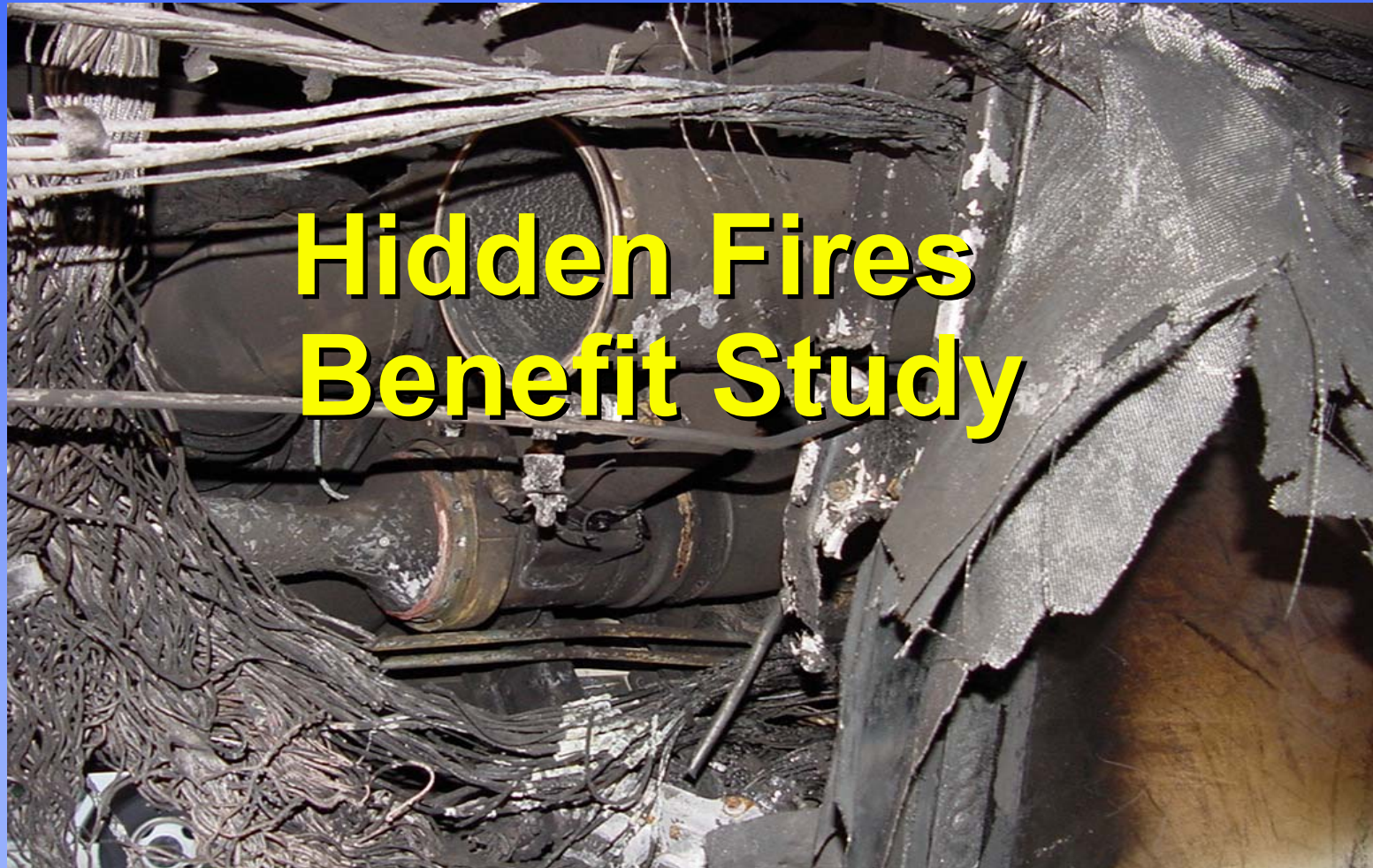


International Aircraft Fire and Cabin Safety Research Conference – Lisbon November 2004



