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OVERRUN PREVENTION SYSTEM FOR AIRCRAFT AT AIRPORT

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Abstract: The correct planning around airport is the principal tool to safeguard the territory from the risk of air accidents. In the past, a long series of fatal events has been occurred in these areas due to various causes. The most of accidents are localized along the extended runway centerline and, for this reason, the Land Use compatibility Plans have been defined just in the areas after the thresholds. Nevertheless, in the past, there have been also several events localized in the runway lateral zone, sometimes with very serious consequences. ENAC and Sapienza-University of Rome have implemented a data-base of air accidents occurred in the last 15 years all over the world, to analize theoccurrence of these events and to define the extension of the safety area on ground around the runway, with particular attention to the lateral zones.

***Index Terms* – That system mainly preventing Run-on Accidents.**

I. INTRODUCTION

A runway excursion is a runway safety incident in which an aircraft makes an inappropriate exit from the runway. Runway excursions include runway overruns, which occur when an aircraft is unable to stop before it reaches the end of the runway. Runway excursions can happen because of pilot error, poor weather, or a fault with the aircraft. Anypilot will tell you that the most critical times of a flight are during takeoff and landing. The margins for errors, in both circumstances, are slim. If anything goes wrong, the likely result is a runway accident, which can have deadly consequences. According to a study published by Boeing Commercial Airplanes, nearly half of all aviation accidents occur during the finalapproach or landing and 14 percent occur during takeoff or initial climb. If you or a loved one have been harmed in an airport runway crash, it is in your best interest to speak with an experienced aviation attorney to protect your rights. The vast amount of rules and regulations governing air travel can make aviation accident cases complex and confusing, therefore, retaining a qualified aviation attorney is vital. Our aviation attorneys at Wisner Baum have represented over 100 passengers in more than a dozen runway accidents, and we have dedicated our practice to ensuring that victims of aviation crashes receive the justice and compensation they deserve. Most of us have misconceptions about how plane crashes happen. Based on what we see in the movies and on TV, when we think of plane crashes, we typically think of the sensational a mid-air collision or engine failure at 30,000 feet, resulting in planes plummeting from the sky. The truth is that the majority of aviation accidents happen on therunway during takeoff or landing, not while the airplane is cruising in accident.

Three reasons why airport runway accidents are the most common of all aviation accidents:

- Take offs and landings are when planes are closest to the ground. There is often not enough time or altitude for the pilots to take corrective action.
- Planes are traveling slower, closer to their stalling speeds, and forced to do more maneuvering during these critical times.
- Planes are in closer proximity to one another when taking off or landing at anairport.

When a plane is close to the ground or in the proximity of other aircraft, there is little room for error. As we think of runway accidents, we typically think of a mechanical malfunction, maintenance issues or a number of other problems occurring during takeoff orlanding that can lead to catastrophe, but oftentimes the pilots didn't do everything they wererequired to do to set up a safe takeoff or landing.

II. LITERATURE REVIEW

1. Adam, V. Atluri, S. Yu and Y. Yesha - 10th NASA Goddard Conference on Mass Storage Systems and Technologies 19th IEEE Symposium on Mass Storage Systems, April 15–18, College Park, MA (2019). This journal Efficient Storage and Management of Environmental Information proposes a suitable architecture for data collection and monitoring of environmental parameters and that allows specification of the queries and their visual presentation.

2.Karthik Krishna, Suraj Thapa, Lokesh Kothari , Harish and Tamil

(2020) in this work' **ARDUINO-Based Weather Monitoring System** explains ARDUINO is an open-source platform that enables us to quickly build electronics projects. It consists of both a physical Programmable Circuit Board (PCB) and a piece of software (an Integrated Development Environment (IDE)) that works on all known operating systems. We use the ARDUINO to develop a weather monitoring system based on temperature and humidity variables obtained from a DHT11 sensor. The system, when tested, was able to report if weather is Hot, Normal, or Cold based on the exact temperature and relative humidity withina 20meter area.

