International Journal of Aviation Research

Volume 16 | Issue 01 Peer-Reviewed Article

Unstable Approaches: Exploring the Legal, Linguistic, and Sociocognitive Dimensions

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The Flight Safety Foundation (2017) states that the approach and landing phases of a flight are the most critical and statistically risky, accounting for approximately 65 percent of all accidents annually. Unstable approaches have been a longstanding hazard in aviation, and addressing this issue as well as reducing approach and landing accidents has been a top priority for aviation organizations. To achieve this goal, extensive research has been conducted on various aspects of the issue, including training, human factors, pilot experience, and compliance with standard operating procedures (SOPs), and informative materials developed by globally recognized organizations such as FAA, IATA and CANSO. Additionally, proactive measures such as Flight Data Monitoring (FDM) have been implemented by airlines to effectively manage the issue by capturing the relevant variables and trends. However, despite these significant efforts, unstable approaches continue to pose a persistent threat to aviation safety. Shockingly, 95-97% of these approaches do not result in a Go-around, contrary to established Standard Operating Procedures (SOPs). This discrepancy highlights a significant gap between the vital level of research and procedures in place to address the real time operational problems faced by pilots and air traffic controllers, underscoring the need for more effective remedial actions to prevent accidents and incidents resulting from unstable approaches. This paper aims to propose some solutions at the operational level based on a data-driven approach to prevent unstable approach accidents and incidents. The propounded solutions take sociocognitive, psychosocial, linguistic, legal, regulatory and training aspects of the issue into account.

Recommended Citation
Hazrati, A. (2024). Unstable Approaches: Exploring the Legal, Linguistic, and Sociocognitive Dimensions. *International Journal of Aviation Research, 16*(1).

Introduction

An Unstable Approach is defined as an undesired state in which an aircraft arrives at the runway threshold too high, too fast, out of alignment with the runway centerline, or incorrectly configured in a way that is not prepared to land (EASA, 2022). Generally, unstable approaches are regarded as botched and precarious. Attempting to land an aircraft during an unstable approach is sometimes likened to docking a ship in a stormy sea. They are divided into two types:

1) Low-energy unstable approaches are characterized by low altitude and slow airspeed. They can lead to aerodynamic stall[1], loss of control, and controlled flight into terrain (CFIT) due to inadequate vertical position awareness.

2) High-energy unstable approaches are characterized by high altitude and fast airspeed. They can lead to hard landings, loss of control on the ground, landing too far down the runway, and runway excursion, which could cause harm or death (Airbus, 2006).

Unstable approaches can be caused by a variety of factors, including pilot error, type of approach such as visual/short approaches, circling approaches/sidestep landings, certain instrument approaches such as dive and drive approaches, poor Air Traffic Control (ATC) Vectoring influenced by local restrictions such as noise abatement procedures or airspace limitations[2], late runway change by the ATC, Weather conditions, aircraft problems, etc. (SKYbrary, 2021-2024).

Conversely, stable approaches are characterized by controlling and maintaining several key flight parameters within a specific range before the aircraft reaches a predetermined point called stabilization altitude or height. These parameters encompass flight path trajectory, attitude and rate of descent, engine thrust and airspeed, and aircraft configuration. If the parameters are not within the range the approach must be discontinued, and the execution of a go-around is mandatory. This approach ensures that the aircraft starts the landing flare at the best possible speed and attitude for a successful landing (SKYbrary, 2021-2024).

Making a stabilized approach significantly enhances the flight crew's situational awareness. It involves closely monitoring the aircraft horizontal and vertical paths, maintaining the desired airspeed, and ensuring proper engine thrust. This meticulous attention to maintaining energy-condition awareness is crucial for safe and efficient approach and landing procedures (Airbus, 2009). The FAA (FAA, 2021, p. 9-4) defines a Stabilized Approach as “one in which the pilot establishes and maintains a constant angle glide path towards a predetermined point on the landing runway. It is based on the pilot’s judgment of certain visual clues and depends on maintaining a constant final descent airspeed and configuration”. Runways differ from one another, but a widely used optimum glide path follows the "3:1" principle, which means the aircraft should descend 1,000 feet for every 3 nautical miles flown over the ground. This descent ratio simulates a 3° glideslope (FAA, 2019). Additionally, flying at a steeper descent ratio increases the likelihood of

[1]Stick-shaker activation provides cues respecting an aerodynamic stall, indicating an unstabilized approach (airspeed less than the required approach speed). See NTSB/AAR-11/02 (P.31) and NTSB/AAR-14/01

[2] See CATSR. (2010). project number M2009LV0225_01, Turkish Airlines Flight1951 crash report

an unstable approach and the risk of approach instability can be doubled as pilots fly higher above a flight path profile that follows the "3:1" principle (FAA, 2022).

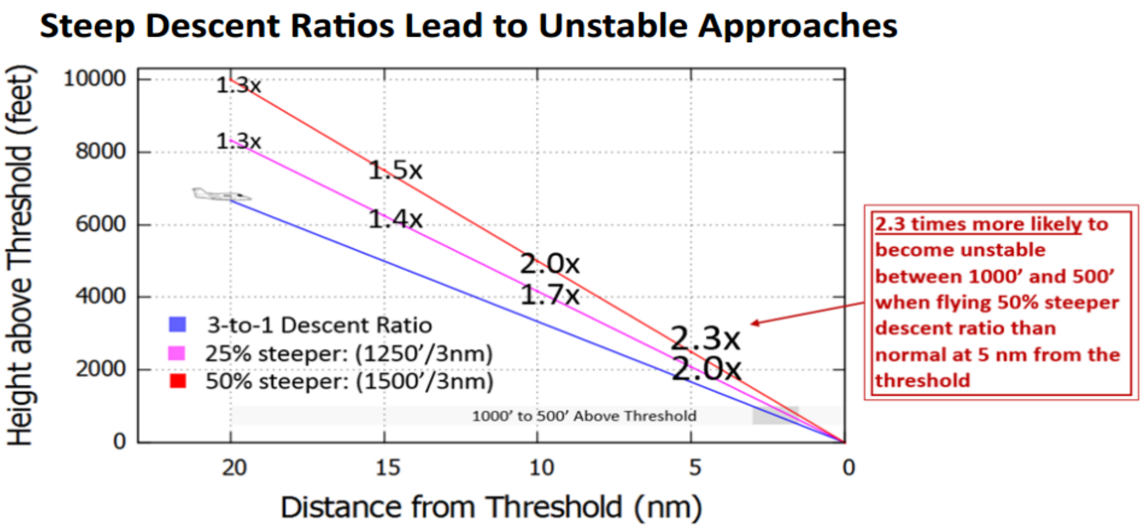

Figure1. Schematic diagram illustrating the descent ratio, adopted from "Stabilized Approach and Landing" by FAA, 2022.

Approach gates (windows) are reference points or time intervals within which certain criteria must be met to ensure stabilization (FAA, 2019). If the pilots fail to meet the criteria within the approach gates (typically not below 1000 ft in IMC or 500 ft above touchdown in VMC for most airlines), they are expected to discontinue the approach and perform a go-around.

