Amazonas Mid-Air (Sep. 29, 2006)

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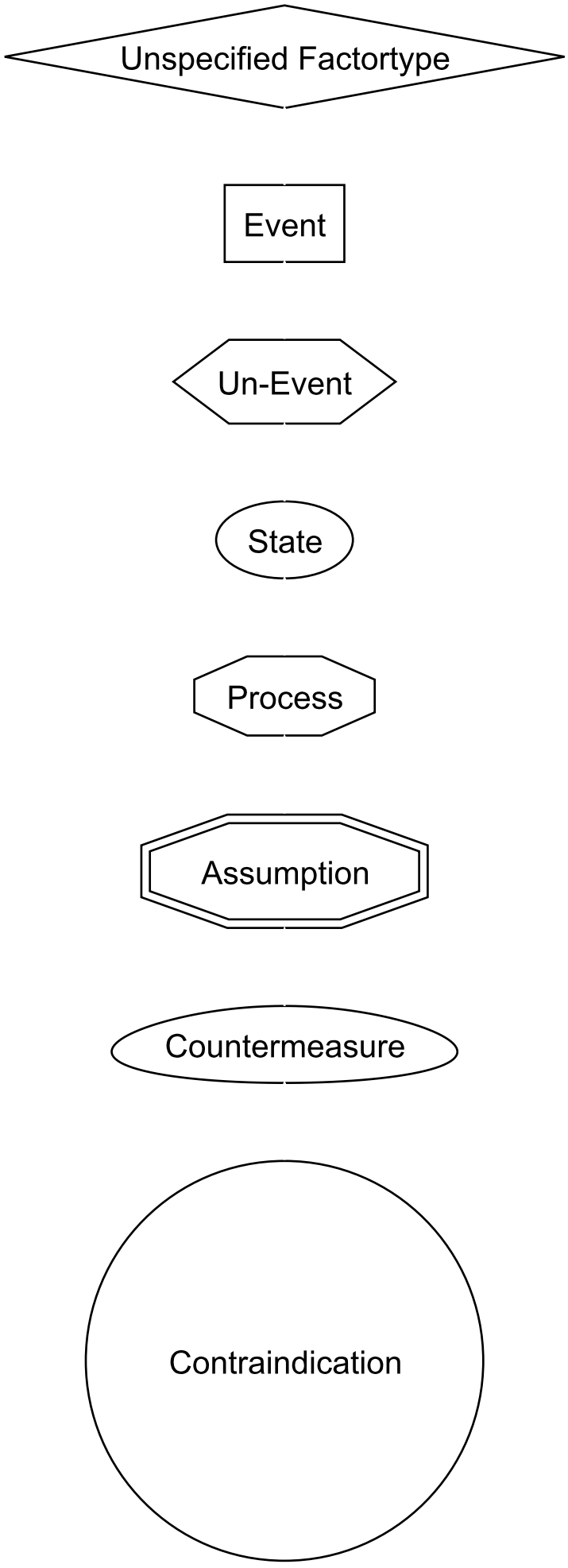
INCIDENT ANALYSIS