3. P. Kinney, (2003).ZigBee Technology work Wireless Control that Simply Works, explains the wireless technology having the performance characteristics that closely meet the requirements for reliability, security, low power and low cost and standard -based, interoperable wireless technology will address the unique needs of low data rate wireless control and sensor-based networks**.**

4. Thu Vu Trong, Tri Dinh Quoc, Anh Nguyen Tuan (2018) work Design and manufacture of a Pico satellite for space technology education and potential applicationthis paper will describe the experience in developing a simple ground receiving station and The basic design of F-1 Pico satellite and gives an insight regarding the design, manufacturing, components and working of a Pico Satellite and its ground control station.

5. H.R.Chiranjeeve1, K.Kalaichelvan2, A.Rajadurai3 work Design and vibration analysis of a 2u-cubesat structure using aa-6061 for aunsat – II provides the ideas for design and analysis of modular 2U Cube sat structure based upon the Cube sat standard forthe exploration of the lower thermosphere were carried out in this project. The structure composed of many sub components and multiple mounting configurations, giving maximum flexibility in the design process. The CAD model of the various parts and their assembly were made using SOLIDWORKS 2018 cad software and subjected to FE analysis using ANSYS 14 in a static load of 9g and 13g.

6. Mohamed Ibrahim, Student Member, IEEE, and Moustafa Youssef, Senior Member, IEEE work CellSense: An Accurate Energy-Efficient GSM Positioning System evaluates the effect of changing the different system parameters on the accuracy-complexity tradeoff and how thecell towers density and fingerprint density affect the system performance.

7. Z. Machacek and V. Srovnal , In 7th WSEAS International Conference (2019) work Automated system for data measuring and analyses from embedded systems presents the design of an automated system for signal processing in embedded systems. The design is worked out for an automatic predictive diagnostic system use. This automated system allowscommunication with embedded systems, an embedded systems control, data collection from sensors, various signal analyses, and react to limits transcendence.

III. RC AIRPLANE

RC planes are small model radio-controlled airplanes that fly using electric motor, gas powered IC engines or small model jet engines. The RC Airplanes are flown remotely withthe help of a transmitter with joysticks that can be used to fly the aircraft and perform different manoeuvres. The transmitter comes also with a receiver which is installed inside the Model RC Airplanes which receives the commands send by the transmitter and controlsservos. The servos are small motors which are mechanically linked to the control surfaces e.g., ailerons for roll control, elevator for pitch control and rudder for yaw control. The servos moves the control rods (which are small rods that connect the servo to different flight control e.g. to elevator etc) which in turn moves the control surface be it elevator, flaps, aileron or rudder. An RC Airplane can be controlled in flight by using the transmitter fromwhere you can control pitch, yaw and roll of your RC Airplane and you can also control thethrottle settings. The receiver which accepts the transmitter signal and the servos attached to it are run on rechargeable batteries. Most popular rechargeable batteries for RC Airplanesuse include Ni-Cad (Nickel Cadmium) and Li-Po (Lithium Polymer). Lithium Polymer lastslonger and more powerful than there Ni-Cad counterparts but a bit more expensive.

IV. RC AIRPLANES PROPULSION/ PLANTS POWER

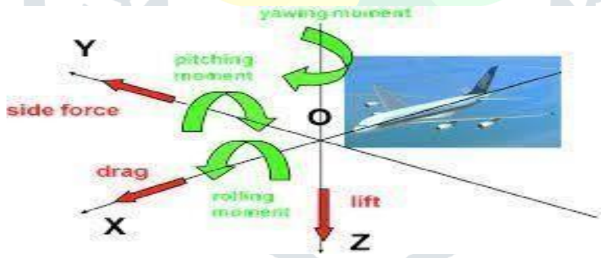
RC Airplanes fly using either electric motor as propulsion device or IC (internal combustion) gas powered engines or small model jet Engines.

