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Selecting and Management of Fire Fighter Aircraft

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A comparison between the performance and direct operating costs of the water bombers Canadair CL215 and the CL415 Turboprop is presented. These aircraft are designed for fire fighting. The CL215s are currently used by the Italian Forest Service. Considering both the importance of forest-fire combating and the potential market for this type of aircraft, the Italian aerospace industry, Alenia, is designing a new aircraft designated the Advanced Amphibious Aircraft (AAA). On the basis of the design data, a comparison between the AAA and the Canadair CL215 and CL415 is shown. Based upon the Italian geographical environment, the operation of the AAA appears less expensive than that of the older aircraft.

Introduction

IN Italy the amphibious aircraft Canadair CL215 is used to fight forest fires.[1] The forest areas in Italy cover about 20% of the overall land area, but they are scattered over the whole territory.

However, the operations of the water bombers are facilitated by the presence of many water sources that are made up not only by the long coastline, but also by several lakes and water basins. Therefore in this work only the "water bomber" aircraft is studied, whereas the "fire bomber" that employs retardants, is not considered.

The water-scooping distance for the Canadair aircraft, considering the clearance of a 15 m height both in approaching and in climbing out, is reported in Fig. 1. In Italy about 85 lakes and water basins permit this kind of operation. By statistical analysis, based on 667 flights in the year 1990, the mean distance between the fire zone and the water source was 20 km.

For the two water bomber aircraft now operating, i.e., the Canadair CL215 and CL415 Turboprop, a comparison between the performance and the direct operating costs (DOC) has been studied. Of course, the results should be considered as a trend based on the Italian economic conditions at the end of the year 1991.

Considering the interest in fire fighting and the potential market for this kind of aircraft, Alenia is designing, in the framework of the European Cooperation Program EUREKA, a new aircraft designated the Advanced Amphibious Aircraft (AAA).[2] The European Research Coordination Agency (EUREKA) has as its main goal the European integration of the programs of technological competitive research. The AAA is designed as a multirole aircraft, including that of a water bomber. On the basis of the design data the performance and the direct operating costs of the AAA have been evaluated and compared with the ones of the two Canadair aircraft. This study is based on technical data given by the aeronautical industries, and it does not take into account the handling and stability characteristics of the aircraft. The two Canadair aircraft have proven to perform satisfactorily in critical conditions, namely at low velocity and in the presence of turbulence due to the ground effect and the heat created by the fires.

In order to achieve the DOCs, the methodology proposed by the Association of European Airlines (AEA) [derived by the classical Air Transport Association (ATA) approach], has been applied. It has been adapted to the peculiar characteristics of the fire fighting aircraft, introducing, e.g., the DOC/scoop and the DOC/kg of dropped water.

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Comparison of the Performances

A comparison between the performances of the fire fighting aircraft Canadair CL215 and CL415 Turboprop is shown in Table 1.

The comparison between these two aircraft has been carried out on the basis of the following operational mission, that can be considered as typical in Italy: 1) distance airport-fire: 150 km and 2) distance water source-fire: 20 km.

In these conditions the performances indicated in Table 2 are shown. To evaluate the management of the fire fighting aircraft, the comparison of performance is not sufficient, but it is also necessary to evaluate the operating costs.

Direct Operating Costs

In order to evaluate the DOCs, the approach proposed by AEA has been considered.[4] The DOCs have been calculated on the basis of the hypothesis as reported in Table 3 for both CL215 and CL415. The utilization time is connected to the mean operational time in the fire fighting Italian conditions and not to the maximum performance of the aircraft.