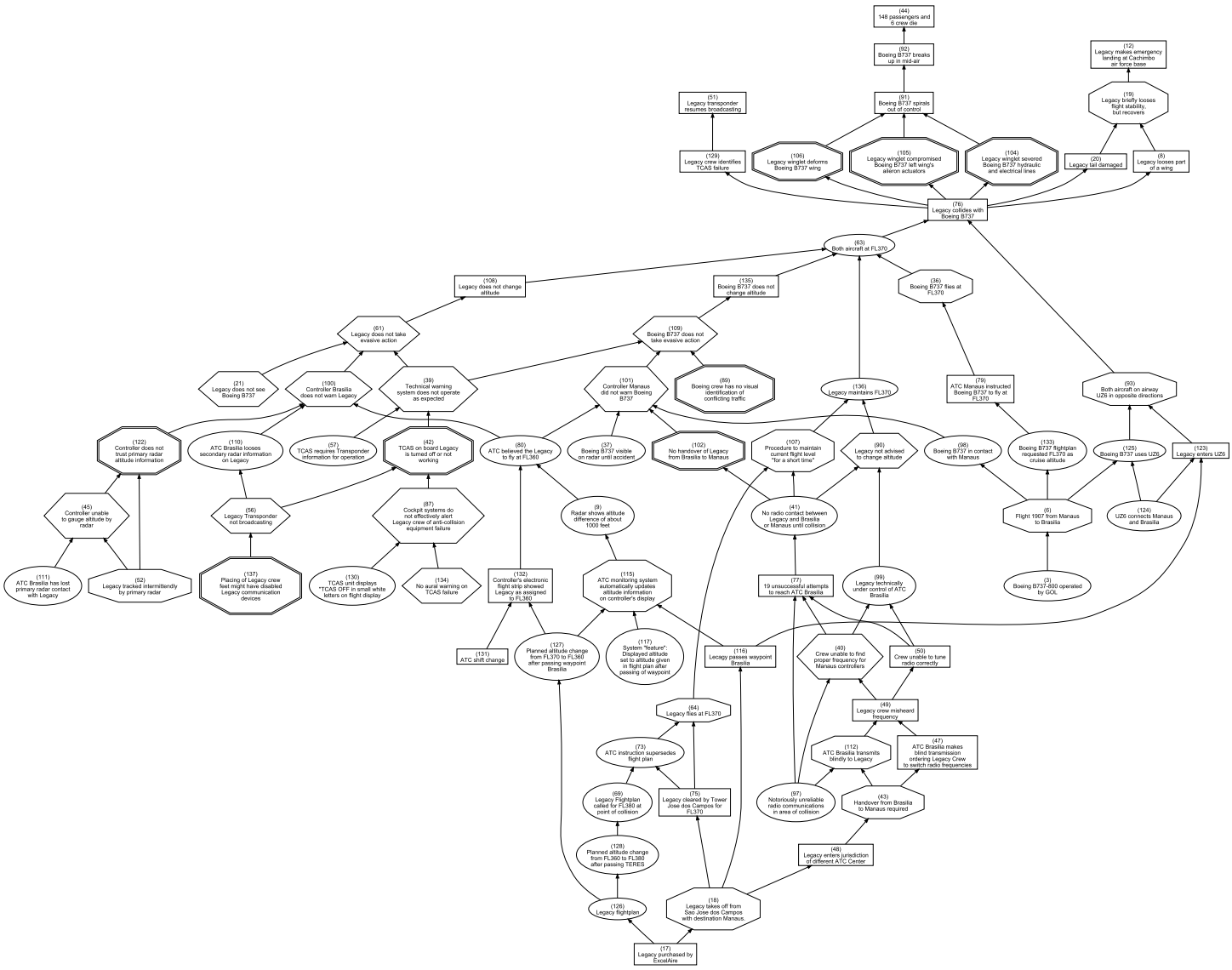
Incident description:

Information taken from IHT Sep 30, 2006 to May 03, 2007, NYT Sep 30, 2006 to May 03, 2007, Flight International Oct 10-16, 2006 to May 08-14, 2007, Aviation Week Oct 9, 2006 to Apr. 30, 2007, NTSB Safety Recommendation May 2, 2007 and the NTSB Factual Report.

Legend of Factorshapes



Why-Because Graph



Timeline of Events

		GOL Flight 1907	Embraer Legacy	Radar operator	ATC Brasilia	ATC Manaus	TCAS System	Joseph Lepore	Sao Jose dos Campos Tower
Legacy takes off from Sao Jose dos Campos with destination Manaus.	14:51:00		X						X
Legacy cleared by Tower Jose dos Campos for FL370	15:11:00							X	X
Legacy flies at FL370	15:33:00		X						
Flight 1907 from Manaus to Brasilia	15:35:00	X							
ATC Brasilia makes blind transmission ordering Legacy Crew to switch radio frequencies	15:51:00		X		X				
Lecagy passes waypoint Brasilia	15:56:00		X						
Boeing B737 flies at FL370	15:58:00	X							
Legacy Transponder not broadcasting	16:02:00		X						
ATC Brasilia looses secondary radar information on Legacy			X		X				
ATC Brasilia transmits blindly to Legacy	16:26:00		X		X				
ATC Brasilia has lost primary radar contact with Legacy	16:30:00		X		X				
Legacy tracked intermittendly by primary radar	16:38:00		X		X				
Legacy crew misheard frequency	16:53:00		X		X				
Legacy collides with Boeing B737	16:57:00	X	X						
Legacy transponder resumes broadcasting	17:02:00		X	X					