V. RC ELECTRIC MOTOR

Electric motors are most used in many model RC Airplanes because of the ease in use.Electric Motors give the advantage of low-cost, easy to use. The throttle of electric motors is controlled using a speed controller which comes with the motor. The speed controller leadis connected to the receiver. The transmitter than can control the throttle of electric motor just as other controls.

VI. BASIC AERODYNAMICS

The understanding of the principles of flights is important in understanding also whathappens to the model during the various stages of its flight. We are unfortunate enough to crash a model through a flying error it is important to know why it is crashed, so that we canavoid making the same mistake again. It is not intended to pursue the detailed aerodynamicsfor design models, etc., but sufficient flies and what effect controls surfaces have. Let us first consider how an airplane stays up in the air. Although it seems to be the general view that the airplane is held in the air by the action of the propeller, it is of course, the wings that create the lift to suspend the aircraft. Now if we look at the side elevation of the model in figure, we can see that the wing is set at slight angle, with the leading edge slightly higher than the trailing. When the model is being propelled forward in straight and level flight in the air, when it reaches the leading edge of the wing, has to divide, some passing over the top of the wing and some underneath. The air passing beneath the wing is forced downwards, owing to the angle of incidence and because it is now in an area of relative pressure, tends to push the wing upwards. Over the top of the wing there is, because of the angle of incidence and the camber of the upper wing surface, an increase in the speed of the airflow, causing an area of relatively low pressure, thus sucking the wing upwards. The combination of the area of high pressure pushing upwards and the low pressure over the wingsucking it upwards are together known as lift.