Hidden Fire Benefit Study

- **The Benefit Analysis was commissioned by the FAA with the objective of evaluating the potential benefit, in terms of lives saved, from enhanced protection from fires within hidden areas in the aircraft cabin.**

Hidden Fire Benefit Study

- For the purposes of the study, a "hidden area" was defined as:

"... any area inside the pressure shell, which is not readily accessible to the crew other than a dedicated cargo area"

Hidden Fire Benefit Study

- The analysis was based on a Mathematical Risk Model using the "Monte Carlo Simulation" methodology

Hidden Fire Benefit Study

- Monte-Carlo simulation is a method where variables are randomly chosen based on their probability of occurrence.
- The variables are then combined to determine the required output – in this case the lives to be saved from the enhanced protection from fires in hidden areas.
- By running the Model many times a distribution of the predicted lives to be saved is generated.

Hidden Fire Benefit Study

- The Model utilises distributions derived from data on in-service aircraft, accidents and incidents.
- The assessment of benefit was based on data for the world fleet of Western-built aircraft over the period 1991 to 2000.



Hidden Fire Benefit Study

Data used by the Model:

- **Hidden Fires Occurrence Rate**
- **Aircraft Weight Category**
- **Time for fire to become Non-Survivable**
- **Available Time to Landing**
- **Total Number of Occupants**

Hidden Fire Benefit Study

Hidden Fire Occurrences:

Occurrence Number	Date	Operator	Aircraft Type	Location
1	08-Aug-00	Air Tran	DC-9-32	Greensboro NC, USA
2	29-Nov-00	Air Tran	DC-9-32	Atlanta GA, USA
3	04-Sep-93	Dominicana	B727	Santo Domingo, Dominican Republic
4	02-Sep-98	Swiss Air	MD-11	Peggy's Cove, Nova Scotia, Canada
5	24-Nov-93	SAS	MD-87	Copenhagen, Denmark

Hidden Fire Benefit Study

Air Tran DC 9 8th August 2000:

The captain and first officer noticed a smell of smoke shortly after takeoff. The crew immediately donned oxygen masks and smoke goggles. The smoke became very dense and restricted the crew's ability to see both the cockpit instruments and the visual references outside the airplane. The flight-crew was able to identify the Greensboro airport and make a successful emergency landing.

Hidden Fire Benefit Study

Air Tran DC 9 8th August 2000:

Extensive heat damage was found to wires and insulation in the electrical panel behind the captain's seat. The heat was sufficient to blister the primer on the fuselage crown skin. Four crewmembers received minor injuries from smoke inhalation in-flight and one passenger received a minor injury during the evacuation; one crewmember and 57 passengers were uninjured. The airplane was substantially damaged from the effects of fire, heat, and smoke.

Hidden Fire Benefit Study

Air Tran DC 9 29th November 2000:

During initial climb, the flight crew noted numerous circuit breaker trips and illumination of several indicator lights. The crew declared an emergency with air traffic control and requested a return to the airport. The airplane landed safely and cleared the runway onto a taxiway. At some point during the landing rollout and taxi, the flight attendants notified the flight crew of smoke in the forward section of the cabin.

The background image shows a close-up of a damaged aircraft fuselage. A large, dark, circular opening is visible, surrounded by twisted metal and exposed wiring. The scene is dark and appears to be the aftermath of a fire or explosion.

Hidden Fire Benefit Study

Air Tran DC 9 29th November 2000:

An emergency evacuation ensued. The fire was extinguished by the Fire Brigade.

Examination of the airplane revealed fire damage to an area of the left fuselage below and aft of the forward passenger entry door, and to the adjacent forward cargo and main cabin floor areas. Wiring, ducts, and hydraulic lines located in this area were also burned.

