Forecasting Research

Forecasting Research Division
Technical Report No. 204

Analysis of User Requirement for Commercial/Transport Aviation

by

Ruth Patton

November 1996

Meteorological Office
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Abstract

For transport aviation users, the sensitivity is measured, where possible, by the cost to the user of a wrong forecast. The costs incurred to airlines in the use of optimistic and pessimistic forecasts of ceiling and visibility at the destination and diversion airports usually occur at the planning stage with respect to fuel loading procedures. The actual cost that results is affected by the decisions made by the captain of the aircraft at various stages of the flight.

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Analysis of User Requirement for Commercial/Transport Aviation

1. INTRODUCTION

The work for this technical report was done under contract to the European Commission as part of the 4MIDaBLE study (Cost/Benefit Definition Study Leading to 4-D Meteorological Information DataBases Linked Across Europe). This part of the project forms the work of WorkPackage 2600.

The ultimate aim is to quantify how sensitive aviation users are to meteorological data and forecasts. We are seeking to establish the values of particular meteorological parameters, principally, visibility and cloud base, which are critical to particular operators. In this context we are dealing principally with TAFs (Terminal Aerodrome Forecasts) and METARS (METeorological Actual ReportS). Questionnaires are used to identify user behaviour and user requirements for meteorological products to the aviation industry.

The costs incurred to airlines in the use of optimistic and pessimistic forecasts of the conditions at the destination and alternate airports usually occur at the planning stage in deciding how much fuel is to be loaded on to the aircraft. The actual cost that results however is also affected by the decisions made by the captain of the aircraft at various stages of the flight. This document will be referring to the ICAO Landing Categories I, II, IIIa and IIIb in terms of aircraft being able to land in the minimum conditions specified for the given category. A table showing the minimum decision height (cloud base) and runway visual range (relating to visibility, time of day and runway lighting) is shown in Appendix 4.

2. FUEL PLANNING

2.1 Airline Policies

The policies of airlines are specified in Airline Flight Crew Orders (FCO). The guidance for these FCO comes from an operations manual which will have been issued by the governing aviation authority in the country concerned. In the UK, the CAP360 or Air Operators Certificate is issued by the CAA. All FCOs specifying operational procedures for the safety of aircraft must be at least as stringent as the procedural guidance specified in the CAP360.

There is a recent publication called the JAR OPS document which specifies the Europe-wide guidance which is to come into effect in 1998. After discussions with airlines it appears that there will be no significant changes in airline fuel loading policies as a result of the JAR OPS document.

The CAP360 states:

Normal Planning: For most flights, the formula for calculating before flight the amount of fuel required is the sum of:

a) start-up and taxy fuel:

b) sector fuel:

c) alternate fuel i.e. fuel for a missed approach procedure and then from overhead the intended destination airfield to a suitable alternate:

d) holding fuel, i.e. fuel to hold and make an approach at the alternate airfield, calculated as follows:

i. in the case of propeller driven airplanes, fuel to hold for 45 minutes and carry out an approach and landing:

ii. in the case of turbo-jet aeroplanes, fuel to hold for 30 minutes at 1500 ft above the airfield under the International Standard Atmosphere (ISA) conditions and carry out an approach and landing:

e) contingency fuel i.e. not less than 5% of the some of Sector fuel and Alternate fuel.

FCOs for a major international airline (A), a national European airline (B) and a regional airline (C) were obtained and the following policies were deduced. Please note that the information concerned is confidential for commercial reasons so the airlines concerned and their policies are not going to be disclosed verbatim. The fuel loading policy is the main issue concerned and this itself is determined by the policies associated with interpreting forecasts and choosing alternate airports. Questionnaires were devised and sent to the airlines on the subject of their choice of alternate policies and this can be found in Appendix 1. The results along with findings from the flight crew orders are now summarised.

With respect to interpretation of TAFs, A states that PROB30[1] statements should be ignored and that PROB40 statements should be treated as if in the main body of the TAF, in effect be treated as PROB100. B and C do not make this distinction and it is assumed they leave the decision to the pilot's discretion.

As regards choice of alternate, both A and C specify the minimum requirement for choice of alternate, that is Cat I. B however has a minimum visibility limit of 5000 m and a minimum cloud base of 3000 ft. A and C also differentiate between the commercial alternate and the fuel alternate where the fuel alternate is the closest alternate to the destination which may not have the relevant commercial facilities should a diversion occur. The commercial alternate has the relevant facilities e.g. for onward travel and baggage handling. B does not make this differentiation. An analysis was done in 1994, (see reference 2), analysing the benefit from improved TAFs and it deals with the behaviour of airlines that do not differentiate between commercial and fuel alternates.

2.2 Pilot Behaviour

The pilots do not necessarily follow the guidelines issued by their company. Approximately 50 questionnaires (see Appendix 2) were sent out to airline pilots but only 3 were returned. (A large number of airlines were also contacted through the WAFC London Newsletter). This may be a reflection on the complexity of the questionnaires. The results do not represent a significant sample of pilots but they do provide a valuable insight into the way that they make decisions.

With regard to question 1a and the issue of ignoring PROB30 statements in the forecast for the preferred alternate, two of the three would load extra fuel but not take it to the extent of choosing a different alternate. The other would ignore the PROB30 statement. Question 1b resulted in one pilot loading extra fuel and the other two choosing a different alternate altogether. This shows that in principle PROB30s are treated less seriously than PROB40s but that the pilots do consider PROB30s a real enough threat to load extra fuel, which is precisely

[1] See Appendix 5 for a definition of PROB terms.

what their airline does not want them to do. In question 2, each of the three boxes was ticked by one of the pilots, so the only conclusion that it is possible to draw is that pilots each have their own interpretation of the best plan of action. In question 3, the only change to the flowchart is that pilots would only go around the loop to "Identify the airport next closest to the destination" twice.

2.3 En-route

Once airborne, the pilots will start to look at the possible delays at their destination and the options that are open to them. The flowchart in question 4 of the pilots questionnaire shows the decision making process and that the two options in the case of delays are to stack and divert. This I not necessarily the case. A pilot may decide to slow down en-route, conserving fuel in the process, allowing him to arrive at the destination after the majority of holding aircraft have either landed or diverted leaving a relatively small stack and more holding fuel than he would normally have had at that stage. The pilot may decide to divert en-route, load extra fuel and then continue to the destination with holding fuel on board. It should be noted that pilots are not restricted to land at the alternate which was specified on the fuel plan. Once a pilot has taken off, the extra fuel that has been uplifted for holding at the destination can be used for diverting to, for example, a commercial alternate rather than the fuel alternate. The decisions made en-route are not solely quantified in terms of the weather at the destination and the fuel planning procedures but also in terms of what other pilots trying to land at the same destination are most likely to do. In this respect, quantifying en-route behaviour for the purposes of a cost analysis is rather difficult.