Factor List

1 Boeing B737 wreckage found
2 Boeing B737 crashes in Mato Grosso area
3 Boeing B737-800 operated by GOL
4 Possible Mid-Air with smaller plane
5 Radar contact lost during flight
6 Flight 1907 from Manaus to Brasilia
7 Legacy collides with "shadow"
8 Legacy looses part of a wing
9 Radar shows altitude difference of about 1000 feet
10 Boeing B737 carrying 149 passengers, 6 crew
11 GOL 1907 had 200 flight hours
12 Legacy makes emergency landing at Cachimbo air force base
13 Boeing B737 strikes ground at more than 300 mph
14 Unlikelyhood of survivors
15 Some kind of contact between Boeing 737 and Legacy
16 Legacy on inaugural flight to United States
17 Legacy purchased by ExcelAire
18 Legacy takes off from Sao Jose dos Campos with destination Manaus.
19 Legacy briefly looses flight stability, but recovers
20 Legacy tail damaged
21 Legacy does not see Boeing B737
22 Lecagy flies stable northwest at FL370
23 Legacy equipped with anticollision device
24 Boeing B737 equipped with anticollision device
25 Legacy might have flown off course
26 Boeing B737 might have had trouble
27 Boeing B737 might have lost parts
28 Parts of B737 might have hit Legacy
29 Possible lack of coordination among air traffic controllers
30 149 passengers and 6 crew die
31 Possible negligence or disregard for air-traffic instructions
32 Failure to detect other aircraft
33 Air-traffic controllers not alerted of dangerous flight path
34 Crew ignored instruction to descent from FL370 to FL360 passing Brasilia
35 Crew decided to fly higher without alerting controllers
36 Boeing B737 flies at FL370
37 Boeing B737 visible on radar until accident
39 Technical warning system does not operate as expected
40 Crew unable to find proper frequency for Manaus controllers
41 No radio contact between Legacy and Brasilia or Manaus until collision
42 TCAS on board Legacy is turned off or not working
43 Handover from Brasilia to Manaus required
44 148 passengers and 6 crew die
45 Controller unable to gauge altitude by radar
46 Single electronic failure on board of the Legacy
47 ATC Brasilia makes blind transmission ordering Legacy Crew to switch radio frequencies
48 Legacy enters jurisdiction of different ATC Center
49 Legacy crew misheard frequency
50 Crew unable to tune radio correctly
51 Legacy transponder resumes broadcasting
52 Legacy tracked intermittendly by primary radar
53 Primary radar gives no altitude information
54 Controller does not warn about possible collision

55 Software requires altitude information for collision warning
56 Legacy Transponder not broadcasting
57 TCAS requires Transponder information for operation
58 Boeing B737 not advised to change altitude
59 Complete radar and radio coverage over jungle
60 Discrepancy between Legacy flightpath, altitude and altitude assignment
61 Legacy does not take evasive action
62 Assumed Mid-Air Collision
63 Both aircraft at FL370
64 Legacy flies at FL370
65 Both aircraft on same airway
66 Legacy TCAS manufactured by Honeywell
67 FAA had ordered recall on TCAS model used in Legacy
68 TCAS device tended to stop broadcasting unexpectedly in certain circumstances
69 Legacy Flightplan called for FL380 at point of collision
70 Boeing B737 CVR lost in rainforest
71 Brazilian Air Traffic System run by Brazilian Air Force
72 Takeoff Clearance called for FL370 for the entire route
73 ATC instruction supersedes flight plan
74 Boeing B737 CVR found
75 Legacy cleared by Tower Jose dos Campos for FL370
76 Legacy collides with Boeing B737
77 19 unsuccessful attempts to reach ATC Brasilia
78 Boeing B737 flight plan called for FL410 at point of collision
79 ATC Manaus instructed Boeing B737 to fly at FL370
80 ATC believed the Legacy to fly at FL360
81 Possible Cause for (56)
82 Avionics component has operational problems
83 Avionics component returned to Honeywell
84 Honeywell returned avionics component to Embraer
85 Embraer installed avionics component
86 One transponder and some radio communications systems installed in avionics component
87 Cockpit systems do not effectively alert Legacy crew of anti-collision equipment failure
88 Boeing unable to avoid collision
89 Boeing crew has no visual identification of conflicting traffic
90 Legacy not advised to change altitude
91 Boeing B737 spirals out of control
92 Boeing B737 breaks up in mid-air
93 Both aircraft on airway UZ6 in opposite directions
96 Radar coverage limits at boarder between airspace sectors
97 Notoriously unreliable radio communications in area of collision
98 Boeing B737 in contact with Manaus
99 Legacy technically under control of ATC Brasilia
100 Controller Brasilia does not warn Legacy
101 Controller Manaus did not warn Boeing B737
102 No handover of Legacy from Brasilia to Manaus
103 Unknown cause
104 Legacy winglet severed Boeing B737 hydraulic and electrical lines
105 Legacy winglet compromised Boeing B737 left wing's aileron actuators
106 Legacy winglet deforms Boeing B737 wing
107 Procedure to maintain current flight level "for a short time"
108 Legacy does not change altitude
109 Boeing B737 does not take evasive action
110 ATC Brasilia looses secondary radar information on Legacy
111 ATC Brasilia has lost primary radar contact with Legacy

