

## FROM LANDING COMPULSION TO CONTROLLED FLIGHT INTO TERRAIN. WHAT PILOTS NEED TO KNOW

(a cura di Aldo Pezzopane)

Il sentiero di volo che percorre un aeromobile dal termine della fase di crociera al punto di contatto con la pista dell'aeroporto dove l'equipaggio intende atterrare, ha una configurazione geometrica ottimale. Le caratteristiche di questa traiettoria [pendenza e velocità] devono garantire la sicurezza dell'operazione, la fluidità di progresso dell'aeromobile in sintonia con il traffico e [ma questa deve essere una conseguenza e non un obiettivo] una ragionevole economia in termini di bilanciamento tra esigenze di orario e consumo di carburante.

Scostamenti macroscopici da questa traiettoria sono il primo avviso che il pilota deve aumentare la sua concentrazione sulla condotta per recuperare la corretta configurazione di traiettoria. La percezione della posizione spaziale in relazione a questa traiettoria virtuale è fondamentale e distrazione, disorientamento, perdita del quadro, sono stati, nella maggior parte dei casi, l'innescò dell'abbandono della traiettoria corretta, terminato con eventi finali accidentali o catastrofici. Le uscite di pista e gli impatti al suolo con velivolo controllabile [Controlled Flight Into Terrain]. Quelli che vi proponiamo sono elementi di riflessione sui fattori di queste due tipologie di eventi. L'industria aeronautica propone un continuo e pressante progresso tecnologico ma i problemi che vengono incontrati in volo dai piloti sono sempre gli stessi, come indicano diversi incidenti accaduti anche recentemente. Per questo appare quanto mai attuale il contenuto dell'intervento effettuato dal Comandante Homer Mouden ad un seminario internazionale della Flight Safety Foundation, tenutosi in Canada oltre vent'anni or sono e frequentemente ripreso e riproposto nei Bulletins della stessa Foundation per molti anni a seguire.

L'analisi di Mouden è diventata un "pezzo" storico per la sua completezza e per l'equilibrio delle sue considerazioni. Ogni pilota di linea che abbia incontrato situazioni analoghe a quelle descritte non può non venire catturato dalle argomentazioni e dallo stile chiaro, pragmatico di Mouden e leggerlo tutto d'un fiato.

### **LANDING COMPULSION**

**by Captain L.Homer Mouden - Manager, Flight Safety - Eastern Air Lines (1978)**

When each of us boarded a flight to come to this seminar assumed that the aircraft would land at the Ottawa International Airport. That was the whole purpose of the flight. If, during a seemingly routine approach, the engine suddenly surged and airplane rotated for a pull-up, every passenger in the cabin would have responded, some with apprehension and others with annoyance. Strangely enough, very few reactions would have been relief. If the go-around resulted in having to go to an alternate with the usual inconvenience, no matter how mild, very, very few of the passengers reactions would have been free of irritation.

A pilot, who encountered a severe wind shear condition while on approach, successfully executed a go-around and then proceeded to his alternate. While deplaning at their alternate airport, several passengers chastized the captain for making them ride a bus from there. Why does this occur? Maybe airline landing reliability has preconditioned the passengers to consider anything other than routine arrival at their intended destination as unacceptable.

Of more than academic interest is the question as to whether such factors influence a pilot's judgment when suddenly faced with a decision to land or to go-around. What are some of the factors that, subtly or otherwise, influence a pilot's judgement? Impact on the flow of air traffic is certainly one of them.

At the busier airports in our present Airways Traffic Control system, a go-around affects much more than just that aircraft. The system itself is basically geared to the anticipation of a landing from each approach. The spacing, of following aircraft,

and the departure from feed-in points, are all immediately affected as soon as an approach is not completed to a landing. It is difficult for a controller, who has observed several hundred consecutive landings without a single go-around, to keep mentally oriented for an incompleting one on every approach. A pilot making 50 to 60 landings at 10 to 15 different airports, month after month, without experiencing a go-around, may become pre-conditioned to expecting all approaches to terminate in successful landings. The last go-around that many pilots made was from a point half a mile or more out on the final approach when some aircraft failed to clear the runway as soon as had been anticipated.

Other factors that may affect a pilot's decision are fuel awareness, passenger inconvenience, and the effect on schedules. **But the human factors are the ones that exert the most pressures on a pilot's judgment.** Perhaps of all the human factors the most subtle and yet the most insidious are **pride, complacency** and **unawareness**. Everyone is affected by these to varying degrees in every action he takes or every judgement he makes. Personal pride can have a contributing or detracting impact on our actions or judgments. Each of us needs to constantly reevaluate those things in which we take particular pride to see if that personal pride is valid or vain.

