Introduction

Lecture 1

ME EN 415
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aning@byu.edu

Syllabus

http://flow.byu.edu/me415/

515 (595R): Aerodynamics

510: Compressible Fluid Flow

541: Computational Fluid Dynamics

415: Flight Vehicle Design

523: Aircraft Structures

456/602: Composites

426: Gas Turbine and Jet Engine Design

431: Control Systems

634: Flight Dynamics and Control

575: Design Optimization

ChE 693R: Dynamic Optimization

Grading

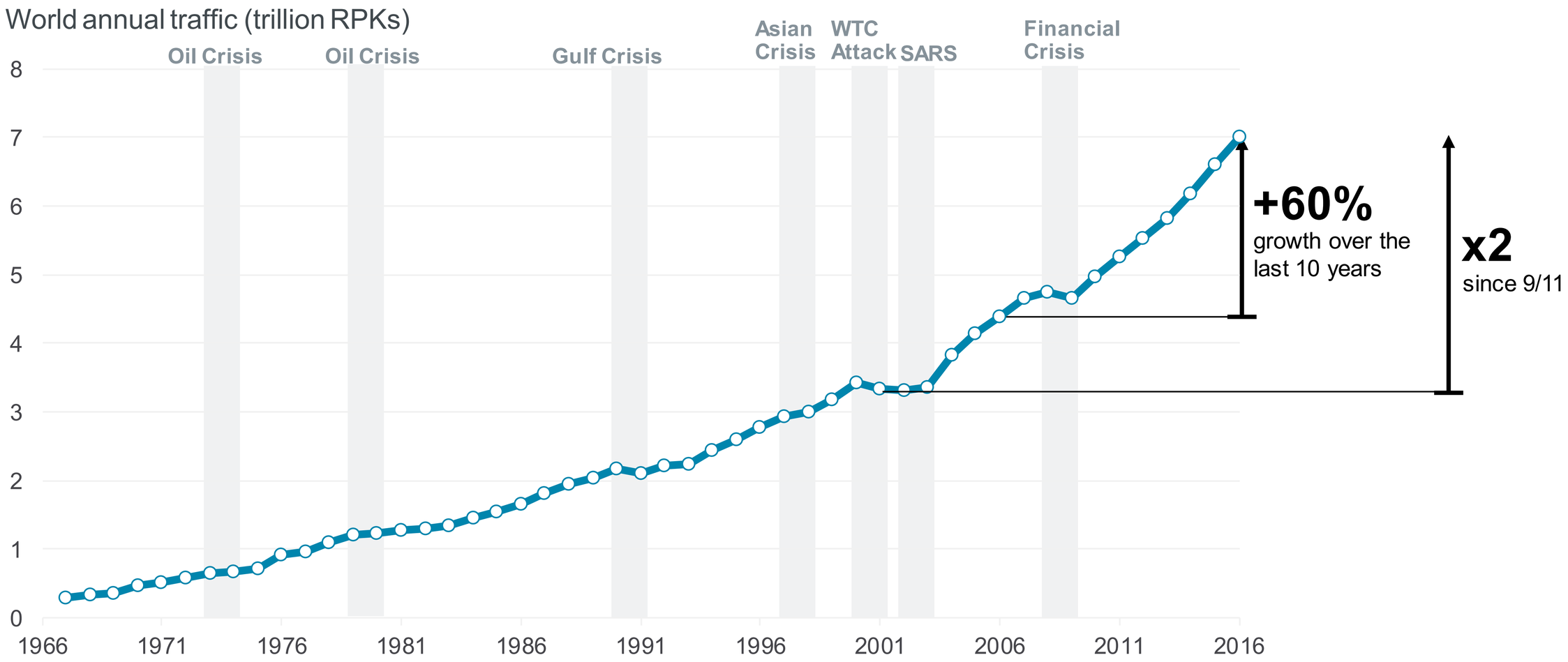
Homework	400
Exams	400
Project	150
Quizzes	50
Total	1000