112 ATC Brasilia transmits blindly to Legacy
113 Secondary radar information trasmits altitude information
115 ATC monitoring system automatically updates altitude information on controller's display
116 Lecagy passes waypoint Brasilia
117 System "feature": Displayed altitude set to altitude given in flight plan after passing of waypoint
118 Brazilian military 3-d primary radar provides flight altitude information
119 Military Primary radar altitude information presented to civilian controllers
120 Military 3-D primary radar altitude information inacurrate
121 Long-Range triangulation
122 Controller does not trust primary radar altitude information
123 Legacy enters UZ6
124 UZ6 connects Manaus and Brasilia
125 Boeing B737 uses UZ6
126 Legacy flightplan
127 Planned altitude change from FL370 to FL360 after passing waypoint Brasilia
128 Planned altitude change from FL360 to FL380 after passing TERES
129 Legacy crew identifies TCAS failure
130 TCAS unit displays "TCAS OFF in small white letters on flight display
131 ATC shift change
132 Controller's electronic flight strip showed Legacy as assigned to FL360
133 Boeing B737 flightplan requested FL370 as cruise altitude
134 No aural warning on TCAS failure
135 Boeing B737 does not change altitude
136 Legacy maintains FL370
137 Placing of Legacy crew feet might have disabled Legacy communication devices

Factor List - Details

1 **Boeing B737 wreckage found**
- Type of Factor: Event
- Date/Time:
- Actors involved: Boeing B737-800
- Annotation: Reuters report, IHT Sep 30, 2006

2 **Boeing B737 crashes in Mato Grosso area**
- Type of Factor: Event
- Date/Time:
- Actors involved: Boeing B737-800
- Annotation: evidenced by Factor 1

3 **Boeing B737-800 operated by GOL**
- Type of Factor: State
- Date/Time:
- Actors involved: Boeing B737-800
- Annotation: Reuters report, IHT Sep 30, 2006

4 **Possible Mid-Air with smaller plane**
- Type of Factor: Assumption
- Date/Time:
- Actors involved: Boeing B737-800
  Embraer Legacy
- Annotation: Reuters report, IHT Sep 30, 2006
  quoting local officials and media reports

5 **Radar contact lost during flight**
- Type of Factor: State
- Date/Time:
- Actors involved: Boeing B737-800
  Radar operator
- Annotation: Reuters report, IHT Sep 30, 2006

6 **Flight 1907 from Manaus to Brasilia**
- Type of Factor: Process
- Date/Time: 29.09.2006 15:35:00
- Actors involved: Boeing B737-800
- Annotation: Reuters report, IHT Sep 30, 2006

7 **Legacy collides with "shadow"**
- Type of Factor: Event
- Date/Time:
- Actors involved: Embraer Legacy
- Annotation: Statement of Defense Minister Waldir Pires on Band TV

8 **Legacy looses part of a wing**
- Type of Factor: Event
- Date/Time:
- Actors involved: Embraer Legacy
- Annotation: Statement of Defense Minister Waldir Pires on Band TV

9 **Radar shows altitude difference of about 1000 feet**
- Type of Factor: State
- Date/Time:
- Actors involved: Boeing B737-800
  Embraer Legacy
  AirTrafficControl Brasila (CINDACTA 1)
  AirTrafficControl Manaus
- Annotation: Reuters report, IHT Sep 30, 2006

10 **Boeing B737 carrying 149 passengers, 6 crew**

Type of Factor: Unspecified
Date/Time:
Actors involved: Boeing B737-800
Annotation: Reuters report, IHT Sep 30, 2006
Statement by GOL

11 **GOL 1907 had 200 flight hours**

Type of Factor: Unspecified
Date/Time:
Actors involved: Boeing B737-800
Annotation: Reuters report, IHT Sep 30, 2006

12 **Legacy makes emergency landing at Cachimbo air force base**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: Reuters report, IHT Sep 30 2006
Statement of Defense Minister Waldr Pires on Band TV

13 **Boeing B737 strikes ground at more than 300 mph**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation: AP report, IHT Oct 1, 2006
quoting Jose Carlos Pereira, president of Brazil's airport authority

14 **Unlikelyhood of survivors**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Annotation: AP report, IHT Oct 1, 2006
quoting Jose Carlos Pereira, president of Brazil's airport authority

15 **Some kind of contact between Boeing 737 and Legacy**

Type of Factor: Unspecified
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: AP report, IHT Oct 1, 2006
quoting Jose Carlos Pereira, president of Brazil's airport authority

16 **Legacy on inaugural flight to United States**

Type of Factor: Unspecified
Date/Time:
Actors involved: Embraer Legacy
Annotation: AP report, IHT Oct 1, 2006

17 **Legacy purchased by ExcelAire**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: AP report, IHT Oct 1, 2006
quoting Embraer and Milton Zuanazzi, general director for Brazil's Civil Aviation Agency Authority

