SYNTHESIS ON UNSTABILISED APPROACHES
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WARNING

This Synthesis was produced from data collected by the BEA during their inquiries into the following events. The events marked with an asterisk are described in the pages which follow:

- the accident of the 21st December 1987 at Bordeaux to an Embraer 120, registration F-GECH;
- the accident of the 20th January 1992 at Strasbourg to the Airbus A320 registration F-GGED;
- the serious incident of the 21st July 1993 at Santo Domingo airport with a B747-100, registration F-BPVF*;
- the serious incident of the 24th September 1994 at Paris Orly with an Airbus A310, registration YR-LCA;
- the accident of 30th June 1997 at Florence Airport to an ATR 42, registration F-GPYE;
- the serious incident of 23rd November 1997 at Paris Orly with an MD83, registration F-GRMC;
- the serious incident of 19th January 1998 at Montpellier Fréjorgues, with a CRJ-100 registration F-GLK*;
- the accident of 6th November 2002 at Luxembourg to a Fokker 50, registration LX-LGB*;
- the accident of 22nd June 2003 at Brest Guipavas to a CRJ-100 registration F-GRIS*;
- the serious incident of 21st March 2004 at Nantes, MD83 registration SU-BMF*.

In accordance with Annexe 13 of the International Convention on Civil Aviation, Directive 94/56/CE and with the Code of Civil Aviation (Book VII), the work of the BEA is not aimed at assigning blame or evaluating individual or collective responsibilities. Its sole aim is to draw lessons from events which can be used to prevent future accidents.

As a consequence, the use of this document for ends other than accident prevention could lead to erroneous interpretations being made.

The 5 Phases of the Approach Procedure

Incident with a 747-100 at Santo Domingo

Incident with a CRJ-100 at Montpellier

Accident involving a Fokker 50 at Luxembourg

Accident involving a CRJ-100 at Brest

Incident with an MD-83 at Nantes
The unstabilised approach can be described by a chronological chain of individual factors which can interfere with the crew's management of the flight (see diagram). There are two critical phases of note: the final segment, during which the aircraft closes with the ground with reduced obstacle clearance margins; and the go-around, which although it is a segment entirely separate from the approach, is not necessarily executed under conditions foreseen by the procedure designer.

**Arrival Preparation**
This phase allows the crew to define a joint plan of action and pre-activate the required information sources to manage possible unforeseen events which may occur during the approach. It is generally carried out at the end of the cruise. The crew define a strategy, notably by taking into account the environmental constraints (traffic management by ATC, meteorological information, design of the procedure etc.). What they do later is potentially affected by changes unforeseen at this stage.

**Initial Approach**
A change to the transition flight path (such as cancellation of a programmed hold, poorly interpreted meteorological phenomena etc.) or a change in the type of approach, whether decided by the crew (or by one of the crew members not challenged by the others) or by ATC, can upset the joint plan of action set up beforehand. These changes are generally accepted by the crew; poor communication can prevent them challenging it. The significant increase in rhythm which follows reduces the capacity of the crew to manage the continuation of the approach.

**Intermediate Approach**
Anything which happens during this phase to change the planned flight path has an especially marked impact if the crew have already been disrupted during the earlier phases. Among these events, has especially been noted the case of a non-functioning automatic intercept of the approach path, or a gap in operators' system knowledge – both flight crews and ATC controllers (automation, deceleration distances, with or without wind, in level flight or in the descent etc.). The crew can be affected by time pressure, felt keenly for instance while approaching the runway. Their flight management is altered, which can manifest itself by a delay in configuring the aircraft, its deceleration, etc. Extra pressure can be added if the intermediate segment is shortened or cancelled by ATC.

**Final Approach**
The events which occur during this phase manifest in different ways according to whether it is a visual approach, a non-precision approach, a Cat. I ILS or a Cat. II/ Cat. III ILS approach and according to what occurred during the previous approach phases. In terms of the type of descent manoeuvre to be performed, the determining factors include the crew's professional ability, knowledge of the aircraft's automation, crew co-ordination or even confidence in the crew's abilities or in each of its members.

**Go-Around**
The Go-Around is an effective safety barrier if it is executed in time. The decision to go-around depends on the crew's awareness of the situation. The go-around is one of the approach segments but in reality it may be flown outside the flight path defined by the chart. This introduces the difficulty for the crew of positioning the aircraft relative to the published flight path.