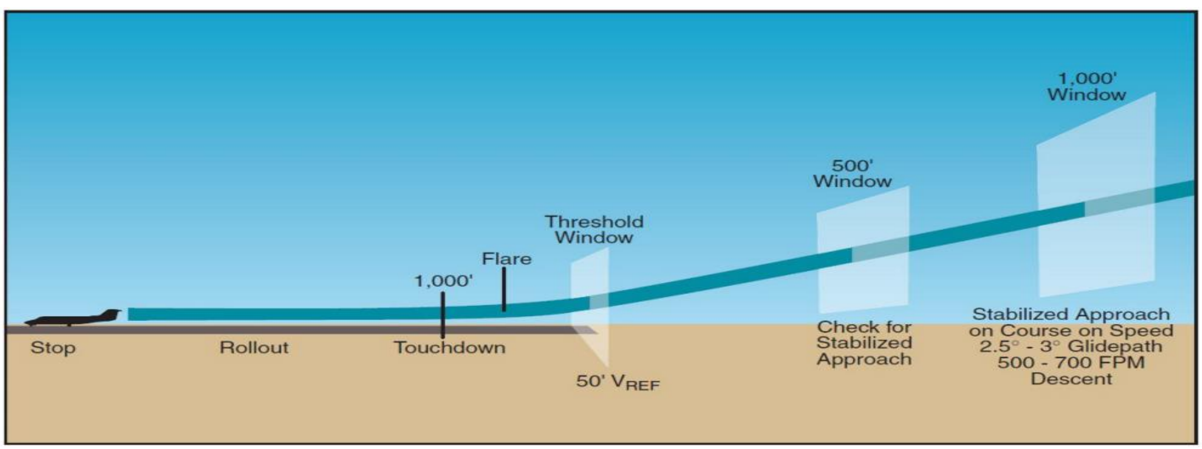

Figure 2. Windows (gates) illustrating points or time intervals, defined as objective means to determine the stability of an approach. Adopted from "ATPB, 2019-1" by FAA, 2019

A review of NTSB-investigated accidents by human factors researchers concluded that approximately 75% of aviation accidents brought about by plan continuation errors in which the crew continued an approach despite the cues that suggested it should not be continued (NTSB, 2015). Moreover, the study of cockpit voice recorder transcripts from aviation accidents reveals that flight crew often had an intuition that something was wrong, but ignored it (AOPA, 2017). "Your intuition should be listened to and treated as another crew member, according to NASA ASRS (ACN: 305072)." In the synopsis of another occurrence in NASA ASRS, it is stated that "A B737 CAPT reports continuing an unstable VFR APCH below 500 ft after intuition told him to

Go-around (ACN: 740385)". 'Intuitive decisions[3]' are based on rapid and unconscious cognitive processes (Dane and Pratt, 2007) made mostly by proficient and experienced pilots and ATCs as they represent the translation of our accumulated experience into action. These decisions are influenced by implicit factors such as subconscious pattern recognition and associative thinking. These processes allow pilots to compute information holistically, rather than relying solely on sequentially structured mnemonics[4] taught as decision-making tools. This is often called system 1 in the cognitive science process of thinking. While System 1 offers advantages in some situations such as determining that the entire approach is unstable, its downsides stem primarily from its susceptibility to cognitive biases that can lead to poor choices. An example is complacency, which can be influenced by System 1 thinking where pilots or ATCs overestimate their abilities, knowledge, or chances of success in handling situations and overlook potential hazards.

However, intuition should not be used as a justification for landing in normal conditions or in place of Standard Operating Procedures (SOPs). Rather, it should be used in conjunction with critical thinking (System 2) and SOPs, as well as all other available resources, such as risk assessment and management tools. This holistic approach ensures a systematic decision-making process, mitigating cognitive biases inherent in System 1 thinking, as real-world decision-making often entails interplay of two systems.

System 2, in contrast, is analytical and grounded in critical thinking (Kahneman et al., 2011). Critical thinking is the art of analyzing and evaluating thought processes to improve them. It involves independent thinking, asking probing questions, considering diverse perspectives, recognizing and managing cognitive biases and preconceptions, and evaluating arguments and evidence to reach optimal solutions. Effective communication, problem-solving abilities, and a commitment to managing biases are all crucial aspects of critical thinking. Regularly practicing critical thinking enhances one's ability to recognize and mitigate cognitive biases, leading to greater awareness of their surroundings (Paul & Elder, 2020). A critical thinker prioritize safety over all other issues. Critical thinking skills encompass more than following a checklist, and when standard operating procedures (SOPs) or regulations prove insufficient, critical thinking skills become invaluable tools for navigating complex situations. According to Paul & Elder (2020), critical thinking employs a linear progression from unreflective thinkers to accomplished thinkers in six distinct stages. However, in the context of aviation, it may be affected by external factors such as fatigue, workload, and team dynamics, and individuals may regress in some areas while excelling in others, exhibiting characteristics from multiple stages simultaneously or progressing non-linearly. What is important is developing a training program that nurtures critical thinking skills and promotes analysis and decision-making[5].

Additionally, cognitive biases are mental shortcuts brought on by our brain's innate propensity to simplify complex situations (the influence of System 1 on System 2 thinking), which

[3] See "Blink" by Malcolm Gladwell (2007) and "Thinking, Fast and Slow" by Daniel Kahneman (2011)
[4] TDODAR, DECIDE, PIOSEE, PAVE, CARE, TEAM. See SKYbrary (2021-2024). Pilot Memory Aids, and FAA (2023). Chapter 2: Aeronautical Decision-Making
[5] Critical thinking may be susceptible to certain limitations, such as time, level, and distance, as well as biases like confirmation bias, which involves favoring information that confirms existing beliefs. In some airlines, any disagreement between flight crew on any critical issue below 1000 feet triggers a go-around, leaving no room for critical thinking.

often causes a loss of objectivity in thinking, misinterpretations of information and poor decision making on the part of the pilots & ATCs. This is particularly true under time pressure, stress, information overload, or lack of clarity. Blind spots, referring to the unacknowledged or unnoticed biases or restriction in our thinking and perception, can prevent us from recognizing and addressing our own biases or from considering alternative perspectives. To overcome blind spots, it is important to welcome opposing viewpoints and seek diverse input, actively solicit feedback, participate in ongoing introspection, and self-analysis. This underlines the importance of aviation training programs that consider the need to recognize and analyze factors that impact how pilots and air traffic controllers perceive information and make decisions.

The challenge lies in recognizing when this intuitive flag requires further evaluation. While pilots decision-making tools (mnemonics) like 3P (Perceive, Process, and Perform) could be considered as a scaffolding for critical thinking, providing a structured approach to decision making in flight and overcoming cognitive biases, they are not a substitute for it. The dynamic environment of flight rarely unfolds linearly making critical thinking skills pivotal for adapting such frameworks to specific situations and evaluating the best course of action in complex and unexpected real-world scenarios.

The incident involving a Boeing 738 at Princess Juliana International Airport on March 7, 2017, exemplifies the dangers of ‘Expectation Bias’. Pilots lost their objectivity in their thinking and mistook hotel lighting for the runway, continuing their approach visually at a dangerously low altitude of 39 feet above the water. According to the incident report:” the flight crew noticed a rain shower ahead and to their left; however, given that they had the shoreline in sight and expected to see the runway shortly afterward, they decided to continue their approach visually”(TSB, A17F0052, p. 3).

Critical thinking could have prevented this expectation bias by encouraging the pilots to continue the approach with a more objective and analytical mindset. This is how critical thinking could have prevented expectation bias in this incident: 1) seeking additional information: critical thinking involves seeking update or additional information to regain situational awareness. The pilots could have actively requested more information from ATC about the latest runway visibility, the intensity of the lights, or any other relevant factors to verify their assumption. 2) Focusing on instruments: critical thinking draws attention to relying on objective data. Relying on objective data from altimeter and other instruments would have provided a clear picture of the plane actual altitude and descent rate.

In another accident involving Southwest Airlines Flight 1455 the captain reported that although he recognized that the aircraft was not in a stable condition at 1000 feet above ground level, he became fixated on the runway and was not able to explain why he did not perform a go-around maneuver, resulting in 44 injuries to passengers (NTSB, 2002). The captain could have questioned his assumption about landing despite the approach instability. He could have asked himself: Is the aircraft truly in a position to land safely? What are the risks of continuing this approach versus initiating a go-around? This is how critical thinking skills could have prevented this accident. A critical thinker prioritizes safety over landing at all costs.

Many air accidents occur due to pilot errors, stemming from a training approach that predominantly emphasizes the physical aspects of aircraft operation. This approach typically centers at imparting sufficient aeronautical knowledge and skills to pass written and practical tests while sometimes risk management is not given sufficient emphasis or importance in pilot training.

In this regard, it has been reported that accidents could have been prevented if the pilots performed a go-around well before the point that they attempted to salvage an unstable landing at low altitude. This is exemplified by the accident involving a Boeing 737-700, where the captain repeatedly exclaimed “get down” to the first officer while the plane was above the glideslope and too high during the approach. These details are derived from the Cockpit Voice Recorder (CVR) of the accident flight with the related timestamps: 17:44:17.7 HOT-1 “Get down. Get down. Get down”. 17:44:20.6 HOT-1 “Get down”. 17:44:23.0 HOT-1 “I got it” (NTSB, 2013, p. 12-47).