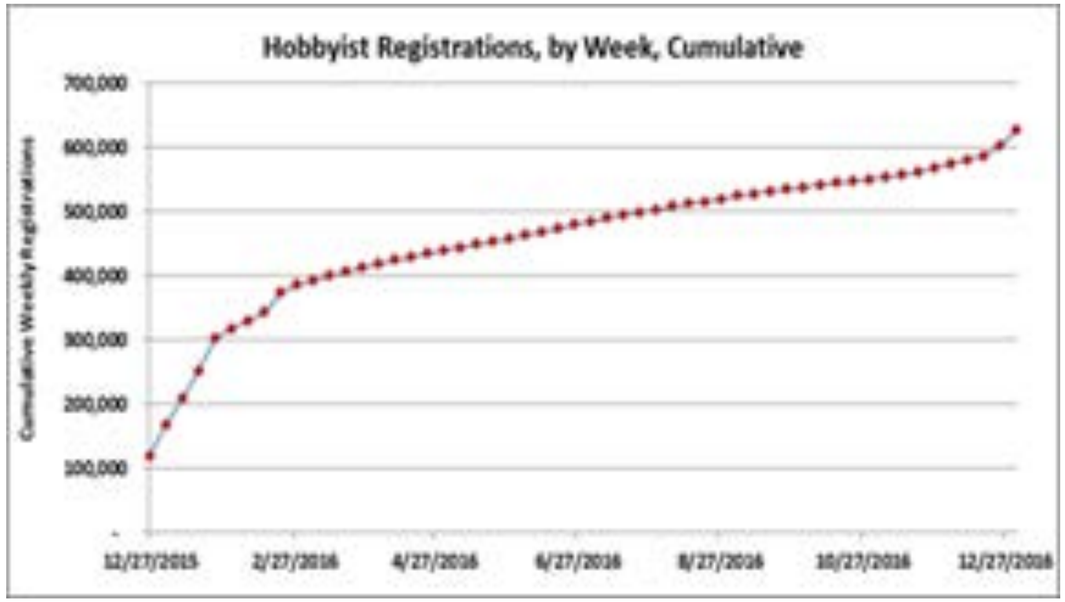
Aircraft Industry

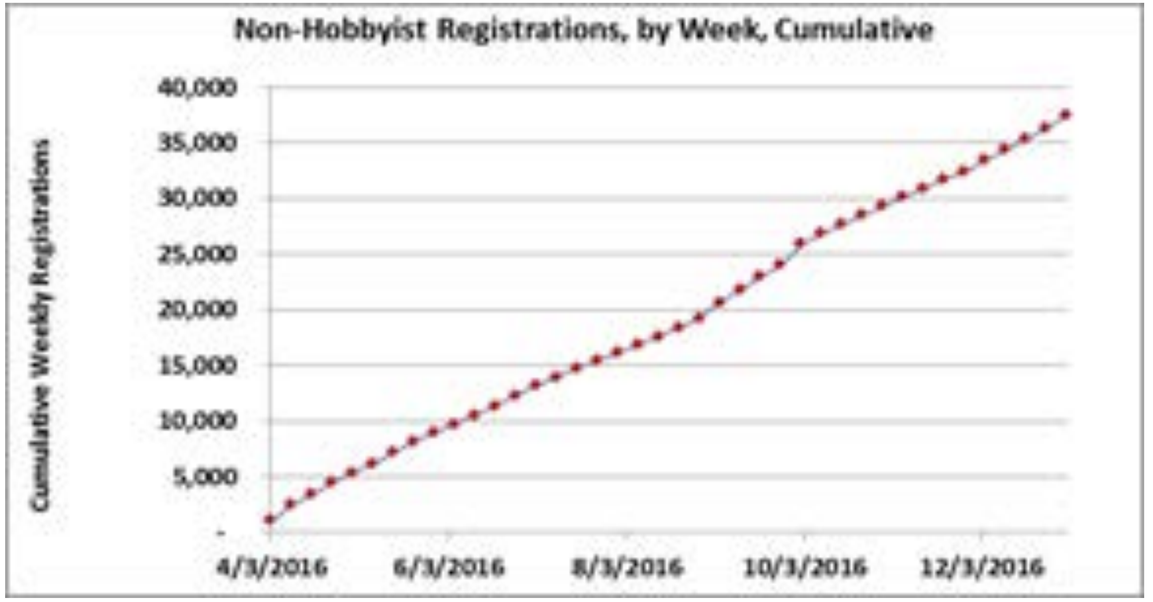

zh
aw
TECHNORAMA


