THE ACCIDENT RISK SCALE

Managing Risk

With

Operational Control

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Introduction

Today we are going to present for your consideration, a viewpoint of risk management from the Aircraft Dispatcher's perspective. We are also going to introduce, for the first time, an **Accident Risk Scale** that can be used to estimate the accident risk of each flight operated under a dispatch system. It represents an initial effort to quantify dispatching risks and is designed to be used primarily as a training tool. Since this scale is making it debut today, we welcome your feedback and suggestions both positive and negative.

Risk management is not a new concept to the aircraft dispatcher. In fact, it "is" what we do and have done since 1938. We do it for every flight we release, and follow. That adds up to approximately 12,000 flights per year for an average dispatcher. A 20-year dispatcher will have almost a quarter of a million flights to his credit.

Risk management by dispatchers is accomplished by exercising Operational Control - that is - we exercise joint authority with the Pilot In Command over initiating, conducting, or terminating a flight. Flights are released only when dispatchers are convinced they can be completed safely. Flights are started only when the pilot in command and aircraft dispatcher believe they can be operated safely as planned. Each flight is allowed to continue as planned as long as the pilot in command and aircraft dispatcher are sure it is safe to continue. If safety is threatened, either the pilot in command or aircraft dispatcher can terminate the flight prematurely.

In order for something to be "safe", one must know what it is they need to be safe from. In other words, what are the hazards? Before safety can be maintained, the hazards must be understood, recognized, and avoided. Hence, one of the definitions of **safety** is - the **understanding, recognition, and avoidance of hazards**. Understanding requires training, recognition requires tools, and avoidance requires time and techniques. The four "T"s, training, tools, time and techniques are the foundation for all competence regardless of the profession.

Definitions & Nomenclature

Aircraft Accident - "An occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage.
(Source - NTSB Regulation Part 830.2)

Safe - Free from danger or injury; free from hazard
(Source American Heritage Dictionary)

Hazard - risk, danger, peril
(Source American Heritage Dictionary)

Danger - exposure or vulnerability to harm or evil
(Source American Heritage Dictionary)

Risk - "chance of harm or loss"
(Source American Heritage Dictionary)

Management - Control, handling, direction
(Source American Heritage Dictionary)

Control - The anatomy of control is start, change, stop.
(Source -Modern Management Defined)

Dispatch-Related Hazards to Flight

In the course of today's discussion, we will only be addressing dispatch-related hazards to flight – those elements of risk that can be reduced through the assertive intervention of dispatchers and flight crews. Clearly, there are hazards to flight that are beyond the protective scope of positive Operational Control. Controlled flight into terrain is an example of an aviation hazard that will not be considered in this study.

A number of years ago, an air safety study showed that there are six accident cause / factors that are related to Operational Control, or the lack of it. For this presentation, we have added a seventh hazard, icing to our list.

"DISPATCH RELATED" CAUSE / FACTORS

1. THUNDERSTORMS
2. CLEAR AIR TURBULENCE
3. UNSAFE AIRPORT CONDITIONS
4. LOW LEVEL WIND CONDITIONS
   Adverse / Unfavorable
5. LOW CEILINGS / VISIBILITY'S
6. FLIGHT CREW ERRORS (Qualified)
7. ICING

The threat of one or more of these hazards affecting the safety of a flight obligates an Aircraft Dispatcher to take an assertive role in the Operational Control of a flight.

These hazards to flight, the fatalities, injuries and aircraft damage they cause, are probably the reason congress took action in 1938 to license Aircraft Dispatchers and give them joint responsibility with the pilot in command for the Operational Control of a flight. Let's go back in time for a moment and remind ourselves what air transport was like in the time before the existence of positive operation control. This story was forwarded to ADF by one of our members, having originated from an unknown source.

We left Chicago at 5:00 PM on May 29, 1934 and I headed for our first stop at Cleveland. We were supposed to go on to Newark but the weather there was lousy and had been all day. Since it was the copilots duty to check the gas before departure (stick the tanks) and thinking we might need all the gas we could get, I filled the tanks - ran them over - to be sure they were full (268 gals). Night had fallen by the time we left Cleveland. I was at the controls and Johnny, the other pilot, requested clearance to Albany, N.Y. for better train connections for the passengers to New York. I headed for the Cleveland to Albany airway over to my left to follow the (airway) beacon lights to Albany. Johnny went back in the cabin and stayed quite a while taking to the passengers. At a point up the line to Albany, Johnny came up to listen to the weather broadcast. We were near the north-south airway that crossed our route about 50 miles northwest of Newark. The weather at Newark on that broadcast was better than planned, 600 - 1/2. Johnny signaled me to head for Newark. When we got down to the Newark range marker, Johnny reported our position over that range. That surprised everyone at air traffic, for at that time we should have been nearing Albany. Johnny took the airplane and as we approached Newark, the weather was down again. Newark had centerline runway lights and I think they were 200 feet apart. Johnny did a good job on each approach. He would let her right down to the ground but on each try was off to the left side of the lights because of the strong winds there that night. I had my head out the side window and could see only one light - dimly - at a time. Also we could not stay down there too long because hangars were close to each side of the runway and at the other end. On each pullout, the red hazard light on our hangar showed up much too close right off my wing tip. After the fourth attempt, we had to give up and go back up on top. The tops were 1200 ft, clear above with stars and moon out. The Empire State building was sticking out like a sore thumb. It was beautiful up there. We were now on our last tank of gas with 36 gallons left. I had pumped the other two tanks dry. As I remember, those engines used about a gallon a minute, (Boeing 247, NC13334) so we had 36 minutes to do something. At about the 15-gallon mark Johnny started letting down slowly, hoping to get underneath. He looked for a flat area -apple orchard or corn field- we couldn't be fussy about an airport. I had my head out my side window, looking for breaks or a field or anything, when I noticed what appeared to be “white caps" *behind* the prop on my side! I thought we were out over the Atlantic, running out of gas, and I couldn't swim. I checked the altimeters and they showed 900ft. It then dawned on me that the "whitecaps" were the undersides of tree leaves. I horsed back on the wheel and we busted out on top again at 1200 feet. That was a narrow escape - but we had more coming. I then suggested to Johnny that we turn 90 degrees to the coast and maybe we would run off (the edge of) the overcast and find an open field. We headed northwest but as far as we could see it was overcast. Now we were down to 4-5 gallons. Johnny started letting down slowly again - we didn't how what the hell was under us. Finally, I saw lights below under the clouds. - We were over a town. Johnny took a quick look and told me to kick out a flare. In just seconds the flare landed among a lot of houses. We went ahead for a minute and Johnny asked for the other flare. It wouldn't release. We had hit something that had partially closed the tube the flare slides out through. (We found out later we darned near knocked over a church steeple in this little town- which was Bethel, Conn.-70 miles northeast of Newark). By then we were down to 1 or 2 gallons of gas - nothing to do but level off - go straight ahead and get away from this town. Finally, after just a few seconds, the fuel pressure lights came on. I pulled my head back in -"might as well hang on to it as long as possible", I thought. We said so long to each other - Johnny slowed her down as much as possible and the last thing I remember was seeing tree branches going by the right landing light which was turned on. When I "came to" it seemed as quiet as a vacuum. My first thought was, 'This trip is over".

