematical model is the utilization of feasible rotations as main unknown variables. Feasible rotations are determined by the time schedule of the flight plan. The principle is illustrated in Figure 15 using a small network

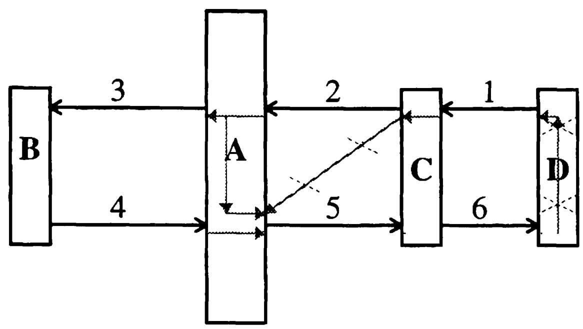

Figure 15. Principle of feasible rotations
(Only few feasible and unfeasible rotations are shown)

consisting of the stations A, B, C, D and the legs 1, 2, 3, 4, 5, and 6. A rotation is defined by its arrival and departure leg. For example, rotation 1-2 is the rotation that arrives from leg 1 and departs to leg 2. It is feasible, if the departure time as stated in the schedule is at least 30 minutes after the arrival time of the incoming leg (if 30 minutes is the minimum transit time) and if it arrives/departs from the same station. Rotation 1-5, for example, is not feasible, because an aircraft can not arrive at station C and depart from station A. Rotation 6-1 is also not feasible, because the departure time of leg 1 is before the arrival time of leg 6 (if, as assumed, the time schedule determines leg one to be the evening flight and leg 6 the early morning returning flight).

Thus, rotations 1-2, 2-5, and 2-3 are examples of feasible rotations. It is also feasible to origin at each station (unless explicitly excluded). That is, rotation 0-1 is feasible. This states that the aircraft starts its nightly routine at station D. Same is true for termination. Leg 1-0 is also feasible. In this case, the aircraft arrives from leg 1 and terminates at station C. The costs of each leg as outlined below are allocated to each rotation by its departure leg. For example, the DOC of leg 3 are allocated to rotation 2-3 and 4-3, since both depart on leg 3.

In the following, chapters 6.2 and 6.3 explain the cost components of the objective function and the rational of the constraints respectively. Chapter 6.4 will explain the mathematical model and the notation which will also appear in the output of the computer solution.

6.2 Cost Components of the Objective Function

The objective function is a sum of all cost components over time discounted to present value at any given discount rate. It is defined as the sum of variable cash operating costs, costs of insufficient capacity (opportunity costs), additional costs daytime operation, capital costs of the conversion, costs of positioning flights at low load factors, conversion station costs, costs of ferry flights, and costs of idle aircraft. The method of how these components were determined is explained below.

6.2.1 Variable Cash Operating Costs

The variable cash operating costs were derived from the standard DOC calculation as presented in chapter four. The costs included are fuel costs, maintenance costs, landing fees, navigation and handling charges. Although some cost elements (such as landing fees) may vary depending upon the routes flown, this fact was not taken into consideration. It was assumed that the effects of lower or higher actual costs would balance out for the network as a whole and would affect all three aircraft types by the same amount. If, for example, the landing fees at one airport are higher than average, they will be higher for all three aircraft types and not particularly high for one aircraft only. Therefore, the variable cash operating costs are only a function of distance with a fixed cost component.

The individual values of the DOC calculation for different stage lengths were regressed with distance as independent variable and DOC per leg as dependent variable. Landing and handling charges are independent from the stage distance and were treated as fixed costs per leg. Their value depends upon the aircraft type (MTOW, max. payload). Fuel and maintenance cost are a linear function of distance. Fuel costs would also vary with the actual aircraft weight, however fuel consumption at max. payload similar to the DOC calculation was assumed. Navigation charges are a nonlinear function of stage distance. ATC fees decrease the further an aircraft leaves central Europe. With a model similar to

$$\text{ATC Cost (Dist)} = K + c_1 \text{ Dist} + c_2 \text{ Ln Dist} + c_3 (\text{Ln Dist})^2 + c_4 (\text{Ln Dist})^3$$

or

$$\text{DOC (Dist)} = C + C_1 \text{ Dist} + C_2 \text{ Ln Dist} + C_3 (\text{Ln Dist})^2 + C_4 (\text{Ln Dist})^3$$

ATC costs could be predicted by +- $10 and total DOC by +- $20 which represents an error of about 1%. The adjusted R^2 of the models were all larger than 0.9999 with F Statistics between 200,000 and 400,000. The models were used as a basis for an Excel spreadsheet where different input parameters such as fuel costs per liter, maintenance costs, or changes in landing fees over time could be changed to analyze different scenarios and to calculate DOC over time. This will be further presented in Chapter 6, "Input Parameters".

6.2.2 Opportunity Costs of Insufficient Capacity

Each route has a certain demand for overnight cargo service with a specific yield. Depending upon this yield it is more or less important for an airline to satisfy all the demand, or offer only limited capacity. The opportunity costs were determined by multiplying the aircraft capacity with a target load factor and subtracting this value from the demand on the particular route. If this value was positive, it was multiplied with the opportunity costs per ton of not accommodated cargo demand. As long as it remained negative (enough capacity), opportunity costs were zero. The opportunity costs can therefore be expressed by the formula

Opp. Cost = (Demand   Max. Payload * Target load factor) * Opp.Cost per ton

if   Demand - Max. Payload of the aircraft * Target load factor > 0;

or 0 otherwise.

If the stage length of a particular route would exceed the optimum range of an aircraft, the max. payload was adjusted accordingly. An expected cargo profile or an expected (unconstrained) cargo growth rate establishes the value of the opportunity costs over time. Different opportunity costs per ton may reflect the expected development of the yield over time. Different maximum payloads of the different aircraft types allocate opportunity costs for each leg for each aircraft. The opportunity costs were added to the DOC as explained in the section above.

6.2.3 Additional Costs Daytime Operation and Capital Costs of the Conversion

The additional costs of daytime operation were estimated by subtracting the DOC per block hour of the unconverted aircraft from the DOC of the QC passenger aircraft and multiplying the difference with the daily utilization. This value per QC aircraft was multiplied with the number of QC aircraft available during the planning period.

The capital costs were determined by subtracting the annual costs of the unconverted aircraft from the annual capital costs of the QC aircraft. This value was then divided by 365 to determine the daily costs. This was done because all costs should be based on the same time horizon. If annual costs would be used, they would be overweighted in the model.

6.2.4 Costs of Positioning Flights and Conversion Station Costs

Cost of positioning flights were determined on a per leg basis similar to the variable cash operating costs. Basis for the cost function were the data of the QC aircraft in passenger configuration. It was assumed that the origin of the positioning flights would be the main hub. Therefore, the stage distance equaled to the distance between the hub and the conversion station. The costs of the positioning flights should decrease with increasing passenger volume. In case the load factor reaches break-even load factor, there should be no costs associated with the positioning flight. The costs of positioning flights were determined by the following formula:

Costs of p-flights = 2 * DOC * (1- actual load factor/break even load factor)

for actual load factor < break-even

Costs of p-flights = 0 for actual load factor ∫ break-even

In case the actual load factor exceeds break-even, costs of positioning flights are set to zero, which means that there are no costs of positioning flights associated with this route. In case of no passengers, costs of positioning flights are equal to total DOC on this leg, which is about equal to the costs of a ferry flight. The DOC were multiplied by two since each positioning flight consists of two legs (outbound and inbound). The costs of the positioning flights were added to the total network costs in case an aircraft originates from the station. Conversion station costs are based on the costs of the seat vans.

6.2.5 Cost of Ferry Flights and Costs of Idle Aircraft

Determining the exact distance a ferry flight flies to a particular station substantially increases the complexity of the model without significantly improving the outcome. If scheduling a particular aircraft type (e.g. A320 QC) would require a ferry flight, any rough estimate of the costs of this ferry flight will eliminate minor cost advantages of the aircraft over other aircraft (e.g. B737 QC) and avoid the ferry flight by scheduling the other aircraft, where the ferry flight is not required. If a ferry flight can not be avoided with any aircraft type, the costs of the ferry flight are unimportant, because the flight is necessary to accommodate the schedule. Therefore, a standard cost for all ferry flights that reflects an average stage length of the network was utilized. Also, the model normally imposes several other costs to a ferry flight (positioning flights may become necessary, additional costs of a conversion station, etc.). Therefore, ferry flights are the exception and can be covered with rough (conservative) estimates of the ferry flight costs.

Costs of idle aircraft are the costs of maintaining a fleet of aircraft that are converted to QC aircraft but are not operated as cargo aircraft during the night. These costs can be set as any large number, which means that the model minimizes the number of aircraft that are not utilized, or they can be set equal to the additional costs daytime operation plus capital costs of the conversion. Introducing costs of idle aircraft is important, if the number of buy/sell transactions per period is limited and fluctuating cargo volume might justify maintaining a larger than minimum fleet of different sized aircraft.

6.3 Scheduling Constraints

These constraints can be grouped into two classes. First, there are those constraints that are essential to generate a workable rotation plan. Second, there is a group of optional constraints that are imposed by the airline's management. The first group includes flight coverage, continuity of equipment, aircraft availability, and schedule balance constraints. The second group is not exhaustive. One important constraint of this group, however, is the limitation of buy/sell transactions over time. The shorter the individual time periods become, the more important becomes this constraint, since seasonal fluctuations in cargo demand may cause the model to change the equipment constantly which is unrealistic. Further constraints in this group can be operational specific, such as excluding a station from becoming a conversion station.

Flight coverage refers to the necessity that each leg in the schedule has to be covered once. Otherwise, the LP would assign zero aircraft to each leg, since the necessity to cover the demand is not explicitly stated in other constraints but is included in the objective function.

Continuity of equipment refers to the necessity that each flight has to begin and end on the same aircraft type. This constraint is imposed by the mathematical formulation of the model and will be explained in further detail below.

Aircraft availability limits the number of aircraft that can be used to the number that is available. This is either a number specified, or results from the objective function. This constraint is particularly important in conjunction with the buy-sell constraint.

Schedule balance refers to the requirement that the schedule can be operated continuously without accumulation of aircraft at a station. This means also that at each conversion station the same aircraft type is converted to a cargo aircraft in the evening as it will be converted to a passenger aircraft in the morning.

6.4 Mathematical Formulation

6.4.1 Notation

T : Planning horizon, number of planning intervals.

M : Number of aircraft types.

L : Number of flight legs.

τ_r : Discount rate at time t.

$x_{i,j,k,t}$: Feasible rotation connecting from leg i to leg j on aircraft type k at time t.

$a_{k,t}$: Number of aircraft type k owned at time t.

$Co_{j,k,t}$: Cash operation costs of operating aircraft type k on leg j at time t.

$Ci_{j,k,t}$: Opportunity costs of insufficient A/C capacity of aircraft type k on leg j at time t.

$Cp_{j,k,t}$: Costs of positioning flights of A/C type k on leg j at time t.

$Cd_{k,t}$: Additional costs daytime operation of one converted aircraft type k at time t.

$Cc_{k,t}$: Capital costs of the conversion of aircraft type k at time t.

$Cs_{k,t,s}$: Costs of A/C conversion station of aircraft type k at station s at time t.

$Cf_{s,k,t}$: Costs of ferry flight of aircraft type k to station s at time t.

$Ce_{k,t}$: Cost of owning one idle aircraft type k at time t.

$O_{s,k}$: Origination shortage of aircraft type k at station s.

$T_{s,k}$: Termination shortage of aircraft type k at station s.

S_t : Number of stations at time t.

$Y_{k,t}$: Number of idle aircraft of type k at time t.

$D_{s,k,t}$: Departures of aircraft type k from station s at time t.

$A_{s,k,t}$: Arrivals of aircraft type k at station s at time t.

$Rs_{k,t}$: Maximum rate of aircraft of type k that may be sold during period t.

$Rb_{k,t}$: Maximum rate of aircraft of type k that may be bought during period t.

$K_{k,t}$: Minimum number of aircraft type k that have to be in the fleet at time t.

6.4.2 Objective function

The objective function can be expressed as follows:

Minimize {total network costs} =

(1) $\sum_{t=1}^{T}\left\{\prod_{r=1}^{T}\frac{1}{1+\tau_r}\cdot\right.$

(2) $\left[\sum_{k=1}^{M}\sum_{i=0}^{L}\sum_{j=1}^{L} x_{i,j,k,t}\ (Co_{j,k,t}+Ci_{j,k,t})+\right.$ Operating costs plus opportunity costs

(3) $+\sum_{k=1}^{M} a_{k,t} \cdot (Cd_{k,t} + Cc_{k,t}) +$ Additional costs daytime operation plus capital costs of the conversion

(4) $+\sum_{\iota=1}^{L}\sum_{k=1}^{M} x_{0,\iota,k,t} \cdot (Cp_{\iota,k,t} + Cs_{k,t}) +$ Costs of positioning flights plus conversion station costs

(5) $+\sum_{s=1}^{S}\sum_{k=1}^{M} Cf_{s,k,t} \cdot (O_{s,k,t} + T_{s,k,t}) +$ Costs of ferry flights (Origination plus Termination shortage)

(6) $+\sum_{k=1}^{M} Ce_{k,t} \cdot y_{k,t} \Big]\Big\}$ Costs of idle aircraft

The first term (1) of the objective function states that the network costs are the sum over the number of planning intervals of the planning horizon, discounted at a given interest (discount) rate. If discounting is not desired, the rate may be set to zero.

The second term (2) expresses the sum of cash operating costs and opportunity costs. Note that the costs are allocated to the departure leg of a feasible rotation. Therefore, the costs of a i-0 rotation are zero since there is no departure leg. However, with the constraint of continuity of equipment a i-0 rotation will require a l-i rotation. The l-i rotation will have the costs of the i-leg assigned to it. Therefore, an i-0 rotation implicitly gets costs assigned. With the constraint of schedule balance, the model will not assign i-0 rotations if not necessary.

Term (3) refers to available aircraft in the fleet. In conjunction with the constraint that the aircraft operated in the fleet (sum of all $x_{0,\iota,k,t}$ rotations) at any given time plus the number of aircraft not operated during the same time period ($y_{k,t}$) this part of the objective function assures that ownership costs are associated with each aircraft in the fleet.

Term (4) implies that for each originating flight (0-i rotation) a positioning flight is required and the conversion station costs incur. In theory, it might be possible that there are several flights originating at a station with economies of scale associated. However, due to the hub-and-spoke system of most QC networks, several conversions at the same station will be rarely found. Therefore, conversion station costs were allocated for each originating flight.

An origination shortage (5) occurs if there are more arrivals than departures at a station. In this case, the excess of arriving flights has to leave the station as a ferry flight to a station, where a termination shortage occurred. Termination shortage is the opposite of origination shortage that is, there are less arrivals than departures or a shortage of aircraft for outgoing flights.

Term (6) imposes an additional cost penalty for idle aircraft. Normally, the cost of idle aircraft are already included in term (3). Idle aircraft, however, should be avoided and therefore an additional cost penalty was imposed. If idle aircraft are not considered an additional penalty, term (6) may be omitted and subsequently constraint (C) has to be changed in that y is omitted from the formula and the equal sign is replaced by a less than or equal sign.

6.4.3 Constraints

The first constraint states that each leg has to be covered once by exactly one aircraft type.

(A) $\sum_{k=1}^{M}\sum_{i=0}^{L} x_{i,j,k,t} = 1$ for all j = 1,...,L and t = 1,.....,T

The constraint states that the sum of all rotations for all aircraft types that depart into leg j (that is depart into leg 1, 2,.....,L) from any arriving leg i has to be equal to one for all planning intervals. Therefore, the LP is forced to pick one, and exactly one aircraft type for each leg of the network during each interval. However, it may chose different aircraft types at different times.

The second constraint assures continuity of equipment.

(B) $\sum_{i=0}^{L} x_{i,l,k,t} = \sum_{j=0}^{L} x_{l,j,k,t}$ for all l = 1,...,L and k = 1,.....,M and t = 1,.....,T

(B) states that if a certain aircraft type (e.g. a B737) was picked to depart into leg l (e.g. 3) at time t (e.g. 1), there must be a departure into any leg i with (in this example) a B737 arriving from leg 3. Or, in other words, the same aircraft type has to depart into, and arrive from the same leg. This must be true for all rotations and all aircraft types at all times. Of course, the aircraft may also just fly this single leg (0-l and l-0) in which case the model may have to assign a ferry flight, if the schedule is not balanced any more. That is, originating and terminating flights are also allowed.

Constraint three (C) limits the number of aircraft used in the schedule:

$$\text{(C)} \quad \sum_{i=1}^{L} x_{0,i,k,t} + y_{k,t} = a_{k,t} \quad \text{for all } k = 1,\ldots,M \text{ and } t = 1,\ldots.,T$$

If $a_{k,1}$ is not externally given as the number of already existing QC aircraft in the fleet ($K_{k,t}$), the model plans the number of aircraft required without consideration of already existing aircraft. The number of aircraft in operation (sum of all $x_{o,i,k,t}$) plus the sum of all aircraft not used during the period ($y_{k,t}$) must be equal to the number available as stated in the objective function ($a_{k,t}$). This constraint has only an effect on the optimum solution, if the number of buy-sell transactions per period is limited (see constraint (E)).

The fourth constraint (D) requires that the schedule is balanced:

$$\sum_{i \in D_{s,k,t}} x_{0,i,k,t} + O_{s,k,t} = \sum_{i \in A_{s,k,t}} x_{i,0,k,t} + T_{s,k,t} \quad \text{for all } s = 1,\ldots.,S;\ k = 1,\ldots,M;\ t = 1,\ldots.,T$$

That is, the sum of all flights on a certain aircraft type k at time t leaving from a station s, plus the number of excess arrivals, must be equal to the sum of all aircraft of type k arriving at station s, plus the number of excess departures at time t For example, if, at time 1, there are four B737 flights departing from station A and six B737 flights arriving at the same station A, then $O_{A,1,B737}$ must be equal to two with the subsequent penalty of ferry flights (see term (5) of the objective function)

The fifth constraint is optional and limits the number of buy sell transactions per period It may appear in different forms dependent upon the airline's situation In the following, it was assumed that the airline keeps converted aircraft for at least seven ($=T_s$) years before they may be sold After seven years, no more than two aircraft per period may be sold of each aircraft type Initial number of aircraft is five ($=K_{737,1}$) B737 QC that may be sold after five years

Mathematically this constraint can be expressed as follows

(E1) $a_{k,t} - a_{k,t-1} \geq 0$ for all k = 1, ,M and t = 1, ,T_s limits the number of sell transactions to zero until $t=T_s$

(E2) $a_{k,t} - a_{k,t-1} + a_{k,t-Ts} \geq 0$ for all k = 1, ,M and t = T_s, ,T allows to sell aircraft older than T_s years

(E3) $a_{k,t} - a_{k,t-1} + Rs_{k,t} \geq 0$ for all k = 1, ,M and t = 1, ,T limits the number of aircraft that may be sold during each period [1]

[1] This has only then a limiting function if $t \geq t_s$ Otherwise, (E1) limits the number of aircraft that may be sold to zero

Additionally, minimum number of aircraft of a specific aircraft type in the fleet at any time may be given by

(E4) $a_{k,t} \geq K_{k,t}$ for any given aircraft type k at a given time t

A similar constraint can be build to limit the number of aircraft purchases per time period

(E5) $a_{k,t} - a_{k,t-1} \leq Rb_{k,t}$ for all k = 1, ,M and t = 1, ,T

However, limiting the number of aircraft that may be bought may result in an infeasible solution, if not enough aircraft to cover the schedule can be purchased The sell and buy rates can be chosen by the airline and depend upon the airline's financial situation, the duration of one planning interval, and the manufacturer's ability to convert aircraft In case Rs and Rb are set large, the constraint may be omitted

Finally, all variables in the model have to be positive integer numbers with all $x_{i,j,k,t}$ being binary numbers However, in most cases, due to the construction of the model, the solution fulfills this requirement without explicitly stating it

7 INPUT PARAMETERS

The following chapter outlines the input parameters as they are used in the model. A complete presentation, however, will not be possible due to the large number of individual values that enter it. The final data set consists of about 42,000 observations containing about 10,000 nonzero values for variables of the objective function. Therefore, data must be presented in aggregated form.

All values are calculated using Excel spreadsheets. The basic data used in the economic comparison served as database. The values were then exported into SAS Software where they were sorted, modified and combined to the sparsedata format that is used for the proc lp statement.[29]

7.1 The network

The network under study is a QC typical hub-and-spoke network which consists of a main hub (A) and 19 stations (B-T) as illustrated in Figure 16. Some services (e.g. D-A or K-A) are one-stop services, which means that they have an intermediate stop at another station before arriving at the hub (e.g. service D-A has an intermediate stop at station C). All incoming legs to station (A) have to connect to the outgoing legs. Except for the

[29] Refer to SAS Institute, **SAS/OR User's Guide,** Version 6 (Cary: SAS Institute, 1989) chapter 7 for details about using SAS/OR for solving LP problems.

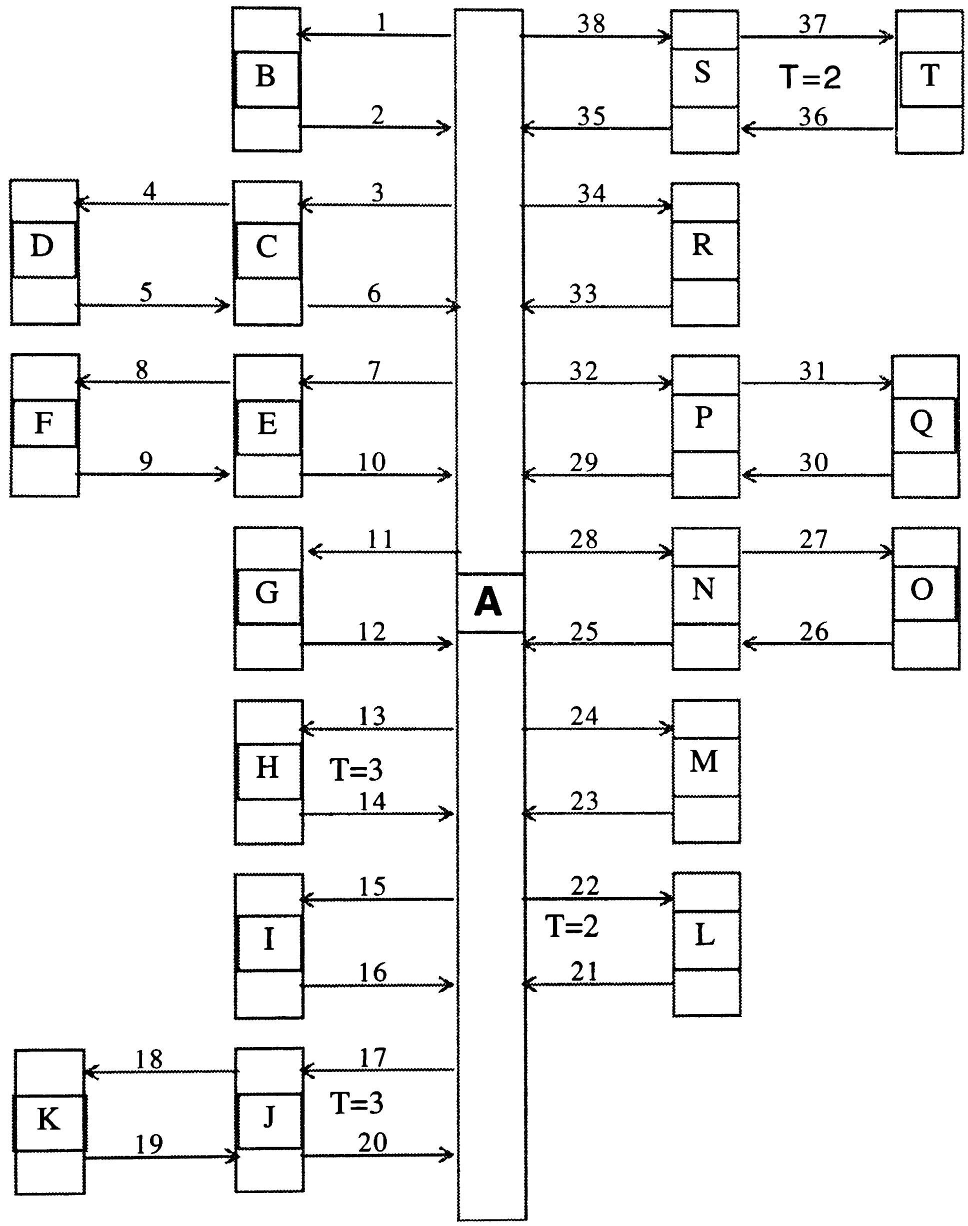

Figure 16 The network

service from station (F) all one-stop services must have a connection to the leg into the hub. Service from station (F) is independent and connects only stations (F) and (E). Service to stations L, S, and T starts at time 2 (second year), and to stations H, J, and K at time 3 (third year). All legs were assigned numbers that will appear in the output of the LP. For example, rotations 2-1 will have leg 2 (inbound from station (B) to station (A)) as arrival leg and leg 1 (outbound from station (A) to station (B)) as departure leg. The number of feasible rotations in the model amounts to 9,027 for all time periods or about 750 per year.

The network includes all routes where cargo service may be offered in the future and QC aircraft may be scheduled. It has to be noted that the model does not consider alternative aircraft such as pure freighters. It determines only how many QC aircraft of each type should be operated, in case the airline decides to acquire QC aircraft. That is, it determines the competitiveness of the Airbus QC aircraft compared to the B737 QC. The airline may still decide to operate pure freighter aircraft, charter capacity, or not to serve a route at all. Therefore, the analysis provides an upper limit for potential demand of A320/321 QC aircraft.

The time horizon is twelve years. This gives a good long-term picture of the fleet planning requirements with the assumed growth rates of passenger and cargo volume. If purchase and sell restrictions are omitted, it also indicates when the Airbus aircraft become competitive.

Network input parameters are illustrated in Table 10. Distances range from 150 km to 2,000 km, which is about the optimum range of the B737 QC. Longer distances are

Table 10.-- Leg Designators, Distances, Initial Demand and Opportunity Costs of the Network.

Leg No.	Leg	Distance* (km)	Assumed initial demand (in tons)	Opportunity costs per ton (in USD)
1	A-B	2,000	12	2,350
2	B-A	2,000	25	2,300
3	A-C	740	18	2,000
4	C-D	1,300	10	2,500
5	D-C	1,300	8	2,650
6	C-A	740	16	2,050
7	A-E	150	25	200
8	E-F	250	8	880
9	F-E	250	15	1,050
10	E-A	150	25	200
11	A-G	530	10	1,180
12	G-A	530	20	1,180
13	A-H	1,000	7	1,750
14	H-A	1,000	10	1,180
15	A-I	1,400	15	1,470
16	I-A	1,400	10	1,750
17	A-J	600	8	1,180
18	J-K	540	4	1,180
19	K-J	540	6	1,180
20	J-A	600	10	1,180
21	L-A	1,600	12	1,750
22	A-L	1,600	10	1,750
23	M-A	1,200	14	1,900
24	A-M	1,200	18	2,100
25	N-A	640	16	1,800
26	O-N	500	6	2,350
27	N-O	500	6	2,350
28	A-N	640	18	1,750
29	P-A	660	12	2,250
30	Q-P	270	8	2,350
31	P-Q	270	8	2,350
32	A-P	660	12	2,250
33	R-A	1,500	12	1,750
34	A-R	1,500	16	1,750
35	S-A	600	14	2,150
36	T-S	480	8	2,650
37	S-T	480	8	2,650
38	S-A	600	14	2,150

* Figures were rounded to the next ten.

infeasible for QC operation, because the departure time of the associated passenger flights has to be too early in the evening to accommodate the departure time requirements of the cargo flight. Initial demand is assumed to grow by 5% annually.[30] Seasonal fluctuation of demand is not considered. Initial screening of available cargo data showed that demand does not fluctuate considerably. Also, fluctuations within the year balance out since time intervals of one year are chosen. The target revenue cargo load factor was set to 80%. This means that if the actual demand in tons on a particular route exceeds 80% of the payload of the aircraft, opportunity costs will be assigned to this aircraft on this route. The opportunity costs per ton remain constant over time.

Initial stock of aircraft is five B737 QC. They may be replaced at the earliest after five years. However, the LP was run twice, once without the sale constraint. This is to separate potential weaknesses of the Airbus aircraft from purchase restrictions of the airline. Expected passenger demand is shown in Table 11. This demand is expected to grow by 3% per time period. Revenue passenger break-even load factor is assumed to be 60%.

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[30] Boeing Commercial Airplane Group, **1994 World Air Cargo Forecast**, (Seattle: July 1994) cargo forecast for Europe.

Table 11.-- Initial Average Passenger Demand to Each Station in the Network.[31]

Conversion station	Stage distance (km)	Average number of passenger
A	0	0
B	1,200	65
C	400	62
D	1,100	106
E	0	0
F	400	0
G	400	56
H	680	60
I	900	53
J	340	50
K	680	65
L	1,000	60
M	750	62
N	420	55
O	700	50
P	400	0
Q	550	43
R	960	60
S	480	0
T	600	55

7.2 Cost Data

A weight summary of individual cost components of the objective function can be seen in Figure 17. The chart was created by adding all individual values of each cost group for all time intervals and all aircraft types and then showing the total amount of

[31] Average demand is defined as the mean of passengers on the evening flight and passengers on the early morning flight.

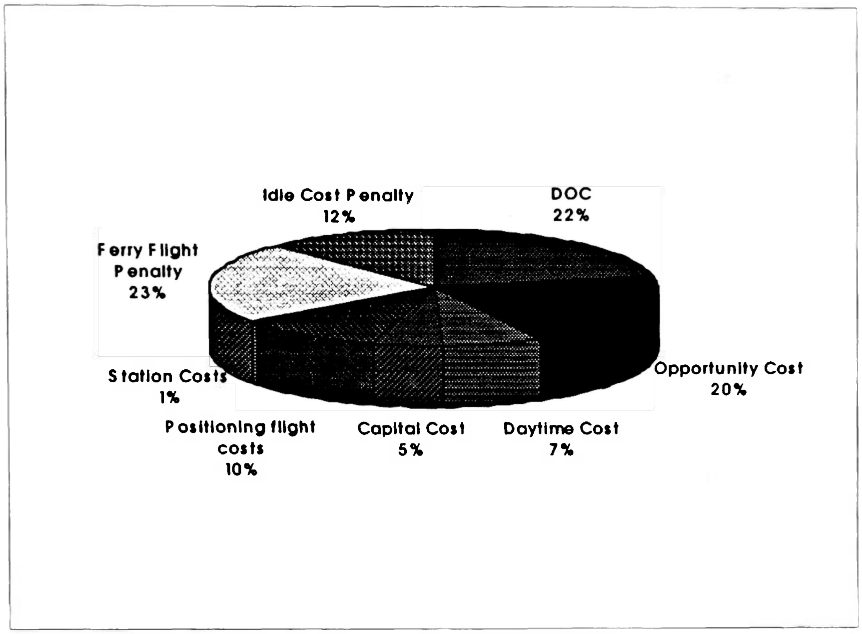

Figure 17 Weight of the cost components of the objective function.

each cost group relative to the sum of all cost components. Therefore, the chart shows how the individual cost components are represented in the model. A high percentage value indicates that minimizing the respective cost component takes a high priority in the solution of the LP.

DOC make up for only 22% of the sum of all nonzero cost components in the objective function which is about the same weight as the opportunity costs. Since opportunity costs are a function of insufficient capacity, this shows that the capacity aspect of the network will become increasingly important. Idle cost penalty has about the same value (12%) as the sum of capital costs plus additional costs of daytime operation. This means that having an idle aircraft in the fleet imposes capital costs and daytime operating costs twice to the aircraft. The ferry flight penalty has about the same amount as the DOC which means that costs of a ferry flight are about as high as the average costs of a leg in the network. Positioning flight costs are about half as important as the DOC but still make up a considerable amount of the components that can not be avoided in operating the network (costs of idle aircraft and ferry flight costs can be avoided). Costs of a conversion station are of minor importance, since only the costs of the seat vans are taken into consideration.

Respective values similar to Figure 17 for each individual aircraft type are shown in Table 12. The weight of direct operating costs is about the same for all aircraft.

Table 12.-- Weight of the Cost Components of Each Aircraft Type.

Cost component	**B737 QC**	**A320 QC**	**A321 QC**
Direct operating costs	21%	22%	22%
Opportunity costs	30%	21%	11%
Additional costs daytime operation	5%	7%	10%
Capital costs	4%	5%	5%
Positioning flight costs	7%	9%	13%
Conversion station costs	1%	1%	1%
Ferry flight penalty	21%	23%	23%
Idle aircraft penalty	10%	12%	14%

Opportunity costs are weighed highest for the B737 which results from the fact that it is the smallest aircraft and demand exceeds 80% capacity on several routes over time. All other cost components are weighed higher for the Airbus aircraft This indicates that the higher capacity (lower opportunity costs) results in higher aircraft related costs

The absolute values are given in Table 13 Note that the absolute values are decreasing over time since they are discounted to year one at 9% Additionally, the number of legs served, and different growth rates of parts of the components as given in Table 14 affect the average values Graphically, the figures are presented in Figure 18 It can be seen that the difference of total cost between the B737 and the Airbus aircraft decreases over time with the increase of cargo demand

The absolute direct operating cost advantage of the B737 is more than outweighed by the lower opportunity costs of the Airbus aircraft (lower two pieces of the bar chart) With the higher daytime operating costs (third piece), all three aircraft are about even Capital costs of the conversion (fourth piece) are similar for all aircraft and do not change the cost structure The cost disadvantage of the Airbus types in the positioning flight costs causes an absolute cost disadvantage in the earlier periods, until passenger demand is assumed to pick up Conversion station costs are negligible Ferry flight costs and costs of idle aircraft are of minor importance, since, as mentioned above, they can be avoided

Table 13.-- Average Costs per Cost Component, Aircraft Type, and Time Period.