The actual costs due to aircraft delivery, aircraft and engines spares, insurance, crew, fuel, and maintenance have been evaluated following the Italian situation at the end of the year

Table 1 CL215 and CL415 characteristics[3]

Characteristics	CL215	CL415
Length, m	19.8	19.8
Wing span, m	28.6	28.6
Wing area, m^2	100.3	100.3
Operating weight empty, kg	12,886	12,333
Maximum takeoff weight, kg	19,731	19,890
Maximum prescooping weight, kg	15,200	16,420
Maximum afterscooping weight, kg	19,731	20,865
Maximum fuel, kg	4,246	4,649
Powerplant, hp	2 × 2,100	2 × 2,380
Crew	2	2

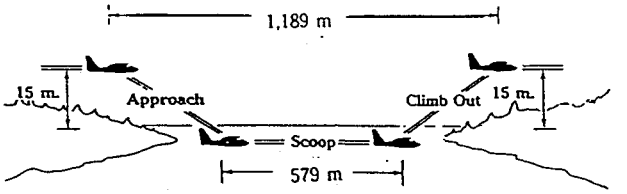

Fig. 1 Water scooping distance.

Table 2 CL215 and CL415 performances

Performances	CL215	CL415
Time on fire, hr	2.9	4.2
Number of scoops	12	20
Scoops/h	4.1	4.8
Dropped water, kg	63,856	117,406

Table 3 DOC evaluation data

Residual value	20%
Utilization, hr	550
Years of depreciation	15
Years of payment	7
Average interest	8%

Table 4 CL215 and CL415 direct operating costs

DOC	CL215	CL415
DOC/flight h, $	4893	5081
DOC/scoop, $	1871	1449
DOC/kg dropped water, $	0.35	0.25

Table 5 AAA characteristics

Length, m	22
Wing span, m	32.8
Wing area, m^2	98
Operating weight empty, kg	12,230
Maximum takeoff weight, kg	23,000
Maximum prescooping weight, kg	17,000
Maximum afterscooping weight, kg	23,000
Maximum fuel, kg	6,400
Powerplant, hp	2 × 2,700
Crew	2

Table 6 AAA performances

Time on fire, h	5.46
Number of scoops	29
Scoops/h	5.3
Dropped water, kg	216,890

Table 7 AAA direct operating costs

DOC/flight h, $	4828
DOC/scoop, $	1147
DOC/kg dropped water, $	0.15

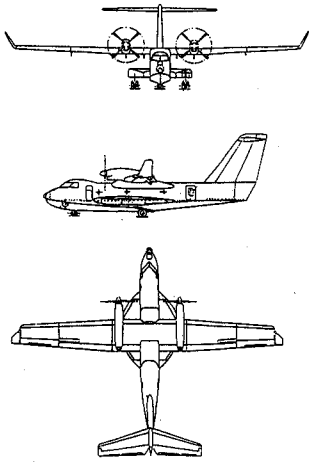

Fig. 2 AAA layout.

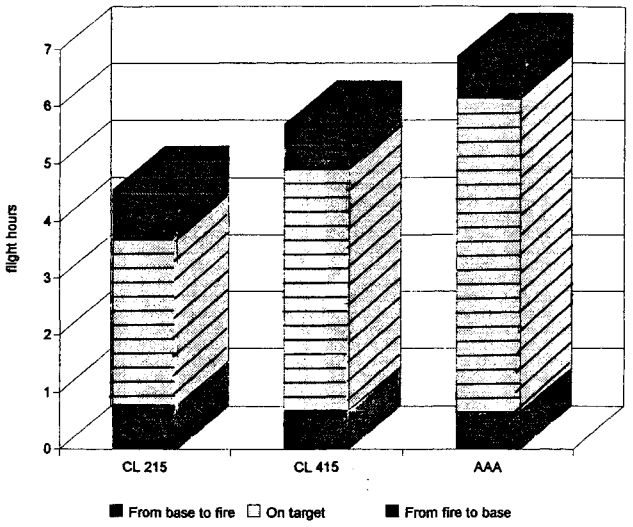

Fig. 3 Operational times for CL215, CL415, AAA.