While the gates provide an objective means of ensuring that the aircraft is in a safe and stable condition during the approach, there are situations where it may be necessary to recognize the overall instability of the approach and initiate a go-around without overly focusing on all the details of the gates or reducing altitude as the situational awareness may be reduced and condition may be exacerbated especially in volatile or ambiguous circumstances[6]. Furthermore, making the go-around decision earlier would probably result in a better execution of the go-around, as the stable approach criteria may not always tell the whole story or provide a complete assessment. Pilots may rely on intuition and/or critical thinking skills along with other available resources. Additionally, during an unstable approach, pilots are vulnerable to a confluence of psychological and psychosocial forces, which can be overwhelming and diminish the effectiveness of relying solely on the gates (windows).

Besides, accident reports reveal that some pilots may not be familiar with stable approach criteria or may lack knowledge regarding what actions to take in the event of an unstable approach. Additionally, it can be challenging to develop standard operating procedures (SOPs) that encompass all possible scenarios due to temporary restrictions or changes in conditions and variables, such as the approach path, runways status, and others. In such situations intuition and critical thinking can help the pilots to discontinue approach and abandon landing. This paper aims to mitigate the risks of unstable approaches by proposing some solutions at the operational level.

Research Question

To achieve the aims of the current study the following question has been presented:

RQ: Taking Legal, Linguistic, and Sociocognitive standpoints what solutions at operational level could be considered to tackle the problem of unstable approaches in addition to the existing practices?

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[6] You cannot see the forest for the trees!

Literature Review

According to the Flight Safety Foundation, approximately 66% of 76 approach and landing accidents that occurred globally from 1984 to 1997 were linked to unstable approaches (SKYbrary, 2021-2024). Similarly, the IATA's Accident Data Exchange Database (ADX) has reported that unstable approaches contributed to 26% of approach and landing accidents between 2016 and 2020 (IATA, 2022). Furthermore, data from IATA's Flight Data Exchange (FDX) shows that there has been an increase in the number of unstable approaches for every 1000 operations during the first half of 2020 compared to the previous two years, as stated by IFALPA (2020). In fact, during the downturn of aviation transportation activities, unstable approaches were cited as a contributing factor in 29% of all accidents (10 accidents) in that year (IATA, 2018).The following figure represents 2011-2020 accidents attributed to unstable approaches.

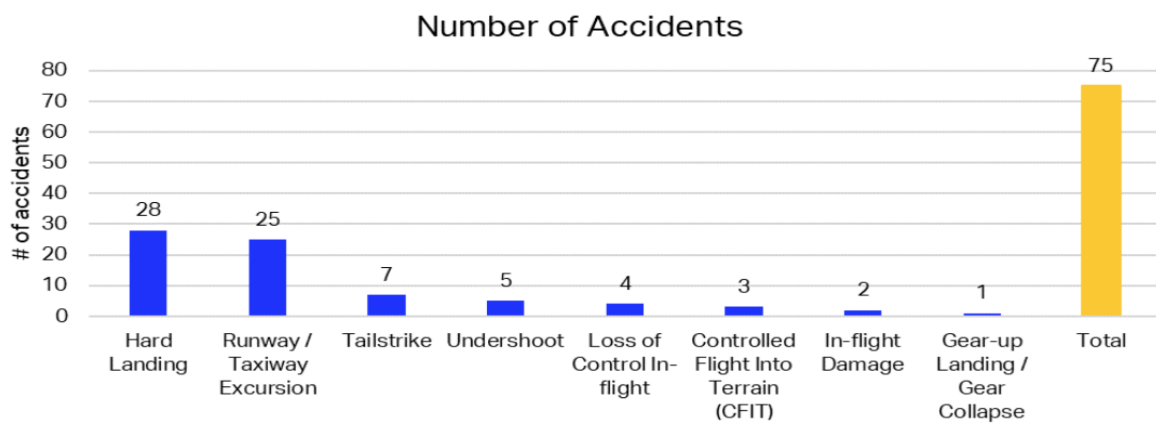

Figure 3. Adopted from IATAs Examining Unstable Approaches -Risk Mitigating Efforts, 2022

As illustrated in the following figure statistically, approximately 3-4% of approaches are reported as unstable. Flight Data Monitoring (FDM) and ongoing research in this regard aim to reduce the occurrence of such approaches. Despite airlines having established standard operating procedures (SOPs) to ensure approach stability and explicitly emphasizing the execution of a go-around if the criteria are not met, almost 95-97% of unstable approaches do not result in a go-around, contrary to the requirements (Burin 2011 as cited in NTSB 2013).

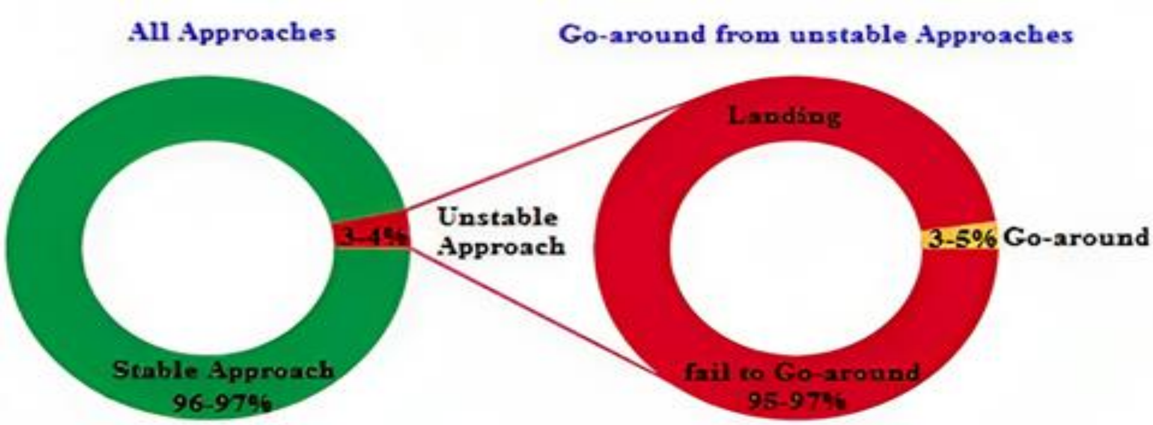

Figure 4. Illustration of the percentage of stable and unstable approaches adapted from (Sewell, 2021)

The overwhelming majority of these 95-97% unstable approaches patently end in a landing without incident. However, taking the definition of safety into account, it does not necessarily imply that they are safe! As they may considerably increase the risk of flight safety. Based on a study conducted by the Flight Safety Foundation over a period of 16 years, it was ascertained that 83% of runway excursions could have been averted if the decision to abandon the landing and execution of "Go-around[7]" had been made (Blajev & Curtis, 2017). In fact, failure to conduct a "Go-around" is the primary factor that increase the risk of approach and landing accidents (ALAs) and the main cause of runway excursions (Burin, 2011). It is likely that the implementation of go-around policies could have prevented more than half of all aviation accidents. Although it is commonly believed that an unstable approach is the leading cause of runway excursions, it was found that slightly over half of runway excursions occur, despite a fully stabilized approach, becoming unstabilized, during the landing phase (FSF, 2017). Moreover, since the circling approaches often require maneuver at low altitude and low speed they have potential to become unstabilized if they (circling part of an approach) are initiated lately or not on Final Approach Fix (FAF), increasing the risk of loss of control or impact with terrain. The risk can be intensified in windy or reduced visibility conditions.

To understand why approximately 97% of unstabilized approaches are still being flown to a landing, contrary to Standard Operating Procedures (SOPs), several aspects, including sociocognitive and linguistic factors, should be considered beyond the pilot's performance in conducting a go-around and the organizational culture's prioritization of arrival on schedule.