Time	Aircraft	Average DOC	Average Opportunity Cost	Daytime costs	Capital costs	Average Costs of Positioning Flights	Conversion Station Costs	Cost penalty of ferry flights	Costs of Idle Aircraft
1	B737	$4,397	$4,167	$1,100	$1,001	$1,648	$161	$4,000	$2,500
1	A320	$4,861	$2,642	$1,526	$1,307	$2,331	$161	$4,700	$3,000
1	A321	$5,438	$1,045	$2,676	$1,481	$3,517	$161	$5,300	$4,000
2	B737	$4,200	$3,992	$1,029	$918	$1,706	$148	$3,853	$2,294
2	A320	$4,648	$2,510	$1,428	$1,199	$2,380	$148	$4,528	$2,752
2	A321	$5,199	$1,062	$2,505	$1,359	$3,525	$148	$5,106	$3,670
3	B737	$3,961	$3,713	$963	$842	$1,424	$136	$3,712	$2,104
3	A320	$4,388	$2,423	$1,337	$1,100	$2,077	$136	$4,361	$2,525
3	A321	$4,909	$1,080	$2,344	$1,247	$3,204	$136	$4,918	$3,367
4	B737	$3,750	$4,013	$901	$773	$1,272	$124	$3,576	$1,930
4	A320	$4,157	$2,689	$1,251	$1,009	$1,892	$124	$4,201	$2,317
4	A321	$4,650	$1,313	$2,193	$1,144	$2,964	$124	$4,738	$3,089
5	B737	$3,552	$4,265	$844	$709	$1,134	$114	$3,444	$1,771
5	A320	$3,938	$2,968	$1,171	$926	$1,718	$114	$4,047	$2,125
5	A321	$4,405	$1,559	$2,052	$1,049	$2,739	$114	$4,564	$2,834
6	B737	$3,364	$4,550	$789	$650	$1,013	$105	$3,318	$1,625
6	A320	$3,732	$3,285	$1,095	$849	$1,555	$105	$3,899	$1,950
6	A321	$4,174	$1,822	$1,921	$963	$2,528	$105	$4,396	$2,600
7	B737	$3,187	$4,814	$739	$597	$908	$96	$3,196	$1,491
7	A320	$3,536	$3,555	$1,025	$779	$1,403	$96	$3,756	$1,789
7	A321	$3,956	$2,089	$1,797	$883	$2,330	$96	$4,235	$2,385
8	B737	$3,019	$5,033	$691	$547	$822	$88	$3,079	$1,368
8	A320	$3,352	$3,784	$959	$715	$1,261	$88	$3,618	$1,641
8	A321	$3,750	$2,318	$1,682	$810	$2,145	$88	$4,080	$2,188
9	B737	$2,861	$5,211	$647	$502	$748	$81	$2,966	$1,255
9	A320	$3,178	$4,033	$898	$656	$1,128	$81	$3,485	$1,506
9	A321	$3,555	$2,558	$1,574	$743	$1,971	$81	$3,930	$2,007
10	B737	$2,712	$5,369	$605	$461	$680	$74	$2,857	$1,151
10	A320	$3,013	$4,272	$840	$602	$1,007	$74	$3,357	$1,381
10	A321	$3,371	$2,831	$1,473	$682	$1,808	$74	$3,786	$1,842
11	B737	$2,571	$5,579	$566	$423	$625	$68	$2,752	$1,056
11	A320	$2,857	$4,470	$786	$552	$900	$68	$3,234	$1,267
11	A321	$3,197	$3,064	$1,378	$626	$1,655	$68	$3,647	$1,690
12	B737	$2,438	$5,747	$530	$388	$578	$62	$2,651	$969
12	A320	$2,710	$4,632	$736	$507	$808	$62	$3,115	$1,163
12	A321	$3,032	$3,260	$1,290	$574	$1,512	$62	$3,513	$1,550

Table 14.-- Growth Rates of Input Parameters

.Parameter	Growth rate
Fuel costs	4.0%
Maintenance costs	3.5%
Handling charges	2.0%
Landing fees	5.0%
ATC fees	4.0%
Opportunity costs	0.0%
Daytime operation costs	3.0%
Station costs	0.0%
Ferry flight penalty	5.0%

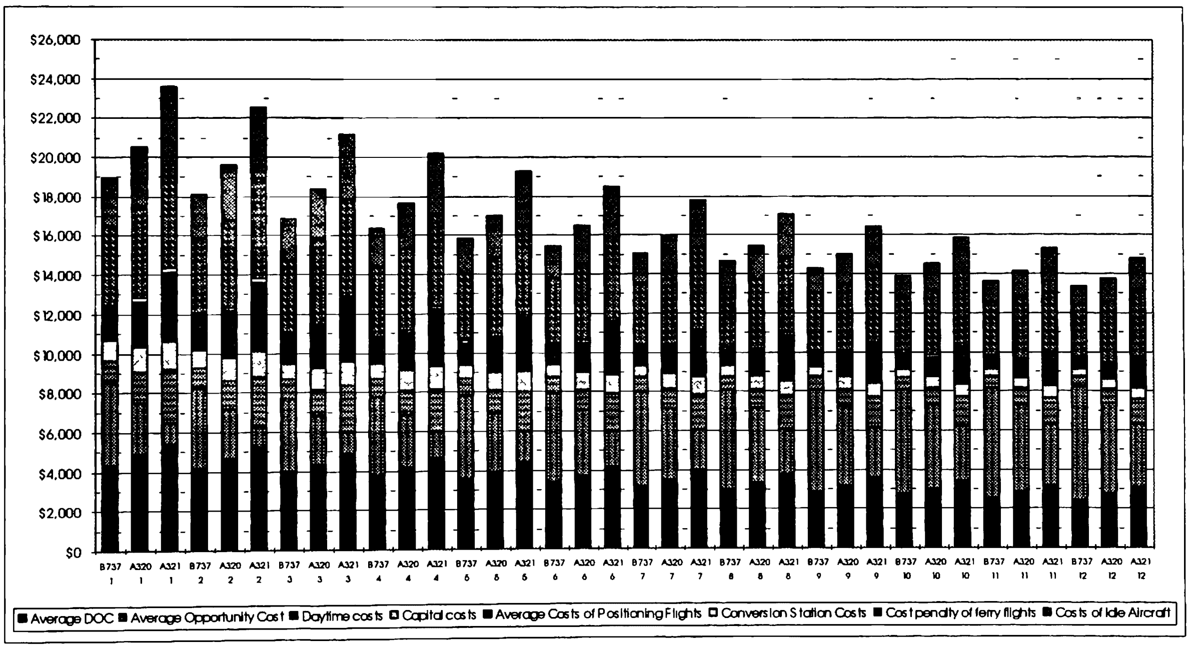

Figure 18 Absolute average values of the objective function cost components .

Relative average values of the objective function cost components are shown in Figure 19. It can be seen that the weight of the DOC remains about constant over time

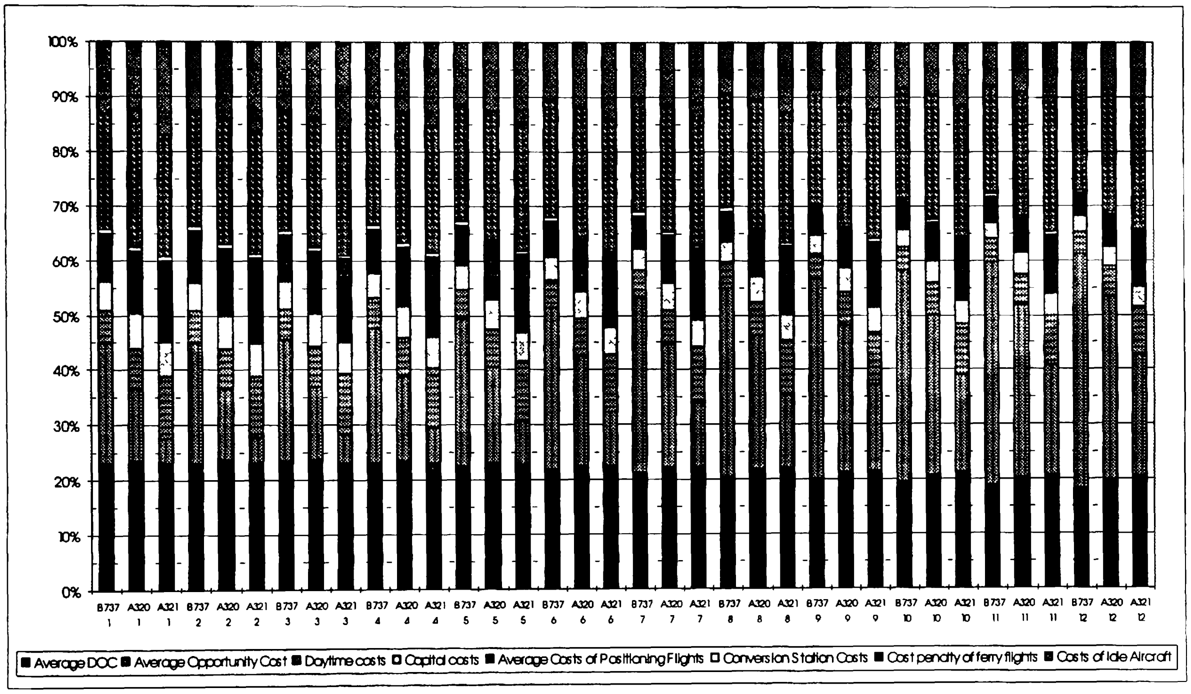

Figure 19 Relative average values of the objective function cost components .

between 19% and 24%. The weight of the opportunity costs, however, increases from about 22% to 43 % in case of the B737 QC, 12% to 33% in case of the A320 QC, and 4% to 22 % in case of the A321 QC. The weight of the positioning flights decreases over time which is a result of the assumed growth in passenger demand. The weight of the other cost components does not change significantly.

All input parameters that determine the components of the network costs were calculated for the first year and then recalculated for subsequent years assuming different growth rates for each parameter A summary of estimated growth rates is given in Table 14

DOC for the first time period were calculated using the formulas

$$DOC_{B737} = 3{,}607 + 1\ 18\ Dist \quad 274\ 7\ \ln(Dist) + 39\ 65(\ln(Dist))^2$$

$$DOC_{A320} = 4{,}068 + 1\ 27\ Dist - 318\ 67\ \ln(Dist) + 45\ 48\ (\ln(Dist))^2$$

$$DOC_{A321} = 4{,}407 + 1\ 45\ Dist \quad 301\ 95\ \ln(Dist) + 45\ 32\ (\ln(Dist))^2$$

8 ANALYSIS OF THE LP OUTPUT

A problem summary, solution summary, and a summary of the nonzero variables of the LP are included in Appendices B and C. The computations were done on a PC with 16 MB RAM and an Intel Pentium P90 processor board. Computation time ranged between one and two hours, depending upon the number of constraints and the desired output data sets. The LP procedure employs a two-phased revised simplex method.[32]

The variable names in the Appendix may be interpreted as follows. Designators that begin with an "A" followed by four digits stand for the number of suggested aircraft in the fleet at a specified time (first digit) for a specific aircraft (last three digits). Designators beginning with an "X" specify a feasible rotation. The first group of digits indicates the inbound and the outbound leg. The following group of letters indicates the departure and arrival station. The last group of digits specifies time and aircraft type similar to "A"-variables.

Section 8.1 presents the recommended fleet mix for the network with and without the sales constraint as outlined in Chapter 5. In section 8.2 the aircraft rotation schedule as derived from the SAS printout will be discussed. Section 8.3 contains a cost analysis of the cost components in the optimum solution and further analysis of the competitiveness of the Airbus aircraft compared to the B737.

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[32] See SAS Institute, **SAS/OR User's Guide**, Version 6 (Cary: SAS Institute, 1989), 229 for details.

8.1 Fleet Mix

The suggested fleet mix is shown in Table 15. It can be seen that the sales constraint is of importance to the results of the LP at the earlier time periods during the

Table 15.-- Suggested Fleet Mix

	No sales constraint				With sales constraint			
Time	**Total**	B737 QC	A320 QC	A321 QC	**Total**	B737 QC	A320 QC	A321 QC
1	**10**	4	2	4	**10**	5	1	4
2	**13**	6	3	4	**13**	6	3	4
3	**14**	6	4	4	**14**	6	3	5
4	**14**	6	3	5	**14**	6	3	5
5	**14**	6	2	6	**14**	6	3	5
6	**14**	5	3	6	**14**	6	3	5
7	**14**	4	3	7	**14**	4	3	7
8	**14**	4	3	7	**14**	4	3	7
9	**15**	5	3	7	**15**	5	3	7
10	**15**	4	2	9	**15**	4	2	9
11	**15**	4	1	10	**15**	4	1	10
12	**15**	3	2	10	**15**	3	2	10

expansion of the network. Initial recommended fleet size is ten aircraft comprising of four B737, two A320, and four A321. If more than five B737 have to be in the fleet, one A320 is traded against the fifth B737. With the expansion of the network in year two, three aircraft are added to the fleet, which gives a similar fleet mix for both versions of the LP. In year three, when the network is expanded further, the fleet is expanded by another aircraft. In case an aircraft may not be sold before seven years, the model suggests to acquire a larger A321 instead of the A320. In year four, both versions of the model suggest the same fleet mix of six B737, three A320, and five A321 since the version without the sales constraint has traded one A320 of period three against an A321. In year five, another A320 is traded against an A321. If this is not allowed, the network is covered with a similar fleet mix as in year four, however, with insufficient payload capacity for this period. As soon as older B737 aircraft may be sold after period six, Boeing aircraft are traded against the larger A321 which becomes the major aircraft type in the fleet.

8.2 Aircraft Rotation Schedule

Suggested aircraft rotation plans without and with sales constraint are shown in Table 16 and Table 17 respectively. The tables were derived from the SAS printouts included in Appendix 2. For example, aircraft rotation 2-1 means that one aircraft flies legs two and one during one night, which comprises of the feasible rotations 0-2, 2-1, and 1-0. For easier analysis, the original suggested rotation plan was slightly modified without any impact on the total network costs of the optimal solution by forming closed aircraft rotations. If, for example, the LP suggested to operate one A321 on legs 2-3-4 and one on legs 5-6-1 during the same time period, the result was modified in that one

Table 16.-- Aircraft Rotation Schedule without Sales Constraint

Aircraft Rotation	Time Period(s)	Aircraft Type
2-1	1-12	A321
5-6-3-4	1-12	A321
10-7	1-12	B737
9-8	1-12	B737
12-11	1-6 7-10 11-12	B737 A320 A321
13-14	3-9 10-12	B737 A320
16-15	1-9 10-12	A320 A321
19-20-17-18	3-11 12	B737 A320
21-22	2-5 6-9 10-12	B737 A320 A321
23-24	1-12	A321
26-25-28-27	1-8	A321
25-28	9-12	A321
26-27	9-12	B737
30-29-32-31	1-2 3-6 7-12	B737 A320 A321
33-34	1-4 5-12	A320 A321
35-38	2	A320
36-37	2	B737
36-35-38-37	3 4-12	A320 A321

Table 17.-- Aircraft Rotation Schedule with Sales Constraint

Aircraft rotation	Time period(s)	Aircraft type
2-1	1-12	A321
5-6-3-4	1-12	A321
9-8	1-12	B737
10-7	1-12	B737
12-11	1-6 7-10 11-12	B737 A320 A321
14-13	3-9 10-12	B737 A320
16-15	1-9 10-12	A320 A321
19-20-17-18	3-11 12	B737 A320
21-22	2-5 6-9 10-12	B737 A320 A231
23-24	1-12	A321
26-25-28-27	1-8	A321
26-27	9-12	B737
25-28	9-12	A321
30-29-32-31	1-2 3-6 9-12	B737 A320 A321
33-34	1 2 3 4-5 6-12	B737 A320 A321 A320 A321
35-38	2	A320
36-37	2	B737
36-35-38-37	3 4-12	A320 A321

A321 operates on legs 2-1 and the other one on legs 5-6-3-4. This has no effect on total costs because feasible rotation 2-1 has the same costs assigned as feasible rotation 6-1. Therefore, since the model is indifferent between picking feasible rotation 2-1 or 6-1 (all constraints are met by both rotations versions), it was simply by chance that the LP did not form closed aircraft cycles as it did in some cases (e.g. 0-10, 10-7, 7-0, time 2, B737).[33]

Among the four rotations that should be served by an A321 from the beginning, two are already served by the airline (26-25-28-27 and 23-24) using B737 equipment. The other two routes are among the ones with the highest probability to be included in the QC network (2-1 and 5-6-3-4). This means that the current equipment is getting too small and should be replaced by a larger aircraft. Among the routes that should be served by an A320, only one rotation (16-15, currently not served) should be flown with an A320 regardless of a sales constraint. The other rotation (33-34, currently served by a B737) should be flown with an A320 after one year, as soon as the Boeing aircraft can be operated on a new route.

33 Per definition, there is no cost advantage if not only the same aircraft type, but even the same aircraft arrives in the morning at the same station as it departed the night before In fact, having closed aircraft cycles in this case has no effect on costs.

8.3 Cost Analysis

Detailed values of individual cost components are included in Appendices D-F. Appendix D contains information about the costs on legs where a B737 QC is recommended. Initially, DOC, opportunity costs, and the cost of positioning flights are shown. This is followed by the equivalent data of the Airbus aircraft on the same legs, including the relative difference to the B737 QC. Capital costs are not included, since they are independent from a particular leg. Costs of conversion stations are included in the positioning flight costs, since they are of minor importance to the optimum solution. All cost data are derived from the LP with the sales constraint. The difference to the solution without sales constraint is negligible and therefore omitted. The structure of Appendices E and F is similar to Appendix D, however the A320 QC and the A321 QC respectively serve as the basis aircraft.

Figure 20 illustrates the weight of the different cost components in the optimum solution. Idle and ferry costs are zero percent, since they were avoided at any period. The weight of direct operating costs has increased to 47%, while opportunity costs have decreased relative to the direct operating costs (in the input data both components have

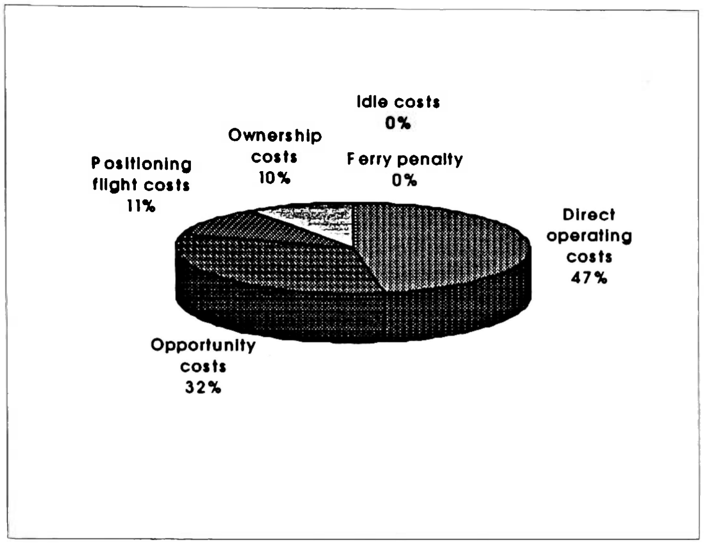

Figure 20 Weight of cost types in the optimum solution.

about the same weight). This indicates that on the average larger equipment with higher DOC but lower opportunity costs is suggested by the LP. Since the LP could have scheduled smaller aircraft at lower DOC, if this would have reduced total network costs but did not do so, it can be concluded that the additional costs of a larger aircraft (A321 QC) in the given network are justified in the light of total network cost minimization. Or, in other words, the marginal benefit of larger equipment (lower opportunity costs) is higher than its marginal costs (higher direct operating, ownership, and positioning flight costs). Consequently, the B737 QC is substituted against the A321 QC with increasing demand over time, although the A321 QC has about 25% higher direct operating costs than the B737 QC.

This conclusion can be illustrated by analyzing aircraft rotation 2-1 (refer to Appendix 6). The LP suggests to operate an A321 QC on the rotation at all times. Even in year one, with a relatively low passenger load factor (65 passengers) on a relatively long positioning flight leg, the high opportunity costs due to high (even unbalanced) cargo demand costs more than outweigh the additional costs of the A321 QC. Total B737 costs of the rotation are about $84,000 higher than the respective A321 costs. This is equivalent to the value of about three tons of cargo per rotation.

The A320 QC is represented with only few aircraft in the suggested fleet mix at a decreasing tendency. This indicates that the range of route characteristics (cargo and passenger demand, stage length, etc.) where scheduling an A320 QC offers cost advantages is relatively narrow. Either, it is still cheaper to operate a B737 QC, or it is already advantageous to switch to the larger A321 QC. The time periods where the A320 as an intermediate aircraft is cheaper are relatively short. Additionally, there is no leg in the network where the A320 QC would offer a payload advantage due to range problems of the other two aircraft. This means that the range advantage is not valued on any route. However, with the scheduling problem of passenger flights on long positioning flights as mentioned in a previous chapter, routes beyond 2,000 km will be the exception for a QC network.

Table 18 gives an overview of the cost components for each aircraft type. The relative weight of each cost variable indicates its portion of the total aircraft related costs. The A321 QC opportunity costs have the highest weight compared tot the other two aircraft, although it is the largest aircraft. This apparent contradiction is due to the fact

Table 18.-- Aggregated Costs per Aircraft Type and Cost Component.

Aircraft	Cost Type	Value	Relative weight	Mean	Standard deviation
B737 QC	Direct operating costs	$436,128	52%	$3,160	808
	Opportunity costs	$212,333	25%	$1,539	2434
	Positioning flight costs	$103,139	12%	$747	1634
	Ownership costs	$86,596	10%	$7,216	3109
A320 QC	Direct operating costs	$290,642	54%	$4,037	914
	Opportunity costs	$124,655	23%	$1,731	2747
	Positioning flight costs	$66,200	12%	$919	1479
	Ownership costs	$58,731	11%	$4,894	2094
A321 QC	Direct operating costs	$965,676	44%	$4,235	1043
	Opportunity costs	$806,962	37%	$3,539	5525
	Positioning flight costs	$214,783	10%	$942	1579
	Ownership costs	$210,015	10%	$17,501	1488
Total all A/C	Direct operating costs	$1,692,446	47%	N/A	N/A
	Opportunity costs	$1,143,950	32%	N/A	N/A
	Positioning flight costs	$384,122	11%	N/A	N/A
	Ownership costs	$355,342	10%	N/A	N/A

that the A321 QC can not be substituted by a larger aircraft if demand exceeds its capacity as it is the case with the other two aircraft. In combination with the fact that the weight of the total opportunity costs has decreased compared to the weight in the input parameters, the fact of the high relative opportunity costs of the A321 QC is no contradiction.

Mean values in Table 18 indicate average annual costs of the respective aircraft types. That is, average DOC of a B737 QC are $3,160, of an A320 QC $4,037, and of an

A321 QC $4,235 per leg. The mean of ownership costs indicates the average amount that has to be spent per year for the particular aircraft fleet.

9 CONCLUSION

Assuming that the Airbus aircraft can be offered as technically specified, both aircraft offer advantages and, mainly in case of the A321 QC, potential cost savings for A-Air. The technical layout with the aft main cargo door eliminates one main QC specific disadvantage which is the reduced comfort in the area of first or business class passengers. Additionally, the threat of engine damage during loading and unloading is reduced and access to the main entrance door 1L is not disturbed by the cargo operation.

Currently, two of the five existing A-Air routes would support operation of an A321 QC. Two of the potential new routes, one with the highest probability of being realized, supplement potential short term demand to a maximum of four A321 QC within the airline's fleet. Medium range demand of the A321 QC amounts to four to seven aircraft, depending upon the rate of the network expansion. In the long run, increasing passenger and especially cargo volumes may increase the number of required A321 QC by another three to four aircraft. This research does not consider whether A-Air has the financial resources to add to its QC fleet at this time. Also, this research does not consider other alternative ways of serving A-Air's cargo market demand and routes which may or may not be less expensive.

A-Air's potential demand for an A320 QC is limited to less than three aircraft. However, if the A321 QC cannot meet its technical specifications, potential A321 QC routes may also be served by an A320 QC. Otherwise, the A320 QC is suggested only as an intermediate aircraft type. The structure of the network with relatively short legs within the optimum range of the other two aircraft does not provide a payload-range advantage for the A320 QC. However, the A320 may represent a viable pure freighter aircraft for medium range operations, where it can benefit from its longer range which would be comparable to the range of the QC version.

REFERENCES

Abara, Jeph. "Applying Integer Linear Programming to the Fleet Assignment Problem." **Interfaces** 19 (July/August 1989): 20-28.

Airbus Industrie. **Performance Doc. P2210** Rev. 2, June 93 and **Performance Doc. P21131** Rev.1, May 92.

Boeing Commercial Aircraft Company. **Performance Doc. D6-37042-4.** Nov. 14 1984.

________. **1994 World Air Cargo Forecast.** Seattle: July 1994.

Borchard, Walter. **A320 Feasibility Study**. Deutsche Aerospace Airbus, February 1994.

Ferguson, AR and GB Dantzig. "The Allocation of Aircraft to Routes-an Example of Linear Programming under Uncertain Demand." **Management Science** 3 (1956).

Goodboy James C. and James G. Gilbertson. **Freighter Network Analysis Model.** (Seattle: Boeing Co., 1960)

Hammer, Robert H. "Fleet and Airplane Acquisition Planning of Regional Airlines." M.S. Thesis, Massachusetts Institute of Technology, 1983.

Hiatt, M.A. and K.C. Plewes. **The Quick-Change Convertible Cargo-Passenger Aircraft Will Aid Air Freight Development in the Next Decade.** Seattle: Boeing Co., 1965. Document Number 650782.

Kirby, D. "Is Your Fleet the Right Size?" **Operations Research Quarterly** 10 (1959): 252; quoted in Christopher Colin New. "Transport Fleet Planning For Multi-Period Operations." **Operations Research Quarterly** 26 (1975).

Sprenger, Wilfried and Karl Kwik. **A320 QC Cabin Layout.** Deutsche Aerospace, March 1994.

Manheim, Marvin L. **Fundamentals of Transportation Systems Analysis. Volume 1: BasicConcepts**. MIT Press Series in Transportation Studies, ed. Marvin L. Manheim. Cambridge: The MIT Press, 1979.

Moos, Hermann. "Zukünftige Einsatzbedingungen und Anforderungen an ein Airbus

A320/321 Frachtflugzeug in der Serien- und Umrüstlösung." [Future conditions and requirements to an Airbus A320/321 freighter as a series and conversion aircraft]. Diplomarbeit FH Würzburg 1993.

New, Christopher Colin. "Transport Fleet Planning For Multi-Period Operations." **Operational Research Quarterly** 26 (1975): 151-166.

Ormsby, R.B. **Development of Total Airline Profit Model Program to Permit Simulation and Evaluation of Total Air Cargo System.** Georgia: Lockheed-Georgia Co., 1969. SAE TRANS 690413.

SAS Institute. **SAS/OR User's Guide.** Version 6. Cary: SAS Insitute, 1989.

Schick, GJ and JW Stroup. "Experience with a Multi-Year Fleet Planning Model." **The International Journal of Management Science** 9 (1981): 389-96.

Shube, DP and JW Stroup. **Fleet Planning Model.** Sacramento: Douglas Aircraft Company, 1975. Paper 6440.

Silva, Armando C. **Cell Fleet Planning: An Industry Case Study.** Cambridge: Massachusetts Institute of Technology, Department of Aeronautics and Astronautics, Flight Transportation Laboratory, May 1984. FTL Report R84-4.

Wyatt, J. K. "Optimal Fleet Size". **Operations Research Quarterly** 12 (1961): 186; quoted in Christopher Colin New. "Transport Fleet Planning For Multi-Period Operations." **Operations Research Quarterly** 26 (1975).

APPENDIX A DIRECT OPERATING COST CALCULATION

Table 19.-- Summary of Input Parameters for the DOC per SKO and TKO Calculation.

	Units	B737-300	B737 QC Pass	B737 QC (cargo)	A320-200	A320 QC (Pass)	A320 QC (Cargo)	A321-100	A321 QC (Pass)	A321 QC (Cargo)
Stage length	NM	500	500	500	500	500	500	500	500	500
Stage length	KM	927	927	927	927	927	927	927	927	927
Payload	kg	14,626	13,563	15,645	16,300	15,509	17,900	19,250	18,634	21,750
Available Seats		123	121	0	144	140	0	182	182	0
Available freight	kg	2,572	1,705	15,645	2,188	1,789	17,900	1,414	798	21,750
Flight time	hr	1.38	1.38	1.38	1.3	1.3	1.3	1.35	1.35	1.35
Block time	hr	1.63	1.63	1.63	1.55	1.55	1.55	1.6	1.6	1.6
Block fuel	kg	3,460	3,532	3,532	3,620	3,780	3,780	4,100	4,600	4,600
Annual Utilization:										
Number of flights		1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920	1,920
Distance	1,000 km	1,779	1,779	1,779	1,779	1,779	1,779	1,779	1,779	1,779
Flight Hours	hr	2,650	2,650	2,650	2,496	2,496	2,496	2,592	2,592	2,592
Block hours	hr	3,130	3,130	3,130	2,976	2,976	2,976	3,072	3,072	3,072
Block fuel	1,000 kg	6,643	6,781	6,781	6,950	7,258	7,258	7,872	8,832	8,832
Ton-km offered	1,000 TKO	26,018	24,127	27,831	28,996	27,589	31,842	34,243	33,148	38,691
Seat-km offered	1,000 SKO	218,802	215,244	0	256,159	249,043	0	323,756	323,756	0

Table 20.-- Annual Direct Operating Costs
(in million USD)

	B737-300	B737 QC (Pass)	B737 QC (cargo)	A320-200	A320 QC (Pass)	A320 QC (Cargo)	A321-100	A321 QC (Pass)	A321 QC (Cargo)
Fuel Cost	1.807	1.845	1.845	1.891	1.974	1.974	2.142	2.403	2.403
Airframe maintenance	1.255	1.287	1.287	1.452	1.520	1.520	1.594	1.617	1.617
Engine maintenance	0.361	0.361	0.361	0.425	0.446	0.446	0.707	0.707	0.707
Landing fees	0.992	1.036	1.036	1.292	1.327	1.327	1.459	1.494	1.494
Handling fees	2.721	2.505	2.884	3.059	2.899	2.960	3.645	3.645	3.091
Navigation charges	1.535	1.569	1.569	1.751	1.775	1.775	1.861	1.883	1.883
Total variable costs	**8.671**	**8.604**	**8.982**	**9.870**	**9.941**	**10.002**	**11.408**	**11.749**	**11.195**
Fixed technical costs	1.860	1.860	1.860	2.144	2.144	2.144	2.334	2.334	2.334
Capital costs	5.109	5.474	5.474	6.603	7.080	7.080	7.724	8.265	8.265
Aircraft depreciation	2.613	2.806	2.806	3.357	3.609	3.609	3.929	4.214	4.214
Spares Depreciation	0.229	0.239	0.239	0.315	0.328	0.328	0.367	0.382	0.382
Aircraft interest	2.085	2.239	2.239	2.679	2.881	2.881	3.135	3.364	3.364
Spares interest	0.182	0.191	0.191	0.252	0.262	0.262	0.293	0.305	0.305
Insurance	0.110	0.118	0.118	0.141	0.152	0.152	0.165	0.177	0.177
Cockpit crew	1.394	1.394	1.394	1.394	1.394	1.394	1.394	1.394	1.394
Cabin crew	1.058	1.058	0.000	1.058	1.058	0.000	1.364	1.364	0.000
Total fixed costs	**9.530**	**9.903**	**8.845**	**11.339**	**11.827**	**10.769**	**12.979**	**13.532**	**12.169**
Total direct costs	**18.201**	**18.507**	**17.827**	**21.209**	**21.768**	**20.771**	**24.387**	**25.281**	**23.364**

APPENDIX B SAS PRINTOUT EXTRACTS OF THE LP SOLUTION WITHOUT SALES CONSTRAINT

LINEAR PROGRAMMING PROCEDURE

PROBLEM SUMMARY

Min Cost	Objective Function
RHS	Rhs Variable
TYPE	Type Variable
Problem Density	0.001102
Variable Type	Number
Non-negative	10308
Total	10308
Constraint Type	Number
EQ	2466
Objective	1
Total	2467

SOLUTION SUMMARY

Terminated Successfully

Objective value	3575451.71
Phase 1 iterations	3845
Phase 2 iterations	2130
Phase 3 iterations	0
Integer iterations	0
Integer solutions	0
Initial basic feasible variables	2
Time used (secs)	1776
Number of inversions	62
Machine epsilon	1E-8
Machine infinity	1.7976931349E308
Maximum phase 1 iterations	8000
Maximum phase 2 iterations	8000
Maximum phase 3 iterations	99999999
Maximum integer iterations	100
Time limit (secs)	10000