3. COST ANALYSIS

This section brings together all of the above ideas into an operational flowchart. A different flowchart is necessary for aircraft with different ICAO Landing Category equipment because each pilot will consider the diversion likely/unlikely question according to the aircraft's landing capabilities. The flowchart for Cat IIIb aircraft should be treated with caution because, using the logic described below, the aircraft never has to divert. This is obviously not a true representation of the situation despite the fact that it may be the usual outcome. The flowcharts are shown in figures 1 - 4.

The first decision to be made is based on the equipment of the aircraft and the forecast at the destination. A diversion is considered likely if the forecast weather is at or close to the landing limits. It is considered unlikely if it is a category below or better. For example, for a Cat II aircraft a diversion is considered unlikely for forecasts of Cat I or better than Cat I (>I)[2]. In the case of Cat IIIa and Cat IIIb weather however, diversion will always be considered likely as ATC delays may result from the increased landing separation required for the conditions. If diversion is considered unlikely then a fuel alternate is preferred. If diversion is likely then a commercial alternate is preferred.

It is assumed that extra fuel for holding at the destination is loaded if the destination is forecast to be at the aircraft's limits or one category worse than that (e.g. for Cat I aircraft, extra holding fuel is loaded if the forecast for the destination is Cat I or Cat II). This is because it can be reasoned that a significant chance of landing at the destination exists but holding will

[2] For a working definition of "better than Cat I" conditions see Appendix 4.

more than likely be necessary. If the forecast at the destination is much worse than the aircraft's landing capabilities then holding will not be fruitful as the chances of landing are very slim indeed.

The CAP360 says that an alternate must be Cat I or better at take-off and forecast to be Cat I or better at the estimated time of arrival and for 1 hour after that. If this is not the case then another alternate is selected. If diversion is likely and the preferred commercial alternate is not available then another commercial alternate further from the destination is nominated.

Once approaching the destination the pilot will land or divert as required by the actual weather conditions there. A cost is incurred in the decision made here. A cost is also incurred to the airline according to the actual conditions at the preferred (and unchosen) alternate. If the forecast was correct at the preferred alternate then no cost is incurred, the correct decision was made. If however, the preferred alternate was better than forecast then a more distant alternate was specified, extra fuel was loading accordingly and subsequently 4% per hour of this extra fuel was consumed en-route in carrying the extra fuel.

The cost codes in the grey boxes on the flowcharts indicate the type of cost that is incurred and these are detailed below.

1. No cost
2. Extra handling charges are paid at the fuel alternate.
3. Extra fuel is loaded to choose a further alternate than was necessary, of which 4% per hour is consumed.
4. Extra fuel is loaded for holding at the destination (assume that this was unnecessary)
5. Both 3 and 4 above apply.