zh
aw
TECHNORAMA

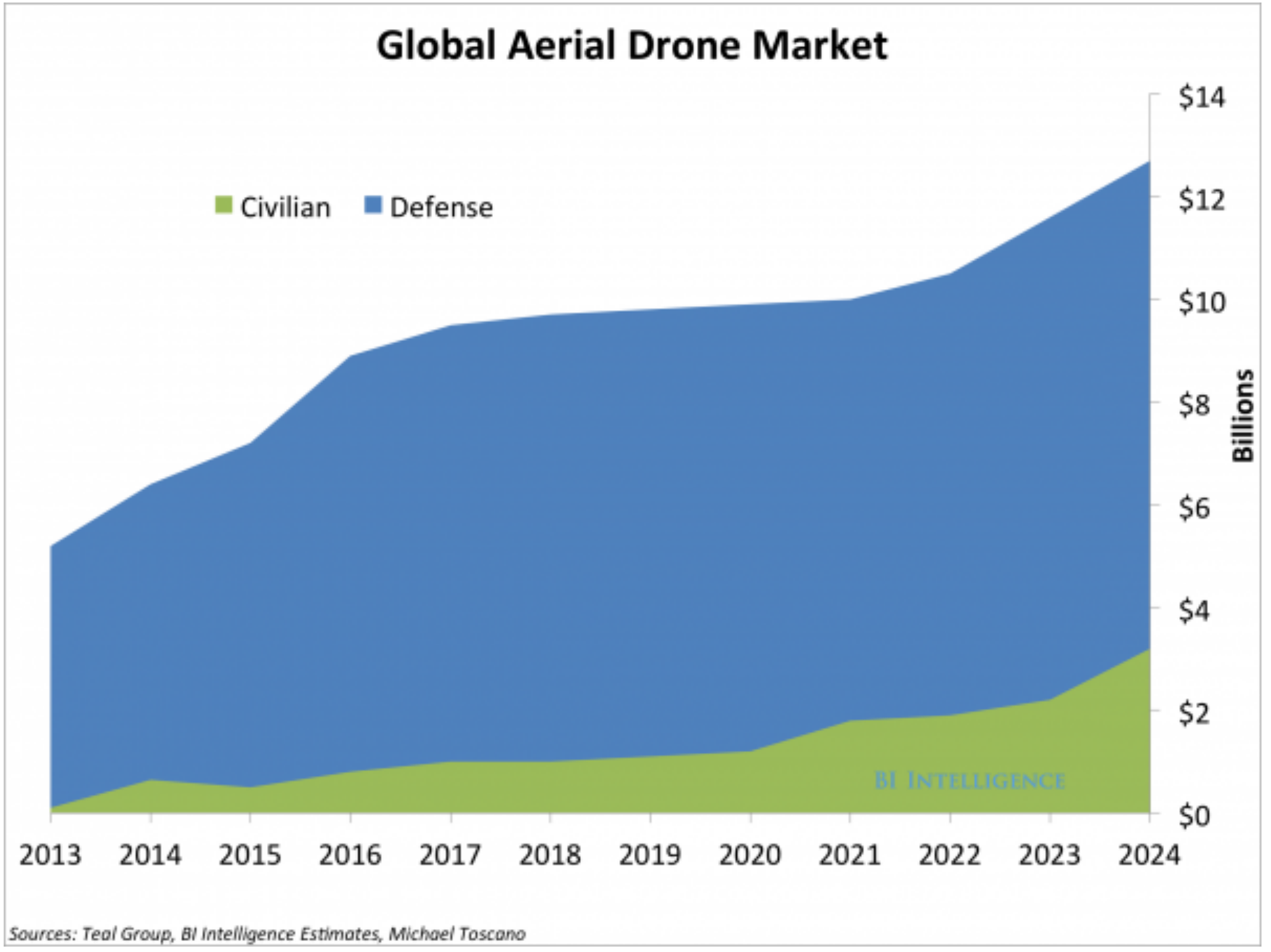
Air travel has proved to be resilient to external shocks