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	A10320	NON-NEG	0	2	1.798E308	1442	0
Cost	A10321	NON-NEG	0	9	1.798E308	2155	0
Cost	A10737	NON-NEG	0	4	1.798E308	1066	0
Cost	A11320	NON-NEG	0	1	1.798E308	1338	0
Cost	A11321	NON-NEG	0	10	1.798E308	2004	0
Cost	A11737	NON-NEG	0	4	1.798E308	989	0
Cost	A12320	NON-NEG	0	2	1.798E308	1242	0
Cost	A12321	NON-NEG	0	10	1.798E308	1864	0
Cost	A12737	NON-NEG	0	3	1.798E308	918	0
Cost	A1320	NON-NEG	0	2	1.798E308	2833	0
Cost	A1321	NON-NEG	0	4	1.798E308	4158	0
Cost	A1737	NON-NEG	0	4	1.798E308	2101	0
Cost	A2320	NON-NEG	0	3	1.798E308	2628	0
Cost	A2321	NON-NEG	0	4	1.798E308	3863	0
Cost	A2737	NON-NEG	0	6	1.798E308	1948	0
Cost	A3320	NON-NEG	0	4	1.798E308	2437	0
Cost	A3321	NON-NEG	0	4	1.798E308	3590	0
Cost	A3737	NON-NEG	0	6	1.798E308	1806	0
Cost	A4320	NON-NEG	0	3	1.798E308	2260	0
Cost	A4321	NON-NEG	0	5	1.798E308	3337	0
Cost	A4737	NON-NEG	0	6	1.798E308	1674	0
Cost	A5320	NON-NEG	0	2	1.798E308	2096	0
Cost	A5321	NON-NEG	0	6	1.798E308	3102	0
Cost	A5737	NON-NEG	0	6	1.798E308	1553	0
Cost	A6320	NON-NEG	0	3	1.798E308	1945	0
Cost	A6321	NON-NEG	0	6	1.798E308	2883	0
Cost	A6737	NON-NEG	0	5	1.798E308	1440	0
Cost	A7320	NON-NEG	0	3	1.798E308	1804	0
Cost	A7321	NON-NEG	0	7	1.798E308	2680	0
Cost	A7737	NON-NEG	0	4	1.798E308	1335	0
Cost	A8320	NON-NEG	0	3	1.798E308	1674	0
Cost	A8321	NON-NEG	0	7	1.798E308	2492	0
Cost	A8737	NON-NEG	0	4	1.798E308	1239	0
Cost	A9320	NON-NEG	0	3	1.798E308	1554	0
Cost	A9321	NON-NEG	0	7	1.798E308	2317	0
Cost	A9737	NON-NEG	0	5	1.798E308	1149	0
Cost	X0-10E-A10737	NON-NEG	0	1	1.798E308	4949	0
Cost	X0-10E-A11737	NON-NEG	0	1	1.798E308	4824	0
Cost	X0-10E-A12737	NON-NEG	0	1	1.798E308	4700	0
Cost	X0-10E-A1737	NON-NEG	0	1	1.798E308	6147	9.095E-13
Cost	X0-10E-A2737	NON-NEG	0	1	1.798E308	6011	0
Cost	X0-10E-A3737	NON-NEG	0	1	1.798E308	5873	0
Cost	X0-10E-A4737	NON-NEG	0	1	1.798E308	5738	0
Cost	X0-10E-A5737	NON-NEG	0	1	1.798E308	5603	0
Cost	X0-10E-A6737	NON-NEG	0	1	1.798E308	5470	0
Cost	X0-10E-A7737	NON-NEG	0	1	1.798E308	5336	9.095E-13
Cost	X0-10E-A8737	NON-NEG	0	1	1.798E308	5206	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-10E-A9737	NON-NEG	0	1	1.798E308	5076	0
Cost	X0-12G-A10320	NON-NEG	0	1	1.798E308	13406	0
Cost	X0-12G-A11321	NON-NEG	0	1	1.798E308	13169	0
Cost	X0-12G-A12321	NON-NEG	0	1	1.798E308	13007	0
Cost	X0-12G-A1737	NON-NEG	0	1	1.798E308	14977	0
Cost	X0-12G-A2737	NON-NEG	0	1	1.798E308	14914	0
Cost	X0-12G-A3737	NON-NEG	0	1	1.798E308	14822	0
Cost	X0-12G-A4737	NON-NEG	0	1	1.798E308	14702	0
Cost	X0-12G-A5737	NON-NEG	0	1	1.798E308	14557	0
Cost	X0-12G-A6737	NON-NEG	0	1	1.798E308	14392	0
Cost	X0-12G-A7320	NON-NEG	0	1	1.798E308	13914	0
Cost	X0-12G-A8320	NON-NEG	0	1	1.798E308	13762	0
Cost	X0-12G-A9320	NON-NEG	0	1	1.798E308	13592	0
Cost	X0-14H-A10320	NON-NEG	0	1	1.798E308	5153	0
Cost	X0-14H-A11320	NON-NEG	0	1	1.798E308	5332	0
Cost	X0-14H-A12320	NON-NEG	0	1	1.798E308	5476	0
Cost	X0-14H-A3737	NON-NEG	0	1	1.798E308	5815	0
Cost	X0-14H-A4737	NON-NEG	0	1	1.798E308	5308	0
Cost	X0-14H-A5737	NON-NEG	0	1	1.798E308	4833	0
Cost	X0-14H-A6737	NON-NEG	0	1	1.798E308	4921	0
Cost	X0-14H-A7737	NON-NEG	0	1	1.798E308	5176	0
Cost	X0-14H-A8737	NON-NEG	0	1	1.798E308	5390	0
Cost	X0-14H-A9737	NON-NEG	0	1	1.798E308	5565	0
Cost	X0-16I-A10321	NON-NEG	0	1	1.798E308	6867	0
Cost	X0-16I-A11321	NON-NEG	0	1	1.798E308	6375	0
Cost	X0-16I-A12321	NON-NEG	0	1	1.798E308	5911	0
Cost	X0-16I-A1320	NON-NEG	0	1	1.798E308	9877	0
Cost	X0-16I-A2320	NON-NEG	0	1	1.798E308	9164	0
Cost	X0-16I-A3320	NON-NEG	0	1	1.798E308	8494	0
Cost	X0-16I-A4320	NON-NEG	0	1	1.798E308	7867	0
Cost	X0-16I-A5320	NON-NEG	0	1	1.798E308	7279	0
Cost	X0-16I-A6320	NON-NEG	0	1	1.798E308	6726	9.095E-13
Cost	X0-16I-A7320	NON-NEG	0	1	1.798E308	6209	9.095E-13
Cost	X0-16I-A8320	NON-NEG	0	1	1.798E308	5723	0
Cost	X0-16I-A9320	NON-NEG	0	1	1.798E308	5629	0
Cost	X0-19K-J10737	NON-NEG	0	1	1.798E308	2667	0
Cost	X0-19K-J11737	NON-NEG	0	1	1.798E308	2536	0
Cost	X0-19K-J12320	NON-NEG	0	1	1.798E308	2684	0
Cost	X0-19K-J3737	NON-NEG	0	1	1.798E308	4689	9.095E-13
Cost	X0-19K-J4737	NON-NEG	0	1	1.798E308	4225	0
Cost	X0-19K-J5737	NON-NEG	0	1	1.798E308	3791	0
Cost	X0-19K-J6737	NON-NEG	0	1	1.798E308	3388	0
Cost	X0-19K-J7737	NON-NEG	0	1	1.798E308	3108	0
Cost	X0-19K-J8737	NON-NEG	0	1	1.798E308	2953	0
Cost	X0-19K-J9737	NON-NEG	0	1	1.798E308	2806	0
Cost	X0-21L-A10321	NON-NEG	0	1	1.798E308	7912	0
Cost	X0-21L-A11321	NON-NEG	0	1	1.798E308	8073	-9.09E-13

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-21L-A12321	NON-NEG	0	1	1.798E308	8195	0
Cost	X0-21L-A2737	NON-NEG	0	1	1.798E308	7590	0
Cost	X0-21L-A3737	NON-NEG	0	1	1.798E308	7904	0
Cost	X0-21L-A4737	NON-NEG	0	1	1.798E308	8163	0
Cost	X0-21L-A5737	NON-NEG	0	1	1.798E308	8373	0
Cost	X0-21L-A6320	NON-NEG	0	1	1.798E308	7752	0
Cost	X0-21L-A7320	NON-NEG	0	1	1.798E308	7972	9.095E-13
Cost	X0-21L-A8320	NON-NEG	0	1	1.798E308	8144	0
Cost	X0-21L-A9320	NON-NEG	0	1	1.798E308	8278	0
Cost	X0-23M-A10321	NON-NEG	0	1	1.798E308	9825	0
Cost	X0-23M-A11321	NON-NEG	0	1	1.798E308	10019	0
Cost	X0-23M-A12321	NON-NEG	0	1	1.798E308	10168	0
Cost	X0-23M-A1321	NON-NEG	0	1	1.798E308	11424	0
Cost	X0-23M-A2321	NON-NEG	0	1	1.798E308	10621	0
Cost	X0-23M-A3321	NON-NEG	0	1	1.798E308	9869	0
Cost	X0-23M-A4321	NON-NEG	0	1	1.798E308	9163	0
Cost	X0-23M-A5321	NON-NEG	0	1	1.798E308	8502	0
Cost	X0-23M-A6321	NON-NEG	0	1	1.798E308	8479	0
Cost	X0-23M-A7321	NON-NEG	0	1	1.798E308	8913	0
Cost	X0-23M-A8321	NON-NEG	0	1	1.798E308	9277	0
Cost	X0-23M-A9321	NON-NEG	0	1	1.798E308	9578	1.819E-12
Cost	X0-25N-A10321	NON-NEG	0	1	1.798E308	12183	0
Cost	X0-25N-A11321	NON-NEG	0	1	1.798E308	12318	0
Cost	X0-25N-A12321	NON-NEG	0	1	1.798E308	12410	1.819E-12
Cost	X0-25N-A9321	NON-NEG	0	1	1.798E308	11998	0
Cost	X0-26O-N10737	NON-NEG	0	1	1.798E308	3045	0
Cost	X0-26O-N11737	NON-NEG	0	1	1.798E308	2754	0
Cost	X0-26O-N12737	NON-NEG	0	1	1.798E308	2480	0
Cost	X0-26O-N1321	NON-NEG	0	1	1.798E308	11310	0
Cost	X0-26O-N2321	NON-NEG	0	1	1.798E308	10555	0
Cost	X0-26O-N3321	NON-NEG	0	1	1.798E308	9846	3.638E-12
Cost	X0-26O-N4321	NON-NEG	0	1	1.798E308	9181	0
Cost	X0-26O-N5321	NON-NEG	0	1	1.798E308	8556	0
Cost	X0-26O-N6321	NON-NEG	0	1	1.798E308	7969	-9.09E-13
Cost	X0-26O-N7321	NON-NEG	0	1	1.798E308	7417	0
Cost	X0-26O-N8321	NON-NEG	0	1	1.798E308	6900	0
Cost	X0-26O-N9737	NON-NEG	0	1	1.798E308	3356	0
Cost	X0-2B-A10321	NON-NEG	0	1	1.798E308	31053	-7.28E-12
Cost	X0-2B-A11321	NON-NEG	0	1	1.798E308	30777	-3.64E-12
Cost	X0-2B-A12321	NON-NEG	0	1	1.798E308	30457	0
Cost	X0-2B-A1321	NON-NEG	0	1	1.798E308	30491	0
Cost	X0-2B-A2321	NON-NEG	0	1	1.798E308	30926	-3.64E-12
Cost	X0-2B-A3321	NON-NEG	0	1	1.798E308	31244	-3.64E-12
Cost	X0-2B-A4321	NON-NEG	0	1	1.798E308	31457	-1.09E-11
Cost	X0-2B-A5321	NON-NEG	0	1	1.798E308	31575	0
Cost	X0-2B-A6321	NON-NEG	0	1	1.798E308	31609	0
Cost	X0-2B-A7321	NON-NEG	0	1	1.798E308	31565	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Cost	Reduced cost
Cost	X0-2B-A8321	NON-NEG	0	1	1.798E308	31453	0
Cost	X0-2B-A9321	NON-NEG	0	1	1.798E308	31280	0
Cost	X0-30Q-P10321	NON-NEG	0	1	1.798E308	6094	0
Cost	X0-30Q-P11321	NON-NEG	0	1	1.798E308	5679	0
Cost	X0-30Q-P12321	NON-NEG	0	1	1.798E308	5289	0
Cost	X0-30Q-P1737	NON-NEG	0	1	1.798E308	6984	9.095E-13
Cost	X0-30Q-P2737	NON-NEG	0	1	1.798E308	6475	0
Cost	X0-30Q-P3320	NON-NEG	0	1	1.798E308	7494	9.095E-13
Cost	X0-30Q-P4320	NON-NEG	0	1	1.798E308	6970	0
Cost	X0-30Q-P5320	NON-NEG	0	1	1.798E308	6478	0
Cost	X0-30Q-P6320	NON-NEG	0	1	1.798E308	6015	-9.09E-13
Cost	X0-30Q-P7321	NON-NEG	0	1	1.798E308	7503	0
Cost	X0-30Q-P8321	NON-NEG	0	1	1.798E308	7003	0
Cost	X0-30Q-P9321	NON-NEG	0	1	1.798E308	6534	0
Cost	X0-33R-A10321	NON-NEG	0	1	1.798E308	7474	0
Cost	X0-33R-A11321	NON-NEG	0	1	1.798E308	7667	-9.09E-13
Cost	X0-33R-A12321	NON-NEG	0	1	1.798E308	7816	0
Cost	X0-33R-A1320	NON-NEG	0	1	1.798E308	9251	0
Cost	X0-33R-A2320	NON-NEG	0	1	1.798E308	8542	0
Cost	X0-33R-A3320	NON-NEG	0	1	1.798E308	7877	0
Cost	X0-33R-A4320	NON-NEG	0	1	1.798E308	7254	0
Cost	X0-33R-A5321	NON-NEG	0	1	1.798E308	9378	0
Cost	X0-33R-A6321	NON-NEG	0	1	1.798E308	8704	0
Cost	X0-33R-A7321	NON-NEG	0	1	1.798E308	8072	9.095E-13
Cost	X0-33R-A8321	NON-NEG	0	1	1.798E308	7479	0
Cost	X0-33R-A9321	NON-NEG	0	1	1.798E308	7237	0
Cost	X0-35S-A2320	NON-NEG	0	1	1.798E308	13378	0
Cost	X0-36T-S10321	NON-NEG	0	1	1.798E308	5714	0
Cost	X0-36T-S11321	NON-NEG	0	1	1.798E308	5286	9.095E-13
Cost	X0-36T-S12321	NON-NEG	0	1	1.798E308	4885	0
Cost	X0-36T-S2737	NON-NEG	0	1	1.798E308	5866	0
Cost	X0-36T-S3320	NON-NEG	0	1	1.798E308	6978	-9.09E-13
Cost	X0-36T-S4321	NON-NEG	0	1	1.798E308	8934	0
Cost	X0-36T-S5321	NON-NEG	0	1	1.798E308	8310	0
Cost	X0-36T-S6321	NON-NEG	0	1	1.798E308	7723	0
Cost	X0-36T-S7321	NON-NEG	0	1	1.798E308	7171	9.095E-13
Cost	X0-36T-S8321	NON-NEG	0	1	1.798E308	6655	0
Cost	X0-36T-S9321	NON-NEG	0	1	1.798E308	6169	0
Cost	X0-5D-C10321	NON-NEG	0	1	1.798E308	4104	0
Cost	X0-5D-C11321	NON-NEG	0	1	1.798E308	3899	0
Cost	X0-5D-C12321	NON-NEG	0	1	1.798E308	3705	0
Cost	X0-5D-C1321	NON-NEG	0	1	1.798E308	6964	0
Cost	X0-5D-C2321	NON-NEG	0	1	1.798E308	6231	9.095E-13
Cost	X0-5D-C3321	NON-NEG	0	1	1.798E308	5917	9.095E-13
Cost	X0-5D-C4321	NON-NEG	0	1	1.798E308	5611	9.095E-13
Cost	X0-5D-C5321	NON-NEG	0	1	1.798E308	5323	0
Cost	X0-5D-C6321	NON-NEG	0	1	1.798E308	5050	-9.09E-13

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-5D-C7321	NON-NEG	0	1	1.798E308	4793	0
Cost	X0-5D-C8321	NON-NEG	0	1	1.798E308	4550	0
Cost	X0-5D-C9321	NON-NEG	0	1	1.798E308	4320	0
Cost	X0-9F-E10737	NON-NEG	0	1	1.798E308	12539	0
Cost	X0-9F-E11737	NON-NEG	0	1	1.798E308	12326	0
Cost	X0-9F-E12737	NON-NEG	0	1	1.798E308	12107	0
Cost	X0-9F-E1737	NON-NEG	0	1	1.798E308	13852	1.819E-12
Cost	X0-9F-E2737	NON-NEG	0	1	1.798E308	13785	0
Cost	X0-9F-E3737	NON-NEG	0	1	1.798E308	13693	0
Cost	X0-9F-E4737	NON-NEG	0	1	1.798E308	13576	0
Cost	X0-9F-E5737	NON-NEG	0	1	1.798E308	13442	0
Cost	X0-9F-E6737	NON-NEG	0	1	1.798E308	13287	0
Cost	X0-9F-E7737	NON-NEG	0	1	1.798E308	13118	0
Cost	X0-9F-E8737	NON-NEG	0	1	1.798E308	12936	0
Cost	X0-9F-E9737	NON-NEG	0	1	1.798E308	12742	0
Cost	X1-0A-B10321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B11321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B12321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B1321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B2321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B3321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B4321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B5321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B6321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B7321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B8321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B9321	NON-NEG	0	1	1.798E308	0	0
Cost	X10-11A-G1737	NON-NEG	0	1	1.798E308	4109	0
Cost	X10-11A-G3737	NON-NEG	0	1	1.798E308	3681	0
Cost	X10-13A-H6737	NON-NEG	0	1	1.798E308	3589	0
Cost	X10-13A-H9737	NON-NEG	0	1	1.798E308	3051	0
Cost	X10-17A-J10737	NON-NEG	0	1	1.798E308	2608	0
Cost	X10-17A-J11737	NON-NEG	0	1	1.798E308	2809	0
Cost	X10-17A-J8737	NON-NEG	0	1	1.798E308	2846	0
Cost	X10-7A-E12737	NON-NEG	0	1	1.798E308	4539	0
Cost	X10-7A-E2737	NON-NEG	0	1	1.798E308	5850	0
Cost	X10-7A-E4737	NON-NEG	0	1	1.798E308	5577	0
Cost	X10-7A-E5737	NON-NEG	0	1	1.798E308	5442	0
Cost	X10-7A-E7737	NON-NEG	0	1	1.798E308	5175	0
Cost	X11-0A-G10320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G11321	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G12321	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G1737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G2737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G3737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G4737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G5737	NON-NEG	0	1	1.798E308	0	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X11-0A-G6737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G7320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G8320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G9320	NON-NEG	0	1	1.798E308	0	0
Cost	X12-11A-G10320	NON-NEG	0	1	1.798E308	3518	0
Cost	X12-11A-G5737	NON-NEG	0	1	1.798E308	3299	0
Cost	X12-11A-G8320	NON-NEG	0	1	1.798E308	3133	0
Cost	X12-13A-H4737	NON-NEG	0	1	1.798E308	4004	0
Cost	X12-15A-I9320	NON-NEG	0	1	1.798E308	11337	0
Cost	X12-17A-J3737	NON-NEG	0	1	1.798E308	3738	0
Cost	X12-17A-J6737	NON-NEG	0	1	1.798E308	3172	0
Cost	X12-22A-L2737	NON-NEG	0	1	1.798E308	5363	0
Cost	X12-22A-L7320	NON-NEG	0	1	1.798E308	4513	0
Cost	X12-24A-M12321	NON-NEG	0	1	1.798E308	15618	1.819E-12
Cost	X12-34A-R11321	NON-NEG	0	1	1.798E308	11059	0
Cost	X12-7A-E1737	NON-NEG	0	1	1.798E308	5986	0
Cost	X13-0A-H10320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H11320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H12320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H3737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H4737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H5737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H6737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H7737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H8737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H9737	NON-NEG	0	1	1.798E308	0	0
Cost	X14-11A-G4737	NON-NEG	0	1	1.798E308	3485	0
Cost	X14-11A-G6737	NON-NEG	0	1	1.798E308	3479	0
Cost	X14-13A-H10320	NON-NEG	0	1	1.798E308	3221	0
Cost	X14-13A-H11320	NON-NEG	0	1	1.798E308	3055	0
Cost	X14-13A-H12320	NON-NEG	0	1	1.798E308	2897	0
Cost	X14-17A-J5737	NON-NEG	0	1	1.798E308	3350	0
Cost	X14-17A-J7737	NON-NEG	0	1	1.798E308	3005	0
Cost	X14-17A-J9737	NON-NEG	0	1	1.798E308	2696	0
Cost	X14-7A-E3737	NON-NEG	0	1	1.798E308	5712	0
Cost	X14-7A-E8737	NON-NEG	0	1	1.798E308	5045	0
Cost	X15-0A-I10321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I11321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I12321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I1320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I2320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I3320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I4320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I5320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I6320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I7320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I8320	NON-NEG	0	1	1.798E308	0	0

Linear Programming Output

No Sales Constraint

Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X15-0A-I9320	NON-NEG	0	1	1.798E308	0	0
Cost	X16-11A-G7320	NON-NEG	0	1	1.798E308	3306	0
Cost	X16-15A-I2320	NON-NEG	0	1	1.798E308	7977	0
Cost	X16-15A-I5320	NON-NEG	0	1	1.798E308	9864	0
Cost	X16-15A-I6320	NON-NEG	0	1	1.798E308	10330	0
Cost	X16-15A-I8320	NON-NEG	0	1	1.798E308	11060	0
Cost	X16-1A-B12321	NON-NEG	0	1	1.798E308	7340	0
Cost	X16-22A-L10321	NON-NEG	0	1	1.798E308	4294	0
Cost	X16-22A-L9320	NON-NEG	0	1	1.798E308	4486	0
Cost	X16-32A-P11321	NON-NEG	0	1	1.798E308	5346	0
Cost	X16-32A-P4320	NON-NEG	0	1	1.798E308	4034	0
Cost	X16-34A-R1320	NON-NEG	0	1	1.798E308	9079	0
Cost	X16-38A-S3320	NON-NEG	0	1	1.798E308	6235	-9.09E-13
Cost	X17-18J-K10737	NON-NEG	0	1	1.798E308	2506	0
Cost	X17-18J-K11737	NON-NEG	0	1	1.798E308	2375	0
Cost	X17-18J-K12320	NON-NEG	0	1	1.798E308	2523	0
Cost	X17-18J-K3737	NON-NEG	0	1	1.798E308	3667	0
Cost	X17-18J-K4737	NON-NEG	0	1	1.798E308	3471	0
Cost	X17-18J-K5737	NON-NEG	0	1	1.798E308	3286	0
Cost	X17-18J-K6737	NON-NEG	0	1	1.798E308	3112	0
Cost	X17-18J-K7737	NON-NEG	0	1	1.798E308	2947	0
Cost	X17-18J-K8737	NON-NEG	0	1	1.798E308	2792	0
Cost	X17-18J-K9737	NON-NEG	0	1	1.798E308	2645	0
Cost	X18-0J-K10737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K11737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K12320	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K3737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K4737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K5737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K6737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K7737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K8737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K9737	NON-NEG	0	1	1.798E308	0	0
Cost	X19-20J-A10737	NON-NEG	0	1	1.798E308	4434	0
Cost	X19-20J-A11737	NON-NEG	0	1	1.798E308	4584	-1.82E-12
Cost	X19-20J-A12320	NON-NEG	0	1	1.798E308	3975	0
Cost	X19-20J-A3737	NON-NEG	0	1	1.798E308	3738	0
Cost	X19-20J-A4737	NON-NEG	0	1	1.798E308	3538	0
Cost	X19-20J-A5737	NON-NEG	0	1	1.798E308	3350	0
Cost	X19-20J-A6737	NON-NEG	0	1	1.798E308	3527	0
Cost	X19-20J-A7737	NON-NEG	0	1	1.798E308	3806	0
Cost	X19-20J-A8737	NON-NEG	0	1	1.798E308	4048	0
Cost	X19-20J-A9737	NON-NEG	0	1	1.798E308	4256	0
Cost	X2-11A-G11321	NON-NEG	0	1	1.798E308	2991	0
Cost	X2-1A-B10321	NON-NEG	0	1	1.798E308	6093	0
Cost	X2-1A-B2321	NON-NEG	0	1	1.798E308	7216	0
Cost	X2-1A-B6321	NON-NEG	0	1	1.798E308	5791	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X2-1A-B9321	NON-NEG	0	1	1.798E308	5339	0
Cost	X2-24A-M4321	NON-NEG	0	1	1.798E308	11097	0
Cost	X2-28A-N1321	NON-NEG	0	1	1.798E308	6343	0
Cost	X2-28A-N8321	NON-NEG	0	1	1.798E308	11785	0
Cost	X2-32A-P12321	NON-NEG	0	1	1.798E308	5965	0
Cost	X2-38A-S5321	NON-NEG	0	1	1.798E308	4203	0
Cost	X2-3A-C3321	NON-NEG	0	1	1.798E308	9152	0
Cost	X2-3A-C7321	NON-NEG	0	1	1.798E308	12535	0
Cost	X20-13A-H7737	NON-NEG	0	1	1.798E308	3399	0
Cost	X20-13A-H8737	NON-NEG	0	1	1.798E308	3220	0
Cost	X20-17A-J12320	NON-NEG	0	1	1.798E308	2571	0
Cost	X20-17A-J4737	NON-NEG	0	1	1.798E308	3538	0
Cost	X20-22A-L3737	NON-NEG	0	1	1.798E308	5075	0
Cost	X20-22A-L5737	NON-NEG	0	1	1.798E308	4547	0
Cost	X20-7A-E10737	NON-NEG	0	1	1.798E308	4788	0
Cost	X20-7A-E11737	NON-NEG	0	1	1.798E308	4663	0
Cost	X20-7A-E6737	NON-NEG	0	1	1.798E308	5309	0
Cost	X20-7A-E9737	NON-NEG	0	1	1.798E308	4915	0
Cost	X21-11A-G2737	NON-NEG	0	1	1.798E308	3889	0
Cost	X21-11A-G9320	NON-NEG	0	1	1.798E308	3259	0
Cost	X21-13A-H3737	NON-NEG	0	1	1.798E308	4229	0
Cost	X21-13A-H5737	NON-NEG	0	1	1.798E308	3790	0
Cost	X21-15A-I7320	NON-NEG	0	1	1.798E308	10727	0
Cost	X21-22A-L11321	NON-NEG	0	1	1.798E308	4070	0
Cost	X21-22A-L12321	NON-NEG	0	1	1.798E308	3859	0
Cost	X21-22A-L4737	NON-NEG	0	1	1.798E308	4803	0
Cost	X21-22A-L6320	NON-NEG	0	1	1.798E308	4764	0
Cost	X21-22A-L8320	NON-NEG	0	1	1.798E308	4276	0
Cost	X21-24A-M10321	NON-NEG	0	1	1.798E308	14998	0
Cost	X22-0A-L10321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L11321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L12321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L2737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L3737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L4737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L5737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L6320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L7320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L8320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L9320	NON-NEG	0	1	1.798E308	0	0
Cost	X23-15A-I10321	NON-NEG	0	1	1.798E308	9272	0
Cost	X23-1A-B1321	NON-NEG	0	1	1.798E308	7628	0
Cost	X23-1A-B5321	NON-NEG	0	1	1.798E308	6116	0
Cost	X23-24A-M2321	NON-NEG	0	1	1.798E308	8874	0
Cost	X23-28A-N3321	NON-NEG	0	1	1.798E308	8438	0
Cost	X23-28A-N9321	NON-NEG	0	1	1.798E308	12200	0
Cost	X23-34A-R6321	NON-NEG	0	1	1.798E308	8835	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X23-34A-R7321	NON-NEG	0	1	1.798E308	9426	0
Cost	X23-38A-S11321	NON-NEG	0	1	1.798E308	8417	0
Cost	X23-3A-C12321	NON-NEG	0	1	1.798E308	14661	0
Cost	X23-3A-C4321	NON-NEG	0	1	1.798E308	10175	0
Cost	X23-3A-C8321	NON-NEG	0	1	1.798E308	13119	0
Cost	X24-0A-M10321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M11321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M12321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M1321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M2321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M3321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M4321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M5321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M6321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M7321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M8321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M9321	NON-NEG	0	1	1.798E308	0	0
Cost	X25-15A-I12321	NON-NEG	0	1	1.798E308	9924	0
Cost	X25-24A-M11321	NON-NEG	0	1	1.798E308	15341	0
Cost	X25-24A-M3321	NON-NEG	0	1	1.798E308	10056	0
Cost	X25-24A-M8321	NON-NEG	0	1	1.798E308	14080	0
Cost	X25-24A-M9321	NON-NEG	0	1	1.798E308	14579	1.819E-12
Cost	X25-28A-N4321	NON-NEG	0	1	1.798E308	9305	0
Cost	X25-28A-N7321	NON-NEG	0	1	1.798E308	11296	0
Cost	X25-34A-P5321	NON-NEG	0	1	1.798E308	8155	0
Cost	X25-38A-R10321	NON-NEG	0	1	1.798E308	7848	0
Cost	X25-38A-R6321	NON-NEG	0	1	1.798E308	4665	0
Cost	X25-3A-C1321	NON-NEG	0	1	1.798E308	6685	0
Cost	X25-3A-C2321	NON-NEG	0	1	1.798E308	7993	0
Cost	X26-25N-A1321	NON-NEG	0	1	1.798E308	5284	0
Cost	X26-25N-A2321	NON-NEG	0	1	1.798E308	5004	0
Cost	X26-25N-A3321	NON-NEG	0	1	1.798E308	5110	0
Cost	X26-25N-A4321	NON-NEG	0	1	1.798E308	6095	0
Cost	X26-25N-A5321	NON-NEG	0	1	1.798E308	6966	0
Cost	X26-25N-A6321	NON-NEG	0	1	1.798E308	7736	0
Cost	X26-25N-A7321	NON-NEG	0	1	1.798E308	8410	0
Cost	X26-25N-A8321	NON-NEG	0	1	1.798E308	8998	0
Cost	X26-27N-O10737	NON-NEG	0	1	1.798E308	2454	0
Cost	X26-27N-O11737	NON-NEG	0	1	1.798E308	2326	0
Cost	X26-27N-O12737	NON-NEG	0	1	1.798E308	2204	0
Cost	X26-27N-O9737	NON-NEG	0	1	1.798E308	2590	0
Cost	X27-0N-O10737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-O11737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-O12737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-O1321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-O2321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-O3321	NON-NEG	0	1	1.798E308	0	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X27-0N-04321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-05321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-06321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-07321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-08321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-09737	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N10321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N11321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N12321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N9321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-27N-01321	NON-NEG	0	1	1.798E308	4991	0
Cost	X28-27N-02321	NON-NEG	0	1	1.798E308	4727	0
Cost	X28-27N-03321	NON-NEG	0	1	1.798E308	4478	0
Cost	X28-27N-04321	NON-NEG	0	1	1.798E308	4243	0
Cost	X28-27N-05321	NON-NEG	0	1	1.798E308	4021	0
Cost	X28-27N-06321	NON-NEG	0	1	1.798E308	3811	0
Cost	X28-27N-07321	NON-NEG	0	1	1.798E308	3612	0
Cost	X28-27N-08321	NON-NEG	0	1	1.798E308	3425	0
Cost	X29-15A-I4320	NON-NEG	0	1	1.798E308	9321	0
Cost	X29-24A-M7321	NON-NEG	0	1	1.798E308	13491	0
Cost	X29-32A-P1737	NON-NEG	0	1	1.798E308	4272	0
Cost	X29-32A-P2737	NON-NEG	0	1	1.798E308	4627	0
Cost	X29-32A-P3320	NON-NEG	0	1	1.798E308	4259	0
Cost	X29-32A-P5320	NON-NEG	0	1	1.798E308	4263	0
Cost	X29-32A-P6320	NON-NEG	0	1	1.798E308	5148	0
Cost	X29-34A-R10321	NON-NEG	0	1	1.798E308	10747	0
Cost	X29-34A-R8321	NON-NEG	0	1	1.798E308	9938	0
Cost	X29-38A-S12321	NON-NEG	0	1	1.798E308	8910	0
Cost	X29-3A-C11321	NON-NEG	0	1	1.798E308	14381	0
Cost	X29-3A-C9321	NON-NEG	0	1	1.798E308	13616	0
Cost	X3-4C-D10321	NON-NEG	0	1	1.798E308	3943	0
Cost	X3-4C-D11321	NON-NEG	0	1	1.798E308	3738	0
Cost	X3-4C-D12321	NON-NEG	0	1	1.798E308	3544	0
Cost	X3-4C-D1321	NON-NEG	0	1	1.798E308	6425	0
Cost	X3-4C-D2321	NON-NEG	0	1	1.798E308	6081	0
Cost	X3-4C-D3321	NON-NEG	0	1	1.798E308	5756	0
Cost	X3-4C-D4321	NON-NEG	0	1	1.798E308	5450	0
Cost	X3-4C-D5321	NON-NEG	0	1	1.798E308	5162	0
Cost	X3-4C-D6321	NON-NEG	0	1	1.798E308	4889	0
Cost	X3-4C-D7321	NON-NEG	0	1	1.798E308	4632	0
Cost	X3-4C-D8321	NON-NEG	0	1	1.798E308	4389	0
Cost	X3-4C-D9321	NON-NEG	0	1	1.798E308	4159	0
Cost	X30-29P-A10321	NON-NEG	0	1	1.798E308	4644	0
Cost	X30-29P-A11321	NON-NEG	0	1	1.798E308	5346	0
Cost	X30-29P-A12321	NON-NEG	0	1	1.798E308	5965	0
Cost	X30-29P-A1737	NON-NEG	0	1	1.798E308	4272	0
Cost	X30-29P-A2737	NON-NEG	0	1	1.798E308	4627	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X30-29P-A3320	NON-NEG	0	1	1.798E308	4259	0
Cost	X30-29P-A4320	NON-NEG	0	1	1.798E308	4034	0
Cost	X30-29P-A5320	NON-NEG	0	1	1.798E308	4263	-1.82E-12
Cost	X30-29P-A6320	NON-NEG	0	1	1.798E308	5148	0
Cost	X30-29P-A7321	NON-NEG	0	1	1.798E308	3840	0
Cost	X30-29P-A8321	NON-NEG	0	1	1.798E308	3640	0
Cost	X30-29P-A9321	NON-NEG	0	1	1.798E308	3852	0
Cost	X31-0P-Q10321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q11321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q12321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q1737	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q2737	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q3320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q4320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q5320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q6320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q7321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q8321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q9321	NON-NEG	0	1	1.798E308	0	0
Cost	X32-31P-Q10321	NON-NEG	0	1	1.798E308	2805	0
Cost	X32-31P-Q11321	NON-NEG	0	1	1.798E308	2660	-9.09E-13
Cost	X32-31P-Q12321	NON-NEG	0	1	1.798E308	2524	0
Cost	X32-31P-Q1737	NON-NEG	0	1	1.798E308	3639	0
Cost	X32-31P-Q2737	NON-NEG	0	1	1.798E308	3444	0
Cost	X32-31P-Q3320	NON-NEG	0	1	1.798E308	3643	-9.09E-13
Cost	X32-31P-Q4320	NON-NEG	0	1	1.798E308	3451	0
Cost	X32-31P-Q5320	NON-NEG	0	1	1.798E308	3270	0
Cost	X32-31P-Q6320	NON-NEG	0	1	1.798E308	3098	0
Cost	X32-31P-Q7321	NON-NEG	0	1	1.798E308	3289	0
Cost	X32-31P-Q8321	NON-NEG	0	1	1.798E308	3118	0
Cost	X32-31P-Q9321	NON-NEG	0	1	1.798E308	2957	0
Cost	X33-11A-G12321	NON-NEG	0	1	1.798E308	2837	0
Cost	X33-15A-I1320	NON-NEG	0	1	1.798E308	7158	0
Cost	X33-15A-I3320	NON-NEG	0	1	1.798E308	8694	0
Cost	X33-1A-B11321	NON-NEG	0	1	1.798E308	6758	0
Cost	X33-28A-N5321	NON-NEG	0	1	1.798E308	10064	0
Cost	X33-28A-N6321	NON-NEG	0	1	1.798E308	10725	0
Cost	X33-32A-P8321	NON-NEG	0	1	1.798E308	3640	0
Cost	X33-34A-R4320	NON-NEG	0	1	1.798E308	11074	0
Cost	X33-34A-R9321	NON-NEG	0	1	1.798E308	10377	0
Cost	X33-38A-S2320	NON-NEG	0	1	1.798E308	5174	0
Cost	X33-38A-S7321	NON-NEG	0	1	1.798E308	5613	0
Cost	X33-3A-C10321	NON-NEG	0	1	1.798E308	14034	0
Cost	X34-0A-R10321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R11321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R12321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R1320	NON-NEG	0	1	1.798E308	0	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X34-0A-R2320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R3320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R4320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R5321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R6321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R7321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R8321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R9321	NON-NEG	0	1	1.798E308	0	0
Cost	X35-15A-I11321	NON-NEG	0	1	1.798E308	9627	0
Cost	X35-1A-B4321	NON-NEG	0	1	1.798E308	6461	0
Cost	X35-24A-M6321	NON-NEG	0	1	1.798E308	12804	0
Cost	X35-28A-N12321	NON-NEG	0	1	1.798E308	13061	0
Cost	X35-32A-P10321	NON-NEG	0	1	1.798E308	4644	0
Cost	X35-32A-P7321	NON-NEG	0	1	1.798E308	3840	0
Cost	X35-34A-R2320	NON-NEG	0	1	1.798E308	9840	0
Cost	X35-34A-R3320	NON-NEG	0	1	1.798E308	10502	0
Cost	X35-38A-S8321	NON-NEG	0	1	1.798E308	6454	0
Cost	X35-38A-S9321	NON-NEG	0	1	1.798E308	7196	0
Cost	X35-3A-C5321	NON-NEG	0	1	1.798E308	11072	0
Cost	X36-35S-A10321	NON-NEG	0	1	1.798E308	7848	1.819E-12
Cost	X36-35S-A11321	NON-NEG	0	1	1.798E308	8417	0
Cost	X36-35S-A12321	NON-NEG	0	1	1.798E308	8910	1.819E-12
Cost	X36-35S-A3320	NON-NEG	0	1	1.798E308	6235	0
Cost	X36-35S-A4321	NON-NEG	0	1	1.798E308	4435	0
Cost	X36-35S-A5321	NON-NEG	0	1	1.798E308	4203	0
Cost	X36-35S-A6321	NON-NEG	0	1	1.798E308	4665	0
Cost	X36-35S-A7321	NON-NEG	0	1	1.798E308	5613	0
Cost	X36-35S-A8321	NON-NEG	0	1	1.798E308	6454	0
Cost	X36-35S-A9321	NON-NEG	0	1	1.798E308	7196	0
Cost	X36-37S-T2737	NON-NEG	0	1	1.798E308	3773	0
Cost	X37-0S-T10321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T11321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T12321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T2737	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T3320	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T4321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T5321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T6321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T7321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T8321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T9321	NON-NEG	0	1	1.798E308	0	0
Cost	X38-0A-S2320	NON-NEG	0	1	1.798E308	0	0
Cost	X38-37S-T10321	NON-NEG	0	1	1.798E308	3063	0
Cost	X38-37S-T11321	NON-NEG	0	1	1.798E308	2905	-1.82E-12
Cost	X38-37S-T12321	NON-NEG	0	1	1.798E308	2756	0
Cost	X38-37S-T3320	NON-NEG	0	1	1.798E308	3982	0
Cost	X38-37S-T4321	NON-NEG	0	1	1.798E308	4219	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X38-37S-T5321	NON-NEG	0	1	1.798E308	3999	0
Cost	X38-37S-T6321	NON-NEG	0	1	1.798E308	3790	0
Cost	X38-37S-T7321	NON-NEG	0	1	1.798E308	3592	0
Cost	X38-37S-T8321	NON-NEG	0	1	1.798E308	3406	0
Cost	X38-37S-T9321	NON-NEG	0	1	1.798E308	3229	0
Cost	X4-0C-D10321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D11321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D12321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D1321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D2321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D3321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D4321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D5321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D6321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D7321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D8321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D9321	NON-NEG	0	1	1.798E308	0	0
Cost	X5-6C-A10321	NON-NEG	0	1	1.798E308	11012	0
Cost	X5-6C-A11321	NON-NEG	0	1	1.798E308	11456	0
Cost	X5-6C-A12321	NON-NEG	0	1	1.798E308	11829	0
Cost	X5-6C-A1321	NON-NEG	0	1	1.798E308	5469	-9.09E-13
Cost	X5-6C-A2321	NON-NEG	0	1	1.798E308	5179	0
Cost	X5-6C-A3321	NON-NEG	0	1	1.798E308	5329	0
Cost	X5-6C-A4321	NON-NEG	0	1	1.798E308	6481	0
Cost	X5-6C-A5321	NON-NEG	0	1	1.798E308	7501	0
Cost	X5-6C-A6321	NON-NEG	0	1	1.798E308	8403	0
Cost	X5-6C-A7321	NON-NEG	0	1	1.798E308	9198	0
Cost	X5-6C-A8321	NON-NEG	0	1	1.798E308	9891	0
Cost	X5-6C-A9321	NON-NEG	0	1	1.798E308	10493	1.819E-12
Cost	X6-1A-B3321	NON-NEG	0	1	1.798E308	6828	-9.09E-13
Cost	X6-1A-B7321	NON-NEG	0	1	1.798E308	5483	0
Cost	X6-1A-B8321	NON-NEG	0	1	1.798E308	5193	0
Cost	X6-24A-M1321	NON-NEG	0	1	1.798E308	7539	0
Cost	X6-24A-M5321	NON-NEG	0	1	1.798E308	12010	0
Cost	X6-28A-N10321	NON-NEG	0	1	1.798E308	12547	-1.82E-12
Cost	X6-28A-N11321	NON-NEG	0	1	1.798E308	12832	0
Cost	X6-28A-N2321	NON-NEG	0	1	1.798E308	7455	0
Cost	X6-32A-P9321	NON-NEG	0	1	1.798E308	3852	0
Cost	X6-34A-R12321	NON-NEG	0	1	1.798E308	11313	0
Cost	X6-38A-S4321	NON-NEG	0	1	1.798E308	4435	0
Cost	X6-3A-C6321	NON-NEG	0	1	1.798E308	11855	0
Cost	X7-0A-E10737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E11737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E12737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E1737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E2737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E3737	NON-NEG	0	1	1.798E308	0	0