Figure 1 - Cat I aircraft

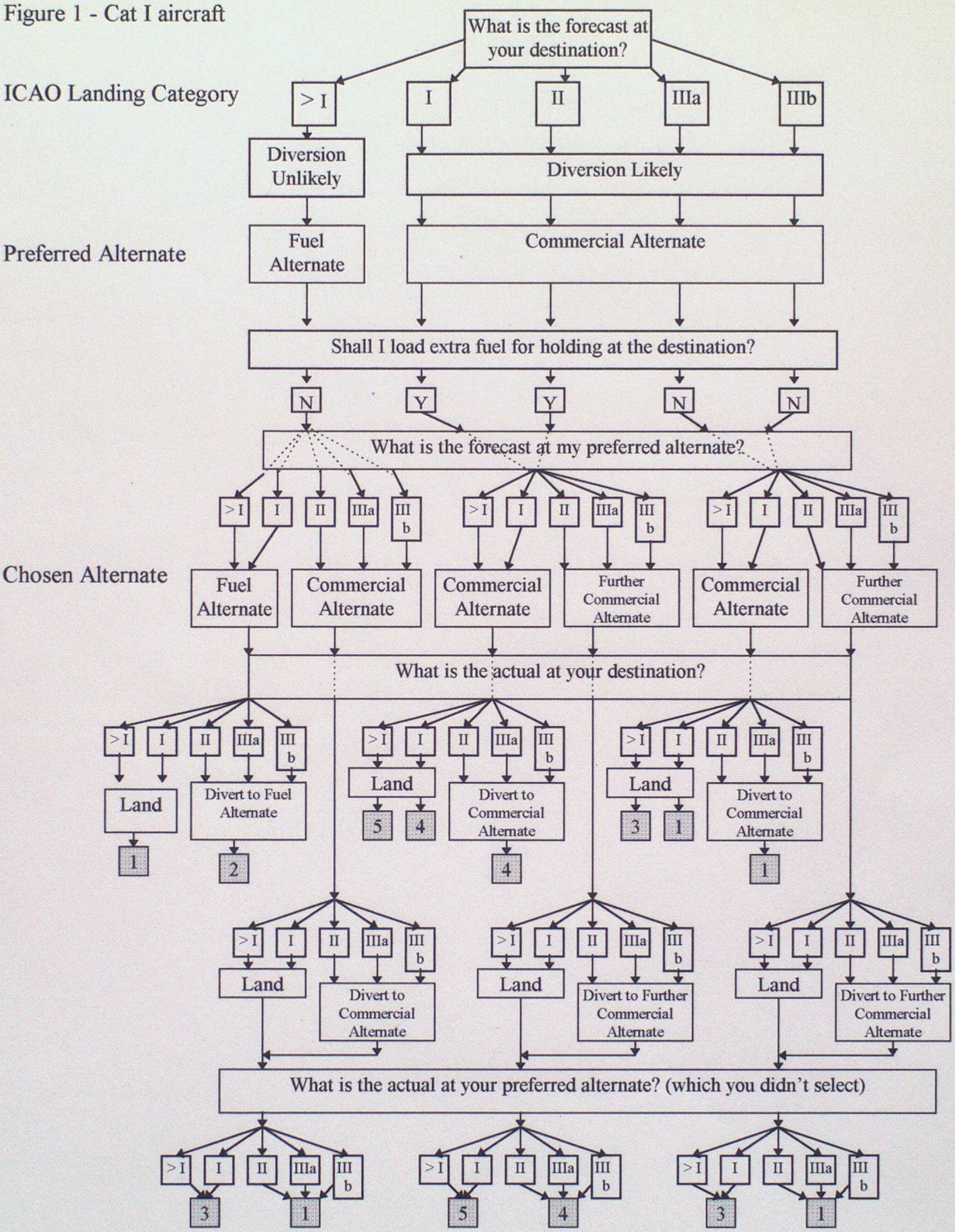


Figure 2 - Cat II aircraft

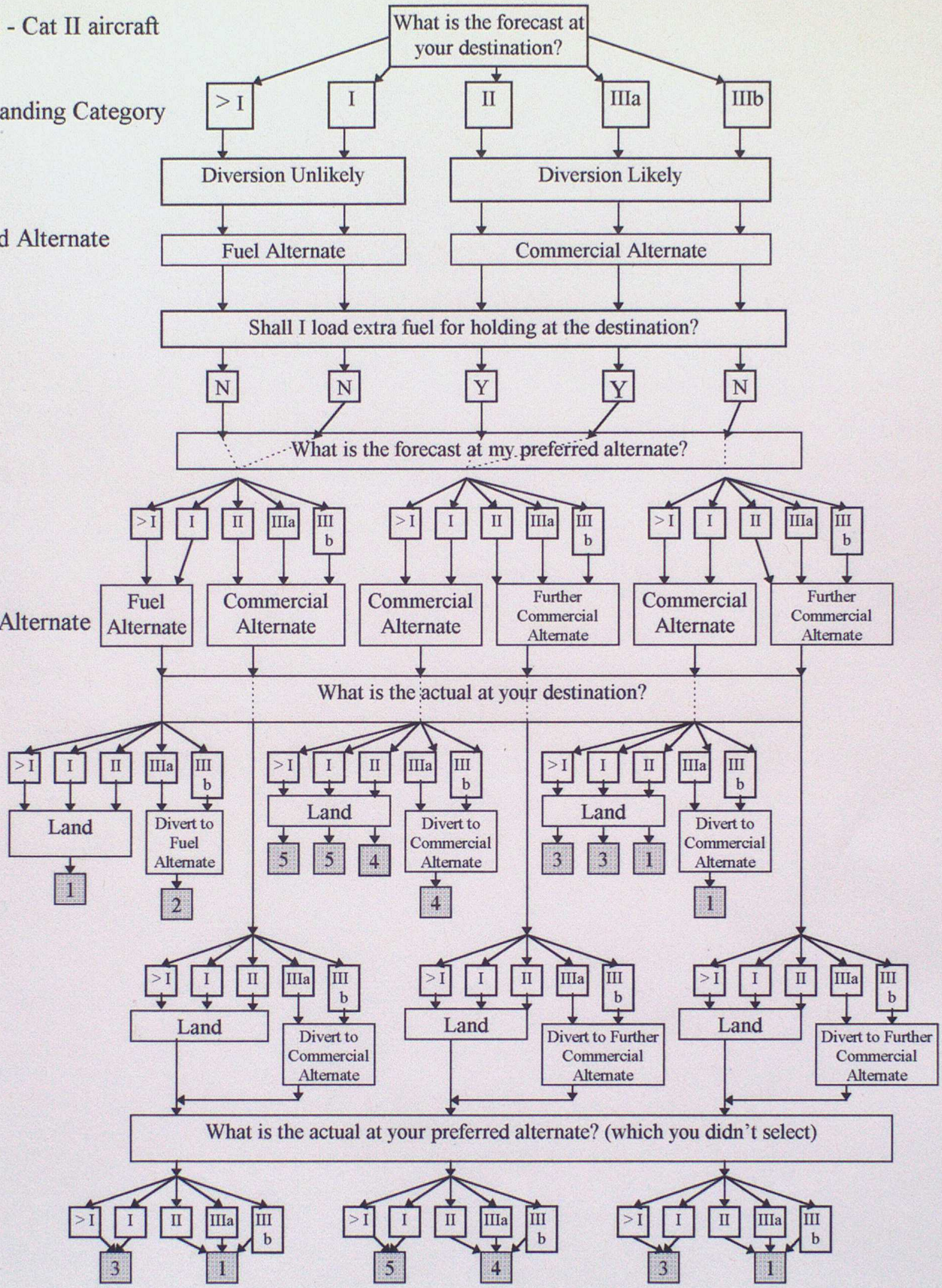


Figure 3 - Cat IIIa aircraft

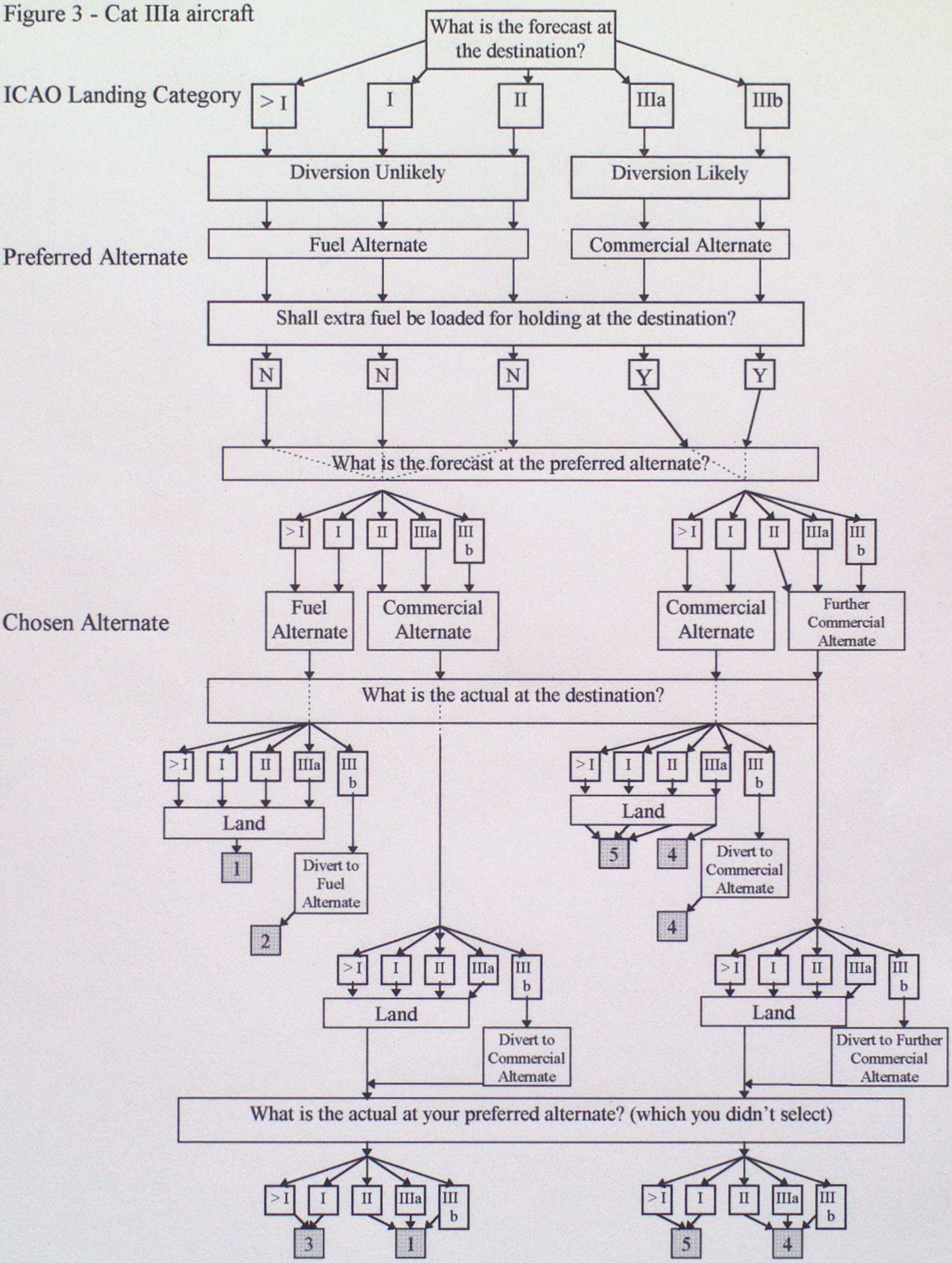
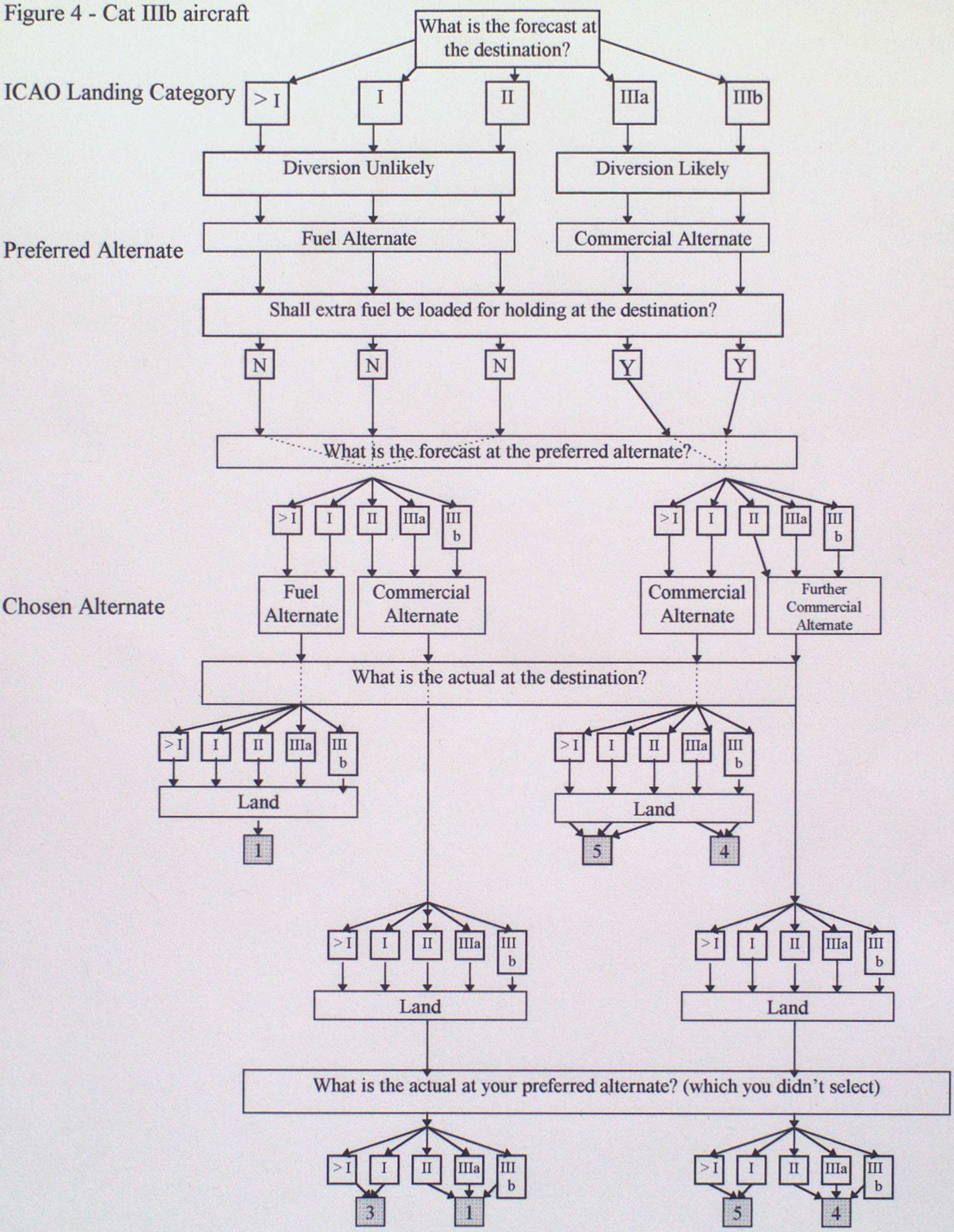


Figure 4 - Cat IIIb aircraft



From information given by the airlines and the aircraft manufacturers, the following table has been deduced. It shows the actual costs in real terms for two scenarios: a wide bodied aircraft on an intercontinental flight and a narrow bodied aircraft on a regional flight.