We had crashed 18 minutes after midnight, May 30, 1934. The tail section broke off behind the cabin door. It had whipped around and turned upside down. The end of the stabilizer leaned right up to the cabin door, so the passengers could slide right down it to the ground. We woke up this little town and a lot of people came over to the wreck and hauled the people over to Danbury, Conn. Hospital, 3 or 4 miles away.

That wreck, I think germinated a few ideas - like having an alternate before takeoff - reserve fuel - to get there, landing minimums and dispatchers to watch out for us. When landing back then, if I remember correctly, we had no minimums - if you could get in with 0-0 weather conditions-fine, there were no questions. Also I think that might have been the beginning of thinking about approach lights, etc. I don't believe we had any of those things in '34.

As alluded to in this story, the origins of many Dispatch related FAR's can be traced to this and a number of other similar accidents which occurred in the early and mid 1930's. Lawmakers of the time clearly recognized the value of a second set of eyes watching over the operation of transport aircraft. Let's review some of these FAR's. Note that the hazards we cited earlier are recognized in the FAR's.

Related Federal Aviation Regulations

FAR Part 1 Definitions

“Operational Control, “ with respect to flight means ***the exercise of authority*** over ***initiating***, ***conducting***, or ***terminating*** a flight.

FAR 65.51 Certificate required.

(a) No person may serve as an aircraft dispatcher ***(exercising responsibility with the pilot in command in the Operational Control of a flight)*** in connection with any civil aircraft in air commerce unless he has in his personal possession a current aircraft dispatcher certificate issued under this subpart.

FAR 121.663 Responsibility for dispatch release: Domestic and flag operations.

Each certificate holder conducting domestic or flag operations shall prepare a dispatch release for each flight between specified points, based on information furnished by an authorized aircraft dispatcher. The pilot in command and an authorized aircraft dispatcher shall sign the release ***only if they both believe that the flight can be made with safety***. The aircraft dispatcher may delegate authority to sign a release for a particular flight, but he may not delegate his authority to dispatch.

FAR 121.627 Continuing flight in unsafe conditions

(a) No pilot in command may allow a flight to continue toward any airport to which it has been dispatched or released if, ***in the opinion of the*** pilot in command or ***dispatcher*** (domestic and flag air carriers only), the flight cannot be completed safely; unless, in the opinion of the pilot in command, there is no safer procedure. In that event, continuation toward that airport is an emergency situation as set forth in FAR 121.557.

(b) If any instrument or item of equipment required under this chapter for the particular operation becomes inoperative enroute; the pilot in command shall comply with the approved procedures for such an occurrence as specified in the certificate holder's manual.

FAR 121.533 Responsibility For Operational Control:

(c) "The Aircraft Dispatcher is responsible for -

(3) ***Canceling*** or ***redispatching*** a flight if, ***in his opinion*** or the opinion of the pilot in command, ***the flight cannot operate or continue to operate safely as planned or released.***

FAR 121.101 Weather reporting facilities

(a) Each domestic and flag carrier must show that enough weather reporting services are available along each route to ensure weather reports and forecasts necessary for the operation.

(b) Except as provided in paragraph (d) of this section, no domestic or flag air carrier may use any weather report to control flight unless -

(1) For operations within the 48 contiguous States and the District of Columbia, it was prepared by the U.S. National Weather Service or a source approved by the U.S. National Weather Service; or

(2) For operations conducted outside the 48 contiguous States and the District of Columbia, it was prepared by a source approved by the Administrator.

(c) Each domestic or flag air carrier that uses forecasts to control flight movements shall use forecasts prepared from weather reports specified in paragraph (b) of this section and from any source approved under its system adopted pursuant to paragraph (d) of this section.

(d) By December 31, 1977, each domestic and flag air carrier shall adopt and put into use an approved system for obtaining forecasts and reports of adverse weather phenomena, such as ***clear air turbulence, thunderstorms, and low altitude windshear***, that may affect safety of flight on each route to be flown and at each airport to be used.

FAR 121.629 Operation in icing conditions.

(a) No person may dispatch or release an aircraft, continue to operate an aircraft enroute, or land an aircraft when ***in the opinion of the*** pilot in command or ***aircraft dispatcher*** (domestic and flag operations only), icing conditions are expected or met that might adversely affect the safety of the flight.

FAR 121.601 Aircraft dispatcher information to pilot in command

(a) The aircraft dispatcher shall provide the pilot in command all available current reports or information on ***airport conditions*** and irregularities of navigation facilities ***that may affect the safety of the flight.***

(b) Before beginning a flight, the aircraft dispatcher shall provide the pilot in command with all available weather reports and forecasts of weather phenomena that may affect the safety of flight, including adverse weather phenomena, such as ***clear air turbulence***, ***thunderstorms***, and ***low altitude windshear***, for each route to be flown and each airport to be used.

(c) During a flight, the aircraft dispatcher shall provide the pilot in command any additional available information of meteorological conditions (including adverse weather phenomena, such as ***clear air turbulence***, ***thunderstorms***, and ***low altitude windshear***), and irregularities of facilities and services that may affect the safety of the flight.