During a pilots' meeting some 35 years ago, a senior pilot stated with some considerable pride, "I haven't missed an approach during the last four and a half years". When I heard this I recalled three approaches that he had missed during the last three winter months while I was flying as his copilot - only we had landed each time! Under the same criteria, I'm sure that every one of us who has flown an airplane has also missed an approach out of which he has landed. And I suspect also, that each of us has secretly wished afterward, that he had gone around on some of them. The vast majority of us were successful at that specific time by virtue of some luck, and perhaps, some skill, rather than good judgment. An old military axiom which says, **"Use your good judgment to avoid situations that require you to demonstrate your superior skill"** has been adapted to modern aviation. At no time is it more applicable than during the final approach.

What are the factors which cause a pilot to continue an approach to land when his subsequent evaluation of his own flight tells him that he should have gone around? Obviously, there never is a single, simple answer any more than there is a single contributing factor to most aircraft incidents or accidents. Neither is there any way to determine the number of flights which landed successfully, but where good judgment would have dictated a go-around. The U.S. airlines complete 4,000,000 landings a year and yet, if only one attempted landing ended in an accident, which could have been avoided by a go-around, the ratio is too high.

That captain who 35 years ago had not missed an approach in four and a half years was flying an airplane with an approach speed of 70 mph that could normally be stopped without difficulty within 1,500 feet from the touchdown point. The minimum ceiling for an approach from the low frequency range was 400 feet. He had 40 seconds and 8/10 of a mile for manoeuvring after breaking out of the cloud base. However, there was no precise directional or vertical guidance, so the primary reason for not being able to land when weather was a factor in those days was the inability to fly on instruments with precision from the low frequency range to the point at which visual contact at minimum ceiling limitations would permit visual alignment for the landing.

Today, a captain making a routine CATII ILS approach to a 100 foot decision height at 140 knots will have only five to eight seconds (11 to 13 seconds to touchdown) from the decision height to the runway in which to analyze and evaluate all factors while covering another 240 feet each second. This in itself is a major contributing

factor to a recognized tendency for pilots to continue to a landing from situations which might subsequently be evaluated as having justified abandoning the approach and making a second attempt.

Even the interpretation of the decision height itself has been a significant contributing factor to this tendency to continue the approach. Part 1 of the U.S.

Federal Air Regulations defines decision height as follows:

Decision height, with respect to the operation of aircraft means a height at which a decision must be made, during an ILS or PAR instrument approach, to either continue the approach or to execute a missed approach.

Since the definition identifies decision height as "...the height at which a decision must be made...", and since neither the human thought process of the pilot nor the response time of the aircraft are instantaneous, the continuation of the landing procedure, even under marginal conditions, may seem more feasible at the time than the execution of a go-around from that particular situation. Even Newton's First Law of Motion, that "an object continues in a uniform straight line unless affected by some outside force", seems easiest to cope with until that external force is about to become the ground.

The definition and physical identification of the decision height has become a subject of considerable controversy. Over ten years ago, Mr. Joseph Ferrarese, then Chief of the FAA's Operations Division, attempted to clarify this in a paper presented at the SAE - National Aeronautics Meeting and Production Forum in which he stated:

"...decision height is the limit to which a pilot may descend before deciding to continue his approach to a landing by means of visual aids and cues, or to execute a missed approach...This is not to say that the pilot waits until he arrives at the decision height before deciding to land or to go-around. The decision making process begins at the time the ILS approach is initiated and continues while the approach is in progress... It therefore becomes evident that while the decision height is an exact point in space at which the pilot makes an operational decision, the information he requires to make this decision has been accumulating for a considerable time, and it would be incorrect to assume that all aspects, of this decision must be formulated and assessed at one critical instant on the approach". There are two factors in this decision-making that merit further consideration. One involves the "visual aids and cues" that the pilot acquires during the last few critical seconds of the approach. These require almost instantaneous analysis and evaluation while he is making the decision to continue an approach to a landing or to execute a go-around. The other factor involves the acquisition of timely information. This is one of the recognized major problems, particularly during rapidly-changing weather conditions. Inaccurate, delayed or absent information can have a significant impact on a pilot's ongoing evaluation of a situation.

What we are really talking about is adequate communication. If a subsequent evaluation of an unsuccessful landing indicates that a go-around would have been a preferred manoeuvre, it would also indicate that somewhere prior to that landing there may have been a break in the informational loop which caused the pilot to make the incorrect decision, i.e., communications breakdown, or, it may have been one of those other factors which we previously mentioned, such as deviation from established procedures, failure to compensate for external forces, or more particularly, failure to recognize the situation.

While all of this may sound as though we are, making excuses for the pilots, it really is for the purpose of putting in focus the fact that during an approach to land with a modern jet airplane, the pilot - a human being - is physically manoeuvring or monitoring a vehicle traversing the airspace at about 230 feet per second while the ground is rushing up to meet him at a rate in excess of 10 feet per second. As all this is going on, the human computer, the brain, is having to process all the bits of information, evaluate their impact on the situation and produce a print-out called

"pilot decision".