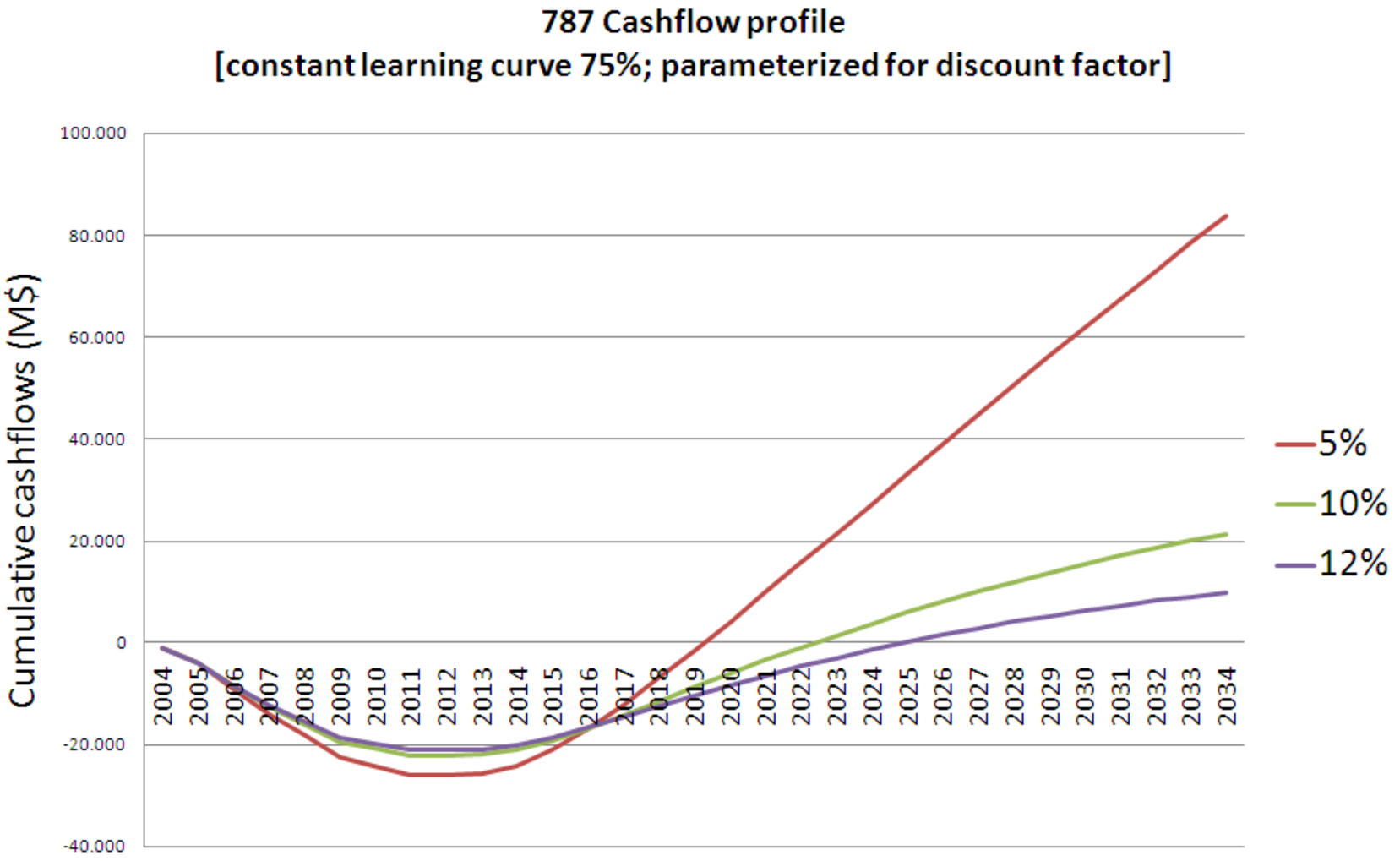




FAA Aerospace Forecast 2017

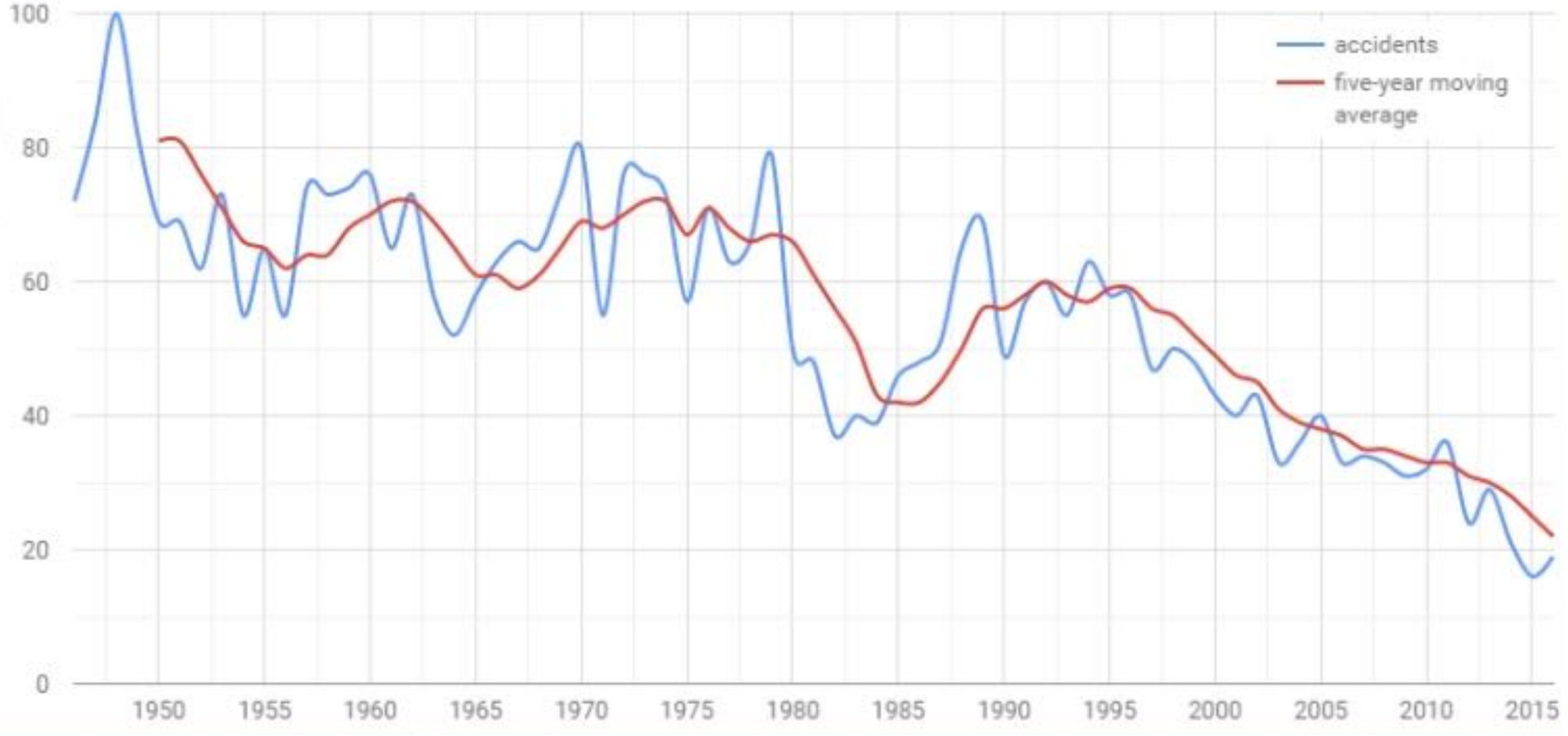

Global Aerial Drone Market
Civilian
Defense
$14
$12
$10
$8
$6
$4
$2
$0
Billions
BI INTELLIGENCE
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
2024
Sources: Teal Group, BI Intelligence Estimates, Michael Toscano