Operational Control (Start-Change-Stop) and Risk Management

In order for a dispatcher to be able to control the risk hazards threatening his or her flights, the dispatcher must have the ability to exercise all three control forces identified earlier in this discussion, (**Start, Change, Stop**). This is Operational Control. If you have the ability to start, change and stop something, you are in control. If you are missing any of these three elements, you are no longer in control.

Consider for a moment, the control of an automobile, you have a key and a starter to **start** the vehicle's journey, the steering wheel allows you to **change** direction and of course, the brakes allow you to **stop**. Take away any of these elements and it is questionable whether you will be able to operate the vehicle safely.

Let's take the thunderstorm hazard and examine how the dispatcher can employee avoidance techniques to minimize risk and enhance safety in all three phases of flight as defined in FAR part 1, **initiating, conducting** and **terminating.**

INITIATING	***CONDUCTING***	***TERMINATING***
	Cruise	
Climb		Descent
Start	***Change***	***Stop***
MEL App	Route	Hold Fuel
Pilot Briefing	Altitude	Alternate(s)
Delay		Redispatch
Cancel		Divert

<u>AVOIDANCE TECHNIQUES</u>

MEL Application
Pilot Briefing
Delay Start
Cancel
Route Selection
Altitude Selection
Adequate Hold Fuel
Safe Alternate(s)
Redispatch – Shorter Alternate(s)
Diversion Direction – Assistance

THE ACCIDENT RISK SCALE

The **Accident Risk Scale** is built by arranging the descriptive terms and nomenclature of each hazard we have previously identified in order of greatest to lowest risk. Next a numeric ***Risk Value*** is assigned to each level of the specific hazards that the flight will be exposed to. The cumulative total of each hazard's risk value yields a ***Total Risk Value*** for the flight. Along the Y-axis on the left side of the scale, values of 1 to 10 are used to quantify risk. On the X-axis, we placed each dispatch-related hazard arranged in a subjective order of danger assessed in terms of fatalities, injuries, and aircraft damage. The degree of risk is classified into four categories, high risk, moderate risk, low risk, and no risk. Three examples of the **Accident Risk Scale** can be found at the back of this booklet and may be used throughout this presentation for reference.

The total accident risk for a particular operation is assessed by asking the question, "What would the risk of an accident be if a flight is planned or allowed to operate with exposure to the identified hazards? As we proceed, we will ask ourselves this question often. We have developed numeric values and descriptive terms to help refine our assessment of specific hazard combinations.

THUNDERSTORMS

The first hazard that we are going to put on our scale is the thunderstorm. It is by far the most dangerous dispatch related hazard. Thunderstorms cause more fatalities and injuries, and damage or destroy more aircraft than any other dispatch-related hazard.

Operationally, the thunderstorm threat is referred to or described in two ways - geographical coverage and intensity.

VALUE	RISK	COVERAGE	INTENSITY
10 **9** **8**	High	Solid Lines Broken Line Broken Line	VIP Level 6 VIP Level 5 VIP Level 4
7 **6** **5**	Moderate	Broken Line Broken Areas Broken Area	VIP Level 2
4 **3** **2**	Low	Scattered Area Widely Scattered Isolated	
1	No Risk	No Thunderstorms	

Accident Example:

Date: April 4, 1977
Type: DC-9-31
Registration: N1335U
Operator: Southern Airways, Inc.
Where: New Hope, Georgia
Report No. NTSB-AAR-78-3
Report Date: January 26, 1978
Pages: 106

At 1619 e.s.t. April 4, 1977, a Southern Airways, Inc., DC-9, Flight 242, crashed in New Hope, Georgia. After losing both engines in flight, it attempted an emergency landing on a highway. Of the 85 persons aboard Flight 242, 62 were killed, 22 were seriously injured, and 1 was slightly injured. Eight persons on the ground were killed and one person was seriously injured; one person died about 1 month later.

Flight 242 entered a severe thunderstorm between 17,000 feet and 14,000 feet near Rome, Georgia, en route from Huntsville to Atlanta. Both engines were damaged and all thrust was lost. The engines could not be restarted and the flightcrew was forced to make an emergency landing.

The National Transportation Safety Board determines that the probable cause of this accident was the total and unique loss of thrust from both engines while the aircraft was penetrating an area of severe thunderstorms. The loss of thrust was caused by the ingestion of massive amounts of water and hail which in combination with thrust lever movement induced severe stalling in and major damage to the engine compressors.

Major contributing factors included the failure of the company's dispatching system to provide the flightcrew with up-to-date severe weather information pertaining to the aircraft's intended route of flight, the captain's reliance on airborne weather radar for penetration of thunderstorm areas, and limitations in the Federal Aviation Administration's air traffic control system which precluded the timely dissemination of real-time hazardous weather information to the flightcrew.

CLEAR AIR TURBULENCE

Clear Air turbulence *(Turbulence not associated with convective activity)* is rated as the second most hazardous of the dispatch related cause/factors in terms of fatalities, injuries, and aircraft damage. The Aeronautical Information Manual provides the standard nomenclature and description of this hazard by intensity. By reversing the table you can see how well it fits with our risk assessment approach. Again our qualifying question is, "What would the risk of an accident be if a flight is planned or allowed to operate into an area of ______________turbulence?

Value	Intensity	Aircraft reaction	Reaction inside
10	Extreme	Turbulence in which the aircraft is violently tossed about and is <u>practically impossible to control</u>. It may cause structural damage.	Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food service and walking are impossible.
7	Severe	Turbulence that causes large, abrupt changes in altitude and/or attitude. It usually causes large variations in indicated airspeed. <u>Aircraft may be momentarily out of control.</u>	Occupants are forced violently against seat belts or shoulder straps. Unsecured objects are tossed about. Food service and walking are impossible.
4	Moderate	Turbulence that is similar to Light Turbulence but of greater intensity. Changes in altitude and/or attitude occur but the aircraft remains in positive control at all times. It usually causes variations in indicated airspeed.	Occupants feel definite strains against seat belts or shoulder straps. Unsecured objects are dislodged. Food service and walking are difficult.
2	Light	Turbulence that momentarily causes slight, erratic changes in altitude and/or attitude (pitch, roll, yaw)	Occupants may feel a slight strain against belts or shoulder straps. Unsecured objects may be displaced slightly. Food service may be conducted and little or no difficulty is encountered in walking.
1	None		

<u>Accident Examples:</u>

There have been several catastrophic air carrier accidents associated with severe turbulence. One of the most notorious occurred on March 5, 1966. On that morning, a BOAC Boeing 707 climbing out of Tokyo's Haneda airport bound for Hong Kong encountered severe turbulence in the vicinity of Mt. Fuji. The aircraft broke up in flight and all 124 on board BA flight 911 perished. Severe turbulence had been forecasted and reported in the vicinity of the accident.