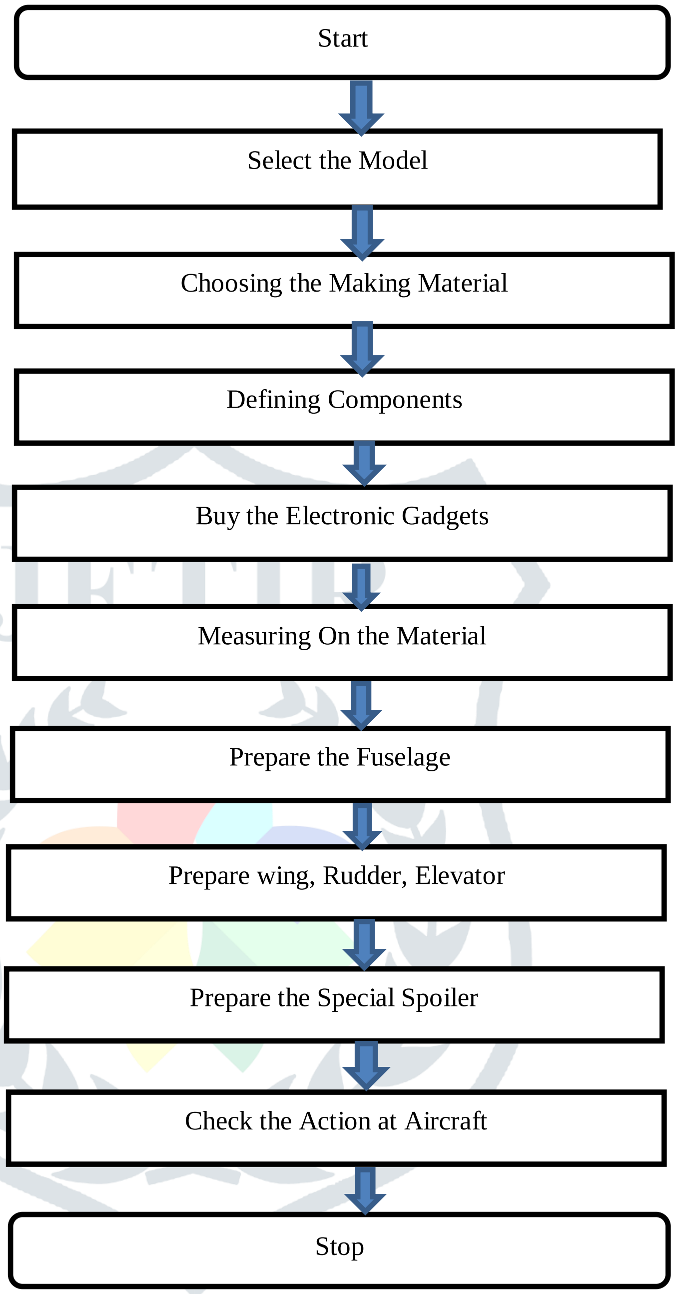


Basic aerodynamic forces

VII. METHODOLOGY

Generally, there are many technical methods to stop an aircraft from landing, but sometimes some unexpected accidents occur on the runway. Our project aims to develop a preventive system to prevent these types of accidents. That means all aircrafts have one to two engines as per their standard. These engines are only used to propel the aircraft forward.It is with the help of this that the plane flies forward. In our project we have to put separate engines for forward and backward movement ofthe aircraft. The forward engine will operate as usual for the aircraft to move forward. At that time the reverse engine is inoperative. Now when the plane is landing the reverse engine will work. For example, during a fast landing, the pilot will gradually reduce the speed of the forward engines and gradually increase the speed of the reverse engines. The aim of our project is that the speed of the aircraft will be completely reduced at that time so that the accidents caused by the aircraft going over the runway can be completely reduced.

VIII. WORKING PROCEDURE



IX. INTRODUCTION

This chapter will discuss about the flow of this Final Year Project from the beginninguntil finish this project. The flow chart is very important to illustrate the sequence of operations to finish the work. The flowchart is generally drawn in the early stages. It will guide to finish the works. Meanwhile, the Gantt chart shows how the project is planned andseen instantly whether the project is behind or ahead of the schedule. The function of the Gantt chart is to guide towards the direction of the project plan. So, these two charts are very important to guide us to finish up the projects. Moreover, in this chapter also will discuss about the concept generation. There were four design of product. Then, list the advantage and disadvantages of each of the product design. After that, proceed to finalize concept. This finalize concept is to choose the good onefrom the four design. The best product will proceed to another step, which is fabrication process. Before that, the material selection is needed to do. This is to select the suitable material that being to use. The material selection is also followed by the function of the product.

X. RUNWAY OVERRUN WARNING (ROW)

ROW becomes active at 500ft and remains active throughout short-final, the flare andtouchdown until transition to ROP. ROW stopping distances are based on the same principlesas the Airbus In-Flight Landing Distances. On Airbus A380, A330 and AIRBUS A-320 family, ROW continuously calculates two stopping distances, the stopping distance on a DRY runway and the stopping distance on a WET runway. If the stopping distance on a WET runway becomes longer than the available runway length, the system triggers an amber message on the PFD “IF WET: RWY TOO SHORT”. If the stopping distance on a DRY runway becomes longer than the available runway length, the system triggers a red message on the PFD “RWY TOO SHORT” and a below 200ft an aural message “RUNWAY TOO SHORT”. On the Airbus A350, the flight crew has a runway state selector knob on the instrument panel. Consequently, ROW predicted stop distance is based on the runway state selected by the crew and thus ROW alerts are directly “RWY TOO SHORT” corresponding to the flightcrew selection. At entry-into-service of the A350, the runway states DRY and WET are available for pilot selection. Extension to contaminated runway states is planned.

XI. RUNWAY OVERRUN PROTECTION (ROP)

ROP becomes active on-ground after transition from ROW and remains active until taxiing speed. ROP uses the aircraft’s current deceleration and aircraft characteristics to determine where the aircraft can safely stop on the runway. If ROP detects a risk of runway overrun, aural and visual alerts are triggered. On the PFD the red visual alert “MAXBRAKING, MAX REVERSE” is displayed. Aural alerts are prioritized: “BRAKE, MAX BRAKING, MAX BRAKING” aural alert is triggered until pilot application of pedal braking,then aural alert “SET MAX REVERSE” if maximum reverse thrust has not been selected. If overrun condition still exists at 70kt, the aural alert “KEEP MAX REVERSE” will trigger to remind the flight crew to keep maximum reverse thrust. ROP is reversible and alerts are cancelled when overrun risk is no longer present. On the Airbus A380 and A350, if an Autobrake mode is engaged, ROP will automatically apply maximum braking in case of runway overrun risk. ROPS and Navigation Display.