Linear Programming Output
No Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X7-0A-E4737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E5737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E6737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E7737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E8737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E9737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F10737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F11737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F12737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F1737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F2737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F3737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F4737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F5737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F6737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F7737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F8737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F9737	NON-NEG	0	1	1.798E308	0	0
Cost	X9-8E-F10737	NON-NEG	0	1	1.798E308	2240	0
Cost	X9-8E-F11737	NON-NEG	0	1	1.798E308	2375	0
Cost	X9-8E-F12737	NON-NEG	0	1	1.798E308	2491	0
Cost	X9-8E-F1737	NON-NEG	0	1	1.798E308	3597	0
Cost	X9-8E-F2737	NON-NEG	0	1	1.798E308	3404	0
Cost	X9-8E-F3737	NON-NEG	0	1	1.798E308	3222	0
Cost	X9-8E-F4737	NON-NEG	0	1	1.798E308	3049	0
Cost	X9-8E-F5737	NON-NEG	0	1	1.798E308	2887	0
Cost	X9-8E-F6737	NON-NEG	0	1	1.798E308	2733	0
Cost	X9-8E-F7737	NON-NEG	0	1	1.798E308	2588	0
Cost	X9-8E-F8737	NON-NEG	0	1	1.798E308	2452	0
Cost	X9-8E-F9737	NON-NEG	0	1	1.798E308	2322	0
Cost	Cost	OBJECT	0	3575452	1.798E308	0	0

APPENDIX C SAS PRINTOUT EXTRACTS OF THE LP SOLUTION WITH SALES CONSTRAINT

LINEAR PROGRAMMING PROCEDURE

PROBLEM SUMMARY

Min Cost	Objective Function
RHS	Rhs Variable
TYPE	Type Variable
Problem Density	0.001088
Variable Type	Number
Non-negative	10308
Surplus	34
Total	10342
Constraint Type	Number
EQ	2466
GE	34
Objective	1
Total	2501

SOLUTION SUMMARY

Terminated Successfully

Objective value	3575859.61
Phase 1 iterations	6053
Phase 2 iterations	6480
Phase 3 iterations	2620
Integer iterations	0
Integer solutions	0
Initial basic feasible variables	35
Time used (secs)	5737
Number of inversions	154
Machine epsilon	1E-8
Machine infinity	1.7976931349E308
Maximum phase 1 iterations	8000
Maximum phase 2 iterations	8000
Maximum phase 3 iterations	99999999
Maximum integer iterations	100
Time limit (secs)	10000

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	A10320	NON-NEG	0	2	1.798E308	1442	0
Cost	A10321	NON-NEG	0	9	1.798E308	2155	0
Cost	A10737	NON-NEG	0	4	1.798E308	1066	0
Cost	A11320	NON-NEG	0	1	1.798E308	1338	0
Cost	A11321	NON-NEG	0	10	1.798E308	2004	0
Cost	A11737	NON-NEG	0	4	1.798E308	989	0
Cost	A12320	NON-NEG	0	2	1.798E308	1242	0
Cost	A12321	NON-NEG	0	10	1.798E308	1864	0
Cost	A12737	NON-NEG	0	3	1.798E308	918	0
Cost	A1320	NON-NEG	0	1	1.798E308	2833	0
Cost	A1321	NON-NEG	0	4	1.798E308	4158	0
Cost	A1737	NON-NEG	0	5	1.798E308	2101	0
Cost	A2320	NON-NEG	0	3	1.798E308	2628	0
Cost	A2321	NON-NEG	0	4	1.798E308	3863	0
Cost	A2737	NON-NEG	0	6	1.798E308	1948	0
Cost	A3320	NON-NEG	0	3	1.798E308	2437	9.095E-13
Cost	A3321	NON-NEG	0	5	1.798E308	3590	0
Cost	A3737	NON-NEG	0	6.	1.798E308	1806	0
Cost	A4320	NON-NEG	0	3	1.798E308	2260	0
Cost	A4321	NON-NEG	0	5	1.798E308	3337	0
Cost	A4737	NON-NEG	0	6	1.798E308	1674	0
Cost	A5320	NON-NEG	0	3	1.798E308	2096	0
Cost	A5321	NON-NEG	0	5	1.798E308	3102	0
Cost	A5737	NON-NEG	0	6	1.798E308	1553	0
Cost	A6320	NON-NEG	0	3	1.798E308	1945	0
Cost	A6321	NON-NEG	0	6	1.798E308	2883	0
Cost	A6737	NON-NEG	0	5	1.798E308	1440	0
Cost	A7320	NON-NEG	0	3	1.798E308	1804	0
Cost	A7321	NON-NEG	0	7	1.798E308	2680	0
Cost	A7737	NON-NEG	0	4	1.798E308	1335	0
Cost	A8320	NON-NEG	0	3	1.798E308	1674	0
Cost	A8321	NON-NEG	0	7	1.798E308	2492	0
Cost	A8737	NON-NEG	0	4	1.798E308	1239	0
Cost	A9320	NON-NEG	0	3	1.798E308	1554	0
Cost	A9321	NON-NEG	0	7	1.798E308	2317	0
Cost	A9737	NON-NEG	0	5	1.798E308	1149	0
Cost	X0-10E-A10737	NON-NEG	0	1	1.798E308	4949	0
Cost	X0-10E-A11737	NON-NEG	0	1	1.798E308	4824	0
Cost	X0-10E-A12737	NON-NEG	0	1	1.798E308	4700	0
Cost	X0-10E-A1737	NON-NEG	0	1	1.798E308	6147	0
Cost	X0-10E-A2737	NON-NEG	0	1	1.798E308	6011	0
Cost	X0-10E-A3737	NON-NEG	0	1	1.798E308	5873	0
Cost	X0-10E-A4737	NON-NEG	0	1	1.798E308	5738	0
Cost	X0-10E-A5737	NON-NEG	0	1	1.798E308	5603	0
Cost	X0-10E-A6737	NON-NEG	0	1	1.798E308	5470	0
Cost	X0-10E-A7737	NON-NEG	0	1	1.798E308	5336	0
Cost	X0-10E-A8737	NON-NEG	0	1	1.798E308	5206	0
Cost	X0-10E-A9737	NON-NEG	0	1	1.798E308	5076	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-12G-A10320	NON-NEG	0	1	1.798E308	13406	0
Cost	X0-12G-A11321	NON-NEG	0	1	1.798E308	13169	0
Cost	X0-12G-A12321	NON-NEG	0	1	1.798E308	13007	1.819E-12
Cost	X0-12G-A1737	NON-NEG	0	1	1.798E308	14977	0
Cost	X0-12G-A2737	NON-NEG	0	1	1.798E308	14914	0
Cost	X0-12G-A3737	NON-NEG	0	1	1.798E308	14822	-1.82E-12
Cost	X0-12G-A4737	NON-NEG	0	1	1.798E308	14702	0
Cost	X0-12G-A5737	NON-NEG	0	1	1.798E308	14557	0
Cost	X0-12G-A6737	NON-NEG	0	1	1.798E308	14392	0
Cost	X0-12G-A7320	NON-NEG	0	1	1.798E308	13914	0
Cost	X0-12G-A8320	NON-NEG	0	1	1.798E308	13762	0
Cost	X0-12G-A9320	NON-NEG	0	1	1.798E308	13592	0
Cost	X0-14H-A10320	NON-NEG	0	1	1.798E308	5153	0
Cost	X0-14H-A11320	NON-NEG	0	1	1.798E308	5332	0
Cost	X0-14H-A12320	NON-NEG	0	1	1.798E308	5476	0
Cost	X0-14H-A3737	NON-NEG	0	1	1.798E308	5815	0
Cost	X0-14H-A4737	NON-NEG	0	1	1.798E308	5308	0
Cost	X0-14H-A5737	NON-NEG	0	1	1.798E308	4833	0
Cost	X0-14H-A6737	NON-NEG	0	1	1.798E308	4921	0
Cost	X0-14H-A7737	NON-NEG	0	1	1.798E308	5176	0
Cost	X0-14H-A8737	NON-NEG	0	1	1.798E308	5390	0
Cost	X0-14H-A9737	NON-NEG	0	1	1.798E308	5565	0
Cost	X0-16I-A10321	NON-NEG	0	1	1.798E308	6867	0
Cost	X0-16I-A11321	NON-NEG	0	1	1.798E308	6375	-9.09E-13
Cost	X0-16I-A12321	NON-NEG	0	1	1.798E308	5911	0
Cost	X0-16I-A1320	NON-NEG	0	1	1.798E308	9877	0
Cost	X0-16I-A2320	NON-NEG	0	1	1.798E308	9164	0
Cost	X0-16I-A3320	NON-NEG	0	1	1.798E308	8494	0
Cost	X0-16I-A4320	NON-NEG	0	1	1.798E308	7867	0
Cost	X0-16I-A5320	NON-NEG	0	1	1.798E308	7279	0
Cost	X0-16I-A6320	NON-NEG	0	1	1.798E308	6726	-1.82E-12
Cost	X0-16I-A7320	NON-NEG	0	1	1.798E308	6209	0
Cost	X0-16I-A8320	NON-NEG	0	1	1.798E308	5723	0
Cost	X0-16I-A9320	NON-NEG	0	1	1.798E308	5629	0
Cost	X0-19K-J10737	NON-NEG	0	1	1.798E308	2667	0
Cost	X0-19K-J11737	NON-NEG	0	1	1.798E308	2536	0
Cost	X0-19K-J12320	NON-NEG	0	1	1.798E308	2684	0
Cost	X0-19K-J3737	NON-NEG	0	1	1.798E308	4689	-9.09E-13
Cost	X0-19K-J4737	NON-NEG	0	1	1.798E308	4225	0
Cost	X0-19K-J5737	NON-NEG	0	1	1.798E308	3791	0
Cost	X0-19K-J6737	NON-NEG	0	1	1.798E308	3388	0
Cost	X0-19K-J7737	NON-NEG	0	1	1.798E308	3108	0
Cost	X0-19K-J8737	NON-NEG	0	1	1.798E308	2953	-4.55E-13
Cost	X0-19K-J9737	NON-NEG	0	1	1.798E308	2806	0
Cost	X0-21L-A10321	NON-NEG	0	1	1.798E308	7912	0
Cost	X0-21L-A11321	NON-NEG	0	1	1.798E308	8073	-9.09E-13
Cost	X0-21L-A12321	NON-NEG	0	1	1.798E308	8195	0
Cost	X0-21L-A2737	NON-NEG	0	1	1.798E308	7590	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-21L-A3737	NON-NEG	0	1	1.798E308	7904	-9.09E-13
Cost	X0-21L-A4737	NON-NEG	0	1	1.798E308	8163	0
Cost	X0-21L-A5737	NON-NEG	0	1	1.798E308	8373	0
Cost	X0-21L-A6320	NON-NEG	0	1	1.798E308	7752	0
Cost	X0-21L-A7320	NON-NEG	0	1	1.798E308	7972	0
Cost	X0-21L-A8320	NON-NEG	0	1	1.798E308	8144	0
Cost	X0-21L-A9320	NON-NEG	0	1	1.798E308	8278	0
Cost	X0-23M-A10321	NON-NEG	0	1	1.798E308	9825	0
Cost	X0-23M-A11321	NON-NEG	0	1	1.798E308	10019	0
Cost	X0-23M-A12321	NON-NEG	0	1	1.798E308	10168	0
Cost	X0-23M-A1321	NON-NEG	0	1	1.798E308	11424	0
Cost	X0-23M-A2321	NON-NEG	0	1	1.798E308	10621	0
Cost	X0-23M-A3321	NON-NEG	0	1	1.798E308	9869	0
Cost	X0-23M-A4321	NON-NEG	0	1	1.798E308	9163	0
Cost	X0-23M-A5321	NON-NEG	0	1	1.798E308	8502	0
Cost	X0-23M-A6321	NON-NEG	0	1	1.798E308	8479	0
Cost	X0-23M-A7321	NON-NEG	0	1	1.798E308	8913	0
Cost	X0-23M-A8321	NON-NEG	0	1	1.798E308	9277	0
Cost	X0-23M-A9321	NON-NEG	0	1	1.798E308	9578	0
Cost	X0-25N-A10321	NON-NEG	0	1	1.798E308	12183	1.819E-12
Cost	X0-25N-A11321	NON-NEG	0	1	1.798E308	12318	0
Cost	X0-25N-A12321	NON-NEG	0	1	1.798E308	12410	0
Cost	X0-25N-A9321	NON-NEG	0	1	1.798E308	11998	0
Cost	X0-26O-N10737	NON-NEG	0	1	1.798E308	3045	0
Cost	X0-26O-N11737	NON-NEG	0	1	1.798E308	2754	0
Cost	X0-26O-N12737	NON-NEG	0	1	1.798E308	2480	0
Cost	X0-26O-N1321	NON-NEG	0	1	1.798E308	11310	0
Cost	X0-26O-N2321	NON-NEG	0	1	1.798E308	10555	0
Cost	X0-26O-N3321	NON-NEG	0	1	1.798E308	9846	-1.82E-12
Cost	X0-26O-N4321	NON-NEG	0	1	1.798E308	9181	0
Cost	X0-26O-N5321	NON-NEG	0	1	1.798E308	8556	0
Cost	X0-26O-N6321	NON-NEG	0	1	1.798E308	7969	-1.82E-12
Cost	X0-26O-N7321	NON-NEG	0	1	1.798E308	7417	9.095E-13
Cost	X0-26O-N8321	NON-NEG	0	1	1.798E308	6900	0
Cost	X0-26O-N9737	NON-NEG	0	1	1.798E308	3356	0
Cost	X0-2B-A10321	NON-NEG	0	1	1.798E308	31053	0
Cost	X0-2B-A11321	NON-NEG	0	1	1.798E308	30777	0
Cost	X0-2B-A12321	NON-NEG	0	1	1.798E308	30457	0
Cost	X0-2B-A1321	NON-NEG	0	1	1.798E308	30491	0
Cost	X0-2B-A2321	NON-NEG	0	1	1.798E308	30926	-7.28E-12
Cost	X0-2B-A3321	NON-NEG	0	1	1.798E308	31244	0
Cost	X0-2B-A4321	NON-NEG	0	1	1.798E308	31457	0
Cost	X0-2B-A5321	NON-NEG	0	1	1.798E308	31575	0
Cost	X0-2B-A6321	NON-NEG	0	1	1.798E308	31609	0
Cost	X0-2B-A7321	NON-NEG	0	1	1.798E308	31565	0
Cost	X0-2B-A8321	NON-NEG	0	1	1.798E308	31453	0
Cost	X0-2B-A9321	NON-NEG	0	1	1.798E308	31280	0
Cost	X0-30Q-P10321	NON-NEG	0	1	1.798E308	6094	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-30Q-P11321	NON-NEG	0	1	1.798E308	5679	0
Cost	X0-30Q-P12321	NON-NEG	0	1	1.798E308	5289	0
Cost	X0-30Q-P1737	NON-NEG	0	1	1.798E308	6984	0
Cost	X0-30Q-P2737	NON-NEG	0	1	1.798E308	6475	0
Cost	X0-30Q-P3320	NON-NEG	0	1	1.798E308	7494	0
Cost	X0-30Q-P4320	NON-NEG	0	1	1.798E308	6970	0
Cost	X0-30Q-P5320	NON-NEG	0	1	1.798E308	6478	0
Cost	X0-30Q-P6320	NON-NEG	0	1	1.798E308	6015	0
Cost	X0-30Q-P7321	NON-NEG	0	1	1.798E308	7503	0
Cost	X0-30Q-P8321	NON-NEG	0	1	1.798E308	7003	0
Cost	X0-30Q-P9321	NON-NEG	0	1	1.798E308	6534	0
Cost	X0-33R-A10321	NON-NEG	0	1	1.798E308	7474	0
Cost	X0-33R-A11321	NON-NEG	0	1	1.798E308	7667	0
Cost	X0-33R-A12321	NON-NEG	0	1	1.798E308	7816	0
Cost	X0-33R-A1737	NON-NEG	0	1	1.798E308	7266	0
Cost	X0-33R-A2320	NON-NEG	0	1	1.798E308	8542	0
Cost	X0-33R-A3321	NON-NEG	0	1	1.798E308	10863	1.819E-12
Cost	X0-33R-A4320	NON-NEG	0	1	1.798E308	7254	0
Cost	X0-33R-A5320	NON-NEG	0	1	1.798E308	7015	0
Cost	X0-33R-A6321	NON-NEG	0	1	1.798E308	8704	-1.82E-12
Cost	X0-33R-A7321	NON-NEG	0	1	1.798E308	8072	9.095E-13
Cost	X0-33R-A8321	NON-NEG	0	1	1.798E308	7479	0
Cost	X0-33R-A9321	NON-NEG	0	1	1.798E308	7237	0
Cost	X0-35S-A2320	NON-NEG	0	1	1.798E308	13378	0
Cost	X0-36T-S10321	NON-NEG	0	1	1.798E308	5714	-1.82E-12
Cost	X0-36T-S11321	NON-NEG	0	1	1.798E308	5286	0
Cost	X0-36T-S12321	NON-NEG	0	1	1.798E308	4885	0
Cost	X0-36T-S2737	NON-NEG	0	1	1.798E308	5866	0
Cost	X0-36T-S3320	NON-NEG	0	1	1.798E308	6978	0
Cost	X0-36T-S4321	NON-NEG	0	1	1.798E308	8934	0
Cost	X0-36T-S5321	NON-NEG	0	1	1.798E308	8310	0
Cost	X0-36T-S6321	NON-NEG	0	1	1.798E308	7723	0
Cost	X0-36T-S7321	NON-NEG	0	1	1.798E308	7171	0
Cost	X0-36T-S8321	NON-NEG	0	1	1.798E308	6655	0
Cost	X0-36T-S9321	NON-NEG	0	1	1.798E308	6169	0
Cost	X0-5D-C10321	NON-NEG	0	1	1.798E308	4104	1.819E-12
Cost	X0-5D-C11321	NON-NEG	0	1	1.798E308	3899	0
Cost	X0-5D-C12321	NON-NEG	0	1	1.798E308	3705	0
Cost	X0-5D-C1321	NON-NEG	0	1	1.798E308	6964	0
Cost	X0-5D-C2321	NON-NEG	0	1	1.798E308	6231	0
Cost	X0-5D-C3321	NON-NEG	0	1	1.798E308	5917	0
Cost	X0-5D-C4321	NON-NEG	0	1	1.798E308	5611	0
Cost	X0-5D-C5321	NON-NEG	0	1	1.798E308	5323	0
Cost	X0-5D-C6321	NON-NEG	0	1	1.798E308	5050	0
Cost	X0-5D-C7321	NON-NEG	0	1	1.798E308	4793	9.095E-13
Cost	X0-5D-C8321	NON-NEG	0	1	1.798E308	4550	0
Cost	X0-5D-C9321	NON-NEG	0	1	1.798E308	4320	0
Cost	X0-9F-E10737	NON-NEG	0	1	1.798E308	12539	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X0-9F-E11737	NON-NEG	0	1	1.798E308	12326	0
Cost	X0-9F-E12737	NON-NEG	0	1	1.798E308	12107	0
Cost	X0-9F-E1737	NON-NEG	0	1	1.798E308	13852	0
Cost	X0-9F-E2737	NON-NEG	0	1	1.798E308	13785	0
Cost	X0-9F-E3737	NON-NEG	0	1	1.798E308	13693	0
Cost	X0-9F-E4737	NON-NEG	0	1	1.798E308	13576	0
Cost	X0-9F-E5737	NON-NEG	0	1	1.798E308	13442	0
Cost	X0-9F-E6737	NON-NEG	0	1	1.798E308	13287	0
Cost	X0-9F-E7737	NON-NEG	0	1	1.798E308	13118	0
Cost	X0-9F-E8737	NON-NEG	0	1	1.798E308	12936	1.819E-12
Cost	X0-9F-E9737	NON-NEG	0	1	1.798E308	12742	0
Cost	X1-0A-B10321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B11321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B12321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B1321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B2321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B3321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B4321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B5321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B6321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B7321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B8321	NON-NEG	0	1	1.798E308	0	0
Cost	X1-0A-B9321	NON-NEG	0	1	1.798E308	0	0
Cost	X10-11A-G3737	NON-NEG	0	1	1.798E308	3681	0
Cost	X10-11A-G5737	NON-NEG	0	1	1.798E308	3299	0
Cost	X10-13A-H7737	NON-NEG	0	1	1.798E308	3399	0
Cost	X10-13A-H9737	NON-NEG	0	1	1.798E308	3051	0
Cost	X10-17A-J11737	NON-NEG	0	1	1.798E308	2809	0
Cost	X10-17A-J6737	NON-NEG	0	1	1.798E308	3172	0
Cost	X10-17A-J8737	NON-NEG	0	1	1.798E308	2846	-4.55E-13
Cost	X10-22A-L4737	NON-NEG	0	1	1.798E308	4803	0
Cost	X10-7A-E10737	NON-NEG	0	1	1.798E308	4788	0
Cost	X10-7A-E12737	NON-NEG	0	1	1.798E308	4539	0
Cost	X10-7A-E1737	NON-NEG	0	1	1.798E308	5986	0
Cost	X10-7A-E2737	NON-NEG	0	1	1.798E308	5850	0
Cost	X11-0A-G10320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G11321	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G12321	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G1737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G2737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G3737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G4737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G5737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G6737	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G7320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G8320	NON-NEG	0	1	1.798E308	0	0
Cost	X11-0A-G9320	NON-NEG	0	1	1.798E308	0	0
Cost	X12-11A-G10320	NON-NEG	0	1	1.798E308	3518	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X12-11A-G2737	NON-NEG	0	1	1.798E308	3889	0
Cost	X12-11A-G4737	NON-NEG	0	1	1.798E308	3485	0
Cost	X12-13A-H6737	NON-NEG	0	1	1.798E308	3589	0
Cost	X12-15A-I12321	NON-NEG	0	1	1.798E308	9924	0
Cost	X12-15A-I7320	NON-NEG	0	1	1.798E308	10727	0
Cost	X12-1A-B11321	NON-NEG	0	1	1.798E308	6758	0
Cost	X12-22A-L3737	NON-NEG	0	1	1.798E308	5075	0
Cost	X12-22A-L8320	NON-NEG	0	1	1.798E308	4276	0
Cost	X12-22A-L9320	NON-NEG	0	1	1.798E308	4486	0
Cost	X12-34A-R1737	NON-NEG	0	1	1.798E308	12028	0
Cost	X12-7A-E5737	NON-NEG	0	1	1.798E308	5442	0
Cost	X13-0A-H10320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H11320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H12320	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H3737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H4737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H5737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H6737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H7737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H8737	NON-NEG	0	1	1.798E308	0	0
Cost	X13-0A-H9737	NON-NEG	0	1	1.798E308	0	0
Cost	X14-13A-H10320	NON-NEG	0	1	1.798E308	3221	0
Cost	X14-13A-H11320	NON-NEG	0	1	1.798E308	3055	0
Cost	X14-13A-H4737	NON-NEG	0	1	1.798E308	4004	0
Cost	X14-17A-J12320	NON-NEG	0	1	1.798E308	2571	0
Cost	X14-17A-J7737	NON-NEG	0	1	1.798E308	3005	0
Cost	X14-17A-J9737	NON-NEG	0	1	1.798E308	2696	0
Cost	X14-22A-L5737	NON-NEG	0	1	1.798E308	4547	0
Cost	X14-7A-E3737	NON-NEG	0	1	1.798E308	5712	0
Cost	X14-7A-E6737	NON-NEG	0	1	1.798E308	5309	0
Cost	X14-7A-E8737	NON-NEG	0	1	1.798E308	5045	0
Cost	X15-0A-I10321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I11321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I12321	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I1320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I2320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I3320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I4320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I5320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I6320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I7320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I8320	NON-NEG	0	1	1.798E308	0	0
Cost	X15-0A-I9320	NON-NEG	0	1	1.798E308	0	0
Cost	X16-11A-G7320	NON-NEG	0	1	1.798E308	3306	0
Cost	X16-11A-G8320	NON-NEG	0	1	1.798E308	3133	0
Cost	X16-15A-I11321	NON-NEG	0	1	1.798E308	9627	0
Cost	X16-15A-I1320	NON-NEG	0	1	1.798E308	7158	0
Cost	X16-15A-I3320	NON-NEG	0	1	1.798E308	8694	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X16-15A-I4320	NON-NEG	0	1	1.798E308	9321	0
Cost	X16-15A-I6320	NON-NEG	0	1	1.798E308	10330	0
Cost	X16-15A-I9320	NON-NEG	0	1	1.798E308	11337	0
Cost	X16-24A-M10321	NON-NEG	0	1	1.798E308	14998	0
Cost	X16-32A-P5320	NON-NEG	0	1	1.798E308	4263	0
Cost	X16-34A-R2320	NON-NEG	0	1	1.798E308	9840	0
Cost	X16-38A-S12321	NON-NEG	0	1	1.798E308	8910	0
Cost	X17-18J-K10737	NON-NEG	0	1	1.798E308	2506	0
Cost	X17-18J-K11737	NON-NEG	0	1	1.798E308	2375	0
Cost	X17-18J-K12320	NON-NEG	0	1	1.798E308	2523	0
Cost	X17-18J-K3737	NON-NEG	0	1	1.798E308	3667	0
Cost	X17-18J-K4737	NON-NEG	0	1	1.798E308	3471	0
Cost	X17-18J-K5737	NON-NEG	0	1	1.798E308	3286	0
Cost	X17-18J-K6737	NON-NEG	0	1	1.798E308	3112	0
Cost	X17-18J-K7737	NON-NEG	0	1	1.798E308	2947	0
Cost	X17-18J-K8737	NON-NEG	0	1	1.798E308	2792	0
Cost	X17-18J-K9737	NON-NEG	0	1	1.798E308	2645	0
Cost	X18-0J-K10737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K11737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K12320	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K3737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K4737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K5737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K6737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K7737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K8737	NON-NEG	0	1	1.798E308	0	0
Cost	X18-0J-K9737	NON-NEG	0	1	1.798E308	0	0
Cost	X19-20J-A10737	NON-NEG	0	1	1.798E308	4434	0
Cost	X19-20J-A11737	NON-NEG	0	1	1.798E308	4584	0
Cost	X19-20J-A12320	NON-NEG	0	1	1.798E308	3975	0
Cost	X19-20J-A3737	NON-NEG	0	1	1.798E308	3738	0
Cost	X19-20J-A4737	NON-NEG	0	1	1.798E308	3538	0
Cost	X19-20J-A5737	NON-NEG	0	1	1.798E308	3350	0
Cost	X19-20J-A6737	NON-NEG	0	1	1.798E308	3527	0
Cost	X19-20J-A7737	NON-NEG	0	1	1.798E308	3806	0
Cost	X19-20J-A8737	NON-NEG	0	1	1.798E308	4048	0
Cost	X19-20J-A9737	NON-NEG	0	1	1.798E308	4256	0
Cost	X2-1A-B12321	NON-NEG	0	1	1.798E308	7340	0
Cost	X2-1A-B2321	NON-NEG	0	1	1.798E308	7216	0
Cost	X2-1A-B4321	NON-NEG	0	1	1.798E308	6461	0
Cost	X2-1A-B9321	NON-NEG	0	1	1.798E308	5339	0
Cost	X2-28A-N11321	NON-NEG	0	1	1.798E308	12832	0
Cost	X2-28A-N1321	NON-NEG	0	1	1.798E308	6343	0
Cost	X2-28A-N6321	NON-NEG	0	1	1.798E308	10725	0
Cost	X2-28A-N7321	NON-NEG	0	1	1.798E308	11296	0
Cost	X2-28A-N8321	NON-NEG	0	1	1.798E308	11785	0
Cost	X2-34A-R3321	NON-NEG	0	1	1.798E308	6497	0
Cost	X2-38A-S10321	NON-NEG	0	1	1.798E308	7848	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X2-38A-S5321	NON-NEG	0	1	1.798E308	4203	0
Cost	X20-11A-G6737	NON-NEG	0	1	1.798E308	3479	0
Cost	X20-13A-H12320	NON-NEG	0	1	1.798E308	2897	0
Cost	X20-13A-H8737	NON-NEG	0	1	1.798E308	3220	0
Cost	X20-17A-J10737	NON-NEG	0	1	1.798E308	2608	0
Cost	X20-17A-J3737	NON-NEG	0	1	1.798E308	3738	0
Cost	X20-17A-J5737	NON-NEG	0	1	1.798E308	3350	0
Cost	X20-7A-E11737	NON-NEG	0	1	1.798E308	4663	0
Cost	X20-7A-E4737	NON-NEG	0	1	1.798E308	5577	0
Cost	X20-7A-E7737	NON-NEG	0	1	1.798E308	5175	0
Cost	X20-7A-E9737	NON-NEG	0	1	1.798E308	4915	0
Cost	X21-11A-G9320	NON-NEG	0	1	1.798E308	3259	0
Cost	X21-13A-H3737	NON-NEG	0	1	1.798E308	4229	9.095E-13
Cost	X21-13A-H5737	NON-NEG	0	1	1.798E308	3790	0
Cost	X21-15A-I8320	NON-NEG	0	1	1.798E308	11060	0
Cost	X21-17A-J4737	NON-NEG	0	1	1.798E308	3538	0
Cost	X21-22A-L10321	NON-NEG	0	1	1.798E308	4294	0
Cost	X21-22A-L7320	NON-NEG	0	1	1.798E308	4513	0
Cost	X21-24A-M11321	NON-NEG	0	1	1.798E308	15341	0
Cost	X21-32A-P12321	NON-NEG	0	1	1.798E308	5965	0
Cost	X21-32A-P2737	NON-NEG	0	1	1.798E308	4627	0
Cost	X21-32A-P6320	NON-NEG	0	1	1.798E308	5148	0
Cost	X22-0A-L10321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L11321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L12321	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L2737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L3737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L4737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L5737	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L6320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L7320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L8320	NON-NEG	0	1	1.798E308	0	0
Cost	X22-0A-L9320	NON-NEG	0	1	1.798E308	0	0
Cost	X23-11A-G11321	NON-NEG	0	1	1.798E308	2991	0
Cost	X23-1A-B5321	NON-NEG	0	1	1.798E308	6116	0
Cost	X23-1A-B6321	NON-NEG	0	1	1.798E308	5791	0
Cost	X23-1A-B8321	NON-NEG	0	1	1.798E308	5193	0
Cost	X23-24A-M12321	NON-NEG	0	1	1.798E308	15618	0
Cost	X23-24A-M2321	NON-NEG	0	1	1.798E308	8874	0
Cost	X23-28A-N3321	NON-NEG	0	1	1.798E308	8438	1.819E-12
Cost	X23-28A-N4321	NON-NEG	0	1	1.798E308	9305	0
Cost	X23-28A-N9321	NON-NEG	0	1	1.798E308	12200	0
Cost	X23-32A-P10321	NON-NEG	0	1	1.798E308	4644	0
Cost	X23-38A-S7321	NON-NEG	0	1	1.798E308	5613	0
Cost	X23-3A-C1321	NON-NEG	0	1	1.798E308	6685	0
Cost	X24-0A-M10321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M11321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M12321	NON-NEG	0	1	1.798E308	0	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X24-0A-M1321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M2321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M3321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M4321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M5321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M6321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M7321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M8321	NON-NEG	0	1	1.798E308	0	0
Cost	X24-0A-M9321	NON-NEG	0	1	1.798E308	0	0
Cost	X25-24A-M1321	NON-NEG	0	1	1.798E308	7539	0
Cost	X25-24A-M4321	NON-NEG	0	1	1.798E308	11097	0
Cost	X25-32A-N9321	NON-NEG	0	1	1.798E308	3852	0
Cost	X25-34A-P10321	NON-NEG	0	1	1.798E308	10747	0
Cost	X25-34A-P12321	NON-NEG	0	1	1.798E308	11313	1.819E-12
Cost	X25-34A-P6321	NON-NEG	0	1	1.798E308	8835	0
Cost	X25-38A-R11321	NON-NEG	0	1	1.798E308	8417	-1.82E-12
Cost	X25-38A-R8321	NON-NEG	0	1	1.798E308	6454	0
Cost	X25-3A-C2321	NON-NEG	0	1	1.798E308	7993	0
Cost	X25-3A-C3321	NON-NEG	0	1	1.798E308	9152	1.819E-12
Cost	X25-3A-C5321	NON-NEG	0	1	1.798E308	11072	0
Cost	X25-3A-C7321	NON-NEG	0	1	1.798E308	12535	0
Cost	X26-25N-A1321	NON-NEG	0	1	1.798E308	5284	0
Cost	X26-25N-A2321	NON-NEG	0	1	1.798E308	5004	0
Cost	X26-25N-A3321	NON-NEG	0	1	1.798E308	5110	0
Cost	X26-25N-A4321	NON-NEG	0	1	1.798E308	6095	0
Cost	X26-25N-A5321	NON-NEG	0	1	1.798E308	6966	0
Cost	X26-25N-A6321	NON-NEG	0	1	1.798E308	7736	0
Cost	X26-25N-A7321	NON-NEG	0	1	1.798E308	8410	0
Cost	X26-25N-A8321	NON-NEG	0	1	1.798E308	8998	0
Cost	X26-27N-010737	NON-NEG	0	1	1.798E308	2454	0
Cost	X26-27N-011737	NON-NEG	0	1	1.798E308	2326	0
Cost	X26-27N-012737	NON-NEG	0	1	1.798E308	2204	0
Cost	X26-27N-09737	NON-NEG	0	1	1.798E308	2590	0
Cost	X27-0N-010737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-011737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-012737	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-01321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-02321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-03321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-04321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-05321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-06321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-07321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-08321	NON-NEG	0	1	1.798E308	0	0
Cost	X27-0N-09737	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N10321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N11321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-0A-N12321	NON-NEG	0	1	1.798E308	0	0
Cost							