18 **Legacy takes off from Sao Jose dos Campos with destination Manaus.**

Type of Factor: Process
Date/Time: 29.09.2006 14:51:00
Actors involved: Embraer Legacy
Air Traffic Control at Sao Jose dos Campos Airport, Brazil
Annotation: AP report, IHT Oct 1, 2006
quoting Diane McNulty, New York Times sopkeswoman

19 **Legacy briefly looses flight stability, but recovers**

Type of Factor: Process
Date/Time:
Actors involved: Embraer Legacy
Annotation: AP report, IHT Oct 1, 2006
quoting Joe Sharkey, passenger on Legacy after Diane McNulty

20 **Legacy tail damaged**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 01, 2006

21 **Legacy does not see Boeing B737**

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
Boeing B737-800
Annotation: New York Times
Oct 01, 2006

quoting Joe Sharkey

22 **Lecagy flies stable northwest at FL370**

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 01, 2006

quoting Joe Sharkey

23 **Legacy equipped with anticollision device**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Collision Avoidance System
Annotation: New York Times
Oct 01, 2006

quoting "authorities"

24 **Boeing B737 equipped with anticollision device**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Collision Avoidance System
Annotation: New York Times
Oct 01, 2006

quoting "authorities"

25 **Legacy might have flown off course**

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 02, 2006

quoting unidentified sources in the Brazilian Air Force

26 **Boeing B737 might have had trouble**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: New York Times
Oct 02, 2006

quoting "Others"

27 **Boeing B737 might have lost parts**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: New York Times
Oct 02, 2006

quoting "Others"

28 **Parts of B737 might have hit Legacy**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: New York Times
Oct 02, 2006

quoting "Others"

29 **Possible lack of coordination among air traffic controllers**

Type of Factor: Assumption
Date/Time:
Actors involved: Radar operator
Annotation: IHT
Oct 03, 2006

quoting Brazilian news reports

30 **149 passengers and 6 crew die**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation: New York Times
Oct 04, 2006

revised to 148 pax, 6 crew by Factor 44

31 **Possible negligence or disregard for air-traffic instructions**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: New York Times
Oct 04, 2006

32 **Failure to detect other aircraft**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: New York Times
Oct 04, 2006

33 **Air-traffic controllers not alerted of dangerous flight path**

Type of Factor: Assumption
Date/Time:
Actors involved: Radar operator
Annotation: New York Times
Oct 04, 2006

34 Crew ignored instruction to descent from FL370 to FL360 passing Brasilia

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 04, 2006

quoting prosecutor Mr. Alves

35 Crew decided to fly higher without alerting controllers

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 04, 2006

quoting prosecutor Mr. Alves

36 Boeing B737 flies at FL370

Type of Factor: Process
Date/Time: 29.09.2006 15:58:00
Actors involved: Boeing B737-800
Annotation: New York Times
Oct 02, 2006

37 Boeing B737 visible on radar until accident

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
AirTrafficControl Manaus
Annotation: New York Times
Oct 05, 2006

quoting Braizilian Air Force investigators

39 Technical warning system does not operate as expected

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
Collision Avoidance System
Annotation: New York Times
Oct 05, 2006

quoting Testimony of Legacy pilots

40 Crew unable to find proper frequency for Manaus controllers

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 05, 2006

quoting Testimony of Legacy pilots

41 No radio contact between Legacy and Brasilia or Manaus until collision

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
AirTrafficControl Manaus
Annotation: New York Times
Oct 05, 2006

quoting Testimony of Legacy pilots

42 TCAS on board Legacy is turned off or not working

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Collision Avoidance System
Annotation: New York Times
Oct 05, 2006

quoting procecutor Adriano Alves

43 Handover from Brasilia to Manaus required

Type of Factor: Process
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
AirTrafficControl Manaus
Annotation: New York Times
Oct 05, 2006

quoting Testimony of Legacy pilots

44 148 passengers and 6 crew die

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation: New York Times
Oct 06, 2006

revised passenger count by GOL

45 Controller unable to gauge altitude by radar

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation: New York Times
Oct 06, 2006

quoting Brazilian officials

46 Single electronic failure on board of the Legacy

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 06, 2006

quoting Technial Experts

47 ATC Brasilia makes blind transmission ordering Legacy Crew to switch radio frequencies

Type of Factor: Event
Date/Time: 29.09.2006 15:51:00
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation: New York Times
Oct 06, 2006

quoting police official

48 **Legacy enters jurisdiction of different ATC Center**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
AirTrafficControl Manaus
Annotation: New York Times
Oct 06, 2006

quoting police official

49 **Legacy crew misheard frequency**

Type of Factor: Event
Date/Time: 29.09.2006 16:53:00
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation: New York Times
Oct 06, 2006