The 5 phases of the approach

1. Arrival Preparation
2. Initial Approach
3. Intermediate Approach
4. Final Approach
5. Go-Around
INCIDENT INVOLVING A B747-100 AT SANTO DOMINGO, 2ND JULY 1993 AT 19:56 UTC

Event: runway overrun following a visual approach and landing during a rain shower.

Flight Environment: this is a short day time stage, following a long haul flight from Paris Charles de Gaulle to Saint Martin which left at 9:15 UTC, with a flight duration of 08:13. Thunderstorm cells are present along the route. The runway is water contaminated, with the presence of rubber. The FO is the PF. The crew has received no CRM training. A single controller in the tower covers the approach, tower and ground frequencies.

First Change in the Plan of Action
ATC does not pass on any information about the reduction in measured visibility or the presence of CBs, nor the recent showers and thunderstorms at Santo Domingo.

The briefings do not cover the minimum stabilisation height (300 feet for a visual approach according to company rules). The preparation of a descent plan control card is not performed for the non-precision approach even though the approach chart only mentions the height at touchdown, there is no unstabilised or go-around callout.

Some uncertainty about the QFU remains.

Second Change in the Plan of Action
The Captain, familiar with the region, envisages a visual approach; the FO has prepared an instrument arrival. At this stage, the arrival briefing is considered finished.

Decision to Execute a Visual Approach
The crew want to maintain the freedom to manoeuvre during the descent to avoid thunderstorms and storms in the area.

The crew lower the gear before the flaps to descend more quickly.

The aircraft is now above the flight path, with air speed varying between 163 and 175kts.

The crew does not hear the information on the runway state, marked by the alarm.

The PF’s correction increases the deviation from the nominal descent path.

The Flight Engineer who terminates the Landing Checklist does not make the “500 feet” callout. There is no unstabilised or go-around callout.

The PF noted that the PAPI was locked below the approach flight path. Touchdown occurs at 147kts. The descending slope of the runway is more pronounced over the last 1000 metres. This information is not mentioned explicitly on the approach or aerodrome chart. 39 seconds expired between the wheels touching down and leaving the runway.

The normal landing configuration (flaps 30º) had become flaps 25º on some aircraft in the fleet. The crew had not yet received any training with this limitation. The flaps 30º configuration was still usable for safety reasons, such as landing on a short runway. The LDA at Santo Domingo for runway 17 is 3,350 metres.

Third Change in the Plan of Action
Switching off the autopilot increases the PF’s workload.
**Event:** runway overrun following an indirect circling approach.

**Flight Environment:** the landing occurs at night after an 18 minute flight and a 35 minute stop-over. It is the fourth and last stage of the day for the Captain and the second for the FO, who is PF. One controller in the tower covers the approach, tower and ground frequencies.

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**Preparation for the VOR DME 13 Left Approach**

During the previous arrival at Marseilles Provence, the crew listen to the ATIS (Mike) at Montpellier. The flight information file given to them during the stop-over contains the meteorological observations at 21:00H. The aircraft takes off at 22:44.

About 3 minutes after take off, the aircraft reaches FL80, its cruising altitude, headed for the FIR VOR. The Captain listens to the ATIS (November) which states: “Arrival procedure VOR DME 13 left, wind 140º, 26-32kts, visibility 10km, light rain, SCT1100, BKN 3000...”

The crew prepare the Landing Card: $V_{app}$ at flaps 45º is 125kts, i.e. $V_{app}$ of 195kts given the wind forecast. They start a standard briefing for the VOR DME 13 left approach.

**First Change in the Plan of Action**

The suggested procedure depends on information transmitted by an aircraft that voluntarily chose 31 right followed by a Circling Approach. Preparation by the crew for this approach is delayed.

There is no communication between the PF and the PNF regarding ATC’s suggestion, nor on accepting this new plan of action. One can note that the frequency is saturated.

The briefing carried out for the VOR DME 13 becomes obsolete. The briefing is not carried out again in accordance with the new information.

**Second Change in the Plan of Action**

The hold at ESPIG is cancelled and the crew commence an ILS approach. Their workload increases. The callout “Approach Checklist Complete” was omitted.

The feasibility of a visual manoeuvre is subject to the meteorological information transmitted by the crew of the preceding aircraft.

**Third Change in the Plan of Action**

The PNF, preoccupied with listening to the frequency, does not reply to the PF’s queries.

After having taken the joint decision to restrict the descent to 2000ft, the crew start the Circling Approach at about 6000 ft. The AMA for the Circling Approach is 780 ft.

The crew’s workload increases again when the autopilot is switched off. The pre-landing checklist is not performed.