XII. MANAGEMENT AND PPREVENTION

Efforts to address runway excursion either focus on preventing runway excursions, or on minimizing the amount of damage or injury caused by a runway excursion. In the latter category, aviation safety regulators may establish standards such as minimum runway safetyareas intended to allow adequate time and distance for an aircraft to stop in the event of a runway excursion.

XIII. RUNWAY WIDENING AND EXTENSION

A key aspect of preventing runway excursions is providing runways of sufficient length and width to accommodate the aircraft used at an airport. In the 1960s, the advent of jet airliners such as the Boeing 707, which operate at faster speeds including at takeoff and landing relative to earlier propeller-driven airliners, required longer runways. In the mid- 1960s, the Federal Aviation Administration (FAA) proposed increasing minimum runway length requirements by 800 feet (240 m) at all U.S. airports with jet airliner service, extendingto 1,200 feet (370 m) feet in rain or snow conditions. However, these requirements would have necessitated building extending runways or even building new airports in some cities. After strong industry response, the FAA withdrew the proposal and instead only mandated a fifteen per cent increase to minimum runway length during wet or slippery landing conditions. Preventing runway excursions can necessitate building new airports, when there is not room to expand existing runways. In July 1965, Continental Airlines Flight 12 (a Boeing 707)overran the runway while landing in rain and high winds at Kansas City Municipal Airport. Investigators ruled out pilot error, and determined it would have been impossible to stop the aircraft in the available runway length. Extending the 7,000 foot (2,100 m) runway was not possible due to space limitations surrounding the urban airport, and construction on Kansas City International Airport north of the city was approved the next year, opening in 1972 withrunways 9,500 feet (2,900 m) and 9,000 feet (2,700 m) in length.

XIV. FLIGHT SYSTEM TECHNOLOGY

Airbus is developing the Runway Overrun Prevention System, a flight systems technology intended to prevent runway overruns by increasing pilots’ situational awareness and enhancing automation during landings.

XV. RUNWAY CONDITION ASSESMENT

Takeoff and Landing Performance Assessment (TALPA) was introduced in 2016, whereby airport operators report Runway Condition Codes (RWYCC) for take-off andlanding.

XVI. RUNWAY CONFUSION

Runway confusion is when a single plane uses the wrong runway or a taxiway during landing or takeoff. Only two fatal runway accidents in recent years have been attributed to runway confusion: Singapore Airlines Flight 006 and Comair Flight 5191. On October 31, 2000, the pilots of Singapore Airlines Flight 006 attempted to takeoff on a closed runway, in the midst of a typhoon. The plane crashed into some construction equipment, killing 83 of the 179 people onboard.

XVII. FACTOR INFLUENCING LANDING PERFORMANCE

There are a number of factors that influence the landing performance. For the present study it is important to have a basic understanding of these factors without going into much detail.This section presents a brief overview of those landing performance factors.

XVIII. WHAT IS GOOD LANDING?

Inshorta'good'landinghasthefollowingcharacteristics.Itstartswithastabilisedapproachon speed, in trim and on glide path. During the approach the aircraft is positioned to land in thetouchdown zone. When the aircraft crosses the threshold it is at the correct height and speed. The approach is ended by a flare without any rapid control column movements which isfollowed by a positive touchdown without floating. Immediately after touchdown of the main gear the spoilers (if available) are raised (manually or automatically), the brakes are applied(manually or automatically), (if available) the reverse thrust or propeller reverse. This is the landing as it can be found in flight crew training manuals. However, not many landing sare conducted exactly like this every day. Deviations from this good practice occur often without any serious consequences .However, when there are large deviations from the 'good' practice it can become more difficult to stop the aircraft on therunway. These deviations are discussed in the next sections.