quoting police official

50 **Crew unable to tune radio correctly**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 06, 2006

quoting police official

51 **Legacy transponder resumes broadcasting**

Type of Factor: Event
Date/Time: 29.09.2006 17:02:00
Actors involved: Embraer Legacy
Radar operator
Annotation: New York Times
Oct 06, 2006

quoting Brazilian officials

52 **Legacy tracked intermittendly by primary radar**

Type of Factor: Process
Date/Time: 29.09.2006 16:38:00
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation: New York Times
Oct 06, 2006

quoting General Pinheiro

refined by Flight International Nov. 21-27, 2006

53 **Primary radar gives no altitude information**

Type of Factor: Un-Event
Date/Time:
Actors involved: Radar operator
Annotation: New York Times
Oct 06, 2006

54 **Controller does not warn about possible collision**

Type of Factor: Un-Event
Date/Time:
Actors involved: Radar operator
Annotation: New York Times
Oct 06, 2006

quoting General Pinheiro

55 **Software requires altitude information for collision warning**

Type of Factor: State
Date/Time:
Actors involved: Radar operator
Annotation: New York Times
Oct 06, 2006

deduced from 54

56 **Legacy Transponder not broadcasting**

Type of Factor: UnEvent
Date/Time: 29.09.2006 16:02:00
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 06, 2006

quoting General Pinheiro

57 **TCAS requires Transponder information for operation**

Type of Factor: State
Date/Time:
Actors involved: Collision Avoidance System
Embraer Legacy
Annotation: New York Times
Oct 06, 2006

58 **Boeing B737 not advised to change altitude**

Type of Factor: UnEvent
Date/Time:
Actors involved: Boeing B737-800
AirTrafficControl Manaus
Annotation: New York Times
Oct 06, 2006

derived from available information and statement from John Cox

59 **Complete radar and radio coverage over jungle**

Type of Factor: State
Date/Time:
Actors involved: Radar operator
Annotation: New York Times
Oct 06, 2006

quoting General Vilarinha

60 **Discrepancy between Legacy flightpath, altitude and altitude assignment**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: New York Times
Oct 06, 2006

61 **Legacy does not take evasive action**

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
Annotation: Derived from Crew Testimony

62 **Assumed Mid-Air Collision**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: superseded by Factor 76

63 **Both aircraft at FL370**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation:

64 **Legacy flies at FL370**

Type of Factor: Process
Date/Time: 29.09.2006 15:33:00
Actors involved: Embraer Legacy
Annotation: Testimony of Legacy Crew

65 **Both aircraft on same airway**

Type of Factor: Process
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: Derived from Flightplans

66 **Legacy TCAS manufactured by Honeywell**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: New York Times
Oct 08, 2006

quting ExcelAire

67 **FAA had ordered recall on TCAS model used in Legacy**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: New York Times
Oct 08, 2006

quoting ExcelAire

False information, corrected by New York Times, Oct 09, 2006

68 **TCAS device tended to stop broadcasting unexpectedly in certain circumstances**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: New York Times
Oct 08, 2006

quoting ExcelAire

TCAS on board Legacy was not recalled by FAA, New York Times Oct 09, 2006

69 **Legacy Flightplan called for FL380 at point of collision**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Oct 12, 2006

quoting police officials

70 **Boeing B737 CVR lost in rainforest**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Annotation: New York Times
Oct 12, 2006

superseded by Factor 74

71 **Brazilian Air Traffic System run by Brazilian Air Force**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: New York Times
Oct 12, 2006

72 **Takeoff Clearance called for FL370 for the entire route**

Type of Factor: Event
Date/Time:
Actors involved: Radar operator
Embraer Legacy
Annotation: New York Times
Oct 28, 2006

quoting Crew lawyer Robert A. Torricella Jr.

supported by Factor 75

73 **ATC instruction supersedes flight plan**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Air Traffic Control at Sao Jose dos Campos Airport, Brazil
Annotation: New York Times
Oct 28, 2006

quoting Crew lawyer Roberto A. Torricella Jr.

generalised, following New York Times, Nov 21, 2006

74 **Boeing B737 CVR found**

Type of Factor: Event
Date/Time:
Actors involved:
Annotation: New York Times
Oct 28, 2006

75 **Legacy cleared by Tower Jose dos Campos for FL370**

Type of Factor: Event
Date/Time: 29.09.2006 15:11:00
Actors involved: Pilot of Embrear Legacy 600XL
Air Traffic Control at Sao Jose dos Campos Airport, Brazil
Annotation: AP report, IHT
Nov 02, 2006

quoting Brazilian newspaper "Folha"
"Folha" allegedly gained access to CVR transcript

confirmed by Brazilian Air Force preliminary report

76 **Legacy collides with Boeing B737**

Type of Factor: Event
Date/Time: 29.09.2006 16:57:00
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: New York Times
Nov 21, 2006