The block charge for the cost of handling aircraft at a fuel alternate was obtained from an airline. The extra distance to a commercial alternate of 70 nm for long haul was calculated from an airline list of fuel and commercial alternates. The figure of 30 nm for regional flights was given to us direct by an airline. The extra cost deduced from this distance was calculated using a spreadsheet which can be found in Appendix 3. It was assumed that 4% of the extra fuel carried is used en-route in carrying its own weight. Typical speeds and fuel consumption rates for the phases of flights concerned were obtained from aircraft manufacturers tables and charts. These can be seen in the spreadsheet.

Cost	**Wide bodied on intercontinental flight** 10 hr flight	**Narrow bodied on regional flight** 2 hr flight
2	**£1000**	**£1000**
3	extra 70 nm to alternate extra cost = **£208**	extra 30 nm to alternate extra cost = **£2**
4	1/2 hour extra holding fuel extra cost = **£189**	1/2 hour extra holding fuel extra cost = **£11**
5	£208 + £189 = **£397**	£2 + £11 = **£13**

Table 1 - Cost incurred to an airline given different scenarios.

It is important to note that the costs calculated only reflect the cost to the airline because the forecast was wrong, not the cost to the airline of having to divert. The aircraft also diverts when the forecast is correct.

Following the logic of the flowchart it becomes apparent that six outcomes are possible for a destination forecast/actual pair. In fact, these six different outcomes, do not have completely different cost codes. Some of them have the same cost codes. For example, for a Cat I equipped aircraft, flying to a destination with a forecast of Cat II and an actual of Cat I, the aircraft can:

1. load extra holding fuel, nominate the commercial alternate and land at the destination. The cost code is 4 as extra holding fuel was loaded.
2. load extra holding fuel, nominate a further commercial alternate, land at the destination and subsequently find out that the actual at the preferred commercial alternate was Cat I or better than Cat I. The cost code is 5 as extra holding fuel was loaded and extra fuel was loaded to nominate a further commercial alternate.
3. load extra holding fuel, nominate a further commercial alternate, land at the destination and subsequently find out that the actual at the preferred commercial alternate was bad (Cat II, IIIa or IIIb). The cost code is 4 as extra holding fuel was loaded. Extra fuel was loaded to nominate a further commercial alternate but this was the correct decision to make as the forecast for the preferred alternate was correct.

The average of the three cost codes is taken and transferred to a matrix in order to determine how much a bad forecast costs an airline. Tables 2 - 5 below show the average costs to an airline given the forecast and the actual weather at a destination in terms of the ICAO Landing Categories for a wide body aircraft on an intercontinental flight. It was decided that the same matrix would not be calculated for the narrow bodied case as the costs in the table above are so low as to be irrelevant in respect to the other costs incurred to the airline that are not a direct result of a bad forecast.

FORECAST		ACTUAL			
	CAT I A/C	Better than I	I	II	IIIa	IIIb
F C	IIIb	£104	£69	£69	£69	£69
O A	IIIa	£104	£69	£69	£69	£69
R S	II	£293	£258	£258	£258	£258
E T	I	£293	£258	£258	£258	£258
	Better than I	£69	£69	£236	£236	£236

Table 2 - Costs to the airline of bad forecast for a Cat I aircraft.

FORECAST		ACTUAL				
	CAT II A/C	Better than I	I	II	IIIa	IIIb
F C	IIIb	£104	£104	£69	£69	£69
O A	IIIa	£293	£293	£258	£258	£258
R S	II	£293	£293	£258	£258	£258
E T	I	£69	£69	£69	£236	£236
	Better than I	£69	£69	£69	£236	£236

Table 3 - Costs to the airline of bad forecast for a Cat II equipped aircraft.

FORECAST		ACTUAL				
	CAT IIIa A/C	Better than I	I	II	IIIa	IIIb
F C	IIIb	£293	£293	£293	£258	£258
O A	IIIa	£293	£293	£293	£258	£258
R S	II	£69	£69	£69	£69	£236
E T	I	£69	£69	£69	£69	£236
	Better than I	£69	£69	£69	£69	£236

Table 4 - Costs to the airline of bad forecast for a Cat IIIa equipped aircraft.

F	C	IIIb	£293	£293	£293	£258	£258
O	A	IIIa	£293	£293	£293	£258	£258
R	S	II	£69	£69	£69	£69	£69
E	T	I	£69	£69	£69	£69	£69
		Better than I	£69	£69	£69	£69	£69
		CAT IIIb A/C	Better than I	I	II	IIIa	IIIb
			ACTUAL				

Table 5 - Costs to the airline of bad forecast for a Cat IIIb equipped aircraft.

As can be seen from the tables, different price areas have appeared and the edges of those areas move depending on the equipment on the aircraft. At this stage it could be deduced that there is no forecast category that is more critical than any other when considering all aircraft. However, the four tables need to be combined to find the critical limits for the overall picture. The fleets of the three airlines are combined to give the result that 1% of their aircraft are Cat I equipped, 19% are Cat II, 77% are Cat IIIa equipped and 3% are Cat IIIb equipped. Multiplying each of the tables above by the relevant percentage and then summing the results gives table 6 below.

F	C	IIIb	£255	£255	£248	£220	£220
O	A	IIIa	£291	£291	£284	£256	£256
R	S	II	£114	£113	£107	£107	£235
E	T	I	£71	£71	£71	£103	£231
		Better than I	£69	£69	£71	£102	£231
		All a/c types	Better than I	I	II	IIIa	IIIb
			ACTUAL				

Table 6 - The cost to airlines of bad forecasts for all aircraft types.

It can be seen that the costs to the airline of bad forecasts jump at the forecast Cat II limit and actual Cat IIIa limit. This reflects the fact that a large percentage (77%) of the aircraft considered are Cat IIIa equipped. It should be noted however that these charts correspond to the forecast and the actual at the destination. The CAP360 states that an alternate cannot be selected unless it is Cat I or better at take-off and forecast to be Cat I or better at the time of arrival. In this respect it is the limits on either side of the Cat I conditions that are considered critical.

Another limitation of the analysis is that I have assumed that the extra fuel that has been loaded for holding purposes was loaded unnecessarily. This is obviously a sweeping assumption that should not be made. The conditions that cause stacking are not solely governed by the weather conditions at the destination. It is governed by pilot behaviour in response to other pilot behaviour. Large holding stacks may well occur in poor weather conditions. If the vast majority of aircraft in the stack decide to divert because of this, then the aircraft that arrives minutes later has much less of a wait at the destination. This is impossible to quantify.