Psychologists tell us that the process of making decisions creates stress within the individual but once a decision has been made, there is a definite feeling of relief. Thus, even if that decision subsequently is determined to have been a wrong one, there may be a tendency to stay with it regardless of the consequences. We are not talking about the individual who deliberately ignores his own good judgment for some overriding reason which at the time seems to justify the risk involved. We are discussing the influencing factors which affect the individual's decision-making process.

Factors which assist in the making of good decisions are time and accurate information. A more effective decision-making process can take place if the maximum amount of useful information has been provided with sufficient time to assimilate, evaluate and act upon it. When Joe Ferrarese stated, "...information a pilot requires to make an operational decision has been accumulating for a considerable time...", he recognized that adequate communication is fundamental to assuring that the required information for making a correct operational decision is available. This is equally true relative to those operational decisions controllers must make. The supplying of real-time information, which cannot be misunderstood, continues to be one of the major problems facing the aviation industry. Nowhere is such information more essential than during an approach under marginal or rapidly-changing meteorological conditions.

There are enough accidents and incidents each year to indicate that the failure to go-around from some approaches being made under the marginal or unknown weather conditions is a continuing problem. But what can we do about it? Is the compulsion to land a realistic problem? Perhaps it would be more realistic to consider it as a normal human reaction to a particular situation. Then, if we agree that there are many landings made or attempted that should have been go-arounds, and I believe that everyone including the pilots will concede this, we must determine the basic as well as the specific reason for this.

Bob Burgin presented a most thought-provoking paper last year. I was in complete agreement with it except for two things, the title, "The Missed Approach" (Review 3/4 1977), and the many references to the terminology "missed approach". You may recall that the term "landing expectancy" was defined and discussed from the pilots' and the controllers' viewpoints but all references to incompleting or non-landings were referred to as "missed approaches".

The connotation of "missing" includes failure or inferior performance! Webster's Collegiate Dictionary defines miss as "to fail to hit, reach, or contact; to fail to obtain; to discover or feel the absence of" - all negative concepts with a connotation of non-performance or inferior achievement. Psychologically, we are using the wrong terminology when we refer to "missed approach". Were you ever duck or goose hunting with a friend when both had an opportunity for a good shot? He made a clean kill while you watched one lonesome feather drift down. Do you remember your feeling of frustration, chagrin and perhaps even some bit of anger as with scarcely concealed glee, he asked, "You missed that shot?" The implied failure to achieve was all tied up in that one word "missed".

Incidentally, the aviation industry has also, unintentionally, contributed to another psychological impact on pilots through the adoption and use of the term "nonprecision approach". All too many pilots have been influenced by this terminology into flying an approach, without the benefit of electronic vertical guidance, with a lesser degree of precision than they would when making an ILS approach. **Even though a "nonprecision" approach usually has higher minimums, it requires a much more precise control of the aircraft and a higher degree of pilot concentration than when flying a straight-in ILS approach.**

Every despotic ruler knows the psychological impact on the minds of people through the use of terms to which a different meaning has been applied. Thus, a "Democratic Republic" might actually be very dictatorial in structure. And many of us are being subtly preconditioned to the acceptance or belief in the validity of "giant size" boxes of soap or cereal, or "super savings" sales of items that are marked down only from the price to which they were raised last month. We should be very careful about the misuse of mind-influencing words. I am convinced that the aviation industry has contributed to this problem.

Recently the Chairman of the National Transportation Safety Board in the United States sent an open letter to the presidents of forty-two U. S. air carriers. One of the points discussed was The Prudence of a Missed Approach. In summarizing the discussion on this subject, he concluded with "Management should insure that the pilot understands that the missed approach manoeuvre is a legitimate manoeuvre under such conditions". Actually, his discussion dealt with the same subject we have been discussing previously - the inability of the pilot to continue the approach to a landing for reasons which may or may not have been within his control.

It is estimated that we are flying in excess of four million instrument approaches each year throughout the world. During the last ten years, in just the United States alone, almost eighteen million approaches have been made at ATC controlled airports. But it has been impossible to obtain a reasonably accurate estimate of the number of those approaches in which weather was a factor, that have not been continued to a landing.

The FAA conducted a survey during the first three months of 1974 of the number of "missed approaches" compared to the number of operations under Instrument Flight Rules that were reported. Since most turbojet aircraft are operated under IFR procedures, irrespective of the meteorological conditions, there was no way to determine in how many of these go-arounds weather was a factor. The available results of the survey also did not identify which were general aviation or air carrier approaches or go-arounds.