More recently, the following very close call occurred.

Nonscheduled 14 CFR 121 operation of Connie Kalitta Services
(D.B.A. American Int'l Airways)
Accident occurred DEC-09-92 at Denver, Co
Aircraft: DOUGLAS DC-8-52, registration: N810CK
Injuries: 3 Uninjured.

While in cruise flight at flight level 310, 20 miles west of Denver, Colorado, the all cargo 14 CFR part 121 flight encountered severe clear air turbulence which caused major fluctuations in speed and oscillations in both pitch and roll. During these departures from controlled flight, the number one engine and 19 feet of the leading edge of the left wing separated from the aircraft. In addition, the number four-engine pylon cracked and experienced substantial structural damage. The flight conducted a precautionary descent and landed at Stapleton international airport, Denver, Colorado. Preceding the occurrence, the flight was encountering light to occasionally moderate chop, with moderate to severe turbulence forecast.

UNSAFE AIRPORT CONDITIONS

The third hazard we are going to examine on our scale will be Unsafe Airport Conditions. Included in this category are slippery or contaminated runways. We have noted a substantial number of accidents caused by this hazard in the course of our accident review. Frequently, these accidents result in substantial aircraft damage, but only minor injuries and few fatalities. These accidents are primarily runway excursions caused by excessive precipitation rates that exceed the ability of the airport operator to remove the contamination. A second danger element associated with this hazard presents itself when residual contaminants have not been treated or removed from the runway. To assess the risk of these hazards we had to rely on the descriptive language used in daily practice.

When dealing with the unsafe airport condition hazard, pilots and dispatchers depend primarily on runway condition reports from the airport authority and braking action reports. These two reports and the safety trend they convey (improving or deteriorating) are mentally combined with the reported weather (special and hourly) to form an opinion as to whether or not it is safe to continue operations. When available, and time permits, dispatchers will monitor tower frequencies for the very latest braking action reports.

Notice how well safety is defined for runway conditions by the legalities for runway contaminants. If contaminants are less than 1/2 inch wet clutter or less than 6 inches dry clutter, it is considered safe to operate. However, once the contaminate becomes greater than 1/2 inch wet or 6 inches dry, operations are considered to be unsafe. The determination of what is safe and unsafe is black and white.

“What would the risk of an accident be if a flight is planned or allowed to operate to an airport that had ______________runway conditions and/or _________________braking action ?

VALUE	RISK	RUNWAY CONDITIONS	BRAKING ACTION
10 **9** **8**	High	Ice Covered Runway >6” Dry Clutter or > 1/2 “ Wet Clutter 6" Dry Clutter or 1/2" Wet Clutter	Nil Poor-Nil Poor
7 **6** **5**	Moderate	<1/2" Snow over Ice < 6” Dry Clutter < 1/2” Wet Clutter	Fair to Poor Fair to Poor Fair to Poor
4 **3** **2**	Low	1/4 Inch of Snow on the Runway Scattered Patches of Ice and Snow Wet	Fair Fair to Good Good
1	No Risk	Clear & Dry	Good

Accident Example:

Date: January 23, 1982
Type: DC-10-30CF
Registration: N113WA
Operator: World Airways, Inc.
Where: Boston-Logan International Airport, Boston, Massachusetts
Report No. NTSB-AAR-82-15
Report Date: December 15, 1982

On January 23, 1982, World Airways, Inc., Flight 30H, a McDonnell Douglas DC-10-30, was a regularly scheduled passenger flight from Oakland, California, to Boston, Massachusetts, with an en route stop at Newark, New Jersey. Following a nonprecision instrument approach to runway 15R at Boston-Logan International Airport, the airplane touched down about 2,500 feet beyond the displaced threshold of the 9,191-foot usable part of the runway. About 1936:40, the airplane veered to avoid the approach light pier at the departure end of the runway and slid into the shallow water of Boston Harbor. The nose section separated from the forward fuselage in the impact after the airplane dropped from the shore embankment. Of the 212 persons on board, two are missing and presumed dead. The others evacuated the airplane safely, but with some injuries.

The weather was 800-foot overcast, 2 1/2-mile visibility, with light rain and fog. The temperature was 38 degrees with the wind from 165 degrees at 3 knots. The surface of runway 15R was covered with rain, hard-packed snow, and glaze ice. At 1736, 2 hours before the accident**, runway braking was reported by a ground vehicle as "fair to poor;" subsequently, several pilots had reported braking as poor, and one pilot had reported braking as "poor to nil" in the hour before the accident.**

The National Transportation Safety Board determines that the probable cause of this accident was the pilot landed the airplane without sufficient information as to runway conditions on a slippery, ice-covered runway, the condition of which exceeded the airplane's stopping capability. The lack of adequate information with respect to the runway was due to the fact that (1) the FAA regulations did not provide guidance to airport management regarding the measurement of runway slipperiness under adverse conditions; (2) the FAA regulations did not provide the flightcrew and other personnel with the means to correlate contaminated surfaces with airplane stopping distances; (3) the FAA regulations did not extend authorized minimum runway lengths to reflect reduced braking effectiveness on icy runways; (4) the Boston-Logan International Airport management failed to exercise maximum efforts to assess and improve the conditions of the ice-covered runways to assure continued safety of heavy jet airplane operations; and, (5) tower controllers failed to transmit available braking information to the pilot of Flight 30H.