Another scenario not addressed is one in which an aircraft is forced to divert because of delays at the destination caused by poor visibility which was not correctly forecast. Frequently, after diverting, the aircraft refuels and at a later stage flies to its original destination. The pilot of such an aircraft would claim that he would have carried more fuel if the forecast had been correct and therefore would have been able to stack for longer. This again, is difficult to quantify.

Also, the rules that apply in the flight planning stage have little relevance once the aircraft is airborne because the pilot is not bound to divert to the alternate specified on the fuel planning sheet.

Finally, it should be noted that airports are categorised in the same way that aircraft are, with Cat I, II, IIIa and IIIb limits. A Cat IIIa aircraft can only land in Cat IIIa conditions if the airport concerned has Cat IIIa equipment. This fact has not been addressed as it is beyond the scope and the time available for this study.

4. CONCLUSIONS

The regulations governing the loading of fuel are somewhat artificial, superficially addressing the scenario of a single aircraft flying to a destination or a number of alternates, at each of which a fixed delay of 30 minutes is assumed. Carrying the right amount of fuel for a Cat IIIc aircraft flying into a Cat IIIc destination is effectively a question of correctly judging the length of delays. Consideration of delays is also a major factor in predicting the fuel required for less well equipped airlines. This is borne out by the pilots responses, but not those of the airlines, which reflect those of the regulations.

Consideration should be given to adding an extra element to the flight planning process in which likely delays are addressed. This cannot be done in the present flight planning process because it considers the individual aircraft in isolation. This extra element is of course linked to air traffic flow management.

The derivation of the likely delay from the forecast visibility and cloud base will be addressed by WP2100 by the end of the project.

5. APPENDICES

1. Airline Questionnaire
2. Airline Pilot Questionnaire
3. Cost Analysis Spreadsheet

5.1 Appendix 1

User of Meteorological Data - Questionnaire

Civil Aviation - Airlines

All replies will be treated in the strictest confidence.

Name of airline...

Your position (optional)..

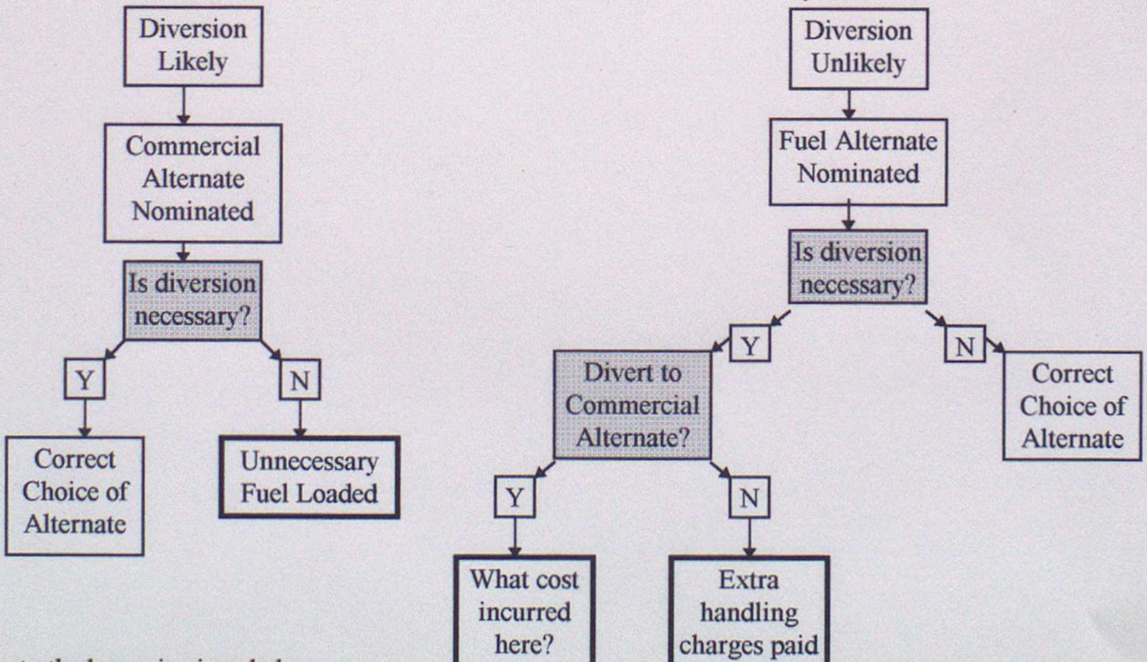
1. Please give the number of aircraft in your fleet that have their **typical** flight time in the following ranges along with their associated ICAO landing capabilities.

	non-rated	Cat I	Cat II	Cat IIIa	Cat IIIb	NDH equipped
< 1 hour						
1 - 3 hours						
3 - 6 hours						
6 - 12 hours						
> 12 hours						

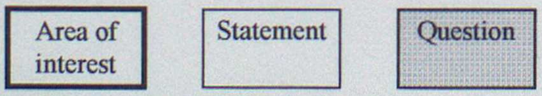
2. How long before departure are the aircraft specified above allocated to a given service? Please give the number of aircraft with a given ICAO capability that fall in the relevant time ranges.

	less than 1 day	1 - 3 days	3 - 7 days	over 1 week	others (please specify)	
non-rated						
Cat I						
Cat II						
Cat IIIa						
Cat IIIb						
NDH equipped						

3. The following flowcharts show the possible scenarios in choosing alternate airfields and subsequent diversions. A Commercial alternate is understood to be the best choice from a handling service point of view. A Fuel Alternate is the closest alternate to the destination. At times the two may be the same.



A guide to the boxes is given below.



3a. Under what circumstances would an aircraft be diverted to a commercial alternate when a fuel alternate has been specified on the flight plan?

....

....

....

3b. Are there any costs incurred in doing this?

....

....

3c. What is the **average** additional cost to the airline of landing at a fuel alternate e.g. extra handling charges?

....

....

3d. What is the **average** distance from a destination airfield to the

- Commercial Alternate?..
- Fuel Alternate?..

(From this we can calculate extra fuel that might be loaded and subsequently used en-route.)

3e. It is assumed that aircraft will hold at the desired destination for as long as legally possible (max. of 50% of the holding fuel to be used) before the aircraft is diverted. Is this assumption correct? If not, please outline your policy on holding procedures.

....

....

....