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X28-0A-N9321	NON-NEG	0	1	1.798E308	0	0
Cost	X28-27N-01321	NON-NEG	0	1	1.798E308	4991	0
Cost	X28-27N-02321	NON-NEG	0	1	1.798E308	4727	0
Cost	X28-27N-03321	NON-NEG	0	1	1.798E308	4478	0
Cost	X28-27N-04321	NON-NEG	0	1	1.798E308	4243	0
Cost	X28-27N-05321	NON-NEG	0	1	1.798E308	4021	0
Cost	X28-27N-06321	NON-NEG	0	1	1.798E308	3811	0
Cost	X28-27N-07321	NON-NEG	0	1	1.798E308	3612	0
Cost	X28-27N-08321	NON-NEG	0	1	1.798E308	3425	0
Cost	X29-15A-I5320	NON-NEG	0	1	1.798E308	9864	0
Cost	X29-1A-B10321	NON-NEG	0	1	1.798E308	6093	0
Cost	X29-1A-B7321	NON-NEG	0	1	1.798E308	5483	0
Cost	X29-22A-L12321	NON-NEG	0	1	1.798E308	3859	0
Cost	X29-22A-L2737	NON-NEG	0	1	1.798E308	5363	0
Cost	X29-22A-L6320	NON-NEG	0	1	1.798E308	4764	0
Cost	X29-24A-M9321	NON-NEG	0	1	1.798E308	14579	3.638E-12
Cost	X29-32A-P1737	NON-NEG	0	1	1.798E308	4272	0
Cost	X29-34A-R4320	NON-NEG	0	1	1.798E308	11074	0
Cost	X29-38A-S3320	NON-NEG	0	1	1.798E308	6235	0
Cost	X29-3A-C11321	NON-NEG	0	1	1.798E308	14381	0
Cost	X29-3A-C8321	NON-NEG	0	1	1.798E308	13119	0
Cost	X3-4C-D10321	NON-NEG	0	1	1.798E308	3943	0
Cost	X3-4C-D11321	NON-NEG	0	1	1.798E308	3738	0
Cost	X3-4C-D12321	NON-NEG	0	1	1.798E308	3544	0
Cost	X3-4C-D1321	NON-NEG	0	1	1.798E308	6425	0
Cost	X3-4C-D2321	NON-NEG	0	1	1.798E308	6081	0
Cost	X3-4C-D3321	NON-NEG	0	1	1.798E308	5756	0
Cost	X3-4C-D4321	NON-NEG	0	1	1.798E308	5450	0
Cost	X3-4C-D5321	NON-NEG	0	1	1.798E308	5162	0
Cost	X3-4C-D6321	NON-NEG	0	1	1.798E308	4889	0
Cost	X3-4C-D7321	NON-NEG	0	1	1.798E308	4632	0
Cost	X3-4C-D8321	NON-NEG	0	1	1.798E308	4389	0
Cost	X3-4C-D9321	NON-NEG	0	1	1.798E308	4159	0
Cost	X30-29P-A10321	NON-NEG	0	1	1.798E308	4644	0
Cost	X30-29P-A11321	NON-NEG	0	1	1.798E308	5346	0
Cost	X30-29P-A12321	NON-NEG	0	1	1.798E308	5965	0
Cost	X30-29P-A1737	NON-NEG	0	1	1.798E308	4272	-1.82E-12
Cost	X30-29P-A2737	NON-NEG	0	1	1.798E308	4627	0
Cost	X30-29P-A3320	NON-NEG	0	1	1.798E308	4259	0
Cost	X30-29P-A4320	NON-NEG	0	1	1.798E308	4034	0
Cost	X30-29P-A5320	NON-NEG	0	1	1.798E308	4263	0
Cost	X30-29P-A6320	NON-NEG	0	1	1.798E308	5148	0
Cost	X30-29P-A7321	NON-NEG	0	1	1.798E308	3840	0
Cost	X30-29P-A8321	NON-NEG	0	1	1.798E308	3640	0
Cost	X30-29P-A9321	NON-NEG	0	1	1.798E308	3852	0
Cost	X31-0P-Q10321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q11321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q12321	NON-NEG	0	1	1.798E308	0	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X31-0P-Q1737	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q2737	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q3320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q4320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q5320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q6320	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q7321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q8321	NON-NEG	0	1	1.798E308	0	0
Cost	X31-0P-Q9321	NON-NEG	0	1	1.798E308	0	0
Cost	X32-31P-Q10321	NON-NEG	0	1	1.798E308	2805	0
Cost	X32-31P-Q11321	NON-NEG	0	1	1.798E308	2660	0
Cost	X32-31P-Q12321	NON-NEG	0	1	1.798E308	2524	0
Cost	X32-31P-Q1737	NON-NEG	0	1	1.798E308	3639	0
Cost	X32-31P-Q2737	NON-NEG	0	1	1.798E308	3444	0
Cost	X32-31P-Q3320	NON-NEG	0	1	1.798E308	3643	0
Cost	X32-31P-Q4320	NON-NEG	0	1	1.798E308	3451	0
Cost	X32-31P-Q5320	NON-NEG	0	1	1.798E308	3270	0
Cost	X32-31P-Q6320	NON-NEG	0	1	1.798E308	3098	0
Cost	X32-31P-Q7321	NON-NEG	0	1	1.798E308	3289	0
Cost	X32-31P-Q8321	NON-NEG	0	1	1.798E308	3118	0
Cost	X32-31P-Q9321	NON-NEG	0	1	1.798E308	2957	0
Cost	X33-11A-G1737	NON-NEG	0	1	1.798E308	4109	0
Cost	X33-15A-I10321	NON-NEG	0	1	1.798E308	9272	0
Cost	X33-1A-B3321	NON-NEG	0	1	1.798E308	6828	1.819E-12
Cost	X33-24A-M8321	NON-NEG	0	1	1.798E308	14080	0
Cost	X33-28A-N12321	NON-NEG	0	1	1.798E308	13061	0
Cost	X33-32A-P11321	NON-NEG	0	1	1.798E308	5346	0
Cost	X33-32A-P4320	NON-NEG	0	1	1.798E308	4034	0
Cost	X33-32A-P7321	NON-NEG	0	1	1.798E308	3840	0
Cost	X33-34A-R5320	NON-NEG	0	1	1.798E308	11565	0
Cost	X33-38A-S2320	NON-NEG	0	1	1.798E308	5174	0
Cost	X33-38A-S9321	NON-NEG	0	1	1.798E308	7196	0
Cost	X33-3A-C6321	NON-NEG	0	1	1.798E308	11855	0
Cost	X34-0A-R10321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R11321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R12321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R1737	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R2320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R3321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R4320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R5320	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R6321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R7321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R8321	NON-NEG	0	1	1.798E308	0	0
Cost	X34-0A-R9321	NON-NEG	0	1	1.798E308	0	0
Cost	X35-15A-I2320	NON-NEG	0	1	1.798E308	7977	0
Cost	X35-22A-L11321	NON-NEG	0	1	1.798E308	4070	0
Cost	X35-24A-M6321	NON-NEG	0	1	1.798E308	12804	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X35-28A-N5321	NON-NEG	0	1	1.798E308	10064	0
Cost	X35-32A-P3320	NON-NEG	0	1	1.798E308	4259	0
Cost	X35-34A-R7321	NON-NEG	0	1	1.798E308	9426	0
Cost	X35-34A-R8321	NON-NEG	0	1	1.798E308	9938	0
Cost	X35-38A-S4321	NON-NEG	0	1	1.798E308	4435	0
Cost	X35-3A-C10321	NON-NEG	0	1	1.798E308	14034	0
Cost	X35-3A-C12321	NON-NEG	0	1	1.798E308	14661	1.819E-12
Cost	X35-3A-C9321	NON-NEG	0	1	1.798E308	13616	-1.82E-12
Cost	X36-35S-A10321	NON-NEG	0	1	1.798E308	7848	0
Cost	X36-35S-A11321	NON-NEG	0	1	1.798E308	8417	0
Cost	X36-35S-A12321	NON-NEG	0	1	1.798E308	8910	0
Cost	X36-35S-A3320	NON-NEG	0	1	1.798E308	6235	0
Cost	X36-35S-A4321	NON-NEG	0	1	1.798E308	4435	0
Cost	X36-35S-A5321	NON-NEG	0	1	1.798E308	4203	0
Cost	X36-35S-A6321	NON-NEG	0	1	1.798E308	4665	0
Cost	X36-35S-A7321	NON-NEG	0	1	1.798E308	5613	0
Cost	X36-35S-A8321	NON-NEG	0	1	1.798E308	6454	0
Cost	X36-35S-A9321	NON-NEG	0	1	1.798E308	7196	0
Cost	X36-37S-T2737	NON-NEG	0	1	1.798E308	3773	0
Cost	X37-0S-T10321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T11321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T12321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T2737	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T3320	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T4321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T5321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T6321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T7321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T8321	NON-NEG	0	1	1.798E308	0	0
Cost	X37-0S-T9321	NON-NEG	0	1	1.798E308	0	0
Cost	X38-0A-S2320	NON-NEG	0	1	1.798E308	0	0
Cost	X38-37S-T10321	NON-NEG	0	1	1.798E308	3063	0
Cost	X38-37S-T11321	NON-NEG	0	1	1.798E308	2905	0
Cost	X38-37S-T12321	NON-NEG	0	1	1.798E308	2756	0
Cost	X38-37S-T3320	NON-NEG	0	1	1.798E308	3982	0
Cost	X38-37S-T4321	NON-NEG	0	1	1.798E308	4219	0
Cost	X38-37S-T5321	NON-NEG	0	1	1.798E308	3999	0
Cost	X38-37S-T6321	NON-NEG	0	1	1.798E308	3790	0
Cost	X38-37S-T7321	NON-NEG	0	1	1.798E308	3592	0
Cost	X38-37S-T8321	NON-NEG	0	1	1.798E308	3406	0
Cost	X38-37S-T9321	NON-NEG	0	1	1.798E308	3229	0
Cost	X4-0C-D10321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D11321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D12321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D1321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D2321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D3321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D4321	NON-NEG	0	1	1.798E308	0	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X4-0C-D5321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D6321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D7321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D8321	NON-NEG	0	1	1.798E308	0	0
Cost	X4-0C-D9321	NON-NEG	0	1	1.798E308	0	0
Cost	X5-6C-A10321	NON-NEG	0	1	1.798E308	11012	0
Cost	X5-6C-A11321	NON-NEG	0	1	1.798E308	11456	0
Cost	X5-6C-A12321	NON-NEG	0	1	1.798E308	11829	0
Cost	X5-6C-A1321	NON-NEG	0	1	1.798E308	5469	0
Cost	X5-6C-A2321	NON-NEG	0	1	1.798E308	5179	0
Cost	X5-6C-A3321	NON-NEG	0	1	1.798E308	5329	-9.09E-13
Cost	X5-6C-A4321	NON-NEG	0	1	1.798E308	6481	0
Cost	X5-6C-A5321	NON-NEG	0	1	1.798E308	7501	0
Cost	X5-6C-A6321	NON-NEG	0	1	1.798E308	8403	0
Cost	X5-6C-A7321	NON-NEG	0	1	1.798E308	9198	0
Cost	X5-6C-A8321	NON-NEG	0	1	1.798E308	9891	0
Cost	X5-6C-A9321	NON-NEG	0	1	1.798E308	10493	0
Cost	X6-11A-G12321	NON-NEG	0	1	1.798E308	2837	0
Cost	X6-1A-B1321	NON-NEG	0	1	1.798E308	7628	0
Cost	X6-24A-M3321	NON-NEG	0	1	1.798E308	10056	1.819E-12
Cost	X6-24A-M5321	NON-NEG	0	1	1.798E308	12010	0
Cost	X6-24A-M7321	NON-NEG	0	1	1.798E308	13491	0
Cost	X6-28A-N10321	NON-NEG	0	1	1.798E308	12547	0
Cost	X6-28A-N2321	NON-NEG	0	1	1.798E308	7455	0
Cost	X6-32A-P8321	NON-NEG	0	1	1.798E308	3640	0
Cost	X6-34A-R11321	NON-NEG	0	1	1.798E308	11059	0
Cost	X6-34A-R9321	NON-NEG	0	1	1.798E308	10377	0
Cost	X6-38A-S6321	NON-NEG	0	1	1.798E308	4665	0
Cost	X6-3A-C4321	NON-NEG	0	1	1.798E308	10175	0
Cost	X7-0A-E10737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E11737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E12737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E1737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E2737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E3737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E4737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E5737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E6737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E7737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E8737	NON-NEG	0	1	1.798E308	0	0
Cost	X7-0A-E9737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F10737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F11737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F12737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F1737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F2737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F3737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F4737	NON-NEG	0	1	1.798E308	0	0

LINEAR PROGRAMMING OUTPUT
With Sales Constraint
Summary of Nonzero Variables of the Objective Function

Objective row	Variable	Type	Lower bound	Value	Upper bound	Price	Reduced cost
Cost	X8-0E-F5737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F6737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F7737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F8737	NON-NEG	0	1	1.798E308	0	0
Cost	X8-0E-F9737	NON-NEG	0	1	1.798E308	0	0
Cost	X9-8E-F10737	NON-NEG	0	1	1.798E308	2240	0
Cost	X9-8E-F11737	NON-NEG	0	1	1.798E308	2375	0
Cost	X9-8E-F12737	NON-NEG	0	1	1.798E308	2491	0
Cost	X9-8E-F1737	NON-NEG	0	1	1.798E308	3597	0
Cost	X9-8E-F2737	NON-NEG	0	1	1.798E308	3404	0
Cost	X9-8E-F3737	NON-NEG	0	1	1.798E308	3222	0
Cost	X9-8E-F4737	NON-NEG	0	1	1.798E308	3049	0
Cost	X9-8E-F5737	NON-NEG	0	1	1.798E308	2887	0
Cost	X9-8E-F6737	NON-NEG	0	1	1.798E308	2733	0
Cost	X9-8E-F7737	NON-NEG	0	1	1.798E308	2588	0
Cost	X9-8E-F8737	NON-NEG	0	1	1.798E308	2452	0
Cost	X9-8E-F9737	NON-NEG	0	1	1.798E308	2322	0
Cost	sell2737	SURPLUS	0	1	1.798E308	0	0
Cost	sell2320	SURPLUS	0	2	1.798E308	0	0
Cost	sell3321	SURPLUS	0	1	1.798E308	0	0
Cost	sell6737	SURPLUS	0	4	1.798E308	0	0
Cost	sell6321	SURPLUS	0	1	1.798E308	0	0
Cost	sell7737	SURPLUS	0	5	1.798E308	0	0
Cost	sell7321	SURPLUS	0	1	1.798E308	0	0
Cost	sell8737	SURPLUS	0	6	1.798E308	0	0
Cost	sell8320	SURPLUS	0	1	1.798E308	0	0
Cost	sell8321	SURPLUS	0	4	1.798E308	0	0
Cost	sell9737	SURPLUS	0	7	1.798E308	0	0
Cost	sell9320	SURPLUS	0	3	1.798E308	0	0
Cost	sell9321	SURPLUS	0	4	1.798E308	0	0
Cost	sell10737	SURPLUS	0	5	1.798E308	0	0
Cost	sell10320	SURPLUS	0	2	1.798E308	0	0
Cost	sell10321	SURPLUS	0	7	1.798E308	0	0
Cost	sell11737	SURPLUS	0	5	1.798E308	0	0
Cost	sell11320	SURPLUS	0	2	1.798E308	0	0
Cost	sell11321	SURPLUS	0	6	1.798E308	0	0
Cost	sell12737	SURPLUS	0	3	1.798E308	0	0
Cost	sell12320	SURPLUS	0	4	1.798E308	0	0
Cost	sell12321	SURPLUS	0	5	1.798E308	0	0
Cost	Cost	OBJECT	0	3575860	1.798E308	0	0

B737 QC NETWORK COST COMPONENTS

Leg	Time	DOC B737	Opp.Cost B737	Pos.Cost B737	Total B737
7	1	$3,375	$2,611	$0	$5,986
	2	$3,194	$2,656	$0	$5,850
	3	$3,022	$2,690	$0	$5,712
	4	$2,861	$2,716	$0	$5,577
	5	$2,708	$2,734	$0	$5,442
	6	$2,564	$2,745	$0	$5,309
	7	$2,427	$2,748	$0	$5,175
	8	$2,299	$2,746	$0	$5,045
	9	$2,177	$2,738	$0	$4,915
	10	$2,062	$2,726	$0	$4,788
	11	$1,954	$2,709	$0	$4,663
	12	$1,851	$2,688	$0	$4,539
7		$30,494	$32,507	$0	$63,001
8	1	$3,597	$0	$0	$3,597
	2	$3,404	$0	$0	$3,404
	3	$3,222	$0	$0	$3,222
	4	$3,049	$0	$0	$3,049
	5	$2,887	$0	$0	$2,887
	6	$2,733	$0	$0	$2,733
	7	$2,588	$0	$0	$2,588
	8	$2,452	$0	$0	$2,452
	9	$2,322	$0	$0	$2,322
	10	$2,200	$40	$0	$2,240
	11	$2,084	$291	$0	$2,375
	12	$1,975	$516	$0	$2,491
8		$32,513	$847	$0	$33,360
9	1	$3,597	$2,838	$7,417	$13,852
	2	$3,404	$3,363	$7,018	$13,785
	3	$3,222	$3,829	$6,642	$13,693
	4	$3,049	$4,240	$6,287	$13,576
	5	$2,887	$4,602	$5,953	$13,442
	6	$2,733	$4,918	$5,636	$13,287
	7	$2,588	$5,192	$5,338	$13,118
	8	$2,452	$5,428	$5,056	$12,936
	9	$2,322	$5,630	$4,790	$12,742
	10	$2,200	$5,800	$4,539	$12,539
	11	$2,084	$5,941	$4,301	$12,326
	12	$1,975	$6,056	$4,076	$12,107
9		$32,513	$57,837	$67,053	$157,403
10	1	$3,375	$2,611	$161	$6,147
	2	$3,194	$2,656	$161	$6,011
	3	$3,022	$2,690	$161	$5,873
	4	$2,861	$2,716	$161	$5,738
	5	$2,708	$2,734	$161	$5,603
	6	$2,564	$2,745	$161	$5,470

B737 QC NETWORK COST COMPONENTS

Leg	Time	DOC B737	Opp.Cost B737	Pos.Cost B737	Total B737
10	7	$2,427	$2,748	$161	$5,336
	8	$2,299	$2,746	$161	$5,206
	9	$2,177	$2,738	$161	$5,076
	10	$2,062	$2,726	$161	$4,949
	11	$1,954	$2,709	$161	$4,824
	12	$1,851	$2,688	$161	$4,700
10		$30,494	$32,507	$1,932	$64,933
11	1	$4,109	$0	$0	$4,109
	2	$3,889	$0	$0	$3,889
	3	$3,681	$0	$0	$3,681
	4	$3,485	$0	$0	$3,485
	5	$3,299	$0	$0	$3,299
	6	$3,124	$355	$0	$3,479
11		$21,587	$355	$0	$21,942
12	1	$4,109	$9,035	$1,833	$14,977
	2	$3,889	$9,455	$1,570	$14,914
	3	$3,681	$9,814	$1,327	$14,822
	4	$3,485	$10,117	$1,100	$14,702
	5	$3,299	$10,368	$890	$14,557
	6	$3,124	$10,574	$694	$14,392
12		$21,587	$59,363	$7,414	$88,364
13	3	$4,229	$0	$0	$4,229
	4	$4,004	$0	$0	$4,004
	5	$3,790	$0	$0	$3,790
	6	$3,589	$0	$0	$3,589
	7	$3,399	$0	$0	$3,399
	8	$3,220	$0	$0	$3,220
	9	$3,051	$0	$0	$3,051
13		$25,282	$0	$0	$25,282
14	3	$4,229	$0	$1,586	$5,815
	4	$4,004	$0	$1,304	$5,308
	5	$3,790	$0	$1,043	$4,833
	6	$3,589	$532	$800	$4,921
	7	$3,399	$1,202	$575	$5,176
	8	$3,220	$1,803	$367	$5,390
	9	$3,051	$2,340	$174	$5,565
14		$25,282	$5,877	$5,849	$37,008
17	3	$3,738	$0	$0	$3,738
	4	$3,538	$0	$0	$3,538
	5	$3,350	$0	$0	$3,350
	6	$3,172	$0	$0	$3,172

B737 QC NETWORK COST COMPONENTS

Leg	Time	DOC B737	Opp.Cost B737	Pos.Cost B737	Total B737
17	7	$3,005	$0	$0	$3,005
	8	$2,846	$0	$0	$2,846
	9	$2,696	$0	$0	$2,696
	10	$2,555	$53	$0	$2,608
	11	$2,421	$388	$0	$2,809
17		$27,321	$441	$0	$27,762
18	3	$3,667	$0	$0	$3,667
	4	$3,471	$0	$0	$3,471
	5	$3,286	$0	$0	$3,286
	6	$3,112	$0	$0	$3,112
	7	$2,947	$0	$0	$2,947
	8	$2,792	$0	$0	$2,792
	9	$2,645	$0	$0	$2,645
	10	$2,506	$0	$0	$2,506
	11	$2,375	$0	$0	$2,375
18		$26,801	$0	$0	$26,801
19	3	$3,667	$0	$1,022	$4,689
	4	$3,471	$0	$754	$4,225
	5	$3,286	$0	$505	$3,791
	6	$3,112	$0	$276	$3,388
	7	$2,947	$0	$161	$3,108
	8	$2,792	$0	$161	$2,953
	9	$2,645	$0	$161	$2,806
	10	$2,506	$0	$161	$2,667
	11	$2,375	$0	$161	$2,536
19		$26,801	$0	$3,362	$30,163
20	3	$3,738	$0	$0	$3,738
	4	$3,538	$0	$0	$3,538
	5	$3,350	$0	$0	$3,350
	6	$3,172	$355	$0	$3,527
	7	$3,005	$801	$0	$3,806
	8	$2,846	$1,202	$0	$4,048
	9	$2,696	$1,560	$0	$4,256
	10	$2,555	$1,879	$0	$4,434
	11	$2,421	$2,163	$0	$4,584
20		$27,321	$7,960	$0	$35,281
21	2	$5,363	$458	$1,769	$7,590
	3	$5,075	$1,377	$1,452	$7,904
	4	$4,803	$2,201	$1,159	$8,163
	5	$4,547	$2,939	$887	$8,373
21		$19,788	$6,975	$5,267	$32,030

B737 QC NETWORK COST COMPONENTS

Leg	Time	DOC B737	Opp.Cost B737	Pos.Cost B737	Total B737
22	2	$5,363	$0	$0	$5,363
	3	$5,075	$0	$0	$5,075
	4	$4,803	$0	$0	$4,803
	5	$4,547	$0	$0	$4,547
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22		$19,788	$0	$0	$19,788
=========		===========	===============	===============	===========
26	9	$2,590	$0	$766	$3,356
	10	$2,454	$0	$591	$3,045
	11	$2,326	$0	$428	$2,754
	12	$2,204	$0	$276	$2,480
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26		$9,574	$0	$2,061	$11,635
=========		===========	===============	===============	===========
27	9	$2,590	$0	$0	$2,590
	10	$2,454	$0	$0	$2,454
	11	$2,326	$0	$0	$2,326
	12	$2,204	$0	$0	$2,204
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27		$9,574	$0	$0	$9,574
=========		===========	===============	===============	===========
29	1	$4,272	$0	$0	$4,272
	2	$4,042	$585	$0	$4,627
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29		$8,314	$585	$0	$8,899
=========		===========	===============	===============	===========
30	1	$3,639	$0	$3,345	$6,984
	2	$3,444	$0	$3,031	$6,475
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30		$7,083	$0	$6,376	$13,459
=========		===========	===============	===============	===========
31	1	$3,639	$0	$0	$3,639
	2	$3,444	$0	$0	$3,444
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31		$7,083	$0	$0	$7,083
=========		===========	===============	===============	===========
32	1	$4,272	$0	$0	$4,272
	2	$4,042	$585	$0	$4,627
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32		$8,314	$585	$0	$8,899
=========		===========	===============	===============	===========
33	1	$5,534	$0	$1,732	$7,266
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33		$5,534	$0	$1,732	$7,266
=========		===========	===============	===============	===========
34	1	$5,534	$6,494	$0	$12,028
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34		$5,534	$6,494	$0	$12,028
=========		===========	===============	===============	===========
36	2	$3,773	$0	$2,093	$5,866

B737 QC NETWORK COST COMPONENTS

Leg	Time	DOC B737	Opp.Cost B737	Pos.Cost B737	Total B737
36		$3,773	$0	$2,093	$5,866
37	2	$3,773	$0	$0	$3,773
37		$3,773	$0	$0	$3,773