Nacelle anti-ice was used. The Captain was able to think there might be a failure in the automatic anti-ice cut-off system when the thrust reversers were selected. They had been disarmed during the climb. The item “Thrust Reversers Armed” is in the landing checklist.

The latest METAR for Montpellier, 44 minutes before takeoff, notes the cloud base has fallen (SCT 1200 to 1000 ft).

The ATIS (November) recorded 48 minutes beforehand differs from the 22:04H METAR, in which the cloud base is at 1000ft (SCT). It also confirms an increase in wind compared to the ATIS (Mike) from 26 to 32kts.

Between 22:15 and 22:20, there was a squall at Montpellier Airport (1.8 to 2mm of rain). This was not reported in the observations transmitted to the crew.

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**Flight Environment:**

- **11th January 1998 at 23:03 local time**
- **Event:** runway overrun following an indirect circling approach.
- **Flight Environment:** landing occurs at night after an 18 minute flight and a 35 minute stop-over. It is the fourth and last stage of the day for the Captain and the second for the FO, who is PF. One controller in the tower covers the approach, tower and ground frequencies.

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Event: Emergency landing after double engine failure on final approach.

Flight Environment: At the end of a flight from Berlin to Luxembourg, the aircraft is directed to the hold at the DIK DVOR. The Captain is the PF. Before entering the hold, the crew are radar vectored for the ILS. Persistent fog covers the airfield. A single controller in the tower covers the tower and ground frequencies.

H – 15min: Vectoring towards the hold
The crew contact their operations department, who confirm that the visibility is below the Cat. II minima (300m) and that a diversion to Sarrebruck is envisaged. The controller asks the crew to enter the hold at the DIK DVOR at FL90. Speed is reduced to 160kts.

H – 7min: Vectoring towards finals
About 10nm before DIK, the controller clears a descent to 3000ft on QNH 1023, heading 130º. The captain calls operations again to find out the RVR.

At H - 4min, while the aircraft is passing through 6000ft, 13nm from the airfield, the controller gives an intercept heading of 220º, clears the crew for the 24 approach and then transfers them to the tower. The RVR is still below the Cat. II minima.

H – 3min: Start of Final Approach
The Captain asks the FO to warn the controller that if the RVR is less than 300m at ELU, they will go-around.

The crew start the pre-approach actions (setting up the instruments and the DH, instructions to the passengers, pressurisation etc.). They pay attention to the RVR information transmitted to other aircraft.

H – 1min: Decision to go-around
Six seconds before the FAP (ELU, situated 5.3nm from the threshold of 24) the FO starts the pre-approach checklist, which takes 23 seconds. Shortly after passing this beacon, the Captain decides unannounced to execute a go-around.

H – 45s: Re-continuation of the approach
Ten seconds after the Captain has decided to go around, the controller communicates the last RVR, which is 300 metres. The Captain decides to re-continue the approach. The aircraft is at a height of 1786ft, at a distance from the threshold of about 4nm and at an airspeed of 155kts in a clean configuration.

H – 42s: Propellers enter Beta Mode
The captain retards the throttle levers, down to the flight-idle stop (the throttle levers therefore depend on the secondary safety system) and then puts the aircraft into the descent. The FO suggests lowering the flaps and then the gear. While the gear is lowering, the secondary safety-device fails and the throttle levers retard further. The propellers enter Beta mode. The violent increase in drag makes the aircraft uncontrollable. The crew shut down both engines before carrying out an emergency landing.

Change in the Controller’s Strategy
Airspace constraints limit the number of aircraft in the hold. The crew are dubious about the controller’s strategy and the feasibility of landing.

The FO remarks that the controller has let them go ahead of other aircraft. The priority given to them in the absence of the required RVR puts pressure on the crew.

The message is not transmitted. The operator, with more restrictive rules than the official limits, requires its crews not to start final approach if the RVR is not met by the FAP. One can note that a hold is possible at ELU but was not envisaged given the number of aircraft on approach. The crew accelerate their actions to conform with the controller’s approach clearance. The distribution of tasks does not follow the operator’s Cat II Procedures.

The ELU beacon was passed 10 seconds ago. This go-around is not followed by a change in either flight path or in configuration.

Change of Plan by the Captain
The communication from the controller whom the crew had informed of their minima sets off this decision. There is no Outer Marker or equivalent on this approach and the height between the start of final descent and the threshold is less than 2000ft.

A malfunction in the anti-skid box, caused by the gear deployment signal, removes the secondary safety system which in flight prevents the propellers entering the ground range from flight idle.