Air Transportation Economics

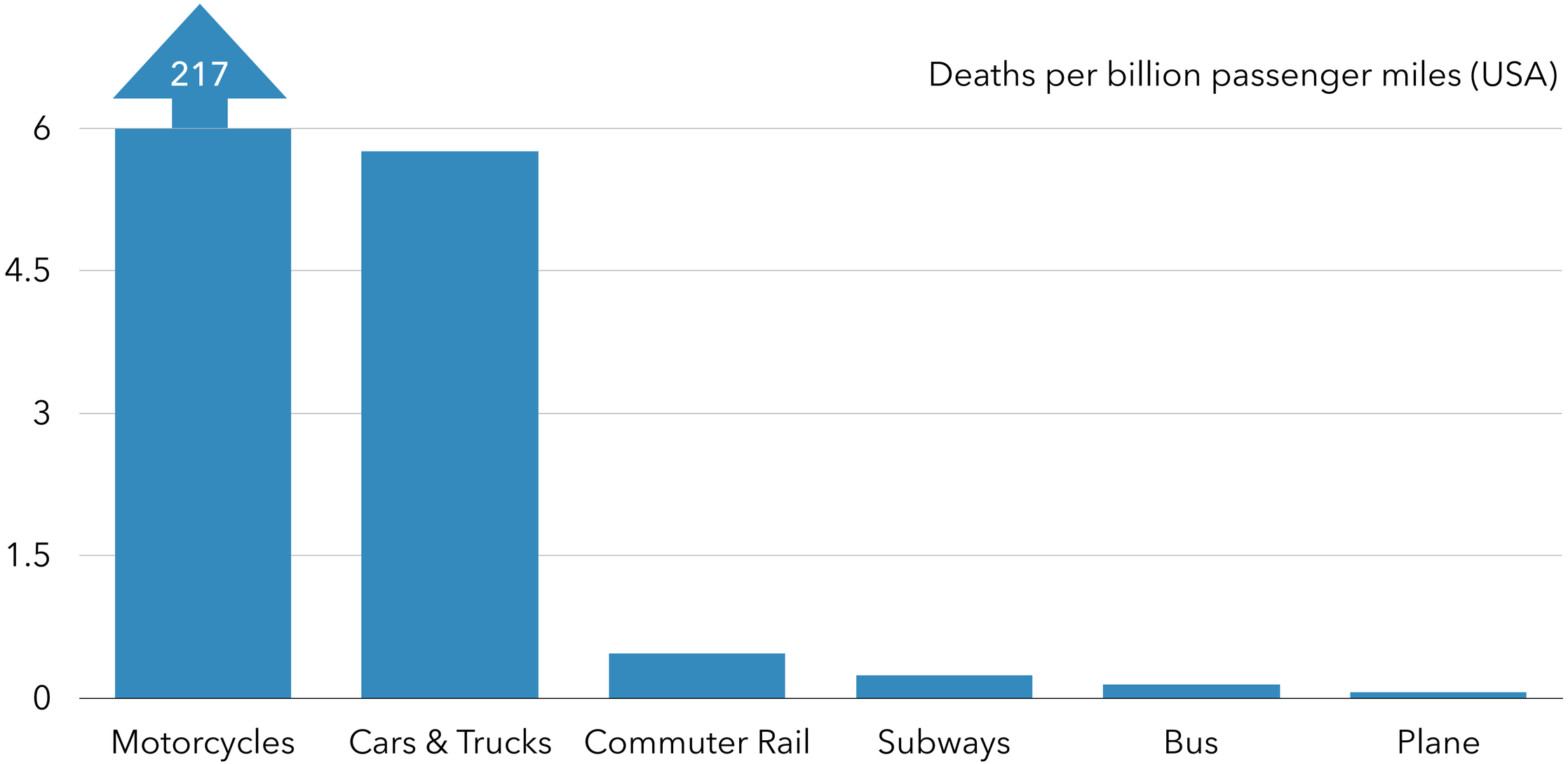


source: Javier Irastorza Mediavilla