The statistics of the rather incomplete survey indicated that 1.7% of all reported approaches resulted in pilot-initiated go-arounds. When this percentage factor was applied to Chicago O'Hare's 273,000 arrivals during that year, it would have meant that almost 5,000 flights had gone around. However, since this same 1.7% in the survey also included all go-around initiated by pilots irrespective of the reasons, the statistics did not identify the issue being explored, namely, those situations in which weather was the contributing factor to the pilot's decision to go-around. A personal survey was then conducted among pilots on one airline as to the number of "missed approaches" because of weather that they could recall. They were queried as to how many of these were within the past year, five years and ten years. Each was also asked for his total airline hours and for all estimate of the total number of landings he had made during that time. Of some one hundred pilots questioned, very few would even attempt an estimate of their number of landings, but over 80% felt reasonably confident that they could recall the number of times they were unable to land because of weather after having made an approach. By dividing the average duration of each flight segment on this airline into the pilot's total airline flying hours, a rough estimate of his total landings was obtained. Even after arbitrarily applying a factor of two - since we recognize the fallibility of the human mind - the ratio of abandoned approaches to total landings ranged from one per fifteen hundred to one per four thousand. The average of all these came to slightly less than one in twenty-six hundred.

Before this survey was completed, it became readily apparent that the infrequency of incompleting landings from an approach was one of the major reasons why pilots and controllers became preconditioned to a landing expectancy. Another interesting

aspect of this survey was that over 70% of the pilots placed a majority of these incompleting approaches as having occurred during the first half of their airline career. No attempt has been made to rationalize whether this is the result of more landing aids, better weather information, a change in the pilot's confidence in his own capabilities or whether the traumatic impact of the first few occurrences left a more vivid impression.

Irrespective of the relative infrequency of completed landings, the statistics of accidents/incidents following a final approach are higher than the aviation industry can continue to accept. Therefore, the real issue is, what can be done to reduce the number of unsuccessful landings following an approach? Some actions which could improve the accident/incident ratio include:

Provide the pilot with real-time accurate wind and weather information throughout the approach to landing.

Install full electronic and visual guidance to all runways.

Develop aircraft and engines that eliminate the necessity for unrealistic noise-abatement procedures which require operation of the aircraft outside parameters for which it was designed.

Improve ATC's capability for expeditiously handling a flight whenever a final approach is not continued to a landing.

Eliminate the connotation of inferior achievement by pilots whenever an approach does not result in a landing, by:

- **discontinuing the use of the terminology "missed approach",**
- **accelerating co-operative education of pilot to recognize that going around from a discontinued approach is a fundamental part of the approach procedure itself, and not an indication of failure.**
- **insuring that pilots include the go-around potential as a part of every approach irrespective of known weather conditions.**
- **insuring that the ATC personnel and system include the possibility of a go-around in every approach clearance.**

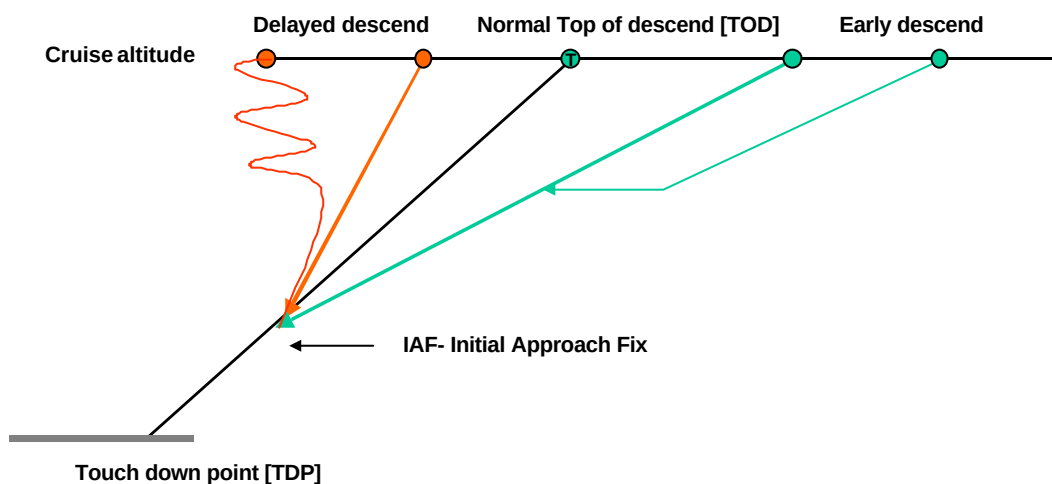
Anticipate the necessity for and provide a continuing and updated educational programme for pilots, ATC controllers and weather personnel on all pertinent aspects of the preceding activities.

The very purpose of each flight is to safely and expeditiously complete a landing at its destination. No one can be more interested in the successful achievement of this goal than the pilots. The entire commercial aviation system must be co-ordinated to help them accomplish this. But during the final phase of each flight the pilots are charged with the responsibility and authority for determining that this approach can be completed to a safe landing; if not, they must go around! We must insure that all pilots are motivated to be mentally and physically prepared for the possibility of going around from every approach, and particularly during those approaches under reduced instrument meteorological conditions.