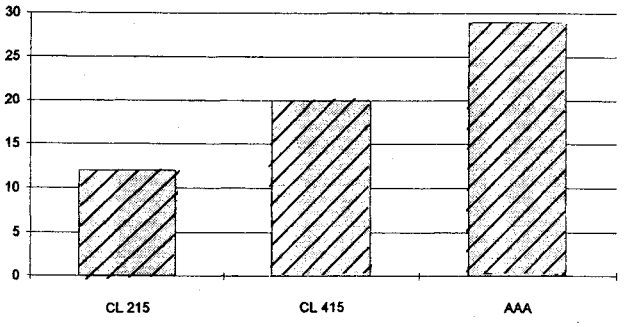

Fig. 4 Number of scoops for CL215, CL415, AAA.

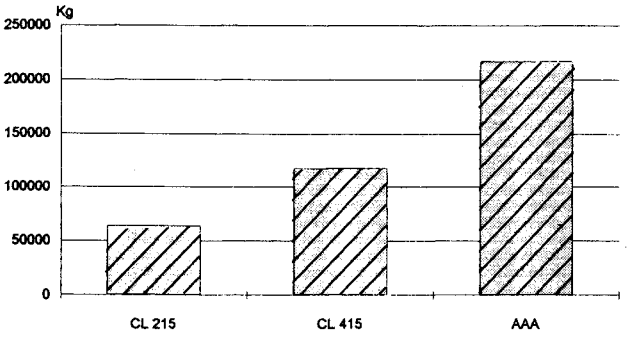

Fig. 5 Quantity of dropped water for CL215, CL415, AAA.

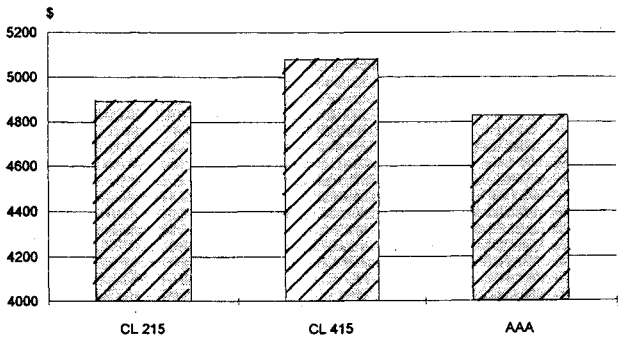

Fig. 6 DOC per flight hours.

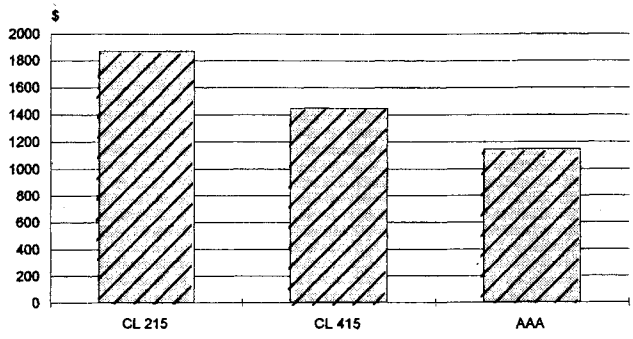

Fig. 7 DOC per number of scoops.

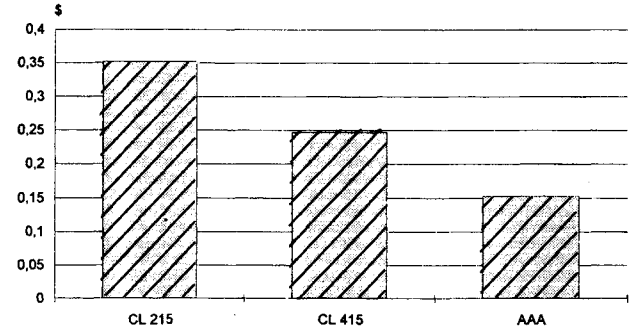

Fig. 8 DOC per dropped water.