XIX. APPROACH SPEED

The approach speed is determined by a number of factors such as flap setting, weight of the aircraft, the headwind, turbulence, and the handling of the pilots. Based on a number of thesefactors the pilot calculate satar get approach speed (bug speed) which the pilot tries to fly during. This is mainly affected by the aerodynamic ground effect which varies amongst different aircraft types. In case of floating the pilot often tries to bleed off the excess speed. This action takes a significant part of the amount of runway remaining to stop the aircraft. The effect of the excess speed on the ground roll distance is usually less than the increase ofthe flare distance due to floating. Thereforeputting down the aircraft with an excess in speed is important instead of bleeding off the excess speed in the air. Excess approach speed landings are more often associated with non-precision and visual approaches than with precision approaches. Precision approaches are inherently related with a procedure in which a constant descent gradient from the final approach altitude to touchdown is defined. The descent gradient can be verified during the flight. However this is notalways the case which makes such approaches more vulnerable to excess speed.

XX. APPROACH PATH

Atmospheric turbulence, guidance errors and inaccurate control by the pilot can result in deviations from the nominal glide path. It is important that the aircraft crosses the threshold at the correct height and with the intended glideslope. Excess height at the threshold can increase the landing distance. The same applies when the glideslope is shallower. For example landing distanceforanaircraftona3degreeglideslopeapproachwithexcessheight of 30 ft. at the threshold is approximately 700 ft. In combination with a one degree shallower glideslope this increases to approximately 1,000 ft. Some pilots tend to make a so-called duckunder manoeuvre when crossing the runway threshold. In this situation the pilot is flying theaircraft below the nominal path with a shallower glideslope. The tendency to do so varies amongst the pilots, aircraft type flown and visual conditions. Such a flying technique can alsoresult in longer landings. Excess height landings are moreoften associated with non-precision and visual approaches than with precision approaches. Precision approaches are inherently related with a procedure.

XXI. FLAREAND TOUCH DOW

During the flare maneuver the pilot reduces the rate of descent so that an excessively hard touchdown is avoided. In the execution of the flare the pilot relies on his/her experience and judgment. The pilot decides on the moment to initiate the flare and on the amount of elevator input during the flare. The touchdown should follow immediately upon the completion of the flare. However, often the aircraft floats for some time before touchdown. This can take a considerable amount of runway. In the example presented in the introduction of this paper, the DC10 landed some 4,700 ft. beyond the threshold. In the example the aircraft floated forsome distance after the initial landing flare. The 20ft. callout was made three times. Thereafter, the Captain (PNF) told the First Officer (PF) to put the aircraft down. The tendency to float depends on anumber of factors which are difficult to generalize. For instance, ground effect appears to play an important role. Ground effect is the aerodynamic influence of the ground on the flowaround an aircraft. It increases the lift, reduces the aerodynamic drag, and generates a nose down pitching moment as the ground is approached. The nature of and magnitude of ground effect are strongly affected by the aircraft configuration. Ground effect provides a landing cushion that feels very comfortable to the pilot. This could explain to some extent the influence of ground effect on the tendency to float. As explained already excess approach speed can also result in floating of the aircraft after the flare as the pilot tries to bleed off theexcess speed.

XXII. AIRCRAFT ACCIDENT DISTRIBUTION RELIGION

It was found that the landing overrun risk varies for the different world regions There are several explanations for this finding.Thereexistsadifferenceinthelevelofaviation safety between the different regions in general. This could also affect the landing overrun risk. Note that an almost similar regional distribution in accident rates was found for landing accidents in general, e.g. not limited to overruns. The highest landing overrun rate was found for Africa. The lowest rate was for North America.However when comparing the rates for the different regions it should be realised that not alldifferences in accident rates are statistically significant (at the 5% level). Although NorthAmerica seems to have the lowest rate it was not found to be statistically different from the rates estimated for the Middle East and Australasia regions. The low rate for North America wasstatistically different from the rate for the Europe and remaining regions.