If a go-around occurs in less than one out of every thousand successful landings, it is hard to remain motivated to such an expectation. The entire aviation system must recognize this and provide the maximum capabilities in real time weather information, expedited re-entry procedures into the final approach pattern, and a co-ordinated programme for keeping the pilots aware of the go-around potential. The goal should not be to abandon a greater percentage of the approaches. Rather, all segments of the industry should be working toward eliminating the necessity for ever going around; but with pilots, controllers and passengers recognizing that the possibility of a go-around is a fundamental part of every approach, for the purpose of every flight is to land safely and successfully at its destination.

Anche se l'analisi di Homer Mouden verte principalmente sull'interruzione dell'avvicinamento in condizioni meteorologiche marginali, le considerazioni sulla difficoltà riscontrata nei piloti ad attuare una opportuna riattaccata, un "go-around", sono applicabili totalmente agli avvicinamenti "non stabilizzati". Per i lettori con meno familiarità con il gergo aeronautico precisiamo che un avvicinamento non è stabilizzato quando l'aeromobile, che si trovi a poche miglia dal contatto con la pista, in genere due o tre minuti prima, non ha la configurazione prevista [carrello esteso e flap estesi come richiesto], non è nel campo di velocità richiesto [dal peso attuale, dalle condizioni di vento, ecc.] e non è su una traiettoria di discesa coerente con il sentiero di avvicinamento [rilevabile dagli strumenti] che generalmente è intorno a  $3^\circ$ , una pendenza del 5%.

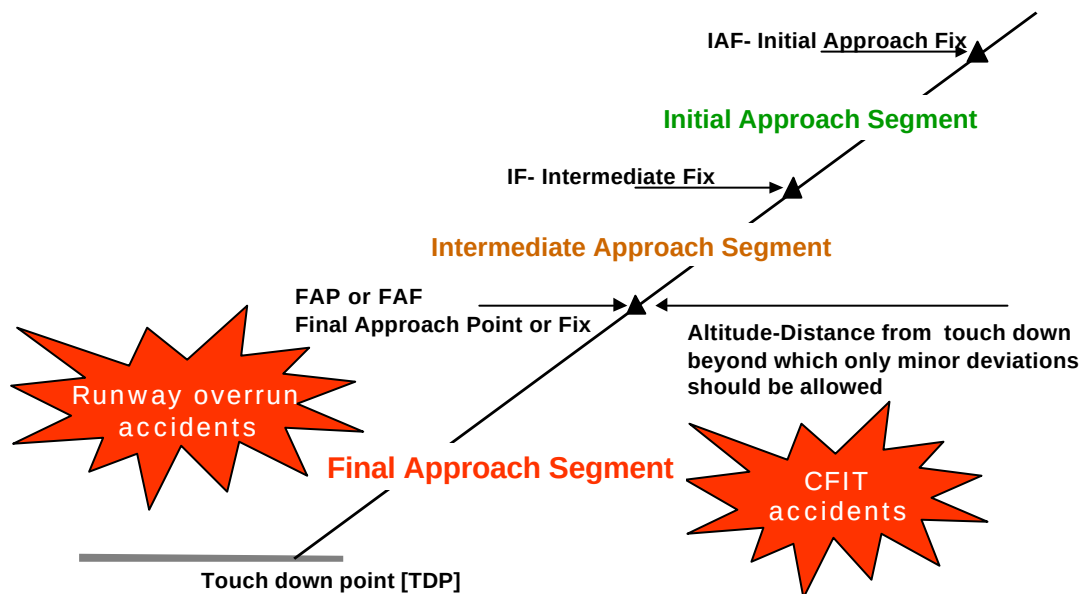
Per i piloti proponiamo una visualizzazione molto schematica delle condizioni che possono predisporre ad avvicinamenti destabilizzati o che evidenziano errori di pianificazione nella discesa. Questa visualizzazione è sostanzialmente acquisita da qualsiasi professionista consolidato e, a grandi linee, rappresenta una raffigurazione delle modalità di attuazione dell'avvicinamento alla pista di atterraggio da parte del pilota.



La linea che va dal punto di normale inizio discesa [TOD] al punto di contatto in pista [TDP] ha una pendenza che corrisponde, per la parte iniziale, ad un rapporto di **uno a tre**, tra la quota [in migliaia di piedi] e la distanza [in miglia nautiche] dalla pista con l'aggiunta di una decina di miglia per la decelerazione. In altre parole da 31.000 ft di altitudine di crociera la discesa deve essere iniziata intorno alle 100-110 miglia nautiche dall'aeroporto. Peso dell'aeromobile, componente di vento, uso di impianti antighiaccio e altri fattori comportano variazioni intorno a quest'ordine di grandezza di distanza in rapporto alla quota.