The sociocognitive aspect consists of cultural factors, such as power distance and communication style, that can further influence go-around decisions. In cultures with a high power distance, there may be a reluctance among first officers or co-pilots to challenge the decisions of the pilot in command or more senior pilots, leading to hesitancy in calling for a go-around or even executing one. Communication styles can also vary across cultures, with some cultures favoring indirect communication or being hesitant to openly express disagreement. Additionally, since language, culture, and cognition are inextricably tied to each other, these factors can interact in intricate ways. In this regard, Hazrati (2015) proposed the concept of Intercultural Communicative Competence (ICC) to be considered in aviation communication. For example, the pilot in command might choose to continue an unstable approach regardless of stabilization criteria or land at the airport, and the first officer may not be assertive enough to alert the pilot flying/captain or dissuade him/her from continuing the approach or even suggesting a go-around due to cultural factors. However, this situation may also arise due to other factors including hierarchical dynamics in the cockpit or the airline SOP in which the captain or pilot monitoring is responsible for initiating the go-around call[8] or even due to undetermined reasons as stated in the Allegheny Airlines Flight 453 accident report: 'He thought the captain understood the meaning of these remarks and would take the appropriate action; he tried to take control after touchdown, but the captain had both hands on the controls; and after touchdown, he believes he said 'go Jack' to

[7] As long as the thrust-reverser system has not been deployed, it is still feasible to abort the landing and perform a go-around if the approach is unstable. It is recommended to execute a go-around whenever the aircraft becomes unstable below the Stable Approach Height (SAH). Nevertheless, most standard operating procedures (SOPs) guide the flight crews to particular decision points prior to thrust-reverser deployment to determine if it is safe to continue with the approach. ATC should be reminded that any time an aircraft might execute a balked landing or missed approach.

[8] It is expected that anyone in the cockpit can initiate a go-around call

indicate the need for a go-around instead of 'oh Jack,' as transcribed from the CVR' (NTSB, 1979, p. 3). Nevertheless, the reason for the captain's lack of awareness or the first officer's failure to provide required callouts was not determined by the safety board (NTSB, 1979).

Various manifestation, including cognitive biases, inflexibility, and the inability to adapt to changing conditions, as well as personality traits such as intolerance of uncertainty can be given rise by these sociocognitive factors. Press-on-itis, a term used in aviation to describe a psychological phenomenon or mindset, represents a persistent determination and decision for continuing the approach to a destination despite indications or factors suggesting it is risky and may not be safe, or when the aircraft or crew are not fully prepared for flying and conditions warrant other action. Press-on-itis is reported to be a factor in 42% of the 76 approach and landing accidents (FSF, 2017).

They may also contribute to or result in subtle and implicit communication of critical flight parameters, fostering over-reliance on the captain's abilities and contributing to inadequate monitoring of cockpit instruments by both the pilot and first officer. As a result, pilots may have incomplete awareness of excessive deviations from stabilized approach parameters resulting in failure to conduct a go-around when necessary. For instance, in one accident, the first officer asked the captain, "Should I go around?" instead of directly expressing concern about the unstabilized approach, despite being aware of the company policy to go around when the stick-shaker is activated (NTSB, 2011).

In accordance with Transportation Safety Board of Canada, a major Canadian airline conducted a survey on stabilized approach within the company and found the first officers' reluctance to speak up when captains continued unstable approaches. Captains also claimed that if first officers raised an alarm, they would have conducted a go-around. It was also disclosed that the first officers did occasionally make remarks but the captains did not grasp their importance (TSB, 2012). Similarly IATA in the 3rd edition of the unstable approach document which was published in 2017, stated the tendency amongst the flight crew to depend heavily on each other to identify and address significant deviation from established parameters ascertained for a stable approach or to make a go-around decision.

This suggests that flight crews may not always exercise critical thinking when faced with such situations. Critical thinkers are more prone to avoiding complacency than non-critical thinkers. They are also more receptive to criticism, capable of analyzing information, able to recognize and address their own cognitive biases, proficient at problem detection and resolution, and adept at clear and assertive communication. These are consistent with the statement from the Flight Safety Foundation (2017), which highlights that pilots who land during unstabilized approaches are more likely to encounter cognitive issues.

Several studies have also investigated the psychology of noncompliance with SOPs, highlighting that if flight crews perceive SOPs as unrealistic, unclear, or convoluted, or if they lack sufficient training on SOPs or awareness of the potential consequences of not following them, they may overlook compliance (Giles, 2013). The Flight Safety Foundation brings to the fore that pilots conducting unstable approaches are less likely to adhere to established operational limits and procedures. Furthermore, according to the analysis conducted by the FSF ALAR Task Force on accidents and serious incidents during approach and landing, the most frequent causal factor was attributed to 'inadequate professional judgment or airmanship,' which is associated with poor decision-making (FSF, 2017).

Methodology

The current study employs a qualitative, data-driven approach to explore the factors and skills influencing unstable approaches and go-around decision-making in aviation. A particular focus is given to the importance of fostering an inclusive and collaborative approach to risk management during unstable approaches. Data is collected from various sources, including ICAO, FAA, CANSO, as well as accident/incident reports related to unstable approaches and academic research on the topics under discussion. Discourse analysis is employed to analyze interactions between ATC and pilots in accident reports to highlight how communication between flight crew and ATC during unstable approaches can affect safety. Furthermore, the paper puts forward some solutions at the operational level to enhance safety and prevent accidents/incidents. This include ATC intervention during unstable approaches in a cooperative manner. In this regard, the paper proposes a phraseology to be used between pilots and air traffic controllers (ATCs) along with the related justifications and rationale behind it from the legal, linguistics and sociocognitive standpoints. It also considers ATC intervention in high-risk unstable approaches or extreme situations and then proposes two other solutions specifically tailored for such situations. The paper aims to evaluate the effectiveness of the proposed solutions based on the following criteria: reduced miscommunication and improved Crew Resource Management (CRM), enhanced hazard identification and situational awareness, mitigation of human factors issues, and improved pilot decision-making. These are stepping stones towards the overarching goal of preventing air accidents and incidents.

According to SKYbrary (2021-2024), Miscommunication is often cited as a leading cause of air accidents, making it one of the most fundamental human factors in general and a potential factor in unstable approaches. IATA (2016) states effective collaboration, cooperation, and communication among all involved parties, including pilots and air traffic controllers, is of pivotal importance to enhance the likelihood of stabilized approaches. In addition, ICAO stipulates that "Whenever an abnormal configuration or condition of an aircraft, including conditions such as landing gear not extended or only partly extended, or unusual smoke emissions from any part of the aircraft is observed by or reported to the aerodrome controller, the aircraft concerned shall be advised without delay" (ICAO, 2016, p. 7-7). The use of “shall” in this item indicates the legal ‘Duty of Care’ tower controllers have to promptly advise the pilots respecting abnormal conditions both for those instances provided and for any other conditions, if observed or reported such as approach path deviation, misalignment with the runway in use, abnormal altitude, speed or rate of descent that indicate a possible unstable approach. Moreover, “a significant number of pilots indicate they are confident in the shared responsibility with ATCO to achieve stable approaches” (IATA, 2022, p. 17). Furthermore, “aviation professionals who breach their legal responsibilities and duty of care face serious legal consequences” (Mateou & Mateou, 2016, p. 1).

The ICAO also underscores that “Aerodrome controllers shall maintain a continuous watch on all flight operations on and in the vicinity of an aerodrome as well as vehicles and personnel on the manoeuvring area. Watch shall be maintained by visual observation, augmented when available by an ATS surveillance system.” (ICAO, 2016, p. 7-1). Besides, the fourth objective of air traffic services, according to 'Annex 11' to the 'Chicago Convention,' is to "provide advice and information useful for the safe and efficient conduct of flights"(ICAO, 2018, p. 2-2).

In a paper published by CANSO in association with ICAO, IATA, IFALPA, IFATCA, EUROCONTROL, ECA piloting safety, and ACI entitled "Runway Excursions - An ATC Perspective on Unstable Approaches" it is clearly stated that "When a possible unstable approach is detected, *query* the pilot and then be responsive to the pilot's requests" (SKYbrary, 2021-2024). However, neither the ICAO nor the other organizations specify how controllers should 'query' the pilots regarding a possible unstable approach. Likewise, in the document published by EUROCONTROL in coordination with Flight Safety Foundation in 2021 entitled “Global Action Plan for the Prevention of Runway Excursions (GAPPRE)” which is validated by EASA, IATA, ACI World, CANSO and supported by FAA, Boeing and Airbus it is stated that “Achieving a stable approach is a collaborative effort by the PF, PM(s) and ATCO(s) which requires that mutual intervention between flight crews and ATCOs, as well as mutual intervention within the flight deck team, is accepted by all team members” (P. 97) and in the last sentence of Table 2 under the section titled “Nudges between the flight crew and ATC” of this document it is stated “ATCO: asking/challenging flight crews if their approach path or approach speed appear higher than usual”.