XXIII. LONG, FAST AND HIGH LANDINGS

In more than half of all accidents the landing was long meaning that the aircraft contacted therunway far beyond the threshold. Landing far beyond the threshold showed the highest landingoverrun risk increase. A long landing itself is not always hazardous. For instance, when a smallturboprop aircraft lands on a very long runway, landing long will not automatically result in difficulties stopping the aircraft on the remaining runway. However, long landings can becomemore hazardous when the available runway to stop the aircraft becomes shorter and/or the runway is slippery. The estimated number of long landings used to derive the risk ratio, contained landings on all kinds of runways with different lengths. In that respect the derive disk ratio for long landings represents an average risk value. Landing fast and/or high also increased the landing overrun risk significantly. Long landings are often associated.The landing overrun risk is much higher when a non-precision or visual approach is flown. These approach types are more likely to become unestablished (e.g. flying too fast and too high)than precision approaches. Indeed the vast majority of overruns in which there was an excess approach speed occurred during a non-precision or visual approach (81%).In80%of all landing overrun accidents that were high over the threshold the approach type was non-precision orvisual. Similar in 82% of all overruns in which a long landing was reported the approach typewas a non-precision or visual approach.

XXIV. RUNWAY CONDITION

Slippery runway conditions were associated with higher risk of a landing overrun accident.This finding is not a surprise and is well known in the aviation community. Howeverquantitative increase in risk was not known. Runway condition affects the braking forces the aircraft tires can generate. Furthermore wheel spin-up can be delayed on slippery runways, which affects the proper functioning of the antiskid system and the deployment of groundspoilers. On wet/flooded or slush covered runways the tire may hydroplane which reduces thebraking forces between the tire and runway significantly. On snow and ice covered runwaysthe braking friction levels are very low making it difficult to stop the aircraft. During the last35 years there have been many initiatives to get a better understanding into runway traction. Numerous studies have been conducted for instance in the United States by NASA, USAF andFAA and in the United Kingdom to understand the impact of runway condition on the stoppingcapabilities of an aircraft. These studies examined the influence of runway texture on brakingfriction, analysed the hydroplaning of tires, and showed what impact snow and ice had on brakingfriction. Several studies also looked at measuring runway friction using ground vehicles and the correlation of the outcome of these vehicles with the friction of an aircraft. Such correlations could be valuable for the pilot when making an assessment of the landing performance. Unfortunately, despite the great effort made so far, an acceptable solution to this Problem of measuring runway friction and correlating it to aircraft landing performance is stillto be found.

XXV. TAIL WIND LANDING

Tailwindlandingareassociatedwithhigherriskoflandingoverruns.Tailwind increases the groundspeed and therefore the landing distance. Typically aircraft are certified to make landings with a maximum tail wind component. For mostcommercial aircraft this is 10 knots on a dry runway. Some aircraft are certified for higher tail winds. However, this is usually not more than 15 knots. On slippery runways lower tailwinds are allowed during the landing varying from 5 knots to no tailwind at all. A more detailed discussion on tailwind operations is provided by Van Es & Karwal, 2001.

XXVI. APPLICATION OF AVAILABLE STOPPING DEVICE

In 8.3% of the landing overrun accidents one or more stopping devices did not function. This was mainly due to problems with the hydraulic systems. This sometimes also prevented the use of flaps which resulted automatically in excess approach speed landings. More worrying is the fact the in 15% of the accidents there was a late or no application of the available stopping devices. In many of these accidents an overrun was avoidable if the available stopping deviceswould have been properly used. The problems were mainly caused by the fact that the groundspoilers were not armed (52% of all cases with a late or no application of the available stopping device). In these cases the pilots often failed to notice that the spoilers did not deploy. Also late or no application of thrust reversers was often found in the accidents (67% of all cases with a late or no application of the available stopping device). In some cases reverse thrust wasselected initially. However shortly afterwards it was deselected again. It could be not derived from the analysed data that insufficient manual braking was often a factor. However, to identify that fact detailed flight data recordings need to be analyzed.