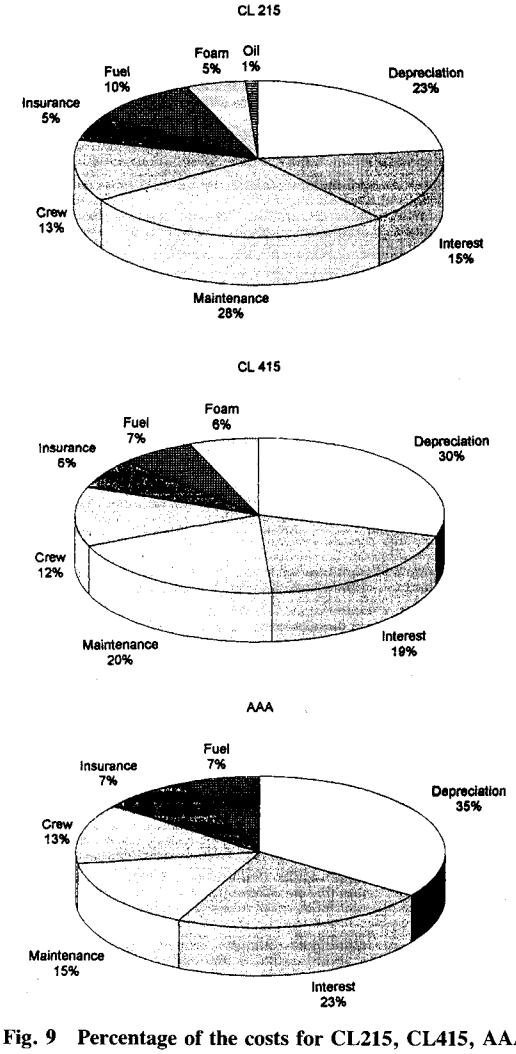

Fig. 9 Percentage of the costs for CL215, CL415, AAA.

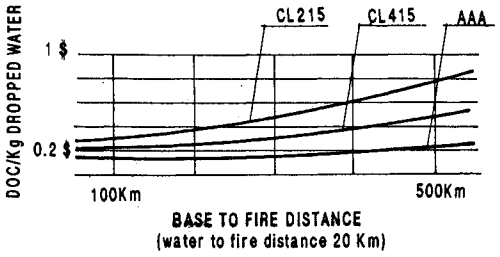

Fig. 10 Effect of the distance airport to fire on DOCs.

1991. The significant DOCs of the two aircraft are reported in Table 4.

From the consideration in Table 4, it is possible to see that the Canadair CL415 Turboprop results as more convenient from the technical as well as the economical point of view.

Advanced Amphibious Aircraft

The AAA is designed as a multirole aircraft for the environmental monitoring, research, and rescue, patrolling and utility transport, as well as a water bomber. The layout of this aircraft is presented in Fig. 2 and the main characteristics are reported in Table 5.

The AAA performance is reported in Table 6 for the same operational mission as that considered for the two Canadair aircraft.

The operational times for the three aircraft are reported in Fig. 3; the number of scoops is presented in Fig. 4 and the quantity of dropped water is shown in Fig. 5.

The main significant direct operating costs of the AAA are shown in Table 7, and the comparison among the DOCs of the two Canadair aircraft is reported in Figs. 6–8.

The percentage of the costs for the three aircraft is reported in Fig. 9.

The increase of the distance from the airport to fire increases the DOCs, but only with a small effect for the AAA as shown in Fig. 10.

Conclusions

This study refers to the cost to operate a water bomber aircraft in Italy. The Canadair CL215, presently used in Italy, appears to have the most expensive operational cost. Therefore, it is suggested that this aircraft be replaced with a modern aircraft, such as the CL415 Turboprop, permitting a significant reduction in the order of 30% of the DOC/kg of dropped water.

The future aircraft AAA proposed by Alenia seems to present a performance that is more economical and flexible than the aircraft currently used. In fact, the DOC/kg of dropped water could be reduced to less than half of the CL215 with the AAA. Considering the fact that there does not exist better alternative means to the water bomber aircraft for fighting forest fires, the development of second-generation fire fighting aircraft seems to be promising from the operational point of view as well as the economical aspect.

Acknowledgment

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