77 19 unsuccessful attempts to reach ATC Brasilia

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: New York Times
Nov 21, 2006

78 Boeing B737 flight plan called for FL410 at point of collision

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Annotation: New York Times
Nov 21, 2006

79 ATC Manaus instructed Boeing B737 to fly at FL370

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
AirTrafficControl Brasila (CINDACTA 1)
Annotation: New York Times
Nov 21, 2006

80 ATC believed the Legacy to fly at FL360

Type of Factor: State
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
AirTrafficControl Manaus
Embraer Legacy
Annotation: AP report, IHT
Dec 05, 2006

quoting Brig. Gen. Luiz Carlos da Silva Bueno

81 Possible Cause for (56)

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation: structural node

82 Avionics component has operational problems

Type of Factor: State
Date/Time:
Actors involved: Collision Avoidance System
Annotation: AP report, IHT
Apr 21, 2007

quoting ExcelAire report to Brazilian federal police

83 Avionics component returned to Honeywell

Type of Factor: Process
Date/Time:
Actors involved: Collision Avoidance System
Annotation: AP report, IHT
Apr 21, 2007

quoting ExcelAire report to Brazilian federal police

84 Honeywell returned avionics component to Embraer

Type of Factor: Process
Date/Time:
Actors involved: Collision Avoidance System
Annotation: Derived from 83 and 85

85 **Embraer installed avionics component**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: AP report, IHT
Apr 21, 2007

quoting ExcelAire report to Brazilian federal police

86 **One transponder and some radio communications systems installed in avionics component**

Type of Factor: State
Date/Time:
Actors involved: Collision Avoidance System
Annotation: AP report, IHT
Apr 21, 2007

quoting ExcelAire report to Brazilian federal police

87 **Cockpit systems do not effectively alert Legacy crew of anti-collision equipment failure**

Type of Factor: UnEvent
Date/Time:
Actors involved: Collision Avoidance System
Embraer Legacy
Annotation: IHT
May 03, 2007

quoting US air safety investigators

88 **Boeing unable to avoid collision**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation:

89 **Boeing crew has no visual identification of conflicting traffic**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Annotation:

90 **Legacy not advised to change altitude**

Type of Factor: UnEvent
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation:

91 **Boeing B737 spirals out of control**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation: Flight International
Oct 10-16, 2006

92 **Boeing B737 breaks up in mid-air**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation: Flight International
Oct 10-16, 2006

93 **Both aircraft on airway UZ6 in opposite directions**

Type of Factor: Process
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: Flight International
Oct 10-16, 2006

96 **Radar coverage limits at boarder between airspace sectors**

Type of Factor: Unspecified
Date/Time:
Actors involved:
Annotation: Flight International
Oct 10-16, 2006

97 **Notoriously unreliable radio communications in area of collision**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: Flight International
Oct 10-16, 2006

quoting local pilots

98 **Boeing B737 in contact with Manaus**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
AirTrafficControl Manaus
Annotation: Flight International
Oct 10-16, 2006

99 **Legacy technically under control of ATC Brasilia**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
Annotation: Flight International
Oct 10-16, 2006

100 **Controller Brasilia does not warn Legacy**

Type of Factor: UnEvent
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Embraer Legacy
Annotation: Splitted up Factor 54

101 **Controller Manaus did not warn Boeing B737**

Type of Factor: UnEvent
Date/Time:
Actors involved: AirTrafficControl Manaus
Boeing B737-800
Annotation: Splitted up Factor 54

102 **No handover of Legacy from Brasilia to Manaus**

Type of Factor: Assumption
Date/Time:
Actors involved: Embraer Legacy
AirTrafficControl Brasila (CINDACTA 1)
AirTrafficControl Manaus
Annotation: Needed factor for Factor 101

103 **Unknown cause**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation:

104 **Legacy winglet severed Boeing B737 hydraulic and electrical lines**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: Flight International
Oct. 17-23, 2006

105 **Legacy winglet compromised Boeing B737 left wing's aileron actuators**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: Flight International
Oct. 17-23, 2006

106 **Legacy winglet deforms Boeing B737 wing**

Type of Factor: Assumption
Date/Time:
Actors involved: Boeing B737-800
Embraer Legacy
Annotation: Flight International
Oct. 17-23, 2006

107 **Procedure to maintain current flight level "for a short time"**

Type of Factor: Process
Date/Time:
Actors involved: Embraer Legacy
Annotation: Flight International
Oct. 17-23, 2006

citing ICAO procedures for pilots under ATC control by radar, who are aware they have lost communication