The failure of the system locking the secondary stop-pin was not known to the pilot. It had been mentioned by the manufacturer but had not been widely communicated to the crews.
ACCIDENT TO A CRJ-100 AT BREST, 22nd JUNE 2003 AT 23:51 LOCAL TIME

Event: Collision with the ground after a go-around from the DA (DH).

Flight Environment: The crew is returning to their base during the fourth and last stage (15min) after a stop-over of 18 minutes. The flight for the calculated landing weight is 132kts.

The aircraft is not equipped with Cat. III or Cat. IV approaches at night. The Captain is the PF. On the ground the FO is a simulator instructor (SFI). Cumulonimbus clouds are present along the route and the crew is surprised by fog on arrival. Cat. II and Cat. III approaches are suspended for maintenance work. A single controller in the tower covers the approach, tower and ground frequencies.

1. From H + 1 hour to H + 4 min: Flight Preparation
   When the crew leave Nantes at 21:09, the 20:00 TAF given to them does not mention the fog at the destination.

2. H + 5 min: Listening to the ATIS and Arrival Preparation
   During the climb, the PNF listens to the 21:00 ATIS (Tango) and says to the PF: “2125 left, visibility 800, fog, broken at 200 with CBs above, 10,000”. In the cruise at FL220, the crew ask the controller for permission to avoid cumulonimbus clouds.

3. H + 12 min: Heading towards BODIL and Hold Expected at GU
   The approach controller tells the crew to expect a circuit in the hold at GU. The crew set up the FMS for the hold. They engage LNAV mode on the FMS, heading towards BODIL. As the aircraft is crossing the descent path controlled by the autopilot, the wind makes the aircraft deviate towards the south of the centreline without the crew realising.

4. H + 5 min: Hold Cancelled
   The controller announces: “Previous aircraft has landed, continue the approach, report the Outer Marker”. The PNF replies: “will report Outer Marker, continuing on approach path.” The controller does not receive this message.

5. As the aircraft is on the localiser path without the autopilot capturing it, the PNF asks for permission to engage theCat. II approach. The FO replies that it is not authorised.

6. H + 1 min: Start of Final Descent
   The crew get ready to perform the holding circuit programmed into the FMS. The Captain tells the air hostess than they are expecting a circuit in the hold.

The fog is covering the ground again. The ground controller tells the crew to expect a circuit in the hold at the destination.

The go-around altitude is identical to that of the aircraft in the previous approach. The wind continues to deviate and crosses the Outer Marker at 2000ft QNH. The crew get ready to perform the holding circuit programmed into the FMS. The Captain tells the air hostess than they are expecting a circuit in the hold.

The 21:00 TAF (9 minutes before block departure and 15 minutes before take-off) does mention the fog. This information was not given to the crew.

The ATIS also mentions that the Cat. II ILS is out of service. Cockpit communication is inefﬁent during this phase of nearly 15 minutes and are practically all about avoiding CBs. Another aircraft in contact with Brest Approach carries out an arrival via BODIL and is cleared for the ILS 26.

The crew expect a straight-in approach.

First change in the Plan of Action
The crew got ready to perform the holding circuit programmed into the FMS. The Captain tells the air hostess than they are expecting a circuit in the hold.

The ground controller tells the crew to expect a circuit in the hold. The glideslope interception altitude on a straight-in approach is 3000ft QNH.

Second change in the Plan of Action
This phase could have inﬂuenced the crew: it does not imply that the decision is up to them, contrary to the format “cleared for the approach”. This late and unexpected change in clearance is accepted implicitly by the pilots.

During the next 25 seconds, the crew’s workload is increased signiﬁcantly: deactivation, conﬁguring the aircraft and starting descent, selection of Autopilot/Flight Director modes, limiting their availability. The fact they have a hold programmed into the FMS and are in LNAV mode increases their work load.

APP mode was never activated. No reading of the mode annunciator panel was heard.

The controller also continues to communicate with the aircraft that is on the ground.

The wind makes the aircraft deviate towards the south of the centreline without the crew realising. The glideslope active callout is not made.

During an approach in difficult meteorological conditions, excessive radio-communications can distract the crew.

The fact that the go-around altitude is identical to that of the aircraft in level ﬂight did not facilitate the engagement of VS mode.

The two pilots seem to concentrate their attention on managing the vertical path without detecting the lateral deviation.

Final approach beyond the deviation limits
The criteria for engaging APP mode are not met, since the aircraft is outside the localiser beam where the autopilot can capture it. This callout could have helped the crew become aware of their situation. The operator had not chosen the option for a “1000’’ callout on the CPWS.