These statements highlight the need for the development of a standard phrase by the regulatory organizations to be used by air traffic controllers to promptly query, alert, or advise pilots regarding unstable approaches. In this regard one possible phrase to propose would be the following:

ATC-Pilot: CONFIRM STABILIZED APPROACH [supplementary information if any].

The propounded phrase conforms to the Gricean's Maxims (1975), known as the ‘*Cooperative Principle’*. Here is the analysis of the proposed phrase in the context of the maxims:

a) Maxim of Quantity: The phrase provides both the necessary confirmation request and additional context. It satisfies the maxim of quantity by providing sufficient information without being excessive.

b) Maxim of Quality: The phrase is straightforward and precise; and assumes that the pilot understands the term ‘stabilized approach’.

c) Maxim of Relevance: The phrase along with the expected reply from the pilots (Affirm, Negative, or Correcting) extremely prevent irrelevant/indirect words and miscommunication and address the problem of unstabilized approaches accurately.

d) Maxim of Manner: The phrase is clear and concise, without any apparent ambiguity or unnecessary complexity.

While the proposed phrase is supposed to be used when the possibility of an unstable approach exists, the pilot's replies may include 'Correcting' in addition to 'Affirm' or 'Negative' to admit the pilots' flexibility in their reply and go-around decision-making. According to the FSF acting chief operating officer, Bozin (2014), in reality, a minor departure from the strict criteria may not necessarily turn out to be a risk significant enough to warrant a go-around decision by the pilots, despite the airline's SOPs' emphasis on conducting a go-around if the approach is unstable.

Moreover, the third go-around execution finding of the study conducted by FSF highlights the fact that one in ten go-around reports record a potentially hazardous go-around outcome, including exceeded aircraft performance limits or fuel endurance (FSF, 2017). Nonetheless, a go-around may be conducted poorly, which increases the risk of loss of control, highlighting the need for more effective and scenario based training for both pilots and air traffic controllers. Furthermore, FAA highlights some common errors in the performance of go-arounds (rejected landings) including failure to recognize a condition that warrants a rejected landing, indecision, delay in initiating a go-around, failure to apply maximum allowable power in a timely manner, abrupt power application and loss of control (FAA, 2021). The proposed phraseology can help improve communication between air traffic controllers and pilots, enhance pilots' awareness of risks and help them to recognize conditions that warrants a rejected landing, eliminate the danger of human factors and behavioral pitfalls to make proper decision during approach and landing to prevent accidents and incidents.

The following are rationales for considering the proposed phraseology:

1) One of the most prominent features of unstable approaches is the presence of diverse communication styles and the absence of a specific framework for exchanging critical information. When the possibility of an unstable approach exists, the lack of a standard phrase can lead to silence, confusion, and poor coordination in conveying essential flight data between controllers and pilots. This, in turn, can open the doors to misinterpretation, misunderstanding, and ultimately affect the decision-making process. Therefore, establishing a standardized protocol, like the one proposed in this paper, is crucial to enhancing safety.

a) Pilot-ATC: “Tatarstan 363, going around, non-landing position” (Interstate Aviation Committee, 2013, p. 13).

b) Pilot-ATC: “We are comfortable, we can make it Inshallah” (YouTube, 2020).

c) FISO-Pilot: “Caspian 6936 confirm normal”. (Iran CAA, 2021, p.12).

d) ATC-ATC: “He (the approach controller) had heard a colleague ask: „ […] was macht der Thai da? (what is the Thai doing)”. “The unstabilized approach was realised at low altitude and a go-around procedure initiated” (Bundesstelle für Flugunfalluntersuchung, 2020, p. 53).

e) Final accident report of Air India Express Flight 812: “As per the ATC controller, the aircraft was high on approach and touched down on the runway, much faster than normal” (Government of India Ministry of Civil Aviation, 2010, p. 4). However, the ATC remained silent owing to the absence of such a phrase to warn the pilots.

f) ATC-Pilot: “You are four miles from touchdown, altitude should be around 1200, can you manage this approach, confirm” (The Dutch Safety Board, 2005, p. 4).

g) The accident report of the M/S Kingfisher Airlines ATR-72 aircraft VT-KAC at Mumbai on 10.11.2009 highlights several key issues. “The aircraft was high on approach and aircraft was making steep descent at high rate of descent. Even below 500 ft, the rate of descent was high and there was warning generated for high sink rate. However, there was no input from the co-pilot to abort the marginal approach and make a ‘go-around’. Thus there was a failure of crew resource management principles on part of the pilot for not carrying out adequate briefing regarding the approach procedure and R/w conditions of R/W 27A and on Part of Copilot in not intervening to abort the unstablized approach and make a “Go Around” (2.5.2). “About 4 DME to touchdown ATC advised IT-4124 to check altitude since the aircraft was high and report field in sight” (1.11.1). In this case, employing a more structured approach by the ATC (using proposed phrase) to address the approach instability by asking 'Confirm stabilized approach, high altitude' could have alerted the crew in respect of approach instability and compensated for the lack of input from the copilot and failure in Crew Resource Management principles to check the approach stability and take an action such as initiating a go-around to save the flight. This recommended phraseology could provide a potential solution to prevent similar accidents in the future.

h) Pilot-ATC: “Hello tower, XXX flight established ILS 29 Right”. ATC-Pilot: ”Hello good morning XXX flight heavy, Tower, Runway 29 Right Romeo, cleared to land QNH 1013, surface wind 330 degrees 15 Knots. Pilot-ATC: Runway 29 Right cleared to land, XXX flight. Pilot-ATC: “tower, XXX flight maintaining 5 thousand, make a left turn, one eighty, to establish, to reducing altitude, confirm”. ATC-XXX flight: “XXX flight, if you are unstabilized approach continue on runway heading” upon observing the flight from the control tower, the controller recognized visually that the flight is too high and repeated again “continue on Runway Heading, continue on Runway Heading and contact radar on 125.1” (the controller instructed the pilot to discontinue the high risk unstable approach without directly stating go-around). XXX flight-ATC: Runway Heading, 125.1 XXX flight thank you”. A few minutes later: Pilot-ATC: “tower XXX flight down wind, descending traffic altitude for visual approach”. ATC-Pilot: Roger, XXX flight surface wind 310 degrees 13 Knots runway 29 right cleared to land. After landing, the tower controller asked the pilot, “Could you confirm that the flight was unstabilized at the first approach?” and the pilot replied, “affirm that’s confirm unstabilized approach.”

The ICAO lays down that in terms of flight path monitoring it may require a specific technology as surveillance system such as radar, ADS-B and MLAT to support such a function (ICAO DOC 4444, 2016). Even with the existence of a surveillance system to render navigational assistance (if prescribed) or flight path monitoring, the lack of a standard phrase in an assertive, cooperative and timely manner to advise or warn the pilots regarding obvious flight path deviation or misalignment with the runway can lead to different common ground and improper communication of vital information.

This is evident in the accident of Tatarstan 363, where the radar controller chose to warn the flight crew of significant flight path deviation by saying, “Tatarstan 363, early base,” and clarified it after 6 seconds by stating, “Lateral distance 6, radial distance 9” (Interstate Aviation Committee, 2013, p. 202). “However, the crew did not analyze the situation as appropriate and took no corrective actions, like turning right for at least 20 degrees to align with the back landing course or requesting vectoring "(Interstate Aviation Committee, 2013, p. 202). In another moment of the accident flight, the ATC asked the pilots if they were ready to land, and the pilot responded: "... on glide path, gear down, ready to land" (Interstate Aviation Committee, 2013, p. 13) and received landing clearance although according to the radar controller "... aircraft was offset right from the track and he was trying to clarify if the crew was ready to land then" (Interstate Aviation Committee, 2013, p. 205). "The ATC officer cleared them for landing, although he could see it on the radar that the aircraft was not stabilized" (Interstate Aviation Committee, 2013, p. 205).