4. It may be sensible to think about the above in the following way. If it is assumed that the cost of diverting an aircraft is dependent on the distance from the destination airport to the alternate airport then the cost may be calculated from, *for example*:

$$\text{Total cost} = (C_1 \times \text{distance}) + C_2 \quad \text{where } C_1 \text{ and } C_2 \text{ are constants.}$$

Other factors may include the length of the flight, handling costs and the number of passengers.
Please give, if possible, details of how **you** calculate the cost to the airline of diverting an aircraft, giving the values of constants in the equation.

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5. Are there any other comments that you wish to make about forecast provision and its effects on your company?...

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5.2 Appendix 2

User of Meteorological Data - Questionnaire

Civil Aviation - Pilots

Where the response requires boxes to be ticked, please tick one box only unless otherwise requested.

Name of airline (optional)..

1a. If the main body of the TAF for the preferred alternate airfield is giving conditions conducive to a landing without any problems but conditions that would prohibit landing were given within a "PROB**30** TEMPO" section, what action would you take with regard to fuel intake?

- ignore the conditions within the "PROB**30** TEMPO" section ☐
- take on more fuel, i.e. expect the worst conditions in the TAF ☐
- choose a different alternate altogether ☐
- other (please specify)..

....

1b. If the main body of the TAF for the preferred alternate airfield is giving conditions conducive to a landing without any problems but conditions that would prohibit landing were given within a "PROB**40** TEMPO" section, what action would you take with regard to fuel intake?

- ignore the conditions within the "PROB**40** TEMPO" section ☐
- take on more fuel, i.e. expect the worst conditions in the TAF ☐
- choose a different alternate altogether ☐
- other (please specify)..

....

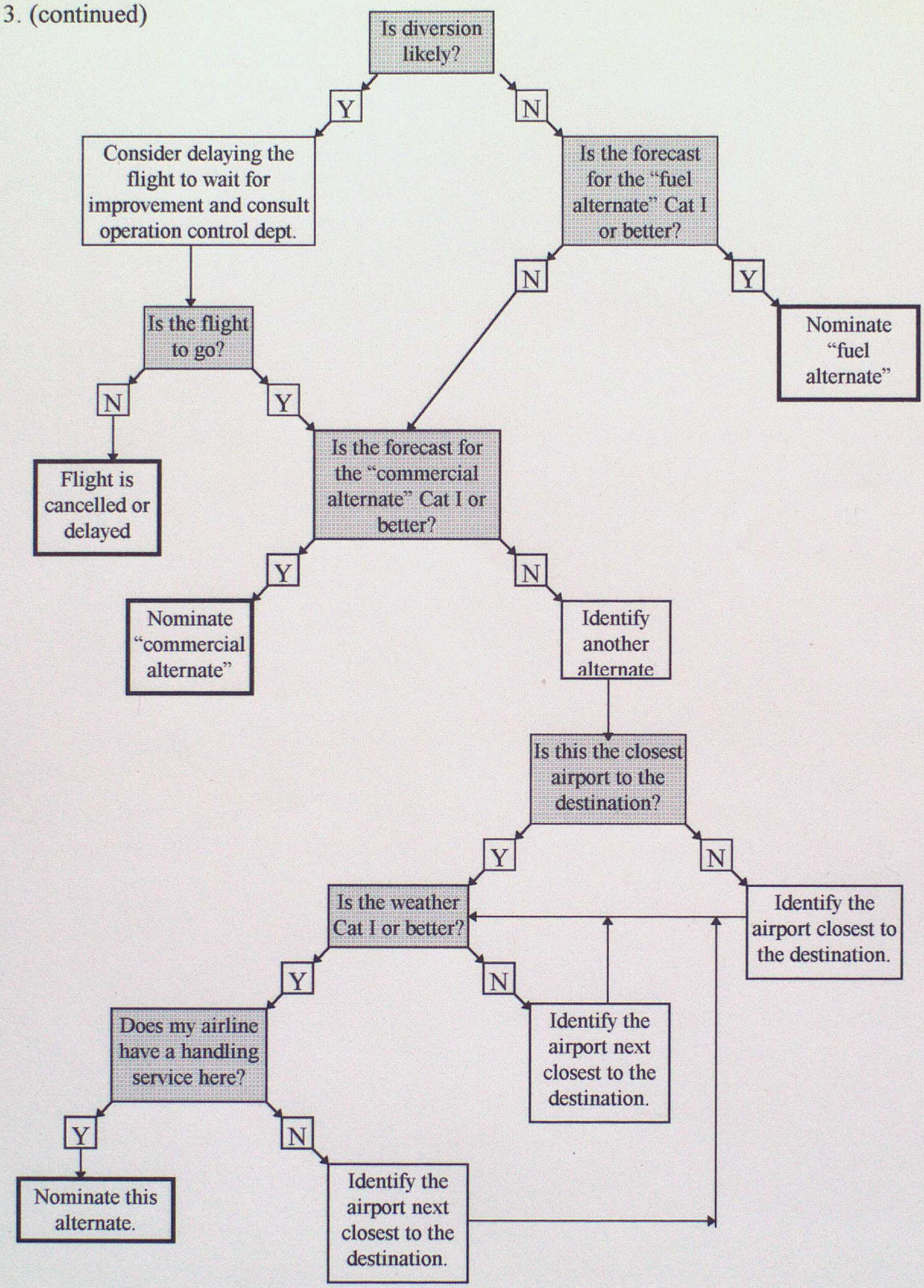
2. The main body of the TAF indicates that the cloud base at the preferred alternate airport will be 100ft above the minimum criteria as specified for the equipment on your aircraft and at the airports concerned. That is to say, you may legally select it, but only just. Do you:
choose your preferred alternate ☐ choose another alternate ☐ load extra fuel ☐
other (please specify)..

....

3. The flow chart overleaf shows a decision making process which may be used by an aircraft pilot when choosing the alternate aerodrome. Please indicate if this process is a sensible one and whether or not it is used by you. If this is not the case, please add comments or draw an equivalent flow chart which is more appropriate.