In addition the operator’s procedures did not link the callout “1000 feet” by the CPWS with the notion of minimum stabilisation height.

The speed decreases to 120kts (i.e., Vfe = 121kts). The aircraft is not equipped with an automatic speed maintenance system.

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INCIDENT INVOLVING AN MD83 AT NANTES, 21ST MARCH 2004 AT 02.28H LOCAL TIME

Event: Go-around during VOR DME approach outside the flight protection envelope.

Flight Environment: This is the second stage out of the four planned. The aircraft, arriving from Luxor 16 hours late, is the only traffic in the airport vicinity. Stratocumulus clouds with a 500–900ft cloud base associated with a warm front are covering the area and producing heavy drizzle. The wind is from 260º at 20-26kts and the visibility is 4km. The FO is the PF. The pilots are carrying out this approach for the first time. The crew has not received any CRM training. A single controller in the tower covers the approach, tower and ground frequencies.

1. Shortening the Transition Flight Path
After listening to the ATIS, the crew prepares for the VOR DME approach to runway 21. The aircraft is directed by the controller directly to ABLAN, situated 3nm after the IAF. The crew are then “cleared final”. The Captain reads it back and adds that he “will leave 3000ft for 500ft established”. The intercept angle with the approach path is 107º.

2. Interception using the Autopilot
On engaging VOR/LOC mode, the aircraft executes a turn and positions itself parallel to the approach path, offset to the left. In the space of 20 seconds, the crew announce that they are aligned, realise they are to the left of the extended centreline (223º), enter HDG SEL mode to get back on the approach path with a heading of 250º, receive landing clearance and commence final descent in VS mode about 0.5nm before the FAF.

3. Interception using the Autopilot
When the aircraft meets the approach path, the captain asks the PF to maintain the heading to avoid an area of red echoes close to the final approach path which appear on the weather radar. The aircraft crosses the approach path.
The crew experience meteorological phenomena (turbulence, strong wind, precipitation) and give a large part of their attention to the weather radar. The descent continues at a rate of between 700 and 1000 ft/min. The aircraft is heading into a wind increasing in strength. This combination of factors drives the aircraft well below the nominal approach profile.

4. Return towards the Approach Path.
At 6D from NTS, the aircraft is situated at about 500ft QNH. The controller had not envisaged keeping watch on the flight path during the final approach with a heading of 250º, receive landing clearance and commence final descent in VS mode about 0.5nm before the FAF.

5. Decision to Go Around.
In coming out of the turn which brings them back towards the final approach path, the aircraft comes out of the layer of cloud about 400ft above the ground and the Captain becomes aware of the anomalous situation. That is when he initiates the go-around.

A single controller in the tower covers the approach, tower and ground frequencies.

ATC Practices

For environmental reasons, the published transition path specifies a DME arc at 15nm. The ATC controllers had got into the habit of directing aircraft directly to an intermediate point without for all that it being under radar control. During first contact with the pilot the controller felt relatively confident, given the quality of the phraseology and the English used. He did not doubt the ability of the aircraft to intercept the approach path automatically, and was not alerted to the intentions of the crew by the Captain’s read back.

This announcement by the crew that they were aligned prompts the landing clearance from the controller which, in turn, appears to initiate the start of the descent. The crew’s workload increases dramatically. The controller was thinking to help the pilot by giving some of his clearances early.

Leaving the protection margins

The PF is distracted by this request. The observed echoes are ground echoes from high-rise buildings below the approach path and not from thunderstorm activity. The tired crew perceive the meteorological conditions they encounter as confirmation of a thunderstorm. The altitude of 500ft corresponds to the MDA and the lowest altitude the Captain had set for level flight up to the MAP. Altitude must be greater than 1730ft between 9D and 5D.

The controller had not envisaged keeping watch on the flight path before finals.

The management of the approach and the communication difficulties between the crew members did not allow them to identify the excessive flight path deviations, which should have led them to break off the approach earlier.

ATC: “Proceed direct to ABLAN, situated 3nm after the IAF. The Captain reads it back and adds that he “will leave 3000ft for 500ft established”. The intercept angle with the approach path is 107º.”

The Minimum Descent Altitude (MDA) is defined in two different ways:

- USA: the lowest altitude, expressed in feet above mean sea level, to which descent is authorised on final approach during an instrument approach procedure without a glideslope.

- ICAO: altitude specified in a non-precision approach or visual manoeuvre below which descent may not be made without visual reference.