Contributing to the accident was the failure of pilot reports on braking to convey the severity of the hazard to following pilots.

The pilot's decision to retain autothrottle speed control throughout the flare and the consequent extended touchdown point on the runway contributed to the severity of the accident.

ADVERSE / UNFAVORABLE LOW LEVEL WIND CONDITIONS

This hazard can take a variety of forms and effect the safety of flight in many ways. In this broad category, we are including the following three hazardous wind conditions; excessive tailwind, excessive crosswind and non-thunderstorm related low level windshear. With regard to the crosswind/tailwind factor, the quantification of this hazard is taken primarily from the certification limitations in the airplane flight manual. Each aircraft we operate has a maximum crosswind/tailwind component that we must observe. A search through the NTSB accident records showed that excessive crosswind/tailwind by itself, as a stand-alone hazard has not caused any 121 air carrier accidents. However, when this hazard is combined with other dispatch related hazards such as unsafe airport conditions, the level of risk increases dramatically. The same can be said for non-thunderstorm induced low-level windshear. When combined with other operational hazards, low level windshear becomes a significant causal factor in a number of accidents. Our qualifying question for this hazard would be, "What would the risk of an accident be if a flight is planned or allowed to operate to an airport that had surface winds ____________________?

Value	Risk	Tailwind / Crosswind
10	High	> MAX Tailwind & Crosswind
9		>MAX Tailwind
8		> MAX Crosswind
7	Moderate	At MAX Tailwind
6		At MAX Crosswind
5		<MAX Tailwind
4	Low Risk	<MAX Crosswind
3		Strong Winds
2	No Risk	Light Winds
1		No Wind

Again, notice how compliance with the Airplane Flight Manual *(certification)* has made the question of safety a black or white choice for tailwind and crosswind limitations.

Accident Example:

Scheduled 14 CFR 121 operation of BUSINESS EXPRESS, INC.
Incident occurred FEB-20-96 at RIFLE, CO
Aircraft: British Aerospace AVRO 146-RJ70A, registration: N832BE
Injuries: 28 Uninjured.

The first officer, who flew the LOC/DME-A approach to runway 26 at a Vref speed of 115+5 knots, said the airplane touched down 2500 feet past the threshold and went off the end of the 7000 foot runway, coming to a halt 300 feet beyond. The airport manager said, and FDR and GPS confirmed, the airplane touched down 4600 feet beyond the runway threshold at 138 knots ground speed and 119 knots indicated airspeed, and traveled 3400 feet before coming to a halt. **Prior to landing, the crew did not request, nor did the airport or company dispatch give, runway condition, braking action, or precipitation reports. The captain said he found one inch of slush on the runway**. The Airplane Flight Manual states landings "on a slippery surface having a braking coefficient of friction of 0.05...are not permitted on a downhill runway unless the downhill slope is less than 0.5% and there is no tailwind component." Runway 26 has a 1.2% downhill gradient and FDR data indicates the wind was 098 at 6 knots.

Probable Cause:
The copilot's failure to compensate for wind conditions, resulting in excessive airspeed, and his failure to attain the proper runway touch down point**. Factors were inadequate dispatch procedures** and the captain's improper in-flight planning/decision in that runway conditions were not requested or obtained; a tail wind, a wet downhill runway, hydroplaning conditions, and the captain's failure to adequately supervise the copilot.

LOW CEILINGS & VISIBILITY

The next hazard we will discuss is Low Ceilings and/or Visibility. Scaling risk for this hazard would start with the high-risk category of landing below minimums. Unlike some of the other hazards that have a well defined mid-level of risk, Low Ceilings and/or Visibility transitions quickly from high risk to low/no risk. Landing "at minimums" can not be classified as anything other than a "low risk event". We have assigned it a risk value of 3 on our scale.

Landing with minimums of <1000 & 3 carries a slightly lower risk value when viewed as a stand-alone hazard. The <1000 & 3 weather category would take on a more substantial risk factor when combined with other hazards, such as adverse low-level winds. At Bozeman, Montana, for example, weather less than 1000 & 3 would preclude circling approaches and force crews to accept the ILS approach. Prevailing winds at BZN almost always yield a tail wind on the ILS runway. We have seen occasions where weather conditions of 1000 overcast and 2 miles and a six-knot tailwind on the ILS runway at BZN have resulted in transport aircraft overruns. Again, note that here the interaction of two hazards, Low Ceilings and/or Visibility with Adverse or Unfavorable Low Level Wind Conditions becomes a much greater threat to safety. The **Accident Risk Scale** will assist us in assessing this combined risk.

The next category on our scale is ceilings of 2000 feet or less, and visibility's of 3 miles or less. FAR 121.619 requires an alternate to be used and shown on the dispatch release for this category whenever the weather reports or forecasts or any combination thereof indicate that ceilings and visibility's below 2000 & 3 are expected one hour before or one hour after the planned arrival time. Notice where the emphasis of the FAR's is placed relative to the degree of risk. It is significant to note that fuel exhaustion accidents will often list this hazard as a major contributing factor.

The qualifying question for this hazard would be, "What would the risk of an accident be if a flight was planned to or allowed to operate to an airport where the ceiling and visibility were ________________________?

VALUE	RISK	Ceiling and Visibility
10	High	Below Minimums
3	Low	At Minimums
2	Low	<1000 & 3
1	No Risk	<2000 & 3

Accident Examples:

On February 2, 1970, a Pilgrim Airlines de Havilland Canada DHC-6 Twin Otter 100, N124PM departed Bridgeport, Conn. enroute to New York's JFK airport. Following extensive holding and several missed approaches at JFK due to low ceilings and fog, the aircraft was forced to ditch in Long Island Sound due to fuel exhaustion. The occupants, 2 crew and 3 passengers all died in this accident.