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC B737	Opp.Cost A320	Diff.Opp B737	Pos.Cost A320	Diff.Pos B737	Total A320	Diff.Tot. B737
7	1	$3,773	12%	$2,199	(16%)	$0	.	$5,972	(0%)
	2	$3,573	12%	$2,274	(14%)	$0	.	$5,847	(0%)
	3	$3,385	12%	$2,337	(13%)	$0	.	$5,722	0%
	4	$3,206	12%	$2,390	(12%)	$0	.	$5,596	0%
	5	$3,038	12%	$2,432	(11%)	$0	.	$5,470	1%
	6	$2,878	12%	$2,464	(10%)	$0	.	$5,342	1%
	7	$2,728	12%	$2,489	(9%)	$0	.	$5,217	1%
	8	$2,586	12%	$2,506	(9%)	$0	.	$5,092	1%
	9	$2,451	13%	$2,516	(8%)	$0	.	$4,967	1%
	10	$2,324	13%	$2,520	(8%)	$0	.	$4,844	1%
	11	$2,203	13%	$2,518	(7%)	$0	.	$4,721	1%
	12	$2,090	13%	$2,511	(7%)	$0	.	$4,601	1%
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7		$34,235		$29,156		$0		$63,391	
===		========		=========		=========		=========	
8	1	$4,015	12%	$0	.	$0	.	$4,015	12%
	2	$3,802	12%	$0	.	$0	.	$3,802	12%
	3	$3,602	12%	$0	.	$0	.	$3,602	12%
	4	$3,412	12%	$0	.	$0	.	$3,412	12%
	5	$3,233	12%	$0	.	$0	.	$3,233	12%
	6	$3,063	12%	$0	.	$0	.	$3,063	12%
	7	$2,903	12%	$0	.	$0	.	$2,903	12%
	8	$2,752	12%	$0	.	$0	.	$2,752	12%
	9	$2,609	12%	$0	.	$0	.	$2,609	12%
	10	$2,474	12%	$0	(100%)	$0	.	$2,474	10%
	11	$2,346	13%	$0	(100%)	$0	.	$2,346	(1%)
	12	$2,225	13%	$0	(100%)	$0	.	$2,225	(11%)
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8		$36,436		$0		$0		$36,436	
===		========		=========		=========		=========	
9	1	$4,015	12%	$720	(75%)	$8,624	16%	$13,359	(4%)
	2	$3,802	12%	$1,402	(58%)	$8,163	16%	$13,367	(3%)
	3	$3,602	12%	$2,013	(47%)	$7,729	16%	$13,344	(3%)
	4	$3,412	12%	$2,559	(40%)	$7,318	16%	$13,289	(2%)
	5	$3,233	12%	$3,045	(34%)	$6,931	16%	$13,209	(2%)
	6	$3,063	12%	$3,476	(29%)	$6,565	16%	$13,104	(1%)
	7	$2,903	12%	$3,858	(26%)	$6,219	17%	$12,980	(1%)
	8	$2,752	12%	$4,193	(23%)	$5,892	17%	$12,837	(1%)
	9	$2,609	12%	$4,486	(20%)	$5,584	17%	$12,679	(0%)
	10	$2,474	12%	$4,741	(18%)	$5,292	17%	$12,507	(0%)
	11	$2,346	13%	$4,960	(17%)	$5,017	17%	$12,323	(0%)
	12	$2,225	13%	$5,147	(15%)	$4,757	17%	$12,129	0%
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9		$36,436		$40,600		$78,091		$155127	
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COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC B737	Opp.Cost A320	Diff.Opp B737	Pos.Cost A320	Diff.Pos B737	Total A320	Diff.Tot. B737
10	1	$3,773	12%	$2,199	(16%)	$161	0%	$6,133	(0%)
	2	$3,573	12%	$2,274	(14%)	$161	0%	$6,008	(0%)
	3	$3,385	12%	$2,337	(13%)	$161	0%	$5,883	0%
	4	$3,206	12%	$2,390	(12%)	$161	0%	$5,757	0%
	5	$3,038	12%	$2,432	(11%)	$161	0%	$5,631	0%
	6	$2,878	12%	$2,464	(10%)	$161	0%	$5,503	1%
	7	$2,728	12%	$2,489	(9%)	$161	0%	$5,378	1%
	8	$2,586	12%	$2,506	(9%)	$161	0%	$5,253	1%
	9	$2,451	13%	$2,516	(8%)	$161	0%	$5,128	1%
	10	$2,324	13%	$2,520	(8%)	$161	0%	$5,005	1%
	11	$2,203	13%	$2,518	(7%)	$161	0%	$4,882	1%
	12	$2,090	13%	$2,511	(7%)	$161	0%	$4,762	1%
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10		$34,235		$29,156		$1,932		$65,323	
===		========		=========		=========		=========	
11	1	$4,573	11%	$0	.	$0	.	$4,573	11%
	2	$4,330	11%	$0	.	$0	.	$4,330	11%
	3	$4,101	11%	$0	.	$0	.	$4,101	11%
	4	$3,885	11%	$0	.	$0	.	$3,885	11%
	5	$3,681	12%	$0	.	$0	.	$3,681	12%
	6	$3,488	12%	$0	(100%)	$0	.	$3,488	0%
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11		$24,058		$0		$0		$24,058	
===		========		=========		=========		=========	
12	1	$4,573	11%	$6,682	(26%)	$3,002	64%	$14,257	(5%)
	2	$4,330	11%	$7,277	(23%)	$2,677	71%	$14,284	(4%)
	3	$4,101	11%	$7,797	(21%)	$2,374	79%	$14,272	(4%)
	4	$3,885	11%	$8,249	(18%)	$2,091	90%	$14,225	(3%)
	5	$3,681	12%	$8,639	(17%)	$1,828	105%	$14,148	(3%)
	6	$3,488	12%	$8,972	(15%)	$1,582	128%	$14,042	(2%)
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12		$24,058		$47,616		$13,554		$85,228	
===		========		=========		=========		=========	
13	3	$4,695	11%	$0	.	$0	.	$4,695	11%
	4	$4,447	11%	$0	.	$0	.	$4,447	11%
	5	$4,213	11%	$0	.	$0	.	$4,213	11%
	6	$3,991	11%	$0	.	$0	.	$3,991	11%
	7	$3,782	11%	$0	.	$0	.	$3,782	11%
	8	$3,585	11%	$0	.	$0	.	$3,585	11%
	9	$3,398	11%	$0	.	$0	.	$3,398	11%
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13		$28,111		$0		$0		$28,111	
===		========		=========		=========		=========	
14	3	$4,695	11%	$0	.	$2,876	81%	$7,571	30%
	4	$4,447	11%	$0	.	$2,526	94%	$6,973	31%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC B737	Opp.Cost A320	Diff.Opp B737	Pos.Cost A320	Diff.Pos B737	Total A320	Diff.Tot. B737
14	5	$4,213	11%	$0	.	$2,200	111%	$6,413	33%
	6	$3,991	11%	$0	(100%)	$1,896	137%	$5,887	20%
	7	$3,782	11%	$0	(100%)	$1,614	181%	$5,396	4%
	8	$3,585	11%	$0	(100%)	$1,351	268%	$4,936	(8%)
	9	$3,398	11%	$433	(81%)	$1,107	536%	$4,938	(11%)
14		$28,111		$433		$13,570		$42,114	
17	3	$4,163	11%	$0	.	$0	.	$4,163	11%
	4	$3,943	11%	$0	.	$0	.	$3,943	11%
	5	$3,736	12%	$0	.	$0	.	$3,736	12%
	6	$3,540	12%	$0	.	$0	.	$3,540	12%
	7	$3,355	12%	$0	.	$0	.	$3,355	12%
	8	$3,180	12%	$0	.	$0	.	$3,180	12%
	9	$3,015	12%	$0	.	$0	.	$3,015	12%
	10	$2,858	12%	$0	(100%)	$0	.	$2,858	10%
	11	$2,711	12%	$0	(100%)	$0	.	$2,711	(3%)
17		$30,501	.	$0		$0		$30,501	
18	3	$4,086	11%	$0	.	$0	.	$4,086	11%
	4	$3,870	11%	$0	.	$0	.	$3,870	11%
	5	$3,667	12%	$0	.	$0	.	$3,667	12%
	6	$3,475	12%	$0	.	$0	.	$3,475	12%
	7	$3,293	12%	$0	.	$0	.	$3,293	12%
	8	$3,121	12%	$0	.	$0	.	$3,121	12%
	9	$2,959	12%	$0	.	$0	.	$2,959	12%
	10	$2,806	12%	$0	.	$0	.	$2,806	12%
	11	$2,661	12%	$0	.	$0	.	$2,661	12%
18		$29,938		$0		$0		$29,938	
19	3	$4,086	11%	$0	.	$2,312	126%	$6,398	36%
	4	$3,870	11%	$0	.	$1,976	162%	$5,846	38%
	5	$3,667	12%	$0	.	$1,663	229%	$5,330	41%
	6	$3,475	12%	$0	.	$1,373	397%	$4,848	43%
	7	$3,293	12%	$0	.	$1,102	584%	$4,395	41%
	8	$3,121	12%	$0	.	$852	429%	$3,973	35%
	9	$2,959	12%	$0	.	$619	284%	$3,578	28%
	10	$2,806	12%	$0	.	$403	150%	$3,209	20%
	11	$2,661	12%	$0	.	$203	26%	$2,864	13%
19		$29,938		$0		$10,503		$40,441	
20	3	$4,163	11%	$0	.	$0	.	$4,163	11%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC B737	Opp.Cost A320	Diff.Opp B737	Pos.Cost A320	Diff.Pos B737	Total A320	Diff.Tot. B737
20	4	$3,943	11%	$0	.	$0	.	$3,943	11%
	5	$3,736	12%	$0	.	$0	.	$3,736	12%
	6	$3,540	12%	$0	(100%)	$0	.	$3,540	0%
	7	$3,355	12%	$0	(100%)	$0	.	$3,355	(12%)
	8	$3,180	12%	$0	(100%)	$0	.	$3,180	(21%)
	9	$3,015	12%	$289	(81%)	$0	.	$3,304	(22%)
	10	$2,858	12%	$702	(63%)	$0	.	$3,560	(20%)
	11	$2,711	12%	$1,073	(50%)	$0	.	$3,784	(17%)
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20		$30,501		$2,064		$0		$32,565	
===		========		=========		=========		=========	
21	2	$5,924	10%	$0	(100%)	$3,202	81%	$9,126	20%
	3	$5,608	11%	$0	(100%)	$2,811	94%	$8,419	7%
	4	$5,310	11%	$0	(100%)	$2,447	111%	$7,757	(5%)
	5	$5,029	11%	$345	(88%)	$2,108	138%	$7,482	(11%)
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21		$21,871		$345		$10,568		$32,784	
===		========		=========		=========		=========	
22	2	$5,924	10%	$0	.	$0	.	$5,924	10%
	3	$5,608	11%	$0	.	$0	.	$5,608	11%
	4	$5,310	11%	$0	.	$0	.	$5,310	11%
	5	$5,029	11%	$0	.	$0	.	$5,029	11%
---		--------		---------		---------		---------	
22		$21,871		$0		$0		$21,871	
===		========		=========		=========		=========	
26	9	$2,900	12%	$0	.	$1,612	110%	$4,512	34%
	10	$2,750	12%	$0	.	$1,392	136%	$4,142	36%
	11	$2,608	12%	$0	.	$1,188	178%	$3,796	38%
	12	$2,473	12%	$0	.	$997	261%	$3,470	40%
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26		$10,731		$0		$5,189		$15,920	
===		========		=========		=========		=========	
27	9	$2,900	12%	$0	.	$0	.	$2,900	12%
	10	$2,750	12%	$0	.	$0	.	$2,750	12%
	11	$2,608	12%	$0	.	$0	.	$2,608	12%
	12	$2,473	12%	$0	.	$0	.	$2,473	12%
---		--------		---------		---------		---------	
27		$10,731		$0		$0		$10,731	
===		========		=========		=========		=========	
29	1	$4,748	11%	$0	.	$0	.	$4,748	11%
	2	$4,497	11%	$0	(100%)	$0	.	$4,497	(3%)
---		--------		---------		---------		---------	
29		$9,245		$0		$0		$9,245	
===		========		=========		=========		=========	
30	1	$4,061	12%	$0	.	$4,586	37%	$8,647	24%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC B737	Opp.Cost A320	Diff.Opp B737	Pos.Cost A320	Diff.Pos B737	Total A320	Diff.Tot. B737
30	2	$3,846	12%	$0	.	$4,206	39%	$8,052	24%
30		$7,907		$0		$8,792		$16,699	
31	1	$4,061	12%	$0	.	$0	.	$4,061	12%
	2	$3,846	12%	$0	.	$0	.	$3,846	12%
31		$7,907		$0		$0		$7,907	
32	1	$4,748	11%	$0	.	$0	.	$4,748	11%
	2	$4,497	11%	$0	(100%)	$0	.	$4,497	(3%)
32		$9,245		$0		$0		$9,245	
33	1	$6,114	10%	$0	.	$3,137	81%	$9,251	27%
33		$6,114		$0		$3,137		$9,251	
34	1	$6,114	10%	$2,965	(54%)	$0	.	$9,079	(25%)
34		$6,114		$2,965		$0		$9,079	
36	2	$4,204	11%	$0	.	$3,350	60%	$7,554	29%
36		$4,204		$0		$3,350		$7,554	
37	2	$4,204	11%	$0	.	$0	.	$4,204	11%
37		$4,204		$0		$0		$4,204	

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.DOC B737	Opp.Cost A321	Diff.Opp B737	Pos.Cost A321	Diff.Pos B737	Total A321	Diff.Tot. B737
7	1	$4,215	25%	$1,565	(40%)	$0	.	$5,780	(3%)
	2	$3,994	25%	$1,687	(36%)	$0	.	$5,681	(3%)
	3	$3,784	25%	$1,794	(33%)	$0	.	$5,578	(2%)
	4	$3,587	25%	$1,886	(31%)	$0	.	$5,473	(2%)
	5	$3,399	26%	$1,965	(28%)	$0	.	$5,364	(1%)
	6	$3,223	26%	$2,033	(26%)	$0	.	$5,256	(1%)
	7	$3,055	26%	$2,089	(24%)	$0	.	$5,144	(1%)
	8	$2,897	26%	$2,136	(22%)	$0	.	$5,033	(0%)
	9	$2,748	26%	$2,173	(21%)	$0	.	$4,921	0%
	10	$2,606	26%	$2,202	(19%)	$0	.	$4,808	0%
	11	$2,472	27%	$2,224	(18%)	$0	.	$4,696	1%
	12	$2,345	27%	$2,239	(17%)	$0	.	$4,584	1%
7		$38,325		$23,993		$0	.	$62,318	(12%)
8	1	$4,488	25%	$0	.	$0	.	$4,488	25%
	2	$4,251	25%	$0	.	$0	.	$4,251	25%
	3	$4,028	25%	$0	.	$0	.	$4,028	25%
	4	$3,818	25%	$0	.	$0	.	$3,818	25%
	5	$3,618	25%	$0	.	$0	.	$3,618	25%
	6	$3,430	26%	$0	.	$0	.	$3,430	26%
	7	$3,252	26%	$0	.	$0	.	$3,252	26%
	8	$3,083	26%	$0	.	$0	.	$3,083	26%
	9	$2,924	26%	$0	.	$0	.	$2,924	26%
	10	$2,773	26%	$0	(100%)	$0	.	$2,773	24%
	11	$2,631	26%	$0	(100%)	$0	.	$2,631	11%
	12	$2,496	26%	$0	(100%)	$0	.	$2,496	0%
8		$40,792		$0		$0	.	$40,792	263%
9	1	$4,488	25%	$0	(100%)	$10,269	38%	$14,757	7%
	2	$4,251	25%	$0	(100%)	$9,716	38%	$13,967	1%
	3	$4,028	25%	$0	(100%)	$9,194	38%	$13,222	(3%)
	4	$3,818	25%	$0	(100%)	$8,702	38%	$12,520	(8%)
	5	$3,618	25%	$648	(86%)	$8,238	38%	$12,504	(7%)
	6	$3,430	26%	$1,257	(74%)	$7,799	38%	$12,486	(6%)
	7	$3,252	26%	$1,803	(65%)	$7,385	38%	$12,440	(5%)
	8	$3,083	26%	$2,290	(58%)	$6,995	38%	$12,368	(4%)
	9	$2,924	26%	$2,724	(52%)	$6,626	38%	$12,274	(4%)
	10	$2,773	26%	$3,109	(46%)	$6,277	38%	$12,159	(3%)
	11	$2,631	26%	$3,449	(42%)	$5,948	38%	$12,028	(2%)
	12	$2,496	26%	$3,749	(38%)	$5,636	38%	$11,881	(2%)
9		$40,792		$19,029		$92,785	460%	$152606	(37%)

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.DOC B737	Opp.Cost A321	Diff.Opp B737	Pos.Cost A321	Diff.Pos B737	Total A321	Diff.Tot. B737
10	1	$4,215	25%	$1,565	(40%)	$161	0%	$5,941	(3%)
	2	$3,994	25%	$1,687	(36%)	$161	0%	$5,842	(3%)
	3	$3,784	25%	$1,794	(33%)	$161	0%	$5,739	(2%)
	4	$3,587	25%	$1,886	(31%)	$161	0%	$5,634	(2%)
	5	$3,399	26%	$1,965	(28%)	$161	0%	$5,525	(1%)
	6	$3,223	26%	$2,033	(26%)	$161	0%	$5,417	(1%)
	7	$3,055	26%	$2,089	(24%)	$161	0%	$5,305	(1%)
	8	$2,897	26%	$2,136	(22%)	$161	0%	$5,194	(0%)
	9	$2,748	26%	$2,173	(21%)	$161	0%	$5,082	0%
	10	$2,606	26%	$2,202	(19%)	$161	0%	$4,969	0%
	11	$2,472	27%	$2,224	(18%)	$161	0%	$4,857	1%
	12	$2,345	27%	$2,239	(17%)	$161	0%	$4,745	1%
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10		$38,325		$23,993		$1,932	0%	$64,250	(11%)
===		========		=========		========	========	=========	=========
11	1	$5,113	24%	$0	.	$0	.	$5,113	24%
	2	$4,842	25%	$0	.	$0	.	$4,842	25%
	3	$4,587	25%	$0	.	$0	.	$4,587	25%
	4	$4,346	25%	$0	.	$0	.	$4,346	25%
	5	$4,118	25%	$0	.	$0	.	$4,118	25%
	6	$3,903	25%	$0	(100%)	$0	.	$3,903	12%
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11		$26,909		$0		$0	.	$26,909	135%
===		========		=========		========	========	=========	=========
12	1	$5,113	24%	$3,059	(66%)	$5,118	179%	$13,290	(11%)
	2	$4,842	25%	$3,922	(59%)	$4,691	199%	$13,455	(10%)
	3	$4,587	25%	$4,690	(52%)	$4,293	224%	$13,570	(8%)
	4	$4,346	25%	$5,372	(47%)	$3,920	256%	$13,638	(7%)
	5	$4,118	25%	$5,975	(42%)	$3,571	301%	$13,664	(6%)
	6	$3,903	25%	$6,506	(38%)	$3,245	368%	$13,654	(5%)
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12		$26,909		$29,524		$24,838	2E3%	$81,271	(48%)
===		========		=========		========	========	=========	=========
13	3	$5,253	24%	$0	.	$0	.	$5,253	24%
	4	$4,975	24%	$0	.	$0	.	$4,975	24%
	5	$4,712	24%	$0	.	$0	.	$4,712	24%
	6	$4,465	24%	$0	.	$0	.	$4,465	24%
	7	$4,231	24%	$0	.	$0	.	$4,231	24%
	8	$4,010	25%	$0	.	$0	.	$4,010	25%
	9	$3,801	25%	$0	.	$0	.	$3,801	25%
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13		$31,447		$0		$0	.	$31,447	171%
===		========		=========		========	========	=========	=========
14	3	$5,253	24%	$0	.	$5,240	230%	$10,493	80%
	4	$4,975	24%	$0	.	$4,778	266%	$9,753	84%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.DOC B737	Opp.Cost A321	Diff.Opp B737	Pos.Cost A321	Diff.Pos B737	Total A321	Diff.Tot. B737
14	5	$4,712	24%	$0	.	$4,347	317%	$9,059	87%
	6	$4,465	24%	$0	(100%)	$3,945	393%	$8,410	71%
	7	$4,231	24%	$0	(100%)	$3,569	521%	$7,800	51%
	8	$4,010	25%	$0	(100%)	$3,217	777%	$7,227	34%
	9	$3,801	25%	$0	(100%)	$2,889	2E3%	$6,690	20%
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14		$31,447		$0		$27,985	4E3%	$59,432	428%
===		========		=========		========	========	=========	=========
17	3	$4,656	25%	$0	.	$0	.	$4,656	25%
	4	$4,411	25%	$0	.	$0	.	$4,411	25%
	5	$4,180	25%	$0	.	$0	.	$4,180	25%
	6	$3,961	25%	$0	.	$0	.	$3,961	25%
	7	$3,754	25%	$0	.	$0	.	$3,754	25%
	8	$3,559	25%	$0	.	$0	.	$3,559	25%
	9	$3,375	25%	$0	.	$0	.	$3,375	25%
	10	$3,200	25%	$0	(100%)	$0	.	$3,200	23%
	11	$3,035	25%	$0	(100%)	$0	.	$3,035	8%
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17		$34,131		$0		$0	.	$34,131	205%
===		========		=========		========	========	=========	=========
18	3	$4,570	25%	$0	.	$0	.	$4,570	25%
	4	$4,329	25%	$0	.	$0	.	$4,329	25%
	5	$4,102	25%	$0	.	$0	.	$4,102	25%
	6	$3,888	25%	$0	.	$0	.	$3,888	25%
	7	$3,685	25%	$0	.	$0	.	$3,685	25%
	8	$3,494	25%	$0	.	$0	.	$3,494	25%
	9	$3,313	25%	$0	.	$0	.	$3,313	25%
	10	$3,142	25%	$0	.	$0	.	$3,142	25%
	11	$2,980	25%	$0	.	$0	.	$2,980	25%
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18		$33,503		$0		$0	.	$33,503	225%
===		========		=========		========	========	=========	=========
19	3	$4,570	25%	$0	.	$4,728	363%	$9,298	98%
	4	$4,329	25%	$0	.	$4,279	468%	$8,608	104%
	5	$4,102	25%	$0	.	$3,861	665%	$7,963	110%
	6	$3,888	25%	$0	.	$3,470	1E3%	$7,358	117%
	7	$3,685	25%	$0	.	$3,105	2E3%	$6,790	118%
	8	$3,494	25%	$0	.	$2,765	2E3%	$6,259	112%
	9	$3,313	25%	$0	.	$2,447	1E3%	$5,760	105%
	10	$3,142	25%	$0	.	$2,151	1E3%	$5,293	98%
	11	$2,980	25%	$0	.	$1,876	1E3%	$4,856	91%
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19		$33,503		$0		$28,682	1E4%	$62,185	955%
===		========		=========		========	========	=========	=========
20	3	$4,656	25%	$0	.	$0	.	$4,656	25%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.DOC B737	Opp.Cost A321	Diff.Opp B737	Pos.Cost A321	Diff.Pos B737	Total A321	Diff.Tot. B737
20	4	$4,411	25%	$0	.	$0	.	$4,411	25%
	5	$4,180	25%	$0	.	$0	.	$4,180	25%
	6	$3,961	25%	$0	(100%)	$0	.	$3,961	12%
	7	$3,754	25%	$0	(100%)	$0	.	$3,754	(1%)
	8	$3,559	25%	$0	(100%)	$0	.	$3,559	(12%)
	9	$3,375	25%	$0	(100%)	$0	.	$3,375	(21%)
	10	$3,200	25%	$0	(100%)	$0	.	$3,200	(28%)
	11	$3,035	25%	$0	(100%)	$0	.	$3,035	(34%)
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20		$34,131		$0		$0	.	$34,131	(9%)
===		========		=========		========	========	=========	=========
21	2	$6,635	24%	$0	(100%)	$5,817	229%	$12,452	64%
	3	$6,279	24%	$0	(100%)	$5,304	265%	$11,583	47%
	4	$5,944	24%	$0	(100%)	$4,824	316%	$10,768	32%
	5	$5,628	24%	$0	(100%)	$4,376	393%	$10,004	19%
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21		$24,486		$0		$20,321	1E3%	$44,807	162%
===		========		=========		========	========	=========	=========
22	2	$6,635	24%	$0	.	$0	.	$6,635	24%
	3	$6,279	24%	$0	.	$0	.	$6,279	24%
	4	$5,944	24%	$0	.	$0	.	$5,944	24%
	5	$5,628	24%	$0	.	$0	.	$5,628	24%
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22		$24,486		$0		$0	.	$24,486	95%
===		========		=========		========	========	=========	=========
26	9	$3,247	25%	$0	.	$3,165	313%	$6,412	91%
	10	$3,080	26%	$0	.	$2,876	387%	$5,956	96%
	11	$2,921	26%	$0	.	$2,606	509%	$5,527	101%
	12	$2,771	26%	$0	.	$2,352	752%	$5,123	107%
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26		$12,019		$0		$10,999	2E3%	$23,018	394%
===		========		=========		========	========	=========	=========
27	9	$3,247	25%	$0	.	$0	.	$3,247	25%
	10	$3,080	26%	$0	.	$0	.	$3,080	26%
	11	$2,921	26%	$0	.	$0	.	$2,921	26%
	12	$2,771	26%	$0	.	$0	.	$2,771	26%
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27		$12,019		$0		$0	.	$12,019	102%
===		========		=========		========	========	=========	=========
29	1	$5,310	24%	$0	.	$0	.	$5,310	24%
	2	$5,029	24%	$0	(100%)	$0	.	$5,029	9%
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29		$10,339		$0		$0	.	$10,339	33%
===		========		=========		========	========	=========	=========
30	1	$4,539	25%	$0	.	$6,697	100%	$11,236	61%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.DOC B737	Opp.Cost A321	Diff.Opp B737	Pos.Cost A321	Diff.Pos B737	Total A321	Diff.Tot. B737
30	2	$4,300	25%	$0	.	$6,214	105%	$10,514	62%
30		$8,839		$0		$12,911	205%	$21,750	123%
31	1	$4,539	25%	$0	.	$0	.	$4,539	25%
	2	$4,300	25%	$0	.	$0	.	$4,300	25%
31		$8,839		$0		$0	.	$8,839	50%
32	1	$5,310	24%	$0	.	$0	.	$5,310	24%
	2	$5,029	24%	$0	(100%)	$0	.	$5,029	9%
32		$10,339		$0		$0	.	$10,339	33%
33	1	$6,848	24%	$0	.	$5,702	229%	$12,550	73%
33		$6,848		$0		$5,702	229%	$12,550	73%
34	1	$6,848	24%	$0	(100%)	$0	.	$6,848	(43%)
34		$6,848		$0		$0	.	$6,848	(43%)
36	2	$4,701	25%	$0	.	$5,608	168%	$10,309	76%
36		$4,701		$0		$5,608	168%	$10,309	76%
37	2	$4,701	25%	$0	.	$0	.	$4,701	25%
37		$4,701		$0		$0	.	$4,701	25%

APPENDIX E A320 QC NETWORK COST COMPONENTS

A320 QC NETWORK COST COMPONENTS

Leg	Time	DOC A320	Opp.Cost A320	Pos.Cost A320	Total A320
11	7	$3,306	$0	$0	$3,306
	8	$3,133	$0	$0	$3,133
	9	$2,970	$289	$0	$3,259
	10	$2,816	$702	$0	$3,518
11		$12,225	$991	$0	$13,216
12	7	$3,306	$9,254	$1,354	$13,914
	8	$3,133	$9,488	$1,141	$13,762
	9	$2,970	$9,680	$942	$13,592
	10	$2,816	$9,832	$758	$13,406
12		$12,225	$38,254	$4,195	$54,674
13	10	$3,221	$0	$0	$3,221
	11	$3,055	$0	$0	$3,055
	12	$2,897	$0	$0	$2,897
13		$9,173	$0	$0	$9,173
14	10	$3,221	$1,053	$879	$5,153
	11	$3,055	$1,609	$668	$5,332
	12	$2,897	$2,107	$472	$5,476
14		$9,173	$4,769	$2,019	$15,961
15	1	$5,958	$1,200	$0	$7,158
	2	$5,640	$2,337	$0	$7,977
	3	$5,339	$3,355	$0	$8,694
	4	$5,056	$4,265	$0	$9,321
	5	$4,789	$5,075	$0	$9,864
	6	$4,536	$5,794	$0	$10,330
	7	$4,298	$6,429	$0	$10,727
	8	$4,072	$6,988	$0	$11,060
	9	$3,860	$7,477	$0	$11,337
15		$43,548	$42,920	$0	$86,468
16	1	$5,958	$0	$3,919	$9,877
	2	$5,640	$0	$3,524	$9,164
	3	$5,339	$0	$3,155	$8,494
	4	$5,056	$0	$2,811	$7,867
	5	$4,789	$0	$2,490	$7,279
	6	$4,536	$0	$2,190	$6,726
	7	$4,298	$0	$1,911	$6,209
	8	$4,072	$0	$1,651	$5,723
	9	$3,860	$361	$1,408	$5,629
16		$43,548	$361	$23,059	$66,968
17	12	$2,571	$0	$0	$2,571

A320 QC NETWORK COST COMPONENTS

Leg	Time	DOC A320	Opp.Cost A320	Pos.Cost A320	Total A320
17		$2,571	$0	$0	$2,571
18	12	$2,523	$0	$0	$2,523
18		$2,523	$0	$0	$2,523
19	12	$2,523	$0	$161	$2,684
19		$2,523	$0	$161	$2,684
20	12	$2,571	$1,404	$0	$3,975
20		$2,571	$1,404	$0	$3,975
21	6	$4,764	$1,195	$1,793	$7,752
	7	$4,513	$1,959	$1,500	$7,972
	8	$4,276	$2,641	$1,227	$8,144
	9	$4,053	$3,251	$974	$8,278
21		$17,606	$9,046	$5,494	$32,146
22	6	$4,764	$0	$0	$4,764
	7	$4,513	$0	$0	$4,513
	8	$4,276	$0	$0	$4,276
	9	$4,053	$433	$0	$4,486
22		$17,606	$433	$0	$18,039
29	3	$4,259	$0	$0	$4,259
	4	$4,034	$0	$0	$4,034
	5	$3,822	$441	$0	$4,263
	6	$3,621	$1,527	$0	$5,148
29		$15,736	$1,968	$0	$17,704
30	3	$3,643	$0	$3,851	$7,494
	4	$3,451	$0	$3,519	$6,970
	5	$3,270	$0	$3,208	$6,478
	6	$3,098	$0	$2,917	$6,015
30		$13,462	$0	$13,495	$26,957
31	3	$3,643	$0	$0	$3,643
	4	$3,451	$0	$0	$3,451
	5	$3,270	$0	$0	$3,270
	6	$3,098	$0	$0	$3,098
31		$13,462	$0	$0	$13,462
32	3	$4,259	$0	$0	$4,259

A320 QC NETWORK COST COMPONENTS

Leg	Time	DOC A320	Opp.Cost A320	Pos.Cost A320	Total A320
32	4	$4,034	$0	$0	$4,034
	5	$3,822	$441	$0	$4,263
	6	$3,621	$1,527	$0	$5,148
32		$15,736	$1,968	$0	$17,704
33	2	$5,788	$0	$2,754	$8,542
	4	$5,188	$0	$2,066	$7,254
	5	$4,913	$345	$1,757	$7,015
33		$15,889	$345	$6,577	$22,811
34	2	$5,788	$4,052	$0	$9,840
	4	$5,188	$5,886	$0	$11,074
	5	$4,913	$6,652	$0	$11,565
34		$15,889	$16,590	$0	$32,479
35	2	$4,420	$754	$8,204	$13,378
	3	$4,186	$2,049	$0	$6,235
35		$8,606	$2,803	$8,204	$19,613
36	3	$3,982	$0	$2,996	$6,978
36		$3,982	$0	$2,996	$6,978
37	3	$3,982	$0	$0	$3,982
37		$3,982	$0	$0	$3,982
38	2	$4,420	$754	$0	$5,174
	3	$4,186	$2,049	$0	$6,235
38		$8,606	$2,803	$0	$11,409

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A320	Opp.Cost B737	Diff.Opp A320	Pos.Cost B737	Diff.Pos A320	Total B737	Diff.Tot. A320
11	7	$2,959	(10%)	$801	.	$0	.	$3,760	14%
	8	$2,803	(11%)	$1,202	.	$0	.	$4,005	28%
	9	$2,655	(11%)	$1,560	440%	$0	.	$4,215	29%
	10	$2,516	(11%)	$1,879	168%	$0	.	$4,395	25%
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11		$10,933		$5,442		$0		$16,375	
===		========		=========		=========		=========	
12	7	$2,959	(10%)	$10,737	16%	$513	(62%)	$14,209	2%
	8	$2,803	(11%)	$10,861	14%	$345	(70%)	$14,009	2%
	9	$2,655	(11%)	$10,951	13%	$189	(80%)	$13,795	1%
	10	$2,516	(11%)	$11,009	12%	$161	(79%)	$13,686	2%
---		--------		---------		---------		---------	
12		$10,933		$43,558		$1,208		$55,699	
===		========		=========		=========		=========	
13	10	$2,891	(10%)	$0	.	$0	.	$2,891	(10%)
	11	$2,739	(10%)	$0	.	$0	.	$2,739	(10%)
	12	$2,596	(10%)	$0	.	$0	.	$2,596	(10%)
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13		$8,226		$0		$0		$8,226	
===		========		=========		=========		=========	
14	10	$2,891	(10%)	$2,819	168%	$161	(82%)	$5,871	14%
	11	$2,739	(10%)	$3,244	102%	$161	(76%)	$6,144	15%
	12	$2,596	(10%)	$3,620	72%	$161	(66%)	$6,377	16%
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14		$8,226		$9,683		$483		$18,392	
===		========		=========		=========		=========	
15	1	$5,389	(10%)	$4,729	294%	$0	.	$10,118	41%
	2	$5,099	(10%)	$5,605	140%	$0	.	$10,704	34%
	3	$4,825	(10%)	$6,381	90%	$0	.	$11,206	29%
	4	$4,567	(10%)	$7,067	66%	$0	.	$11,634	25%
	5	$4,324	(10%)	$7,669	51%	$0	.	$11,993	22%
	6	$4,094	(10%)	$8,196	41%	$0	.	$12,290	19%
	7	$3,877	(10%)	$8,653	35%	$0	.	$12,530	17%
	8	$3,672	(10%)	$9,047	29%	$0	.	$12,719	15%
	9	$3,479	(10%)	$9,383	25%	$0	.	$12,862	13%
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15		$39,326		$66,730		$0		$106056	
===		========		=========		=========		=========	
16	1	$5,389	(10%)	$0	.	$2,548	(35%)	$7,937	(20%)
	2	$5,099	(10%)	$0	.	$2,224	(37%)	$7,323	(20%)
	3	$4,825	(10%)	$0	.	$1,923	(39%)	$6,748	(21%)
	4	$4,567	(10%)	$0	.	$1,643	(42%)	$6,210	(21%)
	5	$4,324	(10%)	$0	.	$1,382	(44%)	$5,706	(22%)
	6	$4,094	(10%)	$443	.	$1,140	(48%)	$5,677	(16%)
	7	$3,877	(10%)	$1,002	.	$915	(52%)	$5,794	(7%)