108 **Legacy does not change altitude**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation: Derived from 64, 90, 107

109 **Boeing B737 does not take evasive action**

Type of Factor: UnEvent
Date/Time:
Actors involved: Boeing B737-800
Annotation: Flight International
Oct 21-27, 2006

110 **ATC Brasilia looses secondary radar information on Legacy**

Type of Factor: State
Date/Time: 29.09.2006 16:02:00
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Embraer Legacy
Annotation: Flight International
Oct 21-27, 2006

111 ATC Brasilia has lost primary radar contact with Legacy

Type of Factor: State
Date/Time: 29.09.2006 16:30:00
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Embraer Legacy
Annotation: Flight International
Oct 21-27, 2006

112 ATC Brasilia transmits blindly to Legacy

Type of Factor: Process
Date/Time: 29.09.2006 16:26:00
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Embraer Legacy
Annotation: Flight International
Oct 21-27, 2006

113 Secondary radar information trasmits altitude information

Type of Factor: State
Date/Time:
Actors involved:
Annotation:

115 ATC monitoring system automatically updates altitude information on controller's display

Type of Factor: Process
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

116 Lecagy passes waypoint Brasilia

Type of Factor: Event
Date/Time: 29.09.2006 15:56:00
Actors involved: Embraer Legacy
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

117 System "feature": Displayed altitude set to altitude given in flight plan after passing of waypoint

Type of Factor: State
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

118 Brazilian military 3-d primary radar provides flight altitude information

Type of Factor: State
Date/Time:
Actors involved:
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

119 Military Primary radar altitude information presented to civilian controllers

Type of Factor: State
Date/Time:
Actors involved:
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

120 **Military 3-D primary radar altitude information inacurrate**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

121 **Long-Range triangulation**

Type of Factor: Process
Date/Time:
Actors involved:
Annotation: Flight International
Dec. 05-11, 2006

quoting IFATCA

122 **Controller does not trust primary radar altitude information**

Type of Factor: Assumption
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Annotation:

123 **Legacy enters UZ6**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Annotation:

124 **UZ6 connects Manaus and Brasilia**

Type of Factor: State
Date/Time:
Actors involved:
Annotation:

125 **Boeing B737 uses UZ6**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Annotation:

126 **Legacy flightplan**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Annotation:

127 **Planned altitude change from FL370 to FL360 after passing waypoint Brasilia**

Type of Factor: State
Date/Time:
Actors involved:
Annotation: Flight International
Dec. 05-11, 2006

128 **Planned altitude change from FL360 to FL380 after passing TERES**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Annotation: Flight International
Oct. 17-23, 2005

129 **Legacy crew identifies TCAS failure**

Type of Factor: Event
Date/Time:
Actors involved: Embraer Legacy
Collision Avoidance System
Annotation: Flight International
May 8-14, 2007

130 **TCAS unit displays "TCAS OFF in small white letters on flight display**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Collision Avoidance System
Annotation: Flight International
May 8-14, 2007

131 **ATC shift change**

Type of Factor: Event
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Annotation: Flight International
May 8-14, 2007

132 **Controller's electronic flight strip showed Legacy as assigned to FL360**

Type of Factor: Event
Date/Time:
Actors involved: AirTrafficControl Brasila (CINDACTA 1)
Embraer Legacy
Annotation: Flight International
May 8-14, 2007

133 **Boeing B737 flightplan requested FL370 as cruise altitude**

Type of Factor: State
Date/Time:
Actors involved: Boeing B737-800
Annotation: NTSB Safety Recommendation
May 2, 2007

134 **No aural warning on TCAS failure**

Type of Factor: UnEvent
Date/Time:
Actors involved: Collision Avoidance System
Embraer Legacy
Annotation: NTSB Safety Recommendation
May 2, 2007

135 **Boeing B737 does not change altitude**

Type of Factor: Event
Date/Time:
Actors involved: Boeing B737-800
Annotation:

136 **Legacy maintains FL370**

Type of Factor: State
Date/Time:
Actors involved: Embraer Legacy
Annotation:

137 **Placing of Legacy crew feet might have disabled Legacy communication devices**

Type of Factor: Assumption
Date/Time:
Actors involved:
Annotation:

Actor List

GOL Flight 1907	Boeing B737-800
Embraer Legacy	Embraer Legacy
Radar operator	Radar operator
ATC Brasilia	AirTrafficControl Brasila (CINDACTA 1)
ATC Manaus	AirTrafficControl Manaus
TCAS System	Collision Avoidance System
Joseph Lepore	Pilot of Embrear Legacy 600XL
Sao Jose dos Campos Tower	Air Traffic Control at Sao Jose dos Campos Airport, Brazil