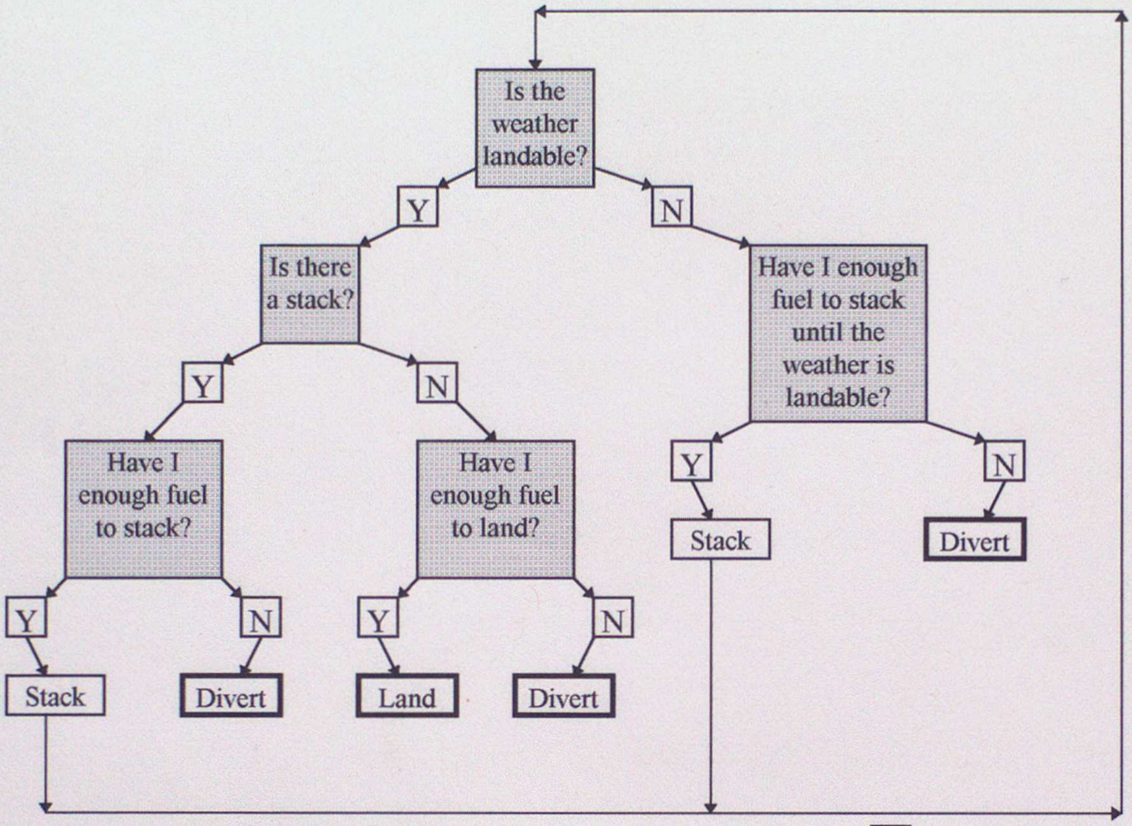
- This flowchart is sensible and I use it ☐
- This flowchart is sensible but I don't use it, please see annotations/diagram overleaf ☐
- This flow chart is not sensible, please see annotations/diagram overleaf ☐

3. (continued)



The decision making process that leads to the choice of an alternate airport.

4. The flowchart below shows a decision making process which may be used by an aircraft pilot when approaching the destination. Please indicate if this process is a sensible one and whether or not it is used by you. If this is not the case, please add comments or draw an equivalent flow chart which is more appropriate.



This flowchart is sensible and I use it ☐
This flowchart is sensible but I don't use it, please see annotations/diagram overleaf ☐
This flow chart is not sensible, please see annotations/diagram overleaf. ☐

5. Are there any other comments that you wish to make regarding TAFs and their usage which have implications for you and/or your organisation?...
....
....
....
....
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....
....
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....

Thank-you for your time in completing this questionnaire.
All responses will be treated in the strictest confidence and results produced in a statistical format.

5.3 Appendix 3

Boeing 747 - 400

Purpose	4%	flight time	fuel cons.	distance	speed	time	fuel cost	cost	div & hold
		hrs	kg/hr	nm	nm/hr	hrs	£/kg	£	£
diversion	0.04	5	12000	70	210	0.33	0.13	104.00	
holding	0.04	5	7264			0.50	0.13	94.43	198.43
holding	0.04	5	7264			1.00	0.13	188.86	292.86
diversion	0.04	10	12000	70	210	0.33	0.13	208.00	
holding	0.04	10	7264			0.50	0.13	188.86	396.86
holding	0.04	10	7264			1.00	0.13	377.73	585.73
diversion	0.04	15	12000	70	210	0.33	0.13	312.00	
holding	0.04	15	7264			0.50	0.13	283.30	595.30
holding	0.04	15	7264			1.00	0.13	566.59	878.59

Boeing 737 - 400

diversion	0.04	1	2290	30	300	0.10	0.13	1.19	
holding	0.04	1	2090			0.50	0.13	5.43	6.62
holding	0.04	1	2090			1.00	0.13	10.87	12.06
diversion	0.04	2	2290	30	300	0.10	0.13	2.38	
holding	0.04	2	2090			0.50	0.13	10.87	13.25
holding	0.04	2	2090			1.00	0.13	21.74	24.12
diversion	0.04	3	2290	30	300	0.10	0.13	3.57	
holding	0.04	3	2090			0.50	0.13	16.30	19.87
holding	0.04	3	2090			1.00	0.13	32.60	36.18

5.4 Appendix 4

Category	Decision height	Runway visual range
I	>200 ft	>550 m
II	100-200 ft	>350 m
IIIa	<100 ft	>200 m
IIIb	0-50 ft	50-200 m
IIIc	none	50-200 m

There are some references in ICAO literature to conditions described as better than category one although these conditions are not precisely defined. In order to cater for this an additional category will be used which will be defined as cloud base in excess of 400 feet and runway visual range in excess of 1000 metres.

5.5 Appendix 5

The PROB statement allows the forecaster to assign a probability to an uncertain event. Examples of such events would be showers or simply to represent uncertainty in the formation of fog. It is worth pointing out that a forecast of showers with a degree of uncertainty attached would often imply a change in visibility as well as other features such as a reduction in cloud base. Currently, the UK regulations stipulate that only probabilities of 30% or 40% can be assigned which does significantly reduce the options for interpretation of such forecasts. A typical statement including a PROB would be:-

24010KT 9999 SCT025 PROB30 3000 SHRA BKN010

Wind of 10 knots from 240°, visibility in excess of 10km and a small amount of cloud with base 2500 feet. A 30% chance at any time of the visibility reducing to 3000 metres with cloud amount increasing and lowering to 1000 feet in a rain shower.