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A320	Opp.Cost B737	Diff.Opp A320	Pos.Cost B737	Diff.Pos A320	Total B737	Diff.Tot. A320
16	8	$3,672	(10%)	$1,502	.	$706	(57%)	$5,880	3%
	9	$3,479	(10%)	$1,950	440%	$512	(64%)	$5,941	6%
16		$39,326		$4,897		$12,993		$57,216	
17	12	$2,294	(11%)	$688	.	$0	.	$2,982	16%
17		$2,294		$688		$0		$2,982	
18	12	$2,251	(11%)	$0	.	$0	.	$2,251	(11%)
18		$2,251		$0		$0		$2,251	
19	12	$2,251	(11%)	$0	.	$161	0%	$2,412	(10%)
19		$2,251		$0		$161		$2,412	
20	12	$2,294	(11%)	$2,414	72%	$0	.	$4,708	18%
20		$2,294		$2,414		$0		$4,708	
21	6	$4,305	(10%)	$3,598	201%	$634	(65%)	$8,537	10%
	7	$4,077	(10%)	$4,183	114%	$401	(73%)	$8,661	9%
	8	$3,862	(10%)	$4,701	78%	$184	(85%)	$8,747	7%
	9	$3,658	(10%)	$5,157	59%	$161	(83%)	$8,976	8%
21		$15,902		$17,639		$1,380		$34,921	
22	6	$4,305	(10%)	$532	.	$0	.	$4,837	2%
	7	$4,077	(10%)	$1,202	.	$0	.	$5,279	17%
	8	$3,862	(10%)	$1,803	.	$0	.	$5,665	32%
	9	$3,658	(10%)	$2,340	440%	$0	.	$5,998	34%
22		$15,902		$5,877		$0		$21,779	
29	3	$3,826	(10%)	$1,759	.	$0	.	$5,585	31%
	4	$3,622	(10%)	$2,813	.	$0	.	$6,435	60%
	5	$3,429	(10%)	$3,756	752%	$0	.	$7,185	69%
	6	$3,247	(10%)	$4,596	201%	$0	.	$7,843	52%
29		$14,124		$12,924		$0		$27,048	
30	3	$3,259	(11%)	$0	.	$2,738	(29%)	$5,997	(20%)
	4	$3,085	(11%)	$0	.	$2,464	(30%)	$5,549	(20%)
	5	$2,921	(11%)	$0	.	$2,209	(31%)	$5,130	(21%)

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A320	Opp.Cost B737	Diff.Opp A320	Pos.Cost B737	Diff.Pos A320	Total B737	Diff.Tot. A320
30	6	$2,766	(11%)	$0	.	$1,970	(32%)	$4,736	(21%)
30		$12,031		$0		$9,381		$21,412	
31	3	$3,259	(11%)	$0	.	$0	.	$3,259	(11%)
	4	$3,085	(11%)	$0	.	$0	.	$3,085	(11%)
	5	$2,921	(11%)	$0	.	$0	.	$2,921	(11%)
	6	$2,766	(11%)	$0	.	$0	.	$2,766	(11%)
31		$12,031		$0		$0		$12,031	
32	3	$3,826	(10%)	$1,759	.	$0	.	$5,585	31%
	4	$3,622	(10%)	$2,813	.	$0	.	$6,435	60%
	5	$3,429	(10%)	$3,756	752%	$0	.	$7,185	69%
	6	$3,247	(10%)	$4,596	201%	$0	.	$7,843	52%
32		$14,124		$12,924		$0		$27,048	
33	2	$5,236	(10%)	$458	.	$1,423	(48%)	$7,117	(17%)
	4	$4,690	(10%)	$2,201	.	$869	(58%)	$7,760	7%
	5	$4,440	(10%)	$2,939	752%	$623	(65%)	$8,002	14%
33		$14,366		$5,598		$2,915		$22,879	
34	2	$5,236	(10%)	$7,320	81%	$0	.	$12,556	28%
	4	$4,690	(10%)	$8,688	48%	$0	.	$13,378	21%
	5	$4,440	(10%)	$9,246	39%	$0	.	$13,686	18%
34		$14,366		$25,254		$0		$39,620	
35	2	$3,971	(10%)	$4,722	526%	$7,030	(14%)	$15,723	18%
	3	$3,759	(10%)	$5,723	179%	$0	.	$9,482	52%
35		$7,730		$10,445		$7,030		$25,205	
36	3	$3,571	(10%)	$0	.	$1,805	(40%)	$5,376	(23%)
36		$3,571		$0		$1,805		$5,376	
37	3	$3,571	(10%)	$0	.	$0	.	$3,571	(10%)
37		$3,571		$0		$0		$3,571	
38	2	$3,971	(10%)	$4,722	526%	$0	.	$8,693	68%
	3	$3,759	(10%)	$5,723	179%	$0	.	$9,482	52%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A320	Opp.Cost B737	Diff.Opp A320	Pos.Cost B737	Diff.Pos A320	Total B737	Diff.Tot. A320
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38		$7,730		$10,445		$0		$18,175	
===		========		=========		=========		=========	

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.Doc A320	Opp.Cost A321	Diff.Opp A320	Pos.Cost A321	Diff.Pos A320	Total A321	Diff.Tot. A320
11	7	$3,699	12%	$0	.	$0	.	$3,699	12%
	8	$3,507	12%	$0	.	$0	.	$3,507	12%
	9	$3,325	12%	$0	(100%)	$0	.	$3,325	2%
	10	$3,153	12%	$0	(100%)	$0	.	$3,153	(10%)
11		$13,684		$0		$0		$13,684	
12	7	$3,699	12%	$6,970	(25%)	$2,940	117%	$13,609	(2%)
	8	$3,507	12%	$7,374	(22%)	$2,655	133%	$13,536	(2%)
	9	$3,325	12%	$7,722	(20%)	$2,389	154%	$13,436	(1%)
	10	$3,153	12%	$8,020	(18%)	$2,140	182%	$13,313	(1%)
12		$13,684		$30,086		$10,124		$53,894	
13	10	$3,603	12%	$0	.	$0	.	$3,603	12%
	11	$3,417	12%	$0	.	$0	.	$3,417	12%
	12	$3,240	12%	$0	.	$0	.	$3,240	12%
13		$10,260		$0		$0		$10,260	
14	10	$3,603	12%	$0	(100%)	$2,583	194%	$6,186	20%
	11	$3,417	12%	$0	(100%)	$2,297	244%	$5,714	7%
	12	$3,240	12%	$0	(100%)	$2,030	330%	$5,270	(4%)
14		$10,260		$0		$6,910		$17,170	
15	1	$6,672	12%	$0	(100%)	$0	.	$6,672	(7%)
	2	$6,314	12%	$0	(100%)	$0	.	$6,314	(21%)
	3	$5,976	12%	$0	(100%)	$0	.	$5,976	(31%)
	4	$5,658	12%	$0	(100%)	$0	.	$5,658	(39%)
	5	$5,358	12%	$1,080	(79%)	$0	.	$6,438	(35%)
	6	$5,074	12%	$2,095	(64%)	$0	.	$7,169	(31%)
	7	$4,807	12%	$3,004	(53%)	$0	.	$7,811	(27%)
	8	$4,554	12%	$3,817	(45%)	$0	.	$8,371	(24%)
	9	$4,316	12%	$4,540	(39%)	$0	.	$8,856	(22%)
15		$48,729		$14,536		$0		$63,265	
16	1	$6,672	12%	$0	.	$6,357	62%	$13,029	32%
	2	$6,314	12%	$0	.	$5,845	66%	$12,159	33%
	3	$5,976	12%	$0	.	$5,366	70%	$11,342	34%
	4	$5,658	12%	$0	.	$4,918	75%	$10,576	34%
	5	$5,358	12%	$0	.	$4,499	81%	$9,857	35%
	6	$5,074	12%	$0	.	$4,107	88%	$9,181	37%
	7	$4,807	12%	$0	.	$3,740	96%	$8,547	38%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.Doc A320	Opp.Cost A321	Diff.Opp A320	Pos.Cost A321	Diff.Pos A320	Total A321	Diff.Tot. A320
16	8	$4,554	12%	$0	.	$3,397	106%	$7,951	39%
	9	$4,316	12%	$0	(100%)	$3,077	119%	$7,393	31%
16		$48,729		$0		$41,306		$90,035	
17	12	$2,879	12%	$0	.	$0	.	$2,879	12%
17		$2,879		$0		$0		$2,879	
18	12	$2,827	12%	$0	.	$0	.	$2,827	12%
18		$2,827		$0		$0		$2,827	
19	12	$2,827	12%	$0	.	$1,619	906%	$4,446	66%
19		$2,827		$0		$1,619		$4,446	
20	12	$2,879	12%	$0	(100%)	$0	.	$2,879	(28%)
20		$2,879		$0		$0		$2,879	
21	6	$5,329	12%	$0	(100%)	$3,958	121%	$9,287	20%
	7	$5,048	12%	$0	(100%)	$3,567	138%	$8,615	8%
	8	$4,782	12%	$0	(100%)	$3,203	161%	$7,985	(2%)
	9	$4,531	12%	$314	(90%)	$2,862	194%	$7,707	(7%)
21		$19,690		$314		$13,590		$33,594	
22	6	$5,329	12%	$0	.	$0	.	$5,329	12%
	7	$5,048	12%	$0	.	$0	.	$5,048	12%
	8	$4,782	12%	$0	.	$0	.	$4,782	12%
	9	$4,531	12%	$0	(100%)	$0	.	$4,531	1%
22		$19,690		$0		$0		$19,690	
29	3	$4,763	12%	$0	.	$0	.	$4,763	12%
	4	$4,512	12%	$0	.	$0	.	$4,512	12%
	5	$4,275	12%	$0	(100%)	$0	.	$4,275	0%
	6	$4,052	12%	$0	(100%)	$0	.	$4,052	(21%)
29		$17,602		$0		$0		$17,602	
30	3	$4,074	12%	- $0	.	$5,761	50%	$9,835	31%
	4	$3,861	12%	$0	.	$5,336	52%	$9,197	32%
	5	$3,659	12%	$0	.	$4,937	54%	$8,596	33%

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.Doc A320	Opp.Cost A321	Diff.Opp A320	Pos.Cost A321	Diff.Pos A320	Total A321	Diff.Tot. A320
30	6	$3,469	12%	$0	.	$4,564	56%	$8,033	34%
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30		$15,063		$0		$20,598		$35,661	
===		========		=========		========		=========	
31	3	$4,074	12%	$0	.	$0	.	$4,074	12%
	4	$3,861	12%	$0	.	$0	.	$3,861	12%
	5	$3,659	12%	$0	.	$0	.	$3,659	12%
	6	$3,469	12%	$0	.	$0	.	$3,469	12%
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31		$15,063		$0		$0		$15,063	
===		========		=========		========		=========	
32	3	$4,763	12%	$0	.	$0	.	$4,763	12%
	4	$4,512	12%	$0	.	$0	.	$4,512	12%
	5	$4,275	12%	$0	(100%)	$0	.	$4,275	0%
	6	$4,052	12%	$0	(100%)	$0	.	$4,052	(21%)
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32		$17,602		$0		$0		$17,602	
===		========		=========		========		=========	
33	2	$6,481	12%	$0	.	$5,199	89%	$11,680	37%
	4	$5,807	12%	$0	.	$4,290	108%	$10,097	39%
	5	$5,498	12%	$0	(100%)	$3,880	121%	$9,378	34%
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33		$17,786		$0		$13,369		$31,155	
===		========		=========		========		=========	
34	2	$6,481	12%	$0	(100%)	$0	.	$6,481	(34%)
	4	$5,807	12%	$1,572	(73%)	$0	.	$7,379	(33%)
	5	$5,498	12%	$2,657	(60%)	$0	.	$8,155	(29%)
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34		$17,786		$4,229		$0		$22,015	
===		========		=========		========		=========	
35	2	$4,942	12%	$0	(100%)	$9,797	19%	$14,739	10%
	3	$4,682	12%	$0	(100%)	$0	.	$4,682	(25%)
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35		$9,624		$0		$9,797		$19,421	
===		========		=========		========		=========	
36	3	$4,453	12%	$0	.	$5,147	72%	$9,600	38%
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36		$4,453		$0		$5,147		$9,600	
===		========		=========		========		=========	
37	3	$4,453	12%	$0	.	$0	.	$4,453	12%
---		--------		---------		--------		---------	
37		$4,453		$0		$0		$4,453	
===		========		=========		========		=========	
38	2	$4,942	12%	$0	(100%)	$0	.	$4,942	(4%)
	3	$4,682	12%	$0	(100%)	$0	.	$4,682	(25%)

COST COMPONENT ANALYSIS
Absolut Values and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC A321	Diff.Doc A320	Opp.Cost A321	Diff.Opp A320	Pos.Cost A321	Diff.Pos A320	Total A321	Diff.Tot. A320
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38		$9,624		$0		$0		$9,624	
===		========		=========		========		=========	

APPENDIX F A321 QC NETWORK COST COMPONENTS

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
1	1	$7,628	$0	$0	$7,628
	2	$7,216	$0	$0	$7,216
	3	$6,828	$0	$0	$6,828
	4	$6,461	$0	$0	$6,461
	5	$6,116	$0	$0	$6,116
	6	$5,791	$0	$0	$5,791
	7	$5,483	$0	$0	$5,483
	8	$5,193	$0	$0	$5,193
	9	$4,920	$419	$0	$5,339
	10	$4,662	$1,431	$0	$6,093
	11	$4,418	$2,340	$0	$6,758
	12	$4,187	$3,153	$0	$7,340
1		$68,903	$7,343	$0	$76,246
2	1	$7,628	$17,435	$5,428	$30,491
	2	$7,216	$18,799	$4,911	$30,926
	3	$6,828	$19,988	$4,428	$31,244
	4	$6,461	$21,017	$3,979	$31,457
	5	$6,116	$21,900	$3,559	$31,575
	6	$5,791	$22,650	$3,168	$31,609
	7	$5,483	$23,279	$2,803	$31,565
	8	$5,193	$23,797	$2,463	$31,453
	9	$4,920	$24,214	$2,146	$31,280
	10	$4,662	$24,540	$1,851	$31,053
	11	$4,418	$24,783	$1,576	$30,777
	12	$4,187	$24,950	$1,320	$30,457
2		$68,903	$267,352	$37,632	$373,887
3	1	$5,469	$1,216	$0	$6,685
	2	$5,179	$2,814	$0	$7,993
	3	$4,905	$4,247	$0	$9,152
	4	$4,647	$5,528	$0	$10,175
	5	$4,402	$6,670	$0	$11,072
	6	$4,171	$7,684	$0	$11,855
	7	$3,954	$8,581	$0	$12,535
	8	$3,748	$9,371	$0	$13,119
	9	$3,553	$10,063	$0	$13,616
	10	$3,369	$10,665	$0	$14,034
	11	$3,195	$11,186	$0	$14,381
	12	$3,030	$11,631	$0	$14,661
3		$49,622	$89,656	$0	$139,278
4	1	$6,425	$0	$0	$6,425
	2	$6,081	$0	$0	$6,081
	3	$5,756	$0	$0	$5,756
	4	$5,450	$0	$0	$5,450
	5	$5,162	$0	$0	$5,162
	6	$4,889	$0	$0	$4,889

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
4	7	$4,632	$0	$0	$4,632
	8	$4,389	$0	$0	$4,389
	9	$4,159	$0	$0	$4,159
	10	$3,943	$0	$0	$3,943
	11	$3,738	$0	$0	$3,738
	12	$3,544	$0	$0	$3,544
4		$58,168	$0	$0	$58,168
5	1	$6,425	$0	$539	$6,964
	2	$6,081	$0	$150	$6,231
	3	$5,756	$0	$161	$5,917
	4	$5,450	$0	$161	$5,611
	5	$5,162	$0	$161	$5,323
	6	$4,889	$0	$161	$5,050
	7	$4,632	$0	$161	$4,793
	8	$4,389	$0	$161	$4,550
	9	$4,159	$0	$161	$4,320
	10	$3,943	$0	$161	$4,104
	11	$3,738	$0	$161	$3,899
	12	$3,544	$0	$161	$3,705
5		$58,168	$0	$2,299	$60,467
6	1	$5,469	$0	$0	$5,469
	2	$5,179	$0	$0	$5,179
	3	$4,905	$424	$0	$5,329
	4	$4,647	$1,834	$0	$6,481
	5	$4,402	$3,099	$0	$7,501
	6	$4,171	$4,232	$0	$8,403
	7	$3,954	$5,244	$0	$9,198
	8	$3,748	$6,143	$0	$9,891
	9	$3,553	$6,940	$0	$10,493
	10	$3,369	$7,643	$0	$11,012
	11	$3,195	$8,261	$0	$11,456
	12	$3,030	$8,799	$0	$11,829
6		$49,622	$52,619	$0	$102,241
11	11	$2,991	$0	$0	$2,991
	12	$2,837	$0	$0	$2,837
11		$5,828	$0	$0	$5,828
12	11	$2,991	$8,271	$1,907	$13,169
	12	$2,837	$8,480	$1,690	$13,007
12		$5,828	$16,751	$3,597	$26,176
15	10	$4,090	$5,182	$0	$9,272
	11	$3,878	$5,749	$0	$9,627

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp Cost A321	Pos Cost A321	Total A321
15	12	$3,676	$6,248	$0	$9,924
15		$11,644	$17,179	$0	$28,823
16	10	$4,090	$0	$2,777	$6,867
	11	$3,878	$0	$2,497	$6,375
	12	$3,676	$0	$2,235	$5,911
16		$11,644	$0	$7,509	$19,153
21	10	$4,294	$1,073	$2,545	$7,912
	11	$4,070	$1,755	$2,248	$8,073
	12	$3,859	$2,364	$1,972	$8,195
21		$12,223	$5,192	$6,765	$24,180
22	10	$4,294	$0	$0	$4,294
	11	$4,070	$0	$0	$4,070
	12	$3,859	$0	$0	$3,859
22		$12,223	$0	$0	$12,223
23	1	$6,268	$0	$5,156	$11,424
	2	$5,933	$0	$4,688	$10,621
	3	$5,617	$0	$4,252	$9,869
	4	$5,319	$0	$3,844	$9,163
	5	$5,038	$0	$3,464	$8,502
	6	$4,772	$599	$3,108	$8,479
	7	$4,521	$1,615	$2,777	$8,913
	8	$4,284	$2,526	$2,467	$9,277
	9	$4,060	$3,340	$2,178	$9,578
	10	$3,849	$4,067	$1,909	$9,825
	11	$3,649	$4,712	$1,658	$10,019
	12	$3,460	$5,284	$1,424	$10,168
23		$56,770	$22,143	$36,925	$115,838
24	1	$6,268	$1,271	$0	$7,539
	2	$5,933	$2,941	$0	$8,874
	3	$5,617	$4,439	$0	$10,056
	4	$5,319	$5,778	$0	$11,097
	5	$5,038	$6,972	$0	$12,010
	6	$4,772	$8,032	$0	$12,804
	7	$4,521	$8,970	$0	$13,491
	8	$4,284	$9,796	$0	$14,080
	9	$4,060	$10,519	$0	$14,579
	10	$3,849	$11,149	$0	$14,998
	11	$3,649	$11,692	$0	$15,341
	12	$3,460	$12,158	$0	$15,618

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
24		$56,770	$93,717	$0	$150,487
25	1	$5,284	$0	$0	$5,284
	2	$5,004	$0	$0	$5,004
	3	$4,739	$371	$0	$5,110
	4	$4,490	$1,605	$0	$6,095
	5	$4,254	$2,712	$0	$6,966
	6	$4,032	$3,704	$0	$7,736
	7	$3,821	$4,589	$0	$8,410
	8	$3,622	$5,376	$0	$8,998
	9	$3,434	$6,074	$2,490	$11,998
	10	$3,257	$6,689	$2,237	$12,183
	11	$3,089	$7,229	$2,000	$12,318
	12	$2,930	$7,701	$1,779	$12,410
25		$47,956	$46,050	$8,506	$102,512
26	1	$4,991	$0	$6,319	$11,310
	2	$4,727	$0	$5,828	$10,555
	3	$4,478	$0	$5,368	$9,846
	4	$4,243	$0	$4,938	$9,181
	5	$4,021	$0	$4,535	$8,556
	6	$3,811	$0	$4,158	$7,969
	7	$3,612	$0	$3,805	$7,417
	8	$3,425	$0	$3,475	$6,900
26		$33,308	$0	$38,426	$71,734
27	1	$4,991	$0	$0	$4,991
	2	$4,727	$0	$0	$4,727
	3	$4,478	$0	$0	$4,478
	4	$4,243	$0	$0	$4,243
	5	$4,021	$0	$0	$4,021
	6	$3,811	$0	$0	$3,811
	7	$3,612	$0	$0	$3,612
	8	$3,425	$0	$0	$3,425
27		$33,308	$0	$0	$33,308
28	1	$5,284	$1,059	$0	$6,343
	2	$5,004	$2,451	$0	$7,455
	3	$4,739	$3,699	$0	$8,438
	4	$4,490	$4,815	$0	$9,305
	5	$4,254	$5,810	$0	$10,064
	6	$4,032	$6,693	$0	$10,725
	7	$3,821	$7,475	$0	$11,296
	8	$3,622	$8,163	$0	$11,785
	9	$3,434	$8,766	$0	$12,200
	10	$3,257	$9,290	$0	$12,547
	11	$3,089	$9,743	$0	$12,832

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
28	12	$2,930	$10,131	$0	$13,061
28		$47,956	$78,095	$0	$126,051
29	7	$3,840	$0	$0	$3,840
	8	$3,640	$0	$0	$3,640
	9	$3,451	$401	$0	$3,852
	10	$3,273	$1,371	$0	$4,644
	11	$3,104	$2,242	$0	$5,346
	12	$2,944	$3,021	$0	$5,965
29		$20,252	$7,035	$0	$27,287
30	7	$3,289	$0	$4,214	$7,503
	8	$3,118	$0	$3,885	$7,003
	9	$2,957	$0	$3,577	$6,534
	10	$2,805	$0	$3,289	$6,094
	11	$2,660	$0	$3,019	$5,679
	12	$2,524	$0	$2,765	$5,289
30		$17,353	$0	$20,749	$38,102
31	7	$3,289	$0	$0	$3,289
	8	$3,118	$0	$0	$3,118
	9	$2,957	$0	$0	$2,957
	10	$2,805	$0	$0	$2,805
	11	$2,660	$0	$0	$2,660
	12	$2,524	$0	$0	$2,524
31		$17,353	$0	$0	$17,353
32	7	$3,840	$0	$0	$3,840
	8	$3,640	$0	$0	$3,640
	9	$3,451	$401	$0	$3,852
	10	$3,273	$1,371	$0	$4,644
	11	$3,104	$2,242	$0	$5,346
	12	$2,944	$3,021	$0	$5,965
32		$20,252	$7,035	$0	$27,287
33	3	$6,134	$0	$4,729	$10,863
	6	$5,207	$0	$3,497	$8,704
	7	$4,932	$0	$3,140	$8,072
	8	$4,673	$0	$2,806	$7,479
	9	$4,428	$314	$2,495	$7,237
	10	$4,196	$1,073	$2,205	$7,474
	11	$3,978	$1,755	$1,934	$7,667
	12	$3,771	$2,364	$1,681	$7,816
33		$37,319	$5,506	$22,487	$65,312

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
34	3	$6,134	$363	$0	$6,497
	6	$5,207	$3,628	$0	$8,835
	7	$4,932	$4,494	$0	$9,426
	8	$4,673	$5,265	$0	$9,938
	9	$4,428	$5,949	$0	$10,377
	10	$4,196	$6,551	$0	$10,747
	11	$3,978	$7,081	$0	$11,059
	12	$3,771	$7,542	$0	$11,313
34		$37,319	$40,873	$0	$78,192
35	4	$4,435	$0	$0	$4,435
	5	$4,203	$0	$0	$4,203
	6	$3,983	$682	$0	$4,665
	7	$3,775	$1,838	$0	$5,613
	8	$3,579	$2,875	$0	$6,454
	9	$3,393	$3,803	$0	$7,196
	10	$3,218	$4,630	$0	$7,848
	11	$3,052	$5,365	$0	$8,417
	12	$2,895	$6,015	$0	$8,910
35		$32,533	$25,208	$0	$57,741
36	4	$4,219	$0	$4,715	$8,934
	5	$3,999	$0	$4,311	$8,310
	6	$3,790	$0	$3,933	$7,723
	7	$3,592	$0	$3,579	$7,171
	8	$3,406	$0	$3,249	$6,655
	9	$3,229	$0	$2,940	$6,169
	10	$3,063	$0	$2,651	$5,714
	11	$2,905	$0	$2,381	$5,286
	12	$2,756	$0	$2,129	$4,885
36		$30,959	$0	$29,888	$60,847
37	4	$4,219	$0	$0	$4,219
	5	$3,999	$0	$0	$3,999
	6	$3,790	$0	$0	$3,790
	7	$3,592	$0	$0	$3,592
	8	$3,406	$0	$0	$3,406
	9	$3,229	$0	$0	$3,229
	10	$3,063	$0	$0	$3,063
	11	$2,905	$0	$0	$2,905
	12	$2,756	$0	$0	$2,756
37		$30,959	$0	$0	$30,959
38	4	$4,435	$0	$0	$4,435
	5	$4,203	$0	$0	$4,203
	6	$3,983	$682	$0	$4,665
	7	$3,775	$1,838	$0	$5,613

A321 QC NETWORK COST COMPONENTS

Leg	Time	DOC A321	Opp.Cost A321	Pos.Cost A321	Total A321
38	8	$3,579	$2,875	$0	$6,454
	9	$3,393	$3,803	$0	$7,196
	10	$3,218	$4,630	$0	$7,848
	11	$3,052	$5,365	$0	$8,417
	12	$2,895	$6,015	$0	$8,910
38		$32,533	$25,208	$0	$57,741

COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
1	1	$6,173	(19%)	$0	.	$0	.	$6,173	(19%)
	2	$5,840	(19%)	$610	.	$0	.	$6,450	(11%)
	3	$5,526	(19%)	$1,836	.	$0	.	$7,362	8%
	4	$5,230	(19%)	$2,935	.	$0	.	$8,165	26%
	5	$4,950	(19%)	$3,919	.	$0	.	$8,869	45%
	6	$4,687	(19%)	$4,797	.	$0	.	$9,484	64%
	7	$4,438	(19%)	$5,577	.	$0	.	$10,015	83%
	8	$4,203	(19%)	$6,268	.	$0	.	$10,471	102%
	9	$3,982	(19%)	$6,877	1541%	$0	.	$10,859	103%
	10	$3,772	(19%)	$7,411	418%	$0	.	$11,183	84%
	11	$3,575	(19%)	$7,876	237%	$0	.	$11,451	69%
	12	$3,388	(19%)	$8,279	163%	$0	.	$11,667	59%
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1		$55,764		$56,385		$0		$112149	
===		========		=========		=========		=========	
2	1	$6,173	(19%)	$29,089	67%	$1,170	(78%)	$36,432	19%
	2	$5,840	(19%)	$29,590	57%	$858	(83%)	$36,288	17%
	3	$5,526	(19%)	$29,979	50%	$569	(87%)	$36,074	15%
	4	$5,230	(19%)	$30,269	44%	$302	(92%)	$35,801	14%
	5	$4,950	(19%)	$30,466	39%	$161	(95%)	$35,577	13%
	6	$4,687	(19%)	$30,582	35%	$161	(95%)	$35,430	12%
	7	$4,438	(19%)	$30,623	32%	$161	(94%)	$35,222	12%
	8	$4,203	(19%)	$30,597	29%	$161	(93%)	$34,961	11%
	9	$3,982	(19%)	$30,511	26%	$161	(92%)	$34,654	11%
	10	$3,772	(19%)	$30,370	24%	$161	(91%)	$34,303	10%
	11	$3,575	(19%)	$30,181	22%	$161	(90%)	$33,917	10%
	12	$3,388	(19%)	$29,949	20%	$161	(88%)	$33,498	10%
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2		$55,764		$362206		$4,187		$422157	
===		========		=========		=========		=========	
3	1	$4,402	(20%)	$11,507	846%	$0	.	$15,909	138%
	2	$4,166	(20%)	$12,343	339%	$0	.	$16,509	107%
	3	$3,943	(20%)	$13,070	208%	$0	.	$17,013	86%
	4	$3,733	(20%)	$13,698	148%	$0	.	$17,431	71%
	5	$3,534	(20%)	$14,234	113%	$0	.	$17,768	60%
	6	$3,347	(20%)	$14,688	91%	$0	.	$18,035	52%
	7	$3,170	(20%)	$15,067	76%	$0	.	$18,237	45%
	8	$3,002	(20%)	$15,376	64%	$0	.	$18,378	40%
	9	$2,844	(20%)	$15,623	55%	$0	.	$18,467	36%
	10	$2,695	(20%)	$15,814	48%	$0	.	$18,509	32%
	11	$2,554	(20%)	$15,952	43%	$0	.	$18,506	29%
	12	$2,421	(20%)	$16,045	38%	$0	.	$18,466	26%
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3		$39,811		$173417		$0		$213228	
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COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
4	1	$5,186	(19%)	$0	.	$0	.	$5,186	(19%)
	2	$4,907	(19%)	$0	.	$0	.	$4,907	(19%)
	3	$4,644	(19%)	$0	.	$0	.	$4,644	(19%)
	4	$4,396	(19%)	$0	.	$0	.	$4,396	(19%)
	5	$4,162	(19%)	$0	.	$0	.	$4,162	(19%)
	6	$3,941	(19%)	$745	.	$0	.	$4,686	(4%)
	7	$3,732	(19%)	$1,683	.	$0	.	$5,415	17%
	8	$3,535	(19%)	$2,524	.	$0	.	$6,059	38%
	9	$3,349	(19%)	$3,276	.	$0	.	$6,625	59%
	10	$3,173	(20%)	$3,947	.	$0	.	$7,120	81%
	11	$3,007	(20%)	$4,542	.	$0	.	$7,549	102%
	12	$2,850	(20%)	$5,068	.	$0	.	$7,918	123%
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4		$46,882		$21,785		$0		$68,667	
===		========		=========		=========		=========	
5	1	$5,186	(19%)	$0	.	$161	(70%)	$5,347	(23%)
	2	$4,907	(19%)	$0	.	$161	7%	$5,068	(19%)
	3	$4,644	(19%)	$0	.	$161	0%	$4,805	(19%)
	4	$4,396	(19%)	$0	.	$161	0%	$4,557	(19%)
	5	$4,162	(19%)	$0	.	$161	0%	$4,323	(19%)
	6	$3,941	(19%)	$0	.	$161	0%	$4,102	(19%)
	7	$3,732	(19%)	$0	.	$161	0%	$3,893	(19%)
	8	$3,535	(19%)	$0	.	$161	0%	$3,696	(19%)
	9	$3,349	(19%)	$0	.	$161	0%	$3,510	(19%)
	10	$3,173	(20%)	$120	.	$161	0%	$3,454	(16%)
	11	$3,007	(20%)	$872	.	$161	0%	$4,040	4%
	12	$2,850	(20%)	$1,547	.	$161	0%	$4,558	23%
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5		$46,882		$2,539		$1,932		$51,353	
===		========		=========		=========		=========	
6	1	$4,402	(20%)	$7,576	.	$0	.	$11,978	119%
	2	$4,166	(20%)	$8,540	.	$0	.	$12,706	145%
	3	$3,943	(20%)	$9,390	2115%	$0	.	$13,333	150%
	4	$3,733	(20%)	$10,136	453%	$0	.	$13,869	114%
	5	$3,534	(20%)	$10,787	248%	$0	.	$14,321	91%
	6	$3,347	(20%)	$11,350	168%	$0	.	$14,697	75%
	7	$3,170	(20%)	$11,834	126%	$0	.	$15,004	63%
	8	$3,002	(20%)	$12,246	99%	$0	.	$15,248	54%
	9	$2,844	(20%)	$12,591	81%	$0	.	$15,435	47%
	10	$2,695	(20%)	$12,875	68%	$0	.	$15,570	41%
	11	$2,554	(20%)	$13,105	59%	$0	.	$15,659	37%
	12	$2,421	(20%)	$13,285	51%	$0	.	$15,706	33%
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6		$39,811		$133715		$0		$173526	
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COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
11	11	$2,384	(20%)	$2,163	.	$0	.	$4,547	52%
	12	$2,259	(20%)	$2,414	.	$0	.	$4,673	65%
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11		$4,643		$4,577		$0		$9,220	
===		========		=========		=========		=========	
12	11	$2,384	(20%)	$11,039	33%	$161	(92%)	$13,584	3%
	12	$2,259	(20%)	$11,043	30%	$161	(90%)	$13,463	4%
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12		$4,643		$22,082		$322		$27,047	
===		========		=========		=========		=========	
15	10	$3,296	(19%)	$9,667	87%	$0	.	$12,963	40%
	11	$3,124	(19%)	$9,902	72%	$0	.	$13,026	35%
	12	$2,961	(19%)	$10,093	62%	$0	.	$13,054	32%
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15		$9,381		$29,662		$0		$39,043	
===		========		=========		=========		=========	
16	10	$3,296	(19%)	$2,349	.	$332	(88%)	$5,977	(13%)
	11	$3,124	(19%)	$2,704	.	$166	(93%)	$5,994	(6%)
	12	$2,961	(19%)	$3,017	.	$161	(93%)	$6,139	4%
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16		$9,381		$8,070		$659		$18,110	
===		========		=========		=========		=========	
21	10	$3,466	(19%)	$5,558	418%	$161	(94%)	$9,185	16%
	11	$3,285	(19%)	$5,907	237%	$161	(93%)	$9,353	16%
	12	$3,113	(19%)	$6,209	163%	$161	(92%)	$9,483	16%
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21		$9,864		$17,674		$483		$28,021	
===		========		=========		=========		=========	
22	10	$3,466	(19%)	$2,819	.	$0	.	$6,285	46%
	11	$3,285	(19%)	$3,244	.	$0	.	$6,529	60%
	12	$3,113	(19%)	$3,620	.	$0	.	$6,733	74%
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22		$9,864		$9,683		$0		$19,547	
===		========		=========		=========		=========	
23	1	$5,058	(19%)	$3,162	.	$1,394	(73%)	$9,614	(16%)
	2	$4,786	(19%)	$4,148	.	$1,110	(76%)	$10,044	(5%)
	3	$4,530	(19%)	$5,027	.	$847	(80%)	$10,404	5%
	4	$4,288	(19%)	$5,808	.	$604	(84%)	$10,700	17%
	5	$4,059	(19%)	$6,499	.	$378	(89%)	$10,936	29%
	6	$3,844	(19%)	$7,107	1086%	$169	(95%)	$11,120	31%
	7	$3,640	(19%)	$7,641	373%	$161	(94%)	$11,442	28%
	8	$3,448	(20%)	$8,105	221%	$161	(93%)	$11,714	26%
	9	$3,267	(20%)	$8,506	155%	$161	(93%)	$11,934	25%
	10	$3,095	(20%)	$8,850	118%	$161	(92%)	$12,106	23%
	11	$2,933	(20%)	$9,141	94%	$161	(90%)	$12,235	22%