Hidden Fire Benefit Study

Dominicana B727 4th September 1993:
Approximately fifteen minutes into a thirty minutes flight from San Juan to Santo Domingo, a flight attendant noticed a flight attendant call button lit for the aft lavatory. She checked the lavatory and saw smoke inside. The airplane landed at Santo Domingo and the passengers exited normally through the L1 door as the cabin began to fill with smoke.

Hidden Fire Benefit Study

Dominicana B727 4th September 1993:
The flight crew requested a mechanic with a fire extinguisher to check the lavatory. The mechanic opened the ventral stairs and saw fire that he judged to be too big to attempt to fight with a hand held extinguisher. The airplane was destroyed by fire. The fire was determined to have originated in the area of the aft lavatory but the cause was never found.

Hidden Fire Benefit Study

Swiss Air MD 11 2nd September 1998:

56 minutes into the flight the flightcrew issued a 'Pan'-call reporting smoke in the cockpit and requesting emergency vectoring to the nearest airport, which they thought was Boston. The Moncton controller cleared the flight to descend to FL310 and offered Halifax as the closest airport.

Hidden Fire Benefit Study

Swiss Air MD 11 2nd September 1998:

About 10 minutes after the first alert message, the crew declared an emergency and reported that they were starting the fuel dump and that they had to land immediately. There were no more radio communications. The airplane hit the water 16 minutes later after the alert message.

Hidden Fire Benefit Study

Swiss Air MD 11 2nd September 1998:

There were 14 crewmembers and 217 passengers (including 2 children) aboard, all were fatally injured. The plane was destroyed as a result of the accident.

Hidden Fire Benefit Study

SAS MD 87 24th November 1993:

During landing a cabin attendant noticed that her work lights suddenly lit up brightly and then went out. While taxiing towards the assigned gate, she noticed a faint smell of electrical smoke/fire. When the lavatory on the right hand side was checked whitish smoke was noticed in front of and above the lavatory door.

Hidden Fire Benefit Study

SAS MD 87 24th November 1993:

After the aircraft was parked the captain requested the assistance of a fire vehicle over the radio. The captain checked the outside of the aircraft and noticed a bright glowing spot on the fuselage. He quickly returned to the cockpit and used the radio to emphasize the urgent need for assistance from fire and rescue services.

Hidden Fire Benefit Study

SAS MD 87 24th November 1993:
About 15 minutes after the sounding of full scale alarm the fire was under control and the fire fighting ended a total of about 1 hour and 5 minutes after the captain's second radio call. Later investigation revealed that factory installed wiring had been pinched and chafed, which led to arcing and ignition of the cabin sidewall insulation material.