Discese iniziate molto prima per ragioni di traffico aereo possono essere effettuate su pendenze inferiori o richiedere livellamenti intermedi mentre discese iniziate in ritardo possono essere corrette con l'uso di aerofreni o, se non è possibile effettuare un

percorso diretto, richiedono delle circuitazioni per perdere quota. In ogni caso, al di là di una certa posizione spaziale che dovrebbe coincidere con un punto preciso della segmentazione d'avvicinamento [in genere la transizione tra segmento di avvicinamento iniziale e segmento di avvicinamento intermedio], non devono esistere deviazioni significative di configurazione e di velocità. Questo avviene fino alla intercettazione del sentiero di discesa di 3° [Final Approach Point] sul quale l'aeromobile dovrebbe procedere come se fosse su dei binari. Ovviamente l'operazione di avvicinamento alla pista non è semplice come questa schematizzazione potrebbe far credere. Le condizioni meteorologiche [windshear, turbolenza, forte precipitazione] ed il conseguente stato della pista [ristagno d'acqua e varie altre amenità come i depositi di gomma] rendono il quadro alquanto complesso e stressante per il pilota e possono rendere estremamente difficile stare sui "binari". A questo riguardo il discorso di Homer Mouden si coniuga perfettamente con l'articolo di J.S.Clauzel già presentato su questo sito: [Documento: Awareness of stresses associated with approaches and landings under marginal conditions - J.S. Clauzel \(english\)](#)



Questo è un ampliamento grafico della precedente illustrazione che comprende i segmenti di avvicinamento.

Esso ci permette di indicare l'area a sinistra della pendenza ideale come zona favorevole alle uscite di pista, dato che gli incidenti di questo tipo sono stati il risultato, quasi nella totalità, di un percorso in volo con caratteristiche di ritardo nella discesa e nelle azioni di rallentamento ed assunzione di configurazione.

La zona a destra, invece, anche se non identifica un "avvicinamento non stabilizzato", indica spesso, nel caso di perdurare della condizione di deviazione dalla traiettoria, una vera e propria mancanza di consapevolezza della posizione da parte del pilota.

Ovviamente avviene in condizioni strumentali o di notte, dopo un avvicinamento iniziale "flat" o "shallow" ed è dovuta a molteplici fattori ampiamente individuati in anni di

investigazioni ed analisi degli "accident" denominati CFIT [Controlled Flight Into Terrain] Abbiamo già parlato di questo tipo di eventi che nel passato hanno funestato anche le compagnie nazionali. Tipico, nel ricordo di molti che sono ancora oggi in attività, il disastro del DC9 avvenuto durante l'avvicinamento a Kloten (Zurigo) e ultimo della serie il disastro dell'ATR42 a Pristina.

Ecco alcune interessanti considerazioni in merito espresse in un voluminoso report su questi eventi realizzato dalla Flight Safety Foundation.

## **CFIT factors**

### **Flight Crew Complacency**

Complacency can be defined as self-satisfaction, smugness, or contentment. You can understand why, after years in the same flight deck, on the same route structure to the same destinations, a flight crew could become content, smug, or selfsatisfied. Add to this equation a modern flightdeck with a well -functioning autopilot, and you have the formula for complacency.

Here is an example of flight crew complacency. The flight crew is flying an arrival. They get a nonstandard clearance to descend to a lower altitude, in an unfamiliar sector. Suddenly, the GPWS warning sounds: "Pull up! Pull up!" The flight crew is not sure what to do, because they have never experienced this before. They may hesitate to pull up, or they may ignore the warning-with disastrous results.

In this scenario, the GPWS warning may not have registered with the flight crew. They have flown into this airport hundreds of times, but because of complacency, their brains may very well have disregarded aural and visual cockpit warnings.

At the other extreme, flight crews may also be exposed to continued false GPWS warnings because of a particular terrain feature and a GPWS database that has not been customized for the arrival. The flight crew becomes conditioned to this situation since they have flown the approach many times. This can also lull the flight crew into complacency, and they may fail to react to an actual threat.

Note: The newer versions of GPWS can be programmed by the manufacturer for specific airfield approach requirements, so that these nuisance warnings are eliminated.

- Know that familiarity can lead to complacency.
- Do not assume that this flight will be like the last flight.
- Adhere to procedures.

### **Procedural Factors Associated With CFIT**

Many studies show that operators with established, well thought out and implemented standard operating procedures (SOP) consistently have safer operations. It is through these procedures that the airline sets the standards that all flight crews are required to follow. CFIT accidents have occurred when flight crews did not know the procedures, did not understand them, and did not comply with them or when there were no procedures established.

More than one CFIT accident has occurred when the flight crew delayed its response to a GPWS warning during IMC.

If an SOP had addressed this situation and provided the flight crew with specific guidance, maybe an accident could have been avoided. In the absence of SOPs, flight crews will establish their own to fill the void in order to complete the flight. Some crews think the weather is never too bad to initiate an approach! It is the responsibility of management to develop the comprehensive procedures, train the flight crews, and quality control the results. It is the responsibility of the flight crew to learn and follow the procedures and provide feedback to management when the procedures are incorrect, inappropriate, or incomplete.