COST COMPONENT ANALYSIS

Absolut values, and Relative Differences to the Solution Aircraft Type

-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
23	12	$2,780	(20%)	$9,385	78%	$161	(89%)	$12,326	21%
23		$45,728		$83,379		$5,468		$134575	
24	1	$5,058	(19%)	$12,028	846%	$0	.	$17,086	127%
	2	$4,786	(19%)	$12,902	339%	$0	.	$17,688	99%
	3	$4,530	(19%)	$13,662	208%	$0	.	$18,192	81%
	4	$4,288	(19%)	$14,318	148%	$0	.	$18,606	68%
	5	$4,059	(19%)	$14,879	113%	$0	.	$18,938	58%
	6	$3,844	(19%)	$15,354	91%	$0	.	$19,198	50%
	7	$3,640	(19%)	$15,749	76%	$0	.	$19,389	44%
	8	$3,448	(20%)	$16,073	64%	$0	.	$19,521	39%
	9	$3,267	(20%)	$16,331	55%	$0	.	$19,598	34%
	10	$3,095	(20%)	$16,530	48%	$0	.	$19,625	31%
	11	$2,933	(20%)	$16,675	43%	$0	.	$19,608	28%
	12	$2,780	(20%)	$16,771	38%	$0	.	$19,551	25%
24		$45,728		$181272		$0		$227000	
25	1	$4,250	(20%)	$6,630	.	$0	.	$10,880	106%
	2	$4,022	(20%)	$7,474	.	$0	.	$11,496	130%
	3	$3,807	(20%)	$8,218	2115%	$0	.	$12,025	135%
	4	$3,604	(20%)	$8,871	453%	$0	.	$12,475	105%
	5	$3,412	(20%)	$9,440	248%	$0	.	$12,852	84%
	6	$3,231	(20%)	$9,933	168%	$0	.	$13,164	70%
	7	$3,060	(20%)	$10,357	126%	$0	.	$13,417	60%
	8	$2,898	(20%)	$10,717	99%	$0	.	$13,615	51%
	9	$2,746	(20%)	$11,019	81%	$274	(89%)	$14,039	17%
	10	$2,602	(20%)	$11,268	68%	$127	(94%)	$13,997	15%
	11	$2,466	(20%)	$11,469	59%	$161	(92%)	$14,096	14%
	12	$2,337	(20%)	$11,626	51%	$161	(91%)	$14,124	14%
25		$38,435		$117022		$723		$156180	
26	1	$4,010	(20%)	$0	.	$2,739	(57%)	$6,749	(40%)
	2	$3,794	(20%)	$0	.	$2,427	(58%)	$6,221	(41%)
	3	$3,591	(20%)	$0	.	$2,136	(60%)	$5,727	(42%)
	4	$3,400	(20%)	$0	.	$1,865	(62%)	$5,265	(43%)
	5	$3,219	(20%)	$0	.	$1,612	(64%)	$4,831	(44%)
	6	$3,048	(20%)	$0	.	$1,377	(67%)	$4,425	(44%)
	7	$2,887	(20%)	$0	.	$1,159	(70%)	$4,046	(45%)
	8	$2,734	(20%)	$0	.	$955	(73%)	$3,689	(47%)
26		$26,683		$0		$14,270		$40,953	

COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
27	1	$4,010	(20%)	$0	.	$0	.	$4,010	(20%)
	2	$3,794	(20%)	$0	.	$0	.	$3,794	(20%)
	3	$3,591	(20%)	$0	.	$0	.	$3,591	(20%)
	4	$3,400	(20%)	$0	.	$0	.	$3,400	(20%)
	5	$3,219	(20%)	$0	.	$0	.	$3,219	(20%)
	6	$3,048	(20%)	$0	.	$0	.	$3,048	(20%)
	7	$2,887	(20%)	$0	.	$0	.	$2,887	(20%)
	8	$2,734	(20%)	$0	.	$0	.	$2,734	(20%)
27		$26,683		$0		$0		$26,683	
28	1	$4,250	(20%)	$10,024	847%	$0	.	$14,274	125%
	2	$4,022	(20%)	$10,752	339%	$0	.	$14,774	98%
	3	$3,807	(20%)	$11,385	208%	$0	.	$15,192	80%
	4	$3,604	(20%)	$11,932	148%	$0	.	$15,536	67%
	5	$3,412	(20%)	$12,399	113%	$0	.	$15,811	57%
	6	$3,231	(20%)	$12,795	91%	$0	.	$16,026	49%
	7	$3,060	(20%)	$13,124	76%	$0	.	$16,184	43%
	8	$2,898	(20%)	$13,394	64%	$0	.	$16,292	38%
	9	$2,746	(20%)	$13,609	55%	$0	.	$16,355	34%
	10	$2,602	(20%)	$13,775	48%	$0	.	$16,377	31%
	11	$2,466	(20%)	$13,896	43%	$0	.	$16,362	28%
	12	$2,337	(20%)	$13,976	38%	$0	.	$16,313	25%
28		$38,435		$151061		$0		$189496	
29	7	$3,076	(20%)	$5,344	.	$0	.	$8,420	119%
	8	$2,913	(20%)	$6,006	.	$0	.	$8,919	145%
	9	$2,760	(20%)	$6,590	1543%	$0	.	$9,350	143%
	10	$2,615	(20%)	$7,101	418%	$0	.	$9,716	109%
	11	$2,478	(20%)	$7,547	237%	$0	.	$10,025	88%
	12	$2,349	(20%)	$7,933	163%	$0	.	$10,282	72%
29		$16,191		$40,521		$0		$56,712	
30	7	$2,619	(20%)	$0	.	$1,748	(59%)	$4,367	(42%)
	8	$2,480	(20%)	$0	.	$1,540	(60%)	$4,020	(43%)
	9	$2,350	(21%)	$0	.	$1,346	(62%)	$3,696	(43%)
	10	$2,226	(21%)	$107	.	$1,166	(65%)	$3,499	(43%)
	11	$2,109	(21%)	$775	.	$997	(67%)	$3,881	(32%)
	12	$1,999	(21%)	$1,375	.	$841	(70%)	$4,215	(20%)
30		$13,783		$2,257		$7,638		$23,678	
31	7	$2,619	(20%)	$0	.	$0	.	$2,619	(20%)

COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
31	8	$2,480	(20%)	$0	.	$0	.	$2,480	(20%)
	9	$2,350	(21%)	$0	.	$0	.	$2,350	(21%)
	10	$2,226	(21%)	$107	.	$0	.	$2,333	(17%)
	11	$2,109	(21%)	$775	.	$0	.	$2,884	8%
	12	$1,999	(21%)	$1,375	.	$0	.	$3,374	34%
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31		$13,783		$2,257		$0		$16,040	
===		========		=========		=========		=========	
32	7	$3,076	(20%)	$5,344	.	$0	.	$8,420	119%
	8	$2,913	(20%)	$6,006	.	$0	.	$8,919	145%
	9	$2,760	(20%)	$6,590	1543%	$0	.	$9,350	143%
	10	$2,615	(20%)	$7,101	418%	$0	.	$9,716	109%
	11	$2,478	(20%)	$7,547	237%	$0	.	$10,025	88%
	12	$2,349	(20%)	$7,933	163%	$0	.	$10,282	72%
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32		$16,191		$40,521		$0		$56,712	
===		========		=========		=========		=========	
33	3	$4,955	(19%)	$1,377	.	$1,136	(76%)	$7,468	(31%)
	6	$4,204	(19%)	$3,598	.	$394	(89%)	$8,196	(6%)
	7	$3,981	(19%)	$4,183	.	$182	(94%)	$8,346	3%
	8	$3,771	(19%)	$4,701	.	$161	(94%)	$8,633	15%
	9	$3,572	(19%)	$5,157	1542%	$161	(94%)	$8,890	23%
	10	$3,385	(19%)	$5,558	418%	$161	(93%)	$9,104	22%
	11	$3,207	(19%)	$5,907	237%	$161	(92%)	$9,275	21%
	12	$3,040	(19%)	$6,209	163%	$161	(90%)	$9,410	20%
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33		$30,115		$36,690		$2,517		$69,322	
===		========		=========		=========		=========	
34	3	$4,955	(19%)	$8,049	2117%	$0	.	$13,004	100%
	6	$4,204	(19%)	$9,729	168%	$0	.	$13,933	58%
	7	$3,981	(19%)	$10,144	126%	$0	.	$14,125	50%
	8	$3,771	(19%)	$10,496	99%	$0	.	$14,267	44%
	9	$3,572	(19%)	$10,792	81%	$0	.	$14,364	38%
	10	$3,385	(19%)	$11,036	68%	$0	.	$14,421	34%
	11	$3,207	(19%)	$11,233	59%	$0	.	$14,440	31%
	12	$3,040	(19%)	$11,387	51%	$0	.	$14,427	28%
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34		$30,115		$82,866		$0		$112981	
===		========		=========		=========		=========	
35	4	$3,558	(20%)	$6,612	.	$0	.	$10,170	129%
	5	$3,369	(20%)	$7,399	.	$0	.	$10,768	156%
	6	$3,190	(20%)	$8,091	1086%	$0	.	$11,281	142%
	7	$3,022	(20%)	$8,698	373%	$0	.	$11,720	109%
	8	$2,862	(20%)	$9,227	221%	$0	.	$12,089	87%
	9	$2,711	(20%)	$9,684	155%	$0	.	$12,395	72%

COST COMPONENT ANALYSIS
Absolut values, and Relative Differences to the Solution Aircraft Type
-Values in Brackets are Negative-

Leg	Time	DOC B737	Diff.DOC A321	Opp.Cost B737	Diff.Opp A321	Pos.Cost B737	Diff.Pos A321	Total B737	Diff.Tot. A321
35	10	$2,569	(20%)	$10,075	118%	$0	.	$12,644	61%
	11	$2,435	(20%)	$10,407	94%	$0	.	$12,842	53%
	12	$2,[illegible]3	(20%)	$10,684	78%	$0	.	$12,992	46%
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35		$26,[illegible]4		$80,877		$0		$106901	
===		========		=========		=========		=========	
36	4	$3,380	(20%)	$0	.	$1,538	(67%)	$4,918	(45%)
	5	$3,201	(20%)	$0	.	$1,290	(70%)	$4,491	(46%)
	6	$3,031	(20%)	$0	.	$1,059	(73%)	$4,090	(47%)
	7	$2,870	(20%)	$0	.	$844	(76%)	$3,714	(48%)
	8	$2,719	(20%)	$0	.	$645	(80%)	$3,364	(49%)
	9	$2,576	(20%)	$0	.	$461	(84%)	$3,037	(51%)
	10	$2,440	(20%)	$120	.	$289	(89%)	$2,849	(50%)
	11	$2,312	(20%)	$872	.	$131	(94%)	$3,315	(37%)
	12	$2,192	(20%)	$1,547	.	$161	(92%)	$3,900	(20%)
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36		$24,721		$2,539		$6,418		$33,678	
===		========		=========		=========		=========	
37	4	$3,380	(20%)	$0	.	$0	.	$3,380	(20%)
	5	$3,201	(20%)	$0	.	$0	.	$3,201	(20%)
	6	$3,031	(20%)	$0	.	$0	.	$3,031	(20%)
	7	$2,870	(20%)	$0	.	$0	.	$2,870	(20%)
	8	$2,719	(20%)	$0	.	$0	.	$2,719	(20%)
	9	$2,576	(20%)	$0	.	$0	.	$2,576	(20%)
	10	$2,440	(20%)	$120	.	$0	.	$2,560	(16%)
	11	$2,312	(20%)	$872	.	$0	.	$3,184	10%
	12	$2,192	(20%)	$1,547	.	$0	.	$3,739	36%
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37		$24,721		$2,539		$0		$27,260	
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38	4	$3,558	(20%)	$6,612	.	$0	.	$10,170	129%
	5	$3,369	(20%)	$7,399	.	$0	.	$10,768	156%
	6	$3,190	(20%)	$8,091	1086%	$0	.	$11,281	142%
	7	$3,022	(20%)	$8,698	373%	$0	.	$11,720	109%
	8	$2,862	(20%)	$9,227	221%	$0	.	$12,089	87%
	9	$2,711	(20%)	$9,684	155%	$0	.	$12,395	72%
	10	$2,569	(20%)	$10,075	118%	$0	.	$12,644	61%
	11	$2,435	(20%)	$10,407	94%	$0	.	$12,842	53%
	12	$2,308	(20%)	$10,684	78%	$0	.	$12,992	46%
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38		$26,024		$80,877		$0		$106901	
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COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
1	1	$6,804	(11%)	$0	.	$0	.	$6,804	(11%)
	2	$6,439	(11%)	$0	.	$0	.	$6,439	(11%)
	3	$6,095	(11%)	$0	.	$0	.	$6,095	(11%)
	4	$5,770	(11%)	$0	.	$0	.	$5,770	(11%)
	5	$5,464	(11%)	$460	.	$0	.	$5,924	(3%)
	6	$5,174	(11%)	$1,594	.	$0	.	$6,768	17%
	7	$4,901	(11%)	$2,611	.	$0	.	$7,512	37%
	8	$4,644	(11%)	$3,522	.	$0	.	$8,166	57%
	9	$4,400	(11%)	$4,334	934%	$0	.	$8,734	64%
	10	$4,171	(11%)	$5,057	253%	$0	.	$9,228	51%
	11	$3,953	(11%)	$5,696	143%	$0	.	$9,649	43%
	12	$3,748	(10%)	$6,261	99%	$0	.	$10,009	36%
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1		$61,563		$29,535		$0		$91,098	
===		========		=========		=========		=========	
2	1	$6,804	(11%)	$24,501	41%	$2,660	(51%)	$33,965	11%
	2	$6,439	(11%)	$25,342	35%	$2,271	(54%)	$34,052	10%
	3	$6,095	(11%)	$26,046	30%	$1,909	(57%)	$34,050	9%
	4	$5,770	(11%)	$26,626	27%	$1,573	(60%)	$33,969	8%
	5	$5,464	(11%)	$27,094	24%	$1,261	(65%)	$33,819	7%
	6	$5,174	(11%)	$27,459	21%	$971	(69%)	$33,604	6%
	7	$4,901	(11%)	$27,732	19%	$703	(75%)	$33,336	6%
	8	$4,644	(11%)	$27,920	17%	$453	(82%)	$33,017	5%
	9	$4,400	(11%)	$28,032	16%	$223	(90%)	$32,655	4%
	10	$4,171	(11%)	$28,075	14%	$161	(91%)	$32,407	4%
	11	$3,953	(11%)	$28,056	13%	$161	(90%)	$32,170	5%
	12	$3,748	(10%)	$27,981	12%	$161	(88%)	$31,890	5%
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2		$61,563		$324864		$12,507		$398934	
===		========		=========		=========		=========	
3	1	$4,890	(11%)	$7,455	513%	$0	.	$12,345	85%
	2	$4,631	(11%)	$8,591	205%	$0	.	$13,222	65%
	3	$4,385	(11%)	$9,596	126%	$0	.	$13,981	53%
	4	$4,154	(11%)	$10,481	90%	$0	.	$14,635	44%
	5	$3,935	(11%)	$11,256	69%	$0	.	$15,191	37%
	6	$3,729	(11%)	$11,931	55%	$0	.	$15,660	32%
	7	$3,534	(11%)	$12,513	46%	$0	.	$16,047	28%
	8	$3,349	(11%)	$13,012	39%	$0	.	$16,361	25%
	9	$3,175	(11%)	$13,434	33%	$0	.	$16,609	22%
	10	$3,010	(11%)	$13,787	29%	$0	.	$16,797	20%
	11	$2,855	(11%)	$14,076	26%	$0	.	$16,931	18%
	12	$2,707	(11%)	$14,307	23%	$0	.	$17,014	16%
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3		$44,354		$140439		$0		$184793	
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COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
4	1	$5,739	(11%)	$0	.	$0	.	$5,739	(11%)
	2	$5,433	(11%)	$0	.	$0	.	$5,433	(11%)
	3	$5,144	(11%)	$0	.	$0	.	$5,144	(11%)
	4	$4,871	(11%)	$0	.	$0	.	$4,871	(11%)
	5	$4,614	(11%)	$0	.	$0	.	$4,614	(11%)
	6	$4,371	(11%)	$0	.	$0	.	$4,371	(11%)
	7	$4,141	(11%)	$0	.	$0	.	$4,141	(11%)
	8	$3,924	(11%)	$0	.	$0	.	$3,924	(11%)
	9	$3,720	(11%)	$607	.	$0	.	$4,327	4%
	10	$3,526	(11%)	$1,475	.	$0	.	$5,001	27%
	11	$3,343	(11%)	$2,253	.	$0	.	$5,596	50%
	12	$3,170	(11%)	$2,949	.	$0	.	$6,119	73%
4		$51,996		$7,284		$0		$59,280	
5	1	$5,739	(11%)	$0	.	$161	(70%)	$5,900	(15%)
	2	$5,433	(11%)	$0	.	$161	7%	$5,594	(10%)
	3	$5,144	(11%)	$0	.	$161	0%	$5,305	(10%)
	4	$4,871	(11%)	$0	.	$161	0%	$5,032	(10%)
	5	$4,614	(11%)	$0	.	$161	0%	$4,775	(10%)
	6	$4,371	(11%)	$0	.	$161	0%	$4,532	(10%)
	7	$4,141	(11%)	$0	.	$161	0%	$4,302	(10%)
	8	$3,924	(11%)	$0	.	$161	0%	$4,085	(10%)
	9	$3,720	(11%)	$0	.	$161	0%	$3,881	(10%)
	10	$3,526	(11%)	$0	.	$161	0%	$3,687	(10%)
	11	$3,343	(11%)	$0	.	$161	0%	$3,504	(10%)
	12	$3,170	(11%)	$0	.	$161	0%	$3,331	(10%)
5		$51,996		$0		$1,932		$53,928	
6	1	$4,890	(11%)	$3,459	.	$0	.	$8,349	53%
	2	$4,631	(11%)	$4,728	.	$0	.	$9,359	81%
	3	$4,385	(11%)	$5,860	1E3%	$0	.	$10,245	92%
	4	$4,154	(11%)	$6,868	274%	$0	.	$11,022	70%
	5	$3,935	(11%)	$7,760	150%	$0	.	$11,695	56%
	6	$3,729	(11%)	$8,548	102%	$0	.	$12,277	46%
	7	$3,534	(11%)	$9,240	76%	$0	.	$12,774	39%
	8	$3,349	(11%)	$9,843	60%	$0	.	$13,192	33%
	9	$3,175	(11%)	$10,366	49%	$0	.	$13,541	29%
	10	$3,010	(11%)	$10,815	42%	$0	.	$13,825	26%
	11	$2,855	(11%)	$11,198	36%	$0	.	$14,053	23%
	12	$2,707	(11%)	$11,519	31%	$0	.	$14,226	20%
6		$44,354		$100204		$0		$144558	

COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
11	11	$2,671	(11%)	$1,073	.	$0	.	$3,744	25%
	12	$2,533	(11%)	$1,404	.	$0	.	$3,937	39%
11		$5,204		$2,477		$0		$7,681	
12	11	$2,671	(11%)	$9,949	20%	$587	(69%)	$13,207	0%
	12	$2,533	(11%)	$10,034	18%	$427	(75%)	$12,994	(0%)
12		$5,204		$19,983		$1,014		$26,201	
15	10	$3,659	(11%)	$7,901	52%	$0	.	$11,560	25%
	11	$3,469	(11%)	$8,267	44%	$0	.	$11,736	22%
	12	$3,289	(11%)	$8,579	37%	$0	.	$11,868	20%
15		$10,417		$24,747		$0		$35,164	
16	10	$3,659	(11%)	$878	.	$1,182	(57%)	$5,719	(17%)
	11	$3,469	(11%)	$1,341	.	$972	(61%)	$5,782	(9%)
	12	$3,289	(11%)	$1,756	.	$776	(65%)	$5,821	(2%)
16		$10,417		$3,975		$2,930		$17,322	
21	10	$3,841	(11%)	$3,792	253%	$738	(71%)	$8,371	6%
	11	$3,642	(11%)	$4,272	143%	$520	(77%)	$8,434	4%
	12	$3,453	(11%)	$4,696	99%	$317	(84%)	$8,466	3%
21		$10,936		$12,760		$1,575		$25,271	
22	10	$3,841	(11%)	$1,053	.	$0	.	$4,894	14%
	11	$3,642	(11%)	$1,609	.	$0	.	$5,251	29%
	12	$3,453	(11%)	$2,107	.	$0	.	$5,560	44%
22		$10,936		$4,769		$0		$15,705	
23	1	$5,600	(11%)	$0	.	$2,716	(47%)	$8,316	(27%)
	2	$5,302	(11%)	$662	.	$2,362	(50%)	$8,326	(22%)
	3	$5,020	(11%)	$1,799	.	$2,034	(52%)	$8,853	(10%)
	4	$4,754	(11%)	$2,819	.	$1,728	(55%)	$9,301	2%
	5	$4,503	(11%)	$3,732	.	$1,443	(58%)	$9,678	14%
	6	$4,266	(11%)	$4,545	659%	$1,179	(62%)	$9,990	18%
	7	$4,042	(11%)	$5,268	226%	$933	(66%)	$10,243	15%
	8	$3,831	(11%)	$5,908	134%	$705	(71%)	$10,444	13%
	9	$3,631	(11%)	$6,472	94%	$493	(77%)	$10,596	11%
	10	$3,442	(11%)	$6,967	71%	$296	(84%)	$10,705	9%
	11	$3,264	(11%)	$7,398	57%	$114	(93%)	$10,776	8%

COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
23	12	$3,095	(11%)	$7,770	47%	$161	(89%)	$11,026	8%
23		$50,750		$53,340		$14,164		$118254	
24	1	$5,600	(11%)	$7,793	513%	$0	.	$13,393	78%
	2	$5,302	(11%)	$8,980	205%	$0	.	$14,282	61%
	3	$5,020	(11%)	$10,031	126%	$0	.	$15,051	50%
	4	$4,754	(11%)	$10,956	90%	$0	.	$15,710	42%
	5	$4,503	(11%)	$11,766	69%	$0	.	$16,269	35%
	6	$4,266	(11%)	$12,471	55%	$0	.	$16,737	31%
	7	$4,042	(11%)	$13,080	46%	$0	.	$17,122	27%
	8	$3,831	(11%)	$13,602	39%	$0	.	$17,433	24%
	9	$3,631	(11%)	$14,043	34%	$0	.	$17,674	21%
	10	$3,442	(11%)	$14,411	29%	$0	.	$17,853	19%
	11	$3,264	(11%)	$14,713	26%	$0	.	$17,977	17%
	12	$3,095	(11%)	$14,955	23%	$0	.	$18,050	16%
24		$50,750		$146801		$0		$197551	
25	1	$4,725	(11%)	$3,027	.	$0	.	$7,752	47%
	2	$4,474	(11%)	$4,137	.	$0	.	$8,611	72%
	3	$4,238	(11%)	$5,128	1E3%	$0	.	$9,366	83%
	4	$4,014	(11%)	$6,010	274%	$0	.	$10,024	64%
	5	$3,803	(11%)	$6,791	150%	$0	.	$10,594	52%
	6	$3,603	(11%)	$7,481	102%	$0	.	$11,084	43%
	7	$3,415	(11%)	$8,086	76%	$0	.	$11,501	37%
	8	$3,237	(11%)	$8,614	60%	$0	.	$11,851	32%
	9	$3,069	(11%)	$9,072	49%	$1,037	(58%)	$13,178	10%
	10	$2,909	(11%)	$9,465	42%	$848	(62%)	$13,222	9%
	11	$2,759	(11%)	$9,800	36%	$673	(66%)	$13,232	7%
	12	$2,617	(11%)	$10,081	31%	$510	(71%)	$13,208	6%
25		$42,863		$87,692		$3,068		$133623	
26	1	$4,464	(11%)	$0	.	$4,038	(36%)	$8,502	(25%)
	2	$4,227	(11%)	$0	.	$3,657	(37%)	$7,884	(25%)
	3	$4,004	(11%)	$0	.	$3,302	(38%)	$7,306	(26%)
	4	$3,793	(11%)	$0	.	$2,969	(40%)	$6,762	(26%)
	5	$3,594	(11%)	$0	.	$2,659	(41%)	$6,253	(27%)
	6	$3,405	(11%)	$0	.	$2,370	(43%)	$5,775	(28%)
	7	$3,227	(11%)	$0	.	$2,099	(45%)	$5,326	(28%)
	8	$3,059	(11%)	$0	.	$1,847	(47%)	$4,906	(29%)
26		$29,773		$0		$22,941		$52,714	

COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
27	1	$4,464	(11%)	$0	.	$0	.	$4,464	(11%)
	2	$4,227	(11%)	$0	.	$0	.	$4,227	(11%)
	3	$4,004	(11%)	$0	.	$0	.	$4,004	(11%)
	4	$3,793	(11%)	$0	.	$0	.	$3,793	(11%)
	5	$3,594	(11%)	$0	.	$0	.	$3,594	(11%)
	6	$3,405	(11%)	$0	.	$0	.	$3,405	(11%)
	7	$3,227	(11%)	$0	.	$0	.	$3,227	(11%)
	8	$3,059	(11%)	$0	.	$0	.	$3,059	(11%)
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27		$29,773		$0		$0		$29,773	
===		========		=========		=========		=========	
28	1	$4,725	(11%)	$6,494	513%	$0	.	$11,219	77%
	2	$4,474	(11%)	$7,484	205%	$0	.	$11,958	60%
	3	$4,238	(11%)	$8,359	126%	$0	.	$12,597	49%
	4	$4,014	(11%)	$9,130	90%	$0	.	$13,144	41%
	5	$3,803	(11%)	$9,805	69%	$0	.	$13,608	35%
	6	$3,603	(11%)	$10,393	55%	$0	.	$13,996	30%
	7	$3,415	(11%)	$10,900	46%	$0	.	$14,315	27%
	8	$3,237	(11%)	$11,335	39%	$0	.	$14,572	24%
	9	$3,069	(11%)	$11,702	33%	$0	.	$14,771	21%
	10	$2,909	(11%)	$12,009	29%	$0	.	$14,918	19%
	11	$2,759	(11%)	$12,261	26%	$0	.	$15,020	17%
	12	$2,617	(11%)	$12,462	23%	$0	.	$15,079	15%
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28		$42,863		$122334		$0		$165197	
===		========		=========		=========		=========	
29	7	$3,432	(11%)	$2,502	.	$0	.	$5,934	55%
	8	$3,253	(11%)	$3,375	.	$0	.	$6,628	82%
	9	$3,084	(11%)	$4,153	936%	$0	.	$7,237	88%
	10	$2,924	(11%)	$4,845	253%	$0	.	$7,769	67%
	11	$2,773	(11%)	$5,459	143%	$0	.	$8,232	54%
	12	$2,630	(11%)	$5,999	99%	$0	.	$8,629	45%
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29		$18,096		$26,333		$0		$44,429	
===		========		=========		=========		=========	
30	7	$2,936	(11%)	$0	.	$2,645	(37%)	$5,581	(26%)
	8	$2,783	(11%)	$0	.	$2,390	(38%)	$5,173	(26%)
	9	$2,639	(11%)	$0	.	$2,152	(40%)	$4,791	(27%)
	10	$2,502	(11%)	$0	.	$1,930	(41%)	$4,432	(27%)
	11	$2,372	(11%)	$0	.	$1,722	(43%)	$4,094	(28%)
	12	$2,250	(11%)	$0	.	$1,527	(45%)	$3,777	(29%)
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30		$15,482		$0		$12,366		$27,848	
===		========		=========		=========		=========	
31	7	$2,936	(11%)	$0	.	$0	.	$2,936	(11%)

COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
31	8	$2,783	(11%)	$0	.	$0	.	$2,783	(11%)
	9	$2,639	(11%)	$0	.	$0	.	$2,639	(11%)
	10	$2,502	(11%)	$0	.	$0	.	$2,502	(11%)
	11	$2,372	(11%)	$0	.	$0	.	$2,372	(11%)
	12	$2,250	(11%)	$0	.	$0	.	$2,250	(11%)
31		$15,482		$0		$0		$15,482	
32	7	$3,432	(11%)	$2,502	.	$0	.	$5,934	55%
	8	$3,253	(11%)	$3,375	.	$0	.	$6,628	82%
	9	$3,084	(11%)	$4,153	936%	$0	.	$7,237	88%
	10	$2,924	(11%)	$4,845	253%	$0	.	$7,769	67%
	11	$2,773	(11%)	$5,459	143%	$0	.	$8,232	54%
	12	$2,630	(11%)	$5,999	99%	$0	.	$8,629	45%
32		$18,096		$26,333		$0		$44,429	
33	3	$5,479	(11%)	$0	.	$2,398	(49%)	$7,877	(27%)
	6	$4,654	(11%)	$1,195	.	$1,470	(58%)	$7,319	(16%)
	7	$4,409	(11%)	$1,959	.	$1,203	(62%)	$7,571	(6%)
	8	$4,178	(11%)	$2,641	.	$955	(66%)	$7,774	4%
	9	$3,960	(11%)	$3,251	935%	$724	(71%)	$7,935	10%
	10	$3,754	(11%)	$3,792	253%	$510	(77%)	$8,056	8%
	11	$3,559	(11%)	$4,272	143%	$312	(84%)	$8,143	6%
	12	$3,374	(11%)	$4,696	99%	$127	(92%)	$8,197	5%
33		$33,367		$21,806		$7,699		$62,872	
34	3	$5,479	(11%)	$5,023	1E3%	$0	.	$10,502	62%
	6	$4,654	(11%)	$7,327	102%	$0	.	$11,981	36%
	7	$4,409	(11%)	$7,920	76%	$0	.	$12,329	31%
	8	$4,178	(11%)	$8,437	60%	$0	.	$12,615	27%
	9	$3,960	(11%)	$8,885	49%	$0	.	$12,845	24%
	10	$3,754	(11%)	$9,270	42%	$0	.	$13,024	21%
	11	$3,559	(11%)	$9,598	36%	$0	.	$13,157	19%
	12	$3,374	(11%)	$9,873	31%	$0	.	$13,247	17%
34		$33,367		$66,333		$0		$99,700	
35	4	$3,965	(11%)	$3,210	.	$0	.	$7,175	62%
	5	$3,757	(11%)	$4,248	.	$0	.	$8,005	90%
	6	$3,560	(11%)	$5,174	659%	$0	.	$8,734	87%
	7	$3,374	(11%)	$5,998	226%	$0	.	$9,372	67%
	8	$3,198	(11%)	$6,726	134%	$0	.	$9,924	54%
	9	$3,031	(11%)	$7,368	94%	$0	.	$10,399	45%

COST COMPONENT ANALYSIS
Absolut Values, and Relative Differences to the Solution Aircraft
-Values in Brackets are Negative-

Leg	TIME	DOC 320	Diff.DOC A321	Opp.Cost A320	Diff.Opp A321	Pos.Cost A320	Diff.Pos A321	Total A320	Diff.Tot. A321
35	10	$2,874	(11%)	$7,931	71%	$0	.	$10,805	38%
	11	$2,725	(11%)	$8,422	57%	$0	.	$11,147	32%
	12	$2,585	(11%)	$8,846	47%	$0	.	$11,431	28%
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35		$29,069		$57,923		$0		$86,992	
===		========		=========		=========		=========	
36	4	$3,772	(11%)	$0	.	$2,666	(43%)	$6,438	(28%)
	5	$3,574	(11%)	$0	.	$2,358	(45%)	$5,932	(29%)
	6	$3,386	(11%)	$0	.	$2,071	(47%)	$5,457	(29%)
	7	$3,209	(11%)	$0	.	$1,803	(50%)	$5,012	(30%)
	8	$3,042	(11%)	$0	.	$1,554	(52%)	$4,596	(31%)
	9	$2,884	(11%)	$0	.	$1,321	(55%)	$4,205	(32%)
	10	$2,735	(11%)	$0	.	$1,105	(58%)	$3,840	(33%)
	11	$2,593	(11%)	$0	.	$904	(62%)	$3,497	(34%)
	12	$2,459	(11%)	$0	.	$716	(66%)	$3,175	(35%)
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36		$27,654		$0		$14,498		$42,152	
===		========		=========		=========		=========	
37	4	$3,772	(11%)	$0	.	$0	.	$3,772	(11%)
	5	$3,574	(11%)	$0	.	$0	.	$3,574	(11%)
	6	$3,386	(11%)	$0	.	$0	.	$3,386	(11%)
	7	$3,209	(11%)	$0	.	$0	.	$3,209	(11%)
	8	$3,042	(11%)	$0	.	$0	.	$3,042	(11%)
	9	$2,884	(11%)	$0	.	$0	.	$2,884	(11%)
	10	$2,735	(11%)	$0	.	$0	.	$2,735	(11%)
	11	$2,593	(11%)	$0	.	$0	.	$2,593	(11%)
	12	$2,459	(11%)	$0	.	$0	.	$2,459	(11%)
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37		$27,654		$0		$0		$27,654	
===		========		=========		=========		=========	
38	4	$3,965	(11%)	$3,210	.	$0	.	$7,175	62%
	5	$3,757	(11%)	$4,248	.	$0	.	$8,005	90%
	6	$3,560	(11%)	$5,174	659%	$0	.	$8,734	87%
	7	$3,374	(11%)	$5,998	226%	$0	.	$9,372	67%
	8	$3,198	(11%)	$6,726	134%	$0	.	$9,924	54%
	9	$3,031	(11%)	$7,368	94%	$0	.	$10,399	45%
	10	$2,874	(11%)	$7,931	71%	$0	.	$10,805	38%
	11	$2,725	(11%)	$8,422	57%	$0	.	$11,147	32%
	12	$2,585	(11%)	$8,846	47%	$0	.	$11,431	28%
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38		$29,069		$57,923		$0		$86,992	
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