Regardless of offering radar vectoring (for e.g. Turn right …), the radar controller could have employed more direct and clearer terminology, such as providing specific information about the deviation from the runway threshold, instead of using ambiguous terms like 'early base' and asking if the crew is ready for landing. This would have effectively communicated the situation to the flight crew, enhancing the pilot's situational awareness and potentially preventing the accident. For example, the ATC could have said, Tatarstan 363, unstabilized approach, misaligned with the runway, deviation of four kilometers.

These examples patently demonstrate the challenges faced by air traffic controllers and pilots in communicating critical information during unstable approaches. While improvisation may be necessary in unforeseen circumstances, it is crucial to rely on a standard phrase that is direct and clear. Such an approach is essential to eliminate the risk of miscommunication consistently while aiding pilot's decision making, thereby enhancing flight safety and efficiency.

2) The first line of defense against any hazard is recognizing its existence, as it enables the mitigation of associated risks and facilitates decision-making process. Therefore, if an unstable approach occurs, the first step is to detect and acknowledge it. In this regard, Misra et al. (2022), highlighted the importance of recognition of unstabilized approaches. Moriarty[9] (2015), stated detection may come from one of four sources:

a) Liveware (self) – The handling pilot recognizes that the approach is unstable.

b) Liveware (others) – The monitoring pilot recognizes that the approach is unstable

c) SOPs – The approach and landing checklists highlight something that shows the approach or landing is unstable

d) Hardware – The GPWS may alert the pilots that they are not in the correct configuration or they are descending too quickly indicating an unstable approach.

Taking into account the taxonomy of CRM & Shared Situation Awareness (SSA) between Pilots and Controllers (Endsley, 1999) in a holistic view of the team, one crucial element missing from this taxonomy is the involvement of Air Traffic Controllers as another valuable Liveware resource. In fact, some formal reports on air accidents have recommended that air traffic controllers be non-passive and provide assistance if technically and pragmatically possible and flight crew request assistance from air traffic controllers. Furthermore, the Go-Around Safety Forum, held in

[9] Captain David Moriarty, Chief CRM Instructor and the author of the book entitled "Practical Human Factors for Pilots"

2013 at Eurocontrol headquarters in Brussels and sponsored by the Flight Safety Foundation, the European Regions Airline Association (ERA), and Eurocontrol, concluded with 21 recommendations regarding unstable approaches. The first recommendation points out that “manufacturers should continue development of and operators should install stable approach and energy management monitoring and alerting systems (FSF, 2017, p. 31). However, accidents such as Asiana Airlines Flight 214 and Pakistan International Airlines Flight 8303 corroborate that, despite providing aural and visual warnings, automation systems are not always sufficient to alert the flight crew during unstable approaches. In this regard, the proposed phraseology ("Confirm Stabilized Approach") can serve as a reminder for the flight crew to check the approach stability, correct it, and also assist them in making go-around decisions. It also has the potential to compensate for failures in Crew Resource Management (CRM).

3) The findings of a study conducted at Embry-Riddle Aeronautical University highlight the vital importance of ‘human factors[10]’ contributing to unstabilized approaches as follows (Ross, 2018): 1) Situational Awareness[11] (77.9%), 2) Communication Breakdown in the cockpit (31.6%), 3) Distraction (31.6%), 4) Confusion (30.5%), 5) Workload (27.4%), 6) Human-machine interface (25.3%), 7) Training/qualifications (22.1%), 8) Time pressure (14.7), 9) Fatigue (12.6%).

Nonetheless, this list is not exhaustive, and continuous research should be conducted to explore other psychological and psycho-social factors that contribute to unstabilized approaches. Similarly Flight Safety Foundation elucidates that “Put very simply, prior to the pilots’ ability to accurately assess the operational landscape for potential threats and risks to aircraft stability, which would then shape their decision-making around compliance, they must first and foremost be fully aware of the objective world around them.” The foundation also states “the unstable approach–recall pilots scored much lower than did the go-around–recall pilots on every facet of situational awareness assessed” (FSF, 2017, p. 15). Put it in a nutshell an accurate understanding of the situation is crucial for formulating a plan and contingencies, implementing the best course of action, and modifying the plan in response to changing conditions. This is a key factor in saving an unstable approach.

The fifth decision-making pilot finding (DMP Finding 5) also highlights that “pilots who continued approaches unstable, compared with those who go around, are less compliant with checklist use and standard calls” (FSF, 2017, p. 28). Using the proposed standard phraseology can serve as a reminder to pilots to evaluate the stability of the approach. It underscores the importance of conforming to a stable approach, improves situational awareness, and alleviates the risk of poor CRM and decision-making.

4) Minimum Stabilization Height (MSH) serves as an approach gate at which a go-around must be initiated if a) the required configuration and airspeed are not established or flight path is not established, when reaching the minimum stabilization height or b) the aircraft becomes unstabilized below the minimum stabilization height (FSF, 2000). Moreover, some airlines specify

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[10] ICAO Circular 240-AN/144[2] lists over 300 human error precursors to air accident & incident

[11] Situational awareness is having an accurate understanding of what is happening around you and what is likely to happen in the near future. It requires at least monitoring, questioning, crosschecking, and refinement of perception (SKYbrary, 2021-2024)

‘should & must gates’[12] (IATA, 2022). However, the gate(s) is not the sole criterion to determine the stability of the flight. The proposed phrase could serve as a reminder for pilots to ensure that specific parameters, such as aircraft configuration, airspeed, descent rate, and alignment with the runway, are in accordance with a stabilized approach. It could help pilots counter fixation problems and cognitive biases, such as plan continuation bias, and refocus their attention on critical information. It can also be beneficial in situations where a radar controller fails to instruct the pilot to maintain speed restrictions, and the aerodrome controller could advise the pilot to resume normal speed. However, the phrase is not a substitute for sound pilot judgment and SOP.

Despite efforts and research on various aspects of the issue aimed at eliminating unstable approaches, the fact remains that such approaches still occur. According to SKYbrary (2021-2024), go-around consists of two essential elements: 1) the decision to go around, which is weighed against the option to continue the approach, and 2) the execution of the decision. However, when it comes to unstable approaches, detection of an unstable approach precedes the decision to go around and its execution.

To streamline efforts to alleviate the perils of unstable approaches and ensure effective communication and go-around decision-making, the following phrases could be considered between flight crew: ‘Go-around’ during critical times or ‘Go-around, unstable’ to provide more context and shared situational awareness. This is excerpted from the final report of the accident involving the Boeing 737-210C “The captain did not interpret the first officer’s statement of 3 mile and not configged as guidance to initiate a go-around. The captain continued the approach and called for additional steps to configure the aircraft” (TSB, 2014, p. 145). Similarly, in the final report of Asiana Airlines Flight 214 accident, it is stated, “About a second after the PM noticed the PAPI was displaying four red lights and that airspeed was 120 knots, the CVR recorded the PM saying, “It’s low” and the PF responding “yeah.” Per Asiana SOPs, the PM should have called out “low glide path” and “low speed” or simply “go around,” so his statement “it’s low” was nonstandard. As previously stated, the PF seemed to interpret the PM’s callout as referring to the airplane being low on the glide path because he attempted to correct the situation by pulling back on the control column. Although this would have been an effective solution if power was also added, neither the PF nor the A/T was managing thrust and airspeed; therefore, the application of pitch alone was insufficient to achieve the desired glide path (NTSB, 2014, p. 92). The PF’s uncertainty about whether he had the authority to make a go-around decision could have stemmed from confusion due to the inconsistent written policy in this area. In either case, the PF’s deference to authority likely played some role in the fact that he did not initiate a go-around (NTSB, 2014, p. 92)”.

While clear and concise crew communication is crucial, ATC phraseology (Confirm Stabilized Approach) can play a supportive role and help pilots to check the stability of the approach in some situations, especially when they are becoming trapped by operational pitfalls or have failed to detect instability of the approach and execute the go-around when necessary.