- Do not invent your own procedures.
- Management must provide satisfactory SOPs and effective training to the flight crew.
- Comply with these procedures.

### **Descent, Approach, and Landing Factors**

CFIT accidents have occurred during departures, but the overwhelming majority of accidents occur during the descent, approach, and landing phases of the flight.

CFIT accidents make up the majority of these accidents.

An enlightening analysis of 40 CFIT accidents and incidents was accomplished for a 5-year period, 1986 to 1990. The airplanes' lateral position in relation to the airport runway and the vertical profile were plotted. (Figures 1 and 2). One of the interesting things is that almost all the position plots in Figure 1 are on the runway centerline inside of 10 mi from the intended airport. The vertical profiles shown in Figure 2 are also significant. The flight paths are relatively constant 3-deg paths-right into the ground! Most of the impacts are between the outer marker and the runway.

The geographical locations of CFIT accidents during the 1970s show a different pattern than those in the late 1980s and 1990s. During the 5 year period from 1972 through 1977, there were 75 CFIT accidents or incidents. Twenty-five of these accidents/incidents were greater than 8 nm from the runway. The preponderance of the remaining accidents/incidents were inside the middle marker. However, for the period 1986 to 1990, the distribution of accidents/incidents was relatively even.

This difference may be the result of improvements made in runway approach aids that took place during this time period. Additional ILS were installed, as well as runway approach lighting systems. Continued capital investment in runway precision approach and lighting systems needs to be made worldwide.

- Know what approach and runway aids are available before initiating an approach.
- Use all available approach and runway aids.
- Use every aid to assist you in knowing your position and the required altitudes at that position.

Most CFIT accidents occur during non-precision approaches, specifically VOR and VOR/DME approaches. Inaccurate or poorly designed approach procedures coupled with a variety of depictions can be part of the problem. Figure 3 is an example of an approach procedure produced by different sources. There are documented cases that the minimum terrain clearances on some published approach charts have contributed to both accidents and incidents. For more than a decade, a worldwide effort has been under way to both raise and standardize the descent gradient of non-precision approaches. There are gradients as little as 0.7 deg in some VOR approach procedures. ASRS report #254276 illustrates the hazard of shallow approaches coupled with other confusion associated with the procedure design. In addition to the shallow approach gradients, many approaches use multiple altitude step-down procedures. This increases flight crew workload and the potential for making errors.

- **Study the approach procedure(s) before departure.**
- **Identify unique gradient and step-down requirements.**
- **Review approach procedures during the approach briefing.**
- **Use autoflight systems, when available.**

There is more than one standard for approach procedures in the world.

The U.S. standard is Terminal Instrument Procedures (TERPS).

The ICAO standard is Procedures for Air Navigation Services-Aircraft Operations (PANS-OPS), and the Russian Federation uses still another.

Flight crews, therefore, may be exposed to different standards and different margins of terrain clearances.

- **Study anticipated approach procedures before departure.**

**-Know that there are different approach design standards.**

Different approach procedure charting requirements and printing can also make it more difficult for flight crews to safely fly an approach. High elevation obstacles and terrain surrounding airports have been annotated on charts for years, but the actual terrain has not been depicted. Slowly, the publishing and printing organizations for aeronautical and approach charts have begun to use color and depict terrain or minimum safe altitude contours. Recently, some of the larger international operators have started printing their own customized charts that include these features. This greatly helps the flight crews to recognize the proximity of high terrain to the approach courses. Hopefully, this will result in fewer accidents.

Unstable approaches contribute to many CFIT accidents or incidents. Unstable approaches increase the possibility of diverting a flight crew's attention to regaining better control of the airplane and away from the approach procedure. A stabilized approach is defined by many operators as a constant rate of descent along an approximate 3deg flight path with stable airspeed, power setting, and trim, with the airplane configured for landing.

**- Fly stabilized approaches.**

**- Execute a missed approach if not stabilized by 500 ft above ground level or the altitude specified by your airline.**

In some modern glass-cockpit aircraft, the flight guidance system has the capability to display flight path vector/flight path angle. Use of this mode enables a stabilized approach to be flown at the required slope during a non-precision approach, with automatic correction for the effects of wind.

Flight management systems also have the capability to provide a computed profile for a non-precision approach. Required conditions for the use of lateral and vertical navigation functions for this purpose are that the approach profile is included in the database, that it is verified in accordance with obstacle clearance criteria, and that the FMS accuracy is confirmed to be high.

The use of these techniques, in conjunction with the autoflight system, reduces crew workload and should ensure a higher level of safety. Procedures specific to the airline type are given in the applicable Flight Crew Operating Manual. Crews should be adequately trained, either in the simulator or in flight, to use the procedures associated with these features.