Hidden Fire Benefit Study

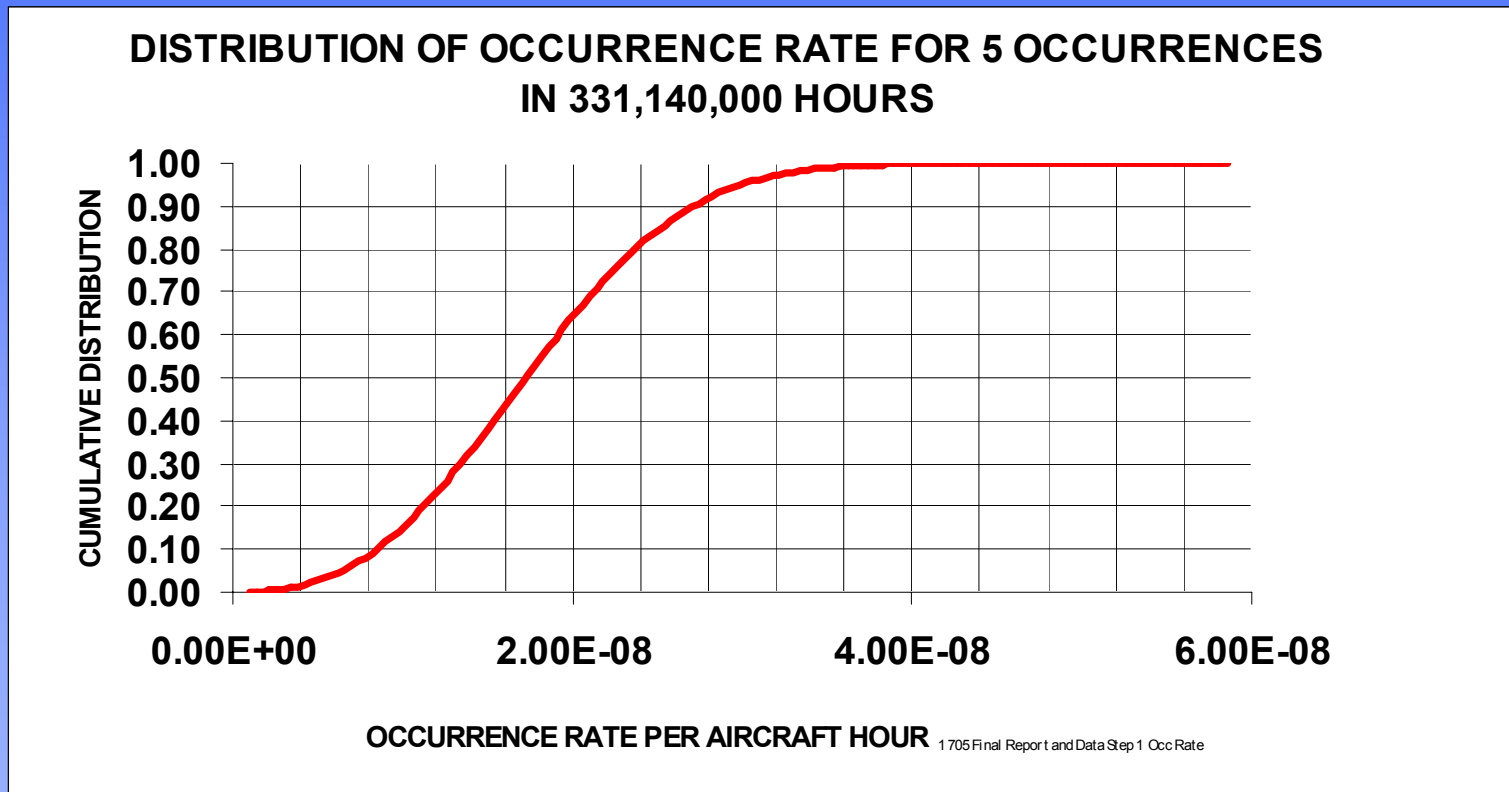
SAS MD 87 24th November 1993:

The fierce fire that erupted in the aft right-hand side of the cabin destroyed major parts of all of the equipment installed in that particular area. The extreme heat development destroyed the fuselage skin and structure over a large area on the aft right-hand side of the aircraft. Additionally, the entire cabin furnishings were severely damaged by smoke and heat. This form of damage extended as far forward as to include the cockpit and cockpit equipment.

AFT CABIN RIGHT-HAND SIDE

Hidden Fire Benefit Study

Hidden Fire Occurrence Rate:



Hidden Fire Benefit Study

Aircraft Weight Category:

Weight Category	Weight	Percentage of Flight Hours
B	12,500 to 100,000 lb	16.8%
C	100,000 to 250,000 lb	52.3%
D	250,000 to 400,000 lb	12.4%
E	Greater than 400,000 lb	18.5%