That same year, on May 2, 1970, an Antillean Airlines McDonnell Douglas DC- 9-33CF (wet lease operation by ONA airlines) operating ALM flight 980 New York-John F. Kennedy to Philipsburg, St. Maarten ditched in the Caribbean sea off St. Croix. The flight had executed 3 missed approaches to St. Maarten and was attempting to divert to St. Croix critically low on fuel. The engines flamed out as the aircraft ran out of fuel short of the St. Croix airport, forcing the ditching. The St. Maarten weather was below landing minimums due to rain showers and fog. This information had not been passed on to the flight crew prior to starting the approach since the operation was not conducted under a dispatch system. A very disappointing aspect of the NTSB's investigation into this accident was that the lack of positive Operational Control as a contributing factor was all but ignored. Rather, almost the entire focus of the Board's recommendations centered on requiring more flotation devices onboard transport aircraft.

ICING

The next hazard to be placed on our **Accident Risk Scale** is icing. The dispatcher's involvement with the icing hazard is normally limited to the takeoff-to-touchdown phase of flight. Additionally, in situations where deicing holdover times clearly do not allow for the required taxiout time, the dispatcher will be required to delay or cancel the flight. The primary focus of this hazard evaluation will be directed towards icing that occurs in flight. Dispatchers have a responsibility to comply with Airplane Flight Manual certification and MEL requirements for initiating and continuing flight in icing conditions. FAA Advisory Circular 91-51A dated July 1996, and the Aeronautical Information Manual contain a reporting table that can be used for descriptive language in building an icing risk scale. The qualifying question for icing would be, "What would the risk of an accident be if a flight was planned into or allowed to operate into an area of ____________________icing?

ICING INTENSITY, ACCUMULATION AND PILOT ACTION

Risk	Intensity	Airframe Accumulation	Pilot Action
10	Severe	The rate of accumulation is such that de-icing/anti-icing equipment fails to reduce or control the hazard.	Immediate heading or altitude change required.
4	Moderate	The rate of accumulation is such that even short encounters become potentially hazardous.	Deicing/anti-icing required or heading or altitude change required.
3	Light	The rate of accumulation may create a problem if flight is prolonged in this environment for one hour).	Deicing/anti-icing required occasionally to remove/prevent accumulation or heading or altitude change required.
2	Trace	Ice becomes perceptible. Rate of accumulation of ice is slightly greater than rate of sublimation.	Unless encountered for one hour or more deicing/anti-icing equipment and/or heading or altitude change not required.
1	No Icing		

(Source: FAA Advisory Circular 91-51A July 1996)

A search of NTSB accident records does not show any air carrier 121 accidents where a failure in the dispatch system was a contributing factor to an icing accident. However, when the accident records of non-121 operations (*No dispatcher and no Operational Control*) are reviewed icing is shown to play a major role in causing accidents.

HUMAN FACTORS PILOTS & DISPATCHERS

The most difficult area to assess and define in this study is the human factors category for Pilots and Dispatchers. FAR 91.13 provided us with a good start for the high-risk end of our scale because it clearly identifies “careless or reckless” as a possible endangerment to life or property. Reckless was placed as a higher risk than careless based on a NTSB law judge’s decision in the 1990 case against a dispatcher at a major carrier. The judge found the dispatcher to be careless but not reckless based on his demeanor and intent. The Dispatcher did not intend to violate the FAR’s he was just following FAA approved company procedures. Poorly trained was added as additional characteristic in the high-risk category. With the top end of the scale defined as such, antonyms to those high-risk traits were used on the low risk end. Reckless, careless and untrained were balanced with cautious, careful and highly trained.

We found further guidance in FAA Advisory Circular 60-22 which addressed some of the traits that the FAA believes would justify the label of careless or reckless as applied to an airman. Here is, in part, the content of that study:

Advisory Circular 60-22
Aeronautical Decision-Making.

Chapter 3. DEALING WITH HAZARDOUS ATTITUDES

HAZARDOUS ATTITUDES.
ADM addresses the following five hazardous attitudes.

A. **Antiauthority** (don't tell me!). This attitude is found in people who do not like anyone telling them what to do. In a sense they are saying no one can tell me what to do. They may be resentful of having someone tell them what to do or may regard rules, regulations, and procedures as silly or unnecessary. However, it is always your prerogative to question authority if you feel it is in error.
B. **Impulsivity** (do something quickly!) is the attitude of people who frequently feel the need to do something - anything - immediately. They do not stop to think about what they are about to do, they do not select the best alternative, and they do the first thing that comes to mind.
C. **Invulnerability** (it won't happen to me). Many people feel that accidents happen to others, but never to them. They know accidents can happen, and they know that anyone can be affected. They never really feel or believe that they will be personally involved. Pilots who think this way are more likely to take chances and increase risk.
D. **Macho** (I can do it). Pilots who are always trying to prove that they are better than anyone else are thinking I can do it - I'll show them. Pilots with this type of attitude will try to prove themselves by taking risks in order to impress others. While this pattern is thought to be a male characteristic, women are equally susceptible.
E. **Resignation** (what's the use?). Pilots who think what's the use? do not see themselves as being able to make a great deal of difference in what happens to them. When things go well, the pilot is apt to think that's good luck. When things go badly, the pilot may feel that someone is out to get me, or attribute it to bad luck. The pilot will leave the action to others, for better or worse. Sometimes, such pilots will even go along with unreasonable requests just to be a "nice guy."

For the middle of the scale we relied on empirical observations of the interactions between pilots and dispatchers when confronted with a hazard. What were they saying to each other and did it offer any clues as to how they intended to deal with a hazardous threat? Could it be assessed and scaled? The three most common responses from pilots that discounted the potentially hazardous situation during preflight briefings were; 1. “We gotta go anyway”, 2. “Give me more fuel and we’ll go”, 3, “I’ll go look at it” and let you know”.

On the dispatchers side we found, 1. “More fuel and go”, 2. “Two alternates and go”. 3. Lackadaisical. These responses and traits are the only clues we could find that indicated risk is increasing because they all indicate at least a degree of disregard for the hazard. The “we gotta go anyway” response indicated the greatest degree of disregard for the hazard and was placed higher on the scale than the other responses.

The “more fuel and go” solution could actually increase the risk when dealing with the Clear Air Turbulence hazard because the additional weight could limit the altitude capability of the aircraft to climb to smoother air. Additional weight when landing on contaminated runways can increase the stopping distance and increase the risk of an overrun. Additional fuel does have its place when used to provide holding at the destination for a thunderstorm to exhaust itself or for ceilings and visibility’s to improve to minimums or above.