**- If a non-precision approach is necessary, use the recommended flight guidance system function to fly a stabilized profile at the required angle whenever possible.**

**- Continuously monitor position and track by reference to the basic approach aid(s).**

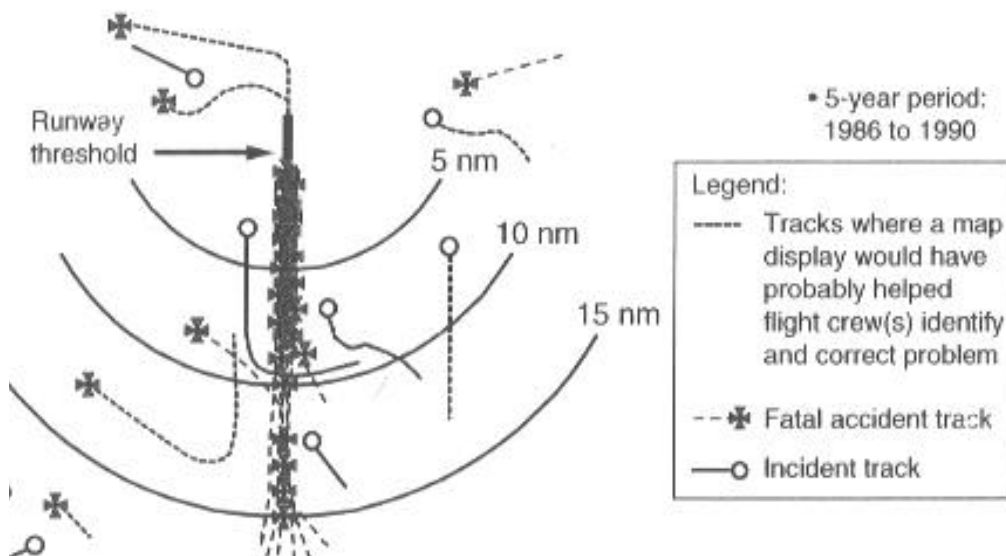


Figura 1

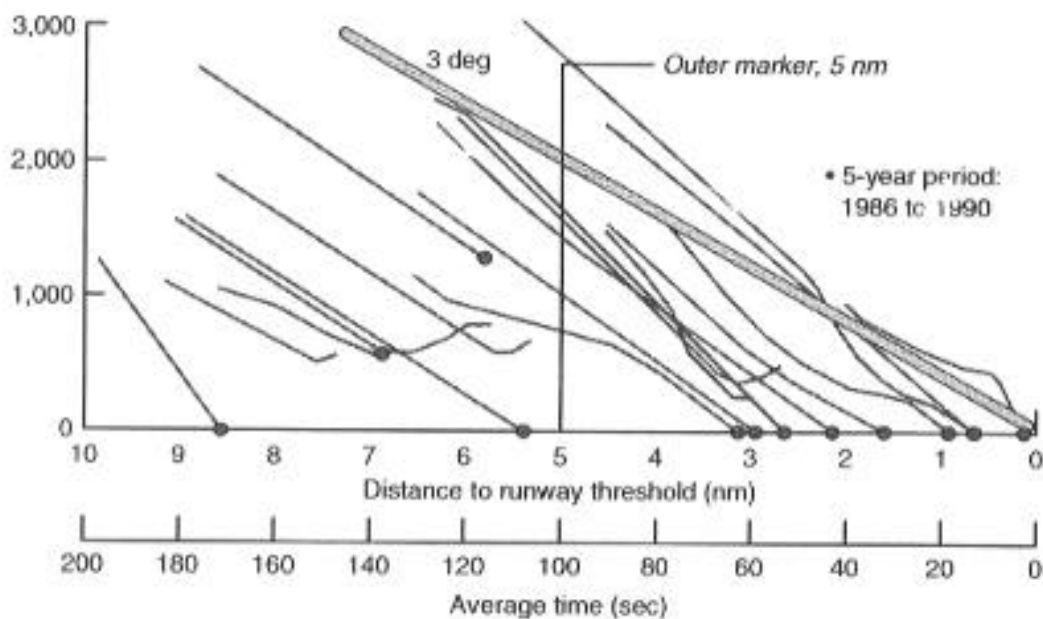


Figura 2

Per ulteriori note e informazioni su argomenti correlati al contenuto di questi due documenti in inglese vi rimandiamo ai seguenti articoli già pubblicati sul nostro sito.

- [Eziologia di un incidente: l'impatto dell'A320 Air Inter sul monte Saint-Odile](#)
- [Il disastro di Mont Saint-Odile \(seconda parte\)](#)
- [CFIT e DOC 8168](#)
- [Malpensa \(1968\) e Frosinone \(1971\) - ricordo di due incidenti](#)
- [Incidenti aerei in Italia negli ultimi trent'anni](#)
- [Overrun a Genova - commento al rapporto finale](#)
- [FLIGHT PATH CONTROL - THE STABILIZED APPROACH \(english\)](#)
- [Eziologia di un incidente in avvicinamento a Malpensa del luglio 1992 \(italian & english version\)](#)