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[12] Some airlines also specify a "should" gate ahead of the "must" gate recommended by the FSF ALAR document. The "should" gate is typically 500 feet above the "must" gate. For example, a "should" gate at 1,000 feet above ground level (AGL) would be followed by a "must" gate at 500 feet AGL. If the "should" gate is not met, corrective action must be taken. However, if the "must" gate is not met, a go-around is necessary.

High Risk Unstable Approaches

The lack of a go-around decision is the leading risk factor in approach-and-landing accidents and the leading cause of runway excursions, according to the Flight Safety Foundation (2017). Research on decision-making during unstable approaches highlights the fact that go-around policies have not entirely achieved their intended objectives. A particular circumstance that can arise during a "high risk" unstable approach is when the aircraft is in a precarious state and the pilots may be susceptible to behavioral traps[13] (Velazquez, 2018). In this regard, the International Air Transport Association (IATA, 2021) states that there is no consensus on the definition of high-risk unstable approaches, which can affect their frequency. This raises concerns about the limitations of the current go-around policies and suggests that relying solely on the criteria for a stabilized approach may be inadequate in addressing critical situations, potentially hindering pilots' ability to make optimal decisions.

In light of the research and evidence concerning the role of human factors and behavioral pitfalls in unstable approach accidents and incidents delineated in this paper and subject to careful consideration of 'setting and context' in a professional way, and regulatory approval, this paper presents two potential solutions for addressing dangerous or high-risk unstable approaches. By exploring alternative approaches such as suggesting a go-around and instructing the pilot to abandon the landing in the proper way, the paper aims to address some of the limitations of current go-around policies and enhance decision-making in critical situations. These solutions, while requiring further evaluation by regulators, pilots/ATCs, aviation safety managers and researchers, air accident/incident investigators, psychologists, lawyers, cognitive science researchers, linguists, and other relevant stakeholders, have the potential to contribute to a more comprehensive and effective approach to mitigating risks associated with unstable approaches. However, it is important to note that the execution of these solutions ultimately rests with the pilots:

1) Suggesting the pilot to go-around: ATC may suggest a go-around by saying: ATC-Pilot: [Suggested to Go-around due to: possible unstabilized approach, etc. (additional information if any)]'. In this way ATC believes it may be advisable to discontinue the approach and execute a go-around maneuver and communicates his/her meaning in a concise and clear manner. However, the pilot-in-command ultimately has the authority to decide whether or not to perform a go around. Concerning the accident of the Boeing 737-500 (53A), VQ-BBN, despite the warnings issued to the flight because of significant deviation from the final approach track (4km) the tower controller asked the pilot if they were ready to land. The pilot falsely reported "... on glide path, gear down, ready to land" and the controller cleared the flight to land! In light of this sequence of events, the final report of the accident suggests that the ATC officer could have made a more appropriate decision to "recommend the flight to go-around (Interstate Aviation Committee, 2013, p.205).

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[13] Behavioral traps are accident-inducing operational pitfalls that can lead pilots to make poor decisions, even when they are aware of the risks. The Federal Aviation Administration (FAA) has identified twelve behavioral traps, including: Peer pressure, Get-there-it is, Loss of situational awareness, Descent below the minimum en route altitude (MEA), Mindset, Duck-under syndrome, Getting behind the aircraft, Continuing visual flight rules (VFR) into Instrument Meteorological Conditions (IMC), Scud running, Operating without adequate fuel reserves, Flying outside the envelope, Neglect of flight planning, preflight inspections, and checklists

2) Instructing the pilot to abandon the landing. Research on air accidents and incidents indicates that pilots may sometimes overlook immediate danger or critical flight parameters due to various human factors, such as task saturation, distraction, fixation, confusion, disorientation, poor communication and coordination between pilots and air traffic controllers (ATC), poor situational awareness, fatigue, or expectation and other cognitive biases and behavioral pitfalls[14]. These factors can contribute to a high-risk/dangerous unstabilized approach, which can impair pilot decision-making and place them in a precarious situation, as highlighted by flight safety instructors: "during a rushed approach, it is possible that we will know that we are unstable but become mentally "locked" into continuing the approach because of plan continuation bias and so continue the landing anyway" (Moriarty, 2015; p. 114). In such situations, air traffic controllers can play a crucial role in assisting pilots to avert the danger[15] by issuing go-around instruction.

In these scenarios, instructing the pilot to go-around in a cooperative manner in extreme situations and critical times, when the previously proposed solutions of the current paper (ATC-Pilot: 'Confirm Stabilized Approach', and ATC-Pilot: 'Suggested to Go-around') are not enough to ensure the safety of the aircraft, could be considered. As pointed out by IATA in 2022, the absence of a consensus on the definition of high risk unstable approaches has made it a formidable task to establish a definitive list of the situations and criteria germane to high risk or dangerous unstable approaches, demanding the exercise of professional judgment by ATC. Based on national or local considerations and subject to regulatory approval, some criteria for ATC interventions in case of high risk/dangerous unstable approaches may be predetermined. Such criteria should be carefully evaluated, refined and adapted to the specific 'setting and context[16]' to ensure the effective implementation with regard to technological advancement on the ground or onboard the aircraft. In this respect, The UK CAP 493, Section 2, Chapter 1, Paragraph 19.5 states that "A landing aircraft, which is considered by a controller to be dangerously positioned on final approach, shall be instructed to carry out a missed approach. An aircraft can be considered as dangerously positioned when it is poorly placed either laterally or vertically for the landing runway". To address these situations, particularly high-risk unstable approaches, joint Pilot-ATC Scenario-Based Flight Simulation Training could be regarded highly effective. A notable program for such training could be the 'Special Purpose Operational Training (SPOT)' sessions. These sessions which can utilize full or partial flight segments depending on the specific training

[14] The symptoms of these behavioral pitfalls, but not limited to, include communication problems, such as communication that does not make sense (as seen in the final report of the American 965 crash), flying erratically, such as making sudden or unexpected turns or changes in altitude, providing incorrect reports of position and level, or providing accurate reports but taking incorrect actions.

[15] Item 'e' of FAA pilot/controller roles and responsibilities highlights that "The responsibilities of the pilot and the controller intentionally overlap in many areas providing a degree of redundancy. Should one or the other fail in any manner, this overlapping responsibility is expected to compensate, in many cases, for failures that may affect safety."

[16] Setting is physical, temporal and non-temporal environment of flight and air traffic control. It may include the location, time, period, distance, approach limitations or specifications, weather conditions, controller resources such as surveillance and/or monitoring equipment and the related characteristics etc. Context on the other hand refers to the broader circumstances that surround a particular situation including the (inter)cultural peculiarities, the pilot and controllers training and experience, familiarity with the airspace, operational, procedures/regulations, restrictions, type of operations, the purpose of flight etc.

objectives, facilitate critique and debriefing of both technical and Crew Resource Management (CRM) performance (FAA AC No: 120-35D, 2015).

Nevertheless, as outlined in the ICAO PANS-ATM (2016), ATC clearances (or instructions) do not relieve pilots of their responsibility to ensure that any clearances issued by air traffic control units are safe (ICAO Doc 4444, 2016, p. 4-14) and the execution of a go-around suggestion or instruction in any case rests on the pilot as the final authority of the flight (ICAO, 2005, p.2-1).

One of the most important operational pitfalls and breakdowns frequently cited in air accidents is 'complacency', which is classified as an overarching hazardous attitude with five subsets[17], may cause pilots to deviate from the criteria for a stabilized approach and veer away from compliance, which can lead to pilots normalizing deviance and avoiding go-arounds (Neff, 2022). Based on the preliminary report of PIA8303 accident "Karachi Approach advised repeatedly (twice to discontinue the approach and once cautioned) about excessive height. Landing approach was not discontinued" (Pakistan AAIB, 2020, p. 11). This is part of the communication exchange of the doomed flight[18]. Pilot-radar controller: "we are comfortable we can make it inshalah". Pilot- radar controller: "we are comfortable now. We are out of 3500 for 3000 established ILS 25 Left". Radar controller-pilot: "Roger, turn left heading 180". Pilot- radar controller: "sir, we are established on ILS 25 left". Radar controller-pilot: "you are 5 miles from touch down …altitude 3500". Pilot-radar controller: "Roger". Radar controller-pilot: "Pakistan 303, cleared to land 25 left".