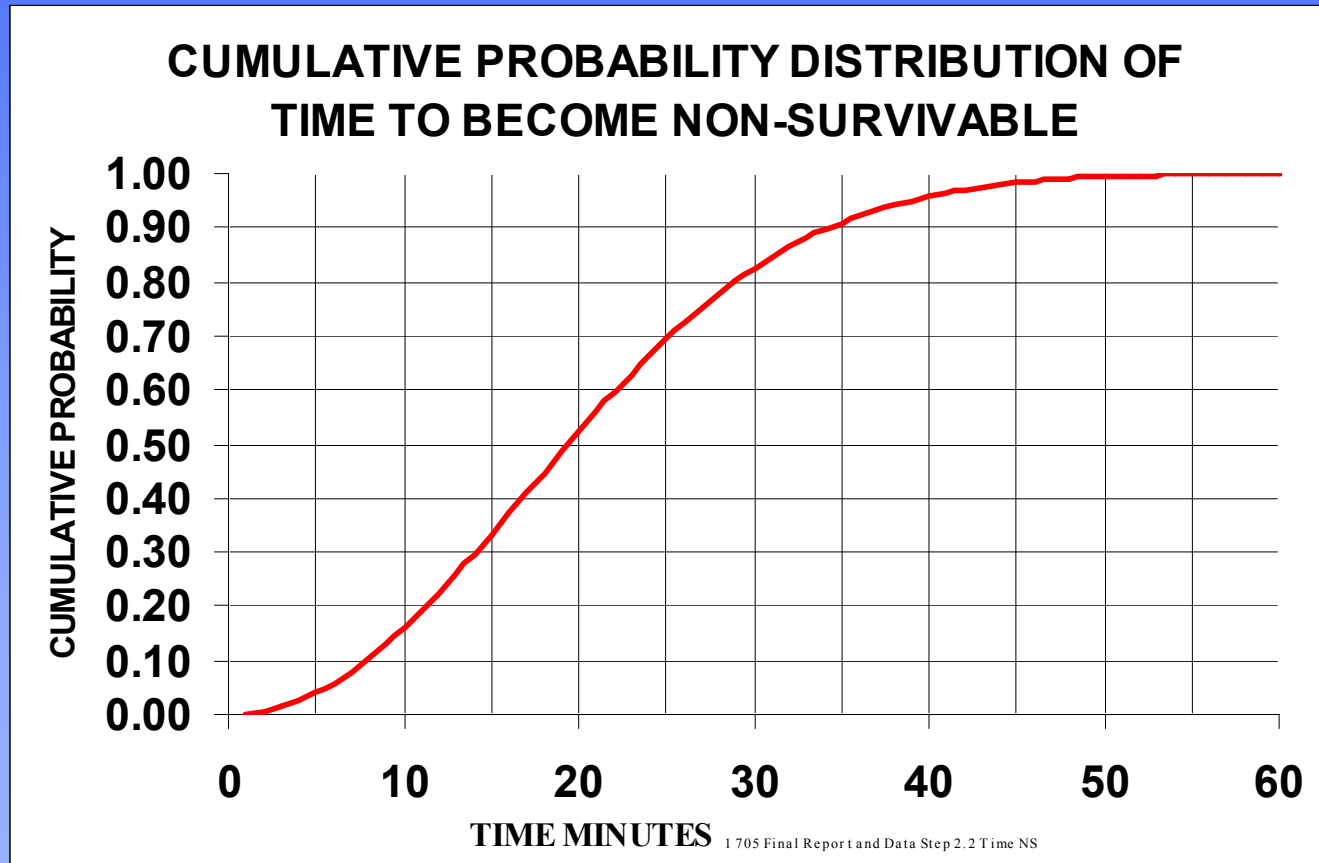
Hidden Fire Benefit Study

Time to become Non-Survivable:

Date	Location	Aircraft Type	Time to become Non-Survivable (minutes)
26-Jul-69	Biskra, Algeria	Caravelle	26
11-Jul-73	Orly, Nr. Paris, France	B707	7
03-Nov-73	Boston, USA (Cargo flight)	B707	35
26-Nov-79	Jeddah, Saudi Arabia	B707	17
02-Jun-83	Cincinnati International Airport, USA	DC-9-32	19
28-Nov-87	Mauritius, Indian Ocean (Cargo flight)	B747	19
02-Sep-98	Peggy's Cove, Nova Scotia, Canada	MD-11	16