XXVII. AUTO LANDS

None of the analysed landing overrun accidents was reported to be attributable to malfunctioning or improper functioning of the auto land system. In one accident from the datasample the crew initially conducted an autoland, however, took manual control over the aircraft Again just after passing the threshold. In only a very few number of other cases it was suspectedthat an auto land was most likely conducted due to the visibility conditions at the time landing. However, not enough details were reported to be absolutely sure about these facts. This madeit difficult to estimate a reliable risk ratio for manual landings. Still it can be argued that autolands can reduce the landing overrun probability as it reduces the likelihood of flying toohigh, too fast, and making long landings. As shown in this study these factors increase the riskof a landing overrun accident.

XXVIII. AUTOMATIC AND MANUAL LANDING

Aircraft that can land during low visibility and/or cloud ceilings (CAT III conditions) are equipped with a system that allows the aircraft to make a fully automatic landing. The majority of aircraft that have these systems installed can only conduct a fully automatic landing up to touchdown (auto land with no roll-out guidance). Ableto the get the aircraft to touchdown on the exact same spot on the runway every time. However compared to manual instrument landings the touchdown scatter of an automatic landing is much less. Unpublished flight data showed that the mean distance from the threshold to the touchdown point is about 30% higher during a manual instrument landing. The scatter inthis distance (in terms of standard deviation) is about 130% higher during a manual landing.

XXIX. FINAL REMARK

The variables that increase the risk of a landing overrun were discussed in the previous sections. Each of the investigated variables played an important role in the chain of events leading to an overrun. Typically a landing overrun was not characterized by the presence of only onevariable. It isoften the combination of factors that finally made the aircraft to overrun the runway. The quantified risk ratios in this study demonstrate that associations exist between a number of landing related factors and the risk of a landing overrun accident. Such associations do not prove any causation and only suggest that an increase in risk for a landing overrun accident appears when the factor is present. The present study did not try to identify the underlying causal factors related to landing overruns. There have been many studies conducted in the pasting which these underlying causal factors have been identify.

XXX. CONCLUSION

The following conclusions can be drawn from the landing overrun accident data studied in this paper:

Africa region demonstrated the highest landing overrun accident rate, followed byCentral/South America, and Asia. All these regions had rates of more than 1 accident per millionlandings.Therestoftheworlddemonstratedratesbelow1accidentpertwomillion landings which was less than half of the rate of the previous mentioned regions. North America had thelowest rate of all regions. worldwide basis, there appears to be a significant increase in landing overrun risk when one of the following factors is present during a landing: Non-precision approach, touching down far beyond the threshold (long landing), excess approach speed, visual approach, significant tailwind present, high on approach, wet/flooded runway, and/or snow/ice/slush covered runway. The highest risk increase occurred when the aircraft touched down far beyond the threshold (long landing), followed by excess approach speed. On a worldwide basis, the landing overrun accident trade has reduced by a factor of three over a period of thirty-five years. This reduction is most likely the result of a number of factorsincluding improvement in braking devices (antiskid, auto brakes etc.), better understanding ofrunway friction issues, and safety awareness campaigns. Late or no application of available stopping devices was often found to be a factor in the landing overrun accident. These overrun accidents were all avoidable if the crew had used theavailable stopping devices, without any delay.

XXXI. RECOMANTATION

It is recommended to disseminate the results of this study to all interested parties includingairlines, regulators, and pilot unions. It is recommended to analyze in detail the characteristics associated with long landings usingrecorded flight data of normal day-to-day landings.

XXXII. ACKNOWLEDGEMENT

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