The PIA8303 was obviously unstabilized with regard to the approach chart (distance/altitude from the runway threshold /airport elevation (100ft) and the rule of 3:1) and the captain was accurately advised and cautioned by the radar controller, while established on ILS. However, the captain was complacent as he was "comfortable" to continue such a high risk unstabilized approach. If the radar controller had been assertive by using a direct terminology such as 'Unstabilized Approach, high & fast' the captain might have been prompted to abandon the landing at first approach.

According to ICAO, EASA and FAA[19], it is upon the radar approach controller to instruct the aircraft to execute a missed approach when the aircraft appears to be dangerously positioned on the final approach or it is "Too high/low" or "Too far right/left" for safe approach (FAA, 2023, p. 5-10-6). This is highlighted at last paragraph of Part 6.1 of IATA guidance on unstable approaches published in 2017. Nevertheless, it is conceivable that aerodrome controllers ascertain that an aircraft is situated in a hazardous position during its final approach through visual observation augmented by the surveillance/monitoring equipment or even in some special circumstances instinctively/intuitively[20].

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[17] The subsets include: Anti-authority: "Don't tell me.", Impulsivity: "Do it quickly." Invulnerability: "It won't happen to me.", Macho: "I can do it.", and Resignation: "What's the use?"

[18] At the time of writing this paper, the final report of the accident has not been published.

[19] See FAA ORDER JO 7110.65AA, 5−10−14. FINAL APPROACH ABNORMALITIES, ICAO Doc 4444, 8.9.6.1.8, 2016 and EASA Easy Access Rules for ATM/ANS PROCEDURES FOR RADAR APPROACHES item (h) and BFU20-0002-EX

[20] Instinctively, refers to a natural or innate behavior or response that is hardwired into an organism. Intuitively, on the other hand refers to the ability to understand or know something without conscious reasoning.

Concerning the accident of the A320 operating as GF-072 on August 23, 2000 resulting from an unstable approach, Flight Safety Foundation (2002) stated that the controller should have instructed the flight crew to conduct a missed approach procedure instead of approving 360-degree left turn in a non- radar environment under IFR flight plan in the night. In the next event, since the approach became unstable the pilot requested a major maneuver as a 360 degree turn for descend profile adjustment in a non-radar environment as follows: Pilot-ATC: “we have to make a 360-degree turn to be established like this”, however, the controller did not accept and instructed the pilot to execute the missed approach procedure.

In the serious incident involving a Boeing 737-86N (registration code I-NEOT) on 1 June 2019 in the vicinity of Bristol Airport, the flight crew did not recognize that the approach was unstabilized. However, the aerodrome controller at the Bristol tower detected the issue instinctively and prevented a catastrophe by instructing the crew to go-around. These details are excerpted from the formal report of the incident: "The controller considered that the aircraft was not in the position he would expect and instinctively instructed the crew to go-around"(AAIB, 2020, p.4). "Flying a shortened routing led to a rushed and unstable approach which did not follow the correct vertical flightpath. This was observed by ATC who instructed the aircraft to go around. The crew found themselves performing a go-around unexpectedly but did not know why they had been required to do so. The go-around was conducted with a mis-set altitude on the MCP, and neither crew member noticed for a significant period that the aircraft was descending during the maneuver"(AAIB, 2020, p.16).

Whether or not aerodrome controllers can issue go-around instruction when possibility of a high risk/dangerous unstable approach exists, depends on the specific regulations, situation demands and careful considerations of the setting and context on a case-by-case basis as there is no one-size-fits-all answer to this question. If an aerodrome controller is uncertain about whether to instruct (if authorized) or suggest to the pilot to conduct a go-around, the current paper propound that he/she should always err on the side of caution and advise/warn the pilot by saying, 'Confirm stabilized approach [additional information].'

Conclusion

Despite ongoing efforts to address unstable approaches and the implementation of various proactive and reactive measures, the persistence of unstable approaches remains a significant safety concern in aviation. Even with the advancement of cockpit technology over time, the significance of problem-solving and making sound decisions continue to be paramount. In this respect, importance of fostering the development of critical thinking as part of an airline's safety culture and training curriculum is highlighted in the current paper. It allows for a thorough analysis of the situation, incorporating situational awareness and risk assessment. The paper suggests that advanced simulator scenarios can be utilized to challenge pilots' vulnerability to biases and enhance their ability to recognize cognitive biases as well as unstable approach parameters in real-time. This, in turn, enables them to make objective choices and sound decisions. For instance, role-playing ATC interactions can simulate scenarios where ATC instructions align with the pilot's initial assumptions (confirmation bias), while also requiring the pilot to consider alternative interpretations and judgments. However, managing cognitive biases involves considering several factors, making it an ongoing and dynamic process which entails continual development of new methods and the implementation of updated training programs to effectively address this critical aspect of aviation safety.

The importance of considering an inclusive approach towards go-around decision making process is also highlighted in this study. This approach should encompass multiple factors, including intuition (valuable for recognizing anomalies and the whole instability of the approach, but not a substitute for established procedures during normal landings), critical thinking, adherence to Standard Operating Procedures (SOPs), and utilization of all available risk management tools and resources, while also acknowledging their limitations. In complex situations, a diverse range of strategies, considerations, or interventions may be necessary, going beyond mere reliance on checklists or rigid procedures. Although critical thinking and intuition are precious assets, they may be susceptible to biases or incomplete information. Standard Operating Procedures (SOPs) prioritize safety during unstable approaches by emphasizing a go-around maneuver. However, even with clear SOP guidance, complex situations may necessitate some flexibility in their execution. This is particularly true during unstable approaches caused by factors like wind shear, airspace/approach limitations, or unexpected events.

Sociocognitive factors, such as the culture of airline pilots regarding how they view and manage the risk of continuing an unstable approach, as well as social & communication norms, personal experiences, and environmental factors, all influence an individual's cognitive processes and decision-making underpinnings. Critical thinking, intuition, cognitive biases, and blind spots are all interwoven with these factors. Comprehending complex situations, such as high-risk unstable approaches, requires flexibility and adaptability in addition to considering alternate strategies, seeking or accepting input from ATCs to conduct go-around.

Additionally, the paper discusses the significance of developing a standard phrase and using more direct and clear terminology between ATC & Pilots to effectively communicate approach instability. It further highlights the importance of clear communication within the flight crew and using a standard phrase to ensure that the required action will be taken and all parties are aware of the situation.

In terms of high-risk or dangerous unstable approaches, the paper takes a proactive approach and proposes two additional solutions as a collaborative effort to prevent accidents. The first solution suggests offering a go-around suggestion to the pilot, as exemplified in the case of Tatarstan 363. The second solution proposes issuing a go-around instruction in extreme situations. The paper acknowledges that such suggestions or instructions require careful consideration of the relevant context and setting, based on a regulatory framework in which the final authority to execute them rests with the pilots. While go-arounds may be disruptive and costly if not executed properly, there are situations such as Approach and Landing Misalignment (ALM) where an ATC's go-around instruction could be crucial in preventing accidents. The proposed solutions in this paper while not an end to the problem of unstable approaches, can contribute to preventing accidents and fostering a safer sky.

Limitations of the Research

This study is limited by the availability of data. While accident reports provided valuable insights, the absence of transcripts in some cases hindered the ability to fully analyze communication patterns in the cockpit and also between flight crew and ATC.

Recommendations for Future Research

Given the multifaceted nature of unstable approaches, which involves human factors, evolving technology, airport infrastructure, airspace complexity, and other factors, it is essential to adopt interdisciplinary research approaches. These approaches are crucial for delving deeper into less-explored or overlooked aspects of this problem that can influence both its occurrence and the strategies for addressing it. One potential avenue is the utilization of data-driven approaches and predictive models derived from large volumes of data in realistic flight simulations. Realistic Competency-based training programs for both ATC and pilots in respect of unstable approaches could be developed with focus on specific competencies such as decision-making under pressure, handling different conditions or extreme situations, and crew resource management to consider real-world like training for such approaches. It could be fascinating to look into how Artificial Intelligence (AI) can help detect and avoid unstable approaches by using real-time data analysis, anomaly detection, decision support systems, and pilot training.

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