The dispatcher’s “two alternates and go” may provide another operational option but it does not remove or neutralize many of the hazards and applies only to avoidance of the hazard at the destination and disregards enroute hazards. It appears to satisfy the need to do something but in actuality does little to avoid most hazards.

The third response from the pilots of “I’ll go look at it, and let you know” indicates a willingness on the part of the pilot in command to proceed but cautiously. Again this response needs to be hazard specific. These very words were used to talk a dispatcher out of canceling a night flight to an airport with contaminated runways and poor braking which resulted on an overrun of the nose gear. In retrospect, how does one go about “looking at” an unsafe airport condition at night with a half mile visibility from a 200 ft decision height traveling at 130 mph.

The responses we included in the moderate risk area should serve as an alert or red flag to pilots and dispatchers that they may have stepped up the risk to a moderate level.

The qualifying question for this group is, “What would the risk of an accident be if the pilot in command or dispatcher was a ___________________________________ pilot or dispatcher?

VALUE	RISK	PILOTS	DISPATCHERS
10 9 8 7	High	Careless and Reckless Reckless Careless Poorly Trained	Careless and Reckless Reckless Careless Poorly Trained
6 5 4	Moderate	Gotta Go Anyway More Fuel & Go I’ll Go Look At It	More Fuel & Go Two Alternates & Go Lackadaisical
3 2 1	No Risk	Wants Briefing Cautious & Careful Highly Trained	Wants To Brief Cautious & Careful Highly Trained

Accident Example:

Scheduled 14 CFR 135 operation of EXPRESS AIRLINES II, INC. (D.B.A. NORTHWEST AIRLINK)
Accident occurred DEC-01-93 at HIBBING, MN
Aircraft: JETSTREAM BA-3100, registration: N334PX
Injuries: 18 Fatal.

While on a localizer back course approach the airplane collided with trees and the terrain approximately 3 miles from the runway threshold. The captain delayed the start of the descent that subsequently required an excessive descent rate to reach the FAF and MDH. The captain's actions led to distractions during critical phases of the approach. The flightcrew lost altitude awareness and allowed the airplane to descend below mandatory level off points. **The captain's record raised questions about his airmanship and behavior that suggested a lack of crew coordination during flight operations, including intimidation of first officers**. Company management did not address these matters adequately. The airline's flight operations management failed to implement provisions to adequately oversee the training of their flightcrews and the operation of their aircraft. FAA guidance to their inspectors concerning implementation of ops bulletins is inadequate and has failed to transmit valuable safety information as intended to airlines.

Probable Cause:
The captain's actions that led to a breakdown in crew coordination and the loss of altitude awareness by the Flightcrew during an unstabilized approach in night instrument meteorological conditions. Contributing to the accident were: the failure of the company management to adequately address **the previously identified deficiencies in airmanship and crew resource management of the captain**; the failure of the company to Identify and correct a widespread, unapproved practice during instrument approach procedures; and the Federal Aviation Administration's inadequate surveillance and oversight of the air carrier.
(NTSB report AAR-94/05)

*The **Accident Risk Scale***

Now that we have identified the hazards on the scale and explored the risk values of each level of the hazards, let's use the scale to examine some example flights. We will evaluate three flights on the scale. Take particular note of two significant factors in this exercise. First, the threat from the existence of one or two hazards to a flight can be greatly reduced by top notched pilots and dispatchers. Second, as these hazards are combined, the threat to a flight increases dramatically. Once the total hazard factor for a flight has been calculated, by using the table below, we can assign a subjective accident risk factor to the flight under consideration.

Total Accident Risk	
None	10 to 14
Very Little	15 to 19
Low	20 to 29
Moderate	30 to 39
High	40 to 69
Extremely High	70 to 100

Example 1

Hazard Type - Factor	*Risk Value*
No Thunderstorms	1
No Turbulence	1
Ice Covered Runway	10
Braking Action Poor	8
Strong Winds	3
No Windshear	1
Clear Skies	1
Highly Trained Pilot	1
Highly Trained Dispatcher	1
No Icing	1
	Accident Risk Total 28

In spite of a slippery runway, the lack of any other significant hazard and top quality pilots and dispatchers, this situation only generates a Low Accident Risk rating on our scale. Now let's add in some additional complications.

Example 2

Hazard Type - Factor	*Risk Value*
No Thunderstorms	1
No Turbulence	1
Ice Covered Runway	10
Braking Action Poor	8
At MAX Crosswind	6
Plus and minus 10 knots of Windshear	4
Clear Skies	1
"Let's Take a Look" Pilot	4
Lackadaisical Dispatcher	4
No Icing	1
	Accident Risk Total 40

Here, we have added the hazard of maximum crosswind, 10 knots of windshear and now have middle of the scale pilots and dispatchers. Notice that this situation now generates a High Accident Risk rating on our scale. Now, let's really complicate things.

Example 3

Hazard Type - Factor	*Risk Value*
No Thunderstorms	1
No Turbulence	1
Ice Covered Runway	10
Braking Action NIL	10
Greater than MAX Crosswind	8
Plus and minus 15 knots of Windshear	7
At Minimums	3
"Careless and Reckless" Pilot	10
"Careless and Reckless" Dispatcher	10
Severe Icing	10
	Accident Risk Total 70

Now, we have added the hazard of severe icing, the maximum crosswind component has been exceeded. We now have 15 knots of windshear with the ceiling and visibility at minimums. We also have thrown in careless and reckless pilots and dispatchers. Notice that this situation now generates an Extremely High Accident Risk rating on our scale. Clearly, this flight should not be allowed to operate. However, if both the pilot and the dispatcher were careless and reckless as indicated, it very well might. A highly trained dispatcher would obviously stop this operation, as would an equally qualified pilot. The system of checks and balance as defined in the FAR's would work as designed.

Closing

The purpose of this exercise has been to show that, as dispatchers, we are confronted with various hazards that may affect the safety of flights over which we exercise Operational Control. These hazards can be identified and their potential risk quantified. There is a significant increase in the probability of an accident when several hazards combine to threaten a flight's safety.