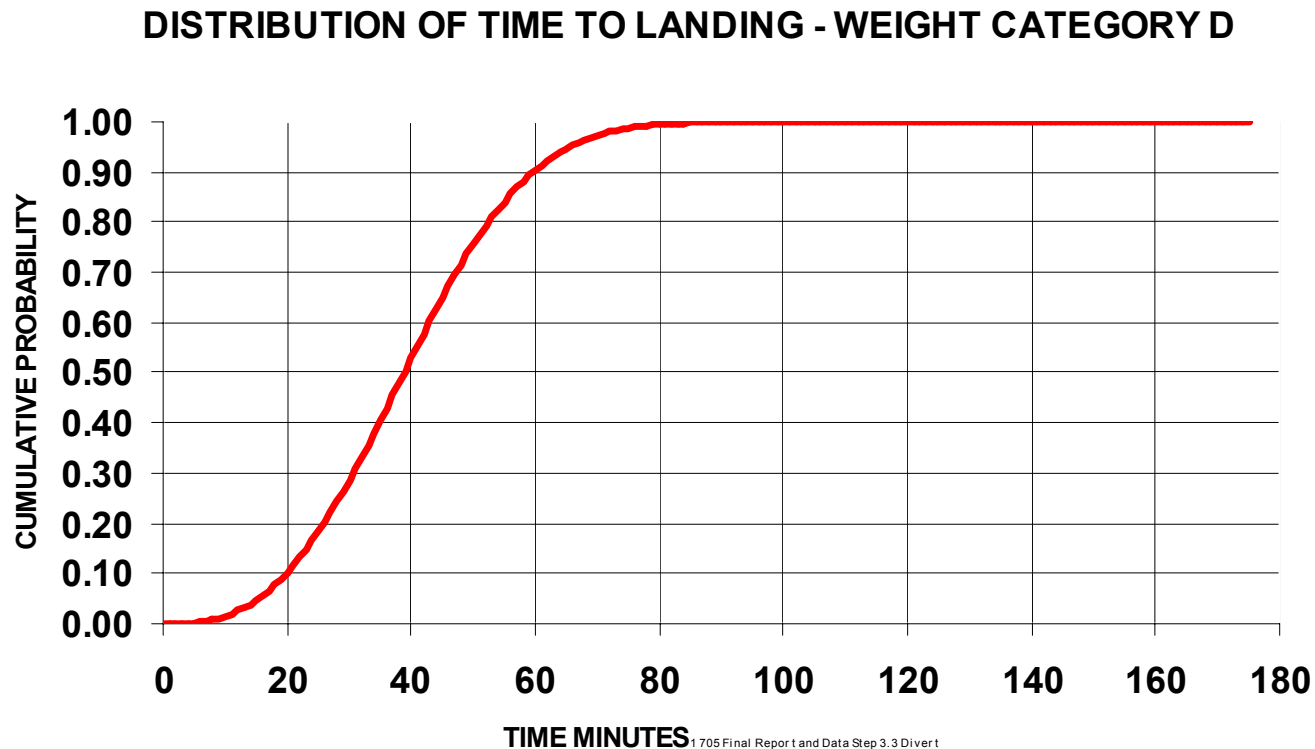
Hidden Fire Benefit Study

Time to become Non-Survivable:



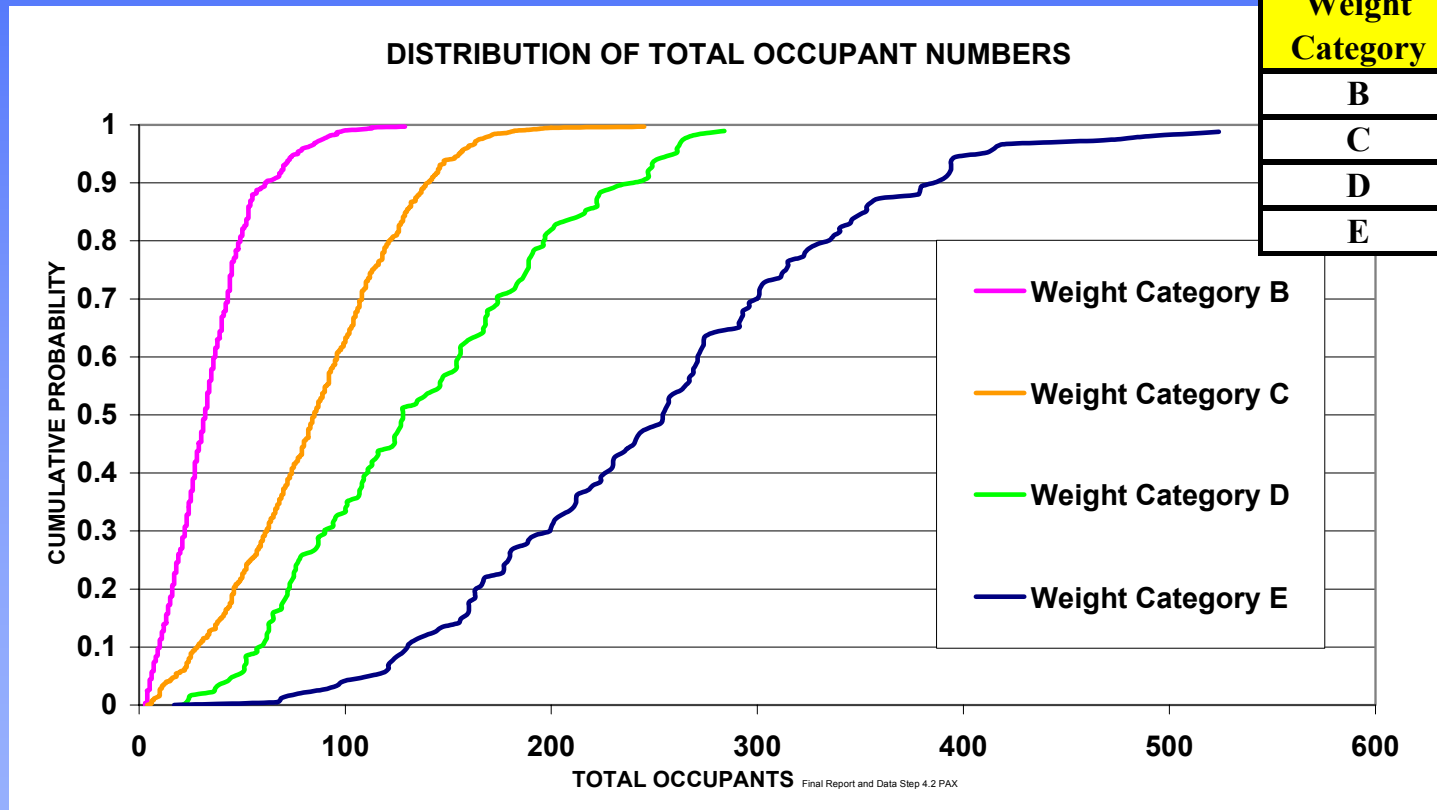
Hidden Fire Benefit Study

Example Distribution of Time to Landing:



Hidden Fire Benefit Study

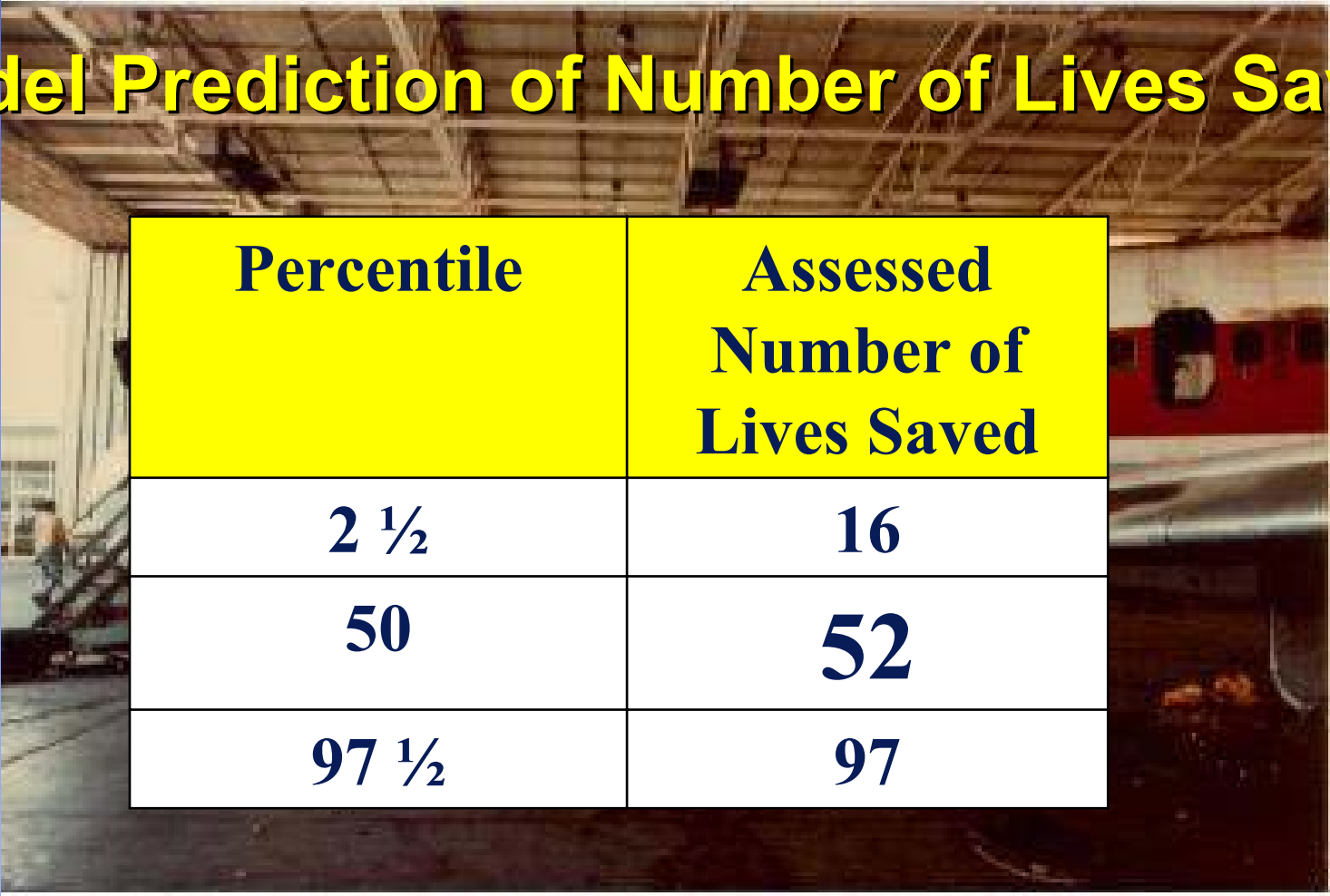
Distribution of Total occupant Numbers:



Weight Category	Average Number of Occupants
B	34
C	85
D	136
E	250

Hidden Fire Benefit Study

Model Prediction of Number of Lives Saved:



Percentile	Assessed Number of Lives Saved
2 ½	16
50	52
97 ½	97