As we close, you should ask yourself what would be the probability of an accident involving a flight that was planned through an area of severe thunderstorms across terrain with forecasted severe mountain wave turbulence to a destination airport with braking action nil, where the weather conditions are forecasted to be below minimums with severe icing in clouds and precipitation and with wind conditions exceeding the aircraft's certificated maximum crosswind component flown by careless pilot and planned by a reckless dispatcher? The answer, by now, should be obvious to you.

We have not been able to locate an accident that combines all the hazards we have covered today; however, a very notorious accident was caused by the combination of a number of these hazards. In a moment, we will subject this accident to an analysis based on our accident risk scale.

Date: January 25, 1990
Type: Boeing 707-321B
Registration: HK 2016
Operator: Avianca, the Airline of Columbia
Where: Cove Neck, New York
Report No. NTSB/AAR-91/04
Report Date: April 30, 1991

On January 25. 1990, at approximately 2134 Eastern Standard Time, Avianca Airlines flight 052, a Boeing 707-321B with Colombian registration HK 2016, crashed in a wooded residential area in Cove Neck, Long Island, New York. AVA052 was a scheduled international passenger flight from Bogota, Colombia, to John F. Kennedy International airport, New York, with an intermediate stop at Jose Maria Cordova Airport, near Medellin, Colombia. Of the 158 persons aboard, 73 were fatally injured. Because of poor weather conditions in the northeastern part of the United States, the flightcrew was placed in holding three times by air traffic control for a total of about 1 hour and 17 minutes. During the third period of holding, the flightcrew reported that the airplane could not hold longer than 5 minutes, that it was running out of fuel, and that it could not reach its alternate airport, Boston-Logan International. Subsequently, the flightcrew executed a missed approach to John F. Kennedy International Airport. While trying to return to the airport, the airplane experienced a loss of power to all four engines and crashed approximately 16 miles from the airport.

The National Transportation Safety Board determines that the probable cause of this accident was the failure of the flightcrew to adequately manage the airplane's fuel load, and their failure to communicate an emergency fuel situation to air traffic control before fuel exhaustion occurred. **Contribution to the accident was the flightcrew's failure to use an airline operation control dispatch system to assist them during the international flight into a high-density airport in poor weather.** Also contributing to the accident was inadequate traffic flow management by the Federal Aviation Administration and the lack of standardized understandable terminology for pilots and controllers for minimum and emergency fuel states.

The Safety board also determines that windshear, crew fatigue and stress were factors that lead to the unsuccessful completion of the first approach and thus contributed to the accident.

The safety issues raised in this report include:

1. Pilot responsibilities and dispatch responsibilities regarding planning. fuel requirements, and flight following during international flights.

2. Pilot to controller communications regarding the terminology to be used to convey fuel status and the need for special handling.

3. ATC flow control procedures and responsibilities to accommodate aircraft with low fuel states.

4. Flightcrew coordination and English language proficiency of foreign crews.

As we evaluate the AVIANCA 707 accident in the context of today's discussion, we note the following hazards effecting the flight as classified on our accident risk scale.

Enroute broken area of thunderstorms which caused holding and deviations -- RISK VALUE 5
Moderate Turbulence on the approach increasing crew workload -- RISK VALUE 3
Wet Runways - RISK VALUE 2
Braking Action Good - RISK VALUE 2
Less than maximum crosswind - RISK VALUE 4
Plus/Minus 15 knots of windshear - RISK VALUE 7
Ceiling and visibility at minimums - RISK VALUE 3
Careless and Reckless Pilot (after all, he ran out of fuel) RISK VALUE 10
Worse than Careless and Reckless Dispatcher - there was NONE! RISK VALUE 10
Light icing in clouds and precipitation. RISK VALUE 3

Therefore, according to our charts, the total risk value for AVIANCA flight 52 on 4/30/1991 would have been in the **high range** at a rating of 49. Interestingly, if we were to inject a top rated dispatcher (RISK VALUE 1) and a top rated pilot (RISK VALUE 1) into the elements that made up this flight, the total risk value for this flight would drop to 31, just barely into the moderate rating on our scale. It is likely that the flight would have been diverted long before fuel would have become an accident threat.

Conclusions

- ✓ The risk of an accident in the presence of multiple hazards is greatly reduced with the interaction of highly trained and proactive dispatchers and/or pilots.

- ✓ The risk of an accident increases in probability as more and more hazards are injected into the flight equation.

- ✓ High Risk situations require published policy and specific procedures for hazard avoidance. When an evaluation of the total risk factor for a flight indicates a high or extremely high risk of an accident, the dispatcher and/or the captain should exercise Operational Control techniques to reduce the risks involved. This would include options such as delaying, diverting or canceling the flight in question.

- ✓ Moderate risk situations require published policy and procedures for reducing the level of risk to prevent the risk level from escalating.

- ✓ Low Risk situations require standard operating procedures.

Challenge

Now that the concept of an **Accident Risk Scale** has been presented, we would like to challenge those of you in the academic community to delve even deeper into this theme. Over the years, our nation's institutions of higher learning have made significant contributions to aviation safety through their meticulous analysis our profession. We believe that the topics we have explored today merit further research. In addition, we would encourage the FAA to examine to possibility of using these concepts in the training regimen of those involved in oversight of the Operational Control community. By understanding the risks and challenges that face the aircraft dispatcher on a daily basis, inspectors will be better postured to assist us in the pursuit of aviation safety.

Notes:

Evaluation & Feedback

DO NOT SIGN OR IDENTIFY YOURSELF. This allows you to be as frank and open as you care or dare to be.

Your Affiliation__________________ Position _______________________
(Company or Organization) *(Job Title)*

1. Specifically, what did you ***like*** about this presentation on risk management ?

2. Specifically, what did you ***dislike*** about this presentation on risk management ?

3. Did you feel sleepy, tired, or disinterested during any part of the presentation ? If so please indicate which part.

4. Did you learn anything you can directly apply to your profession ?

5. On a scale of 1 to 10, how would you grade the overall quality of this presentation ?

Poor ---------------------------to -----------------------------------Excellent

1 2 3 4 5 6 7 8 9 10

6. Is there anything else you would like to say or ask?