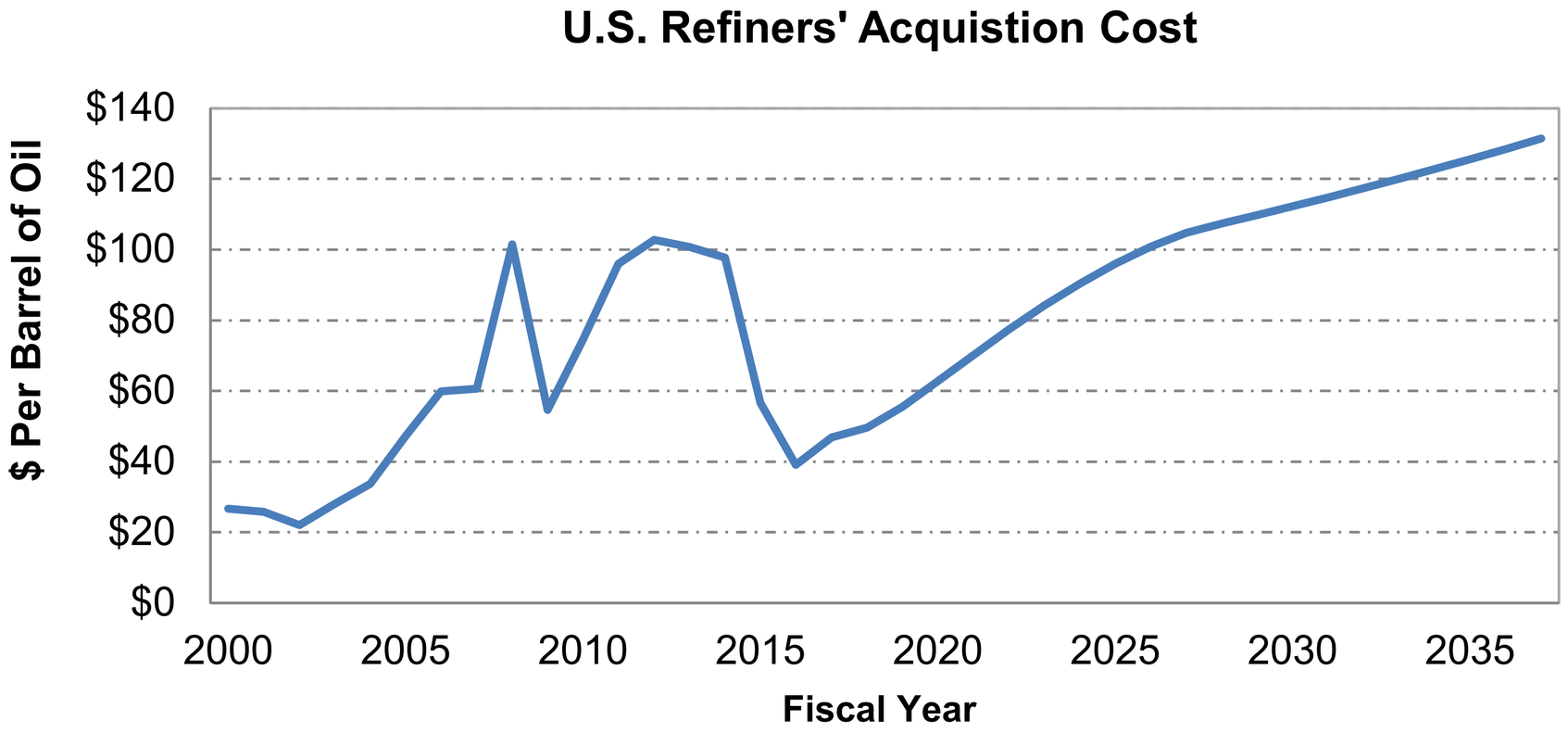
Air Transportation Safety



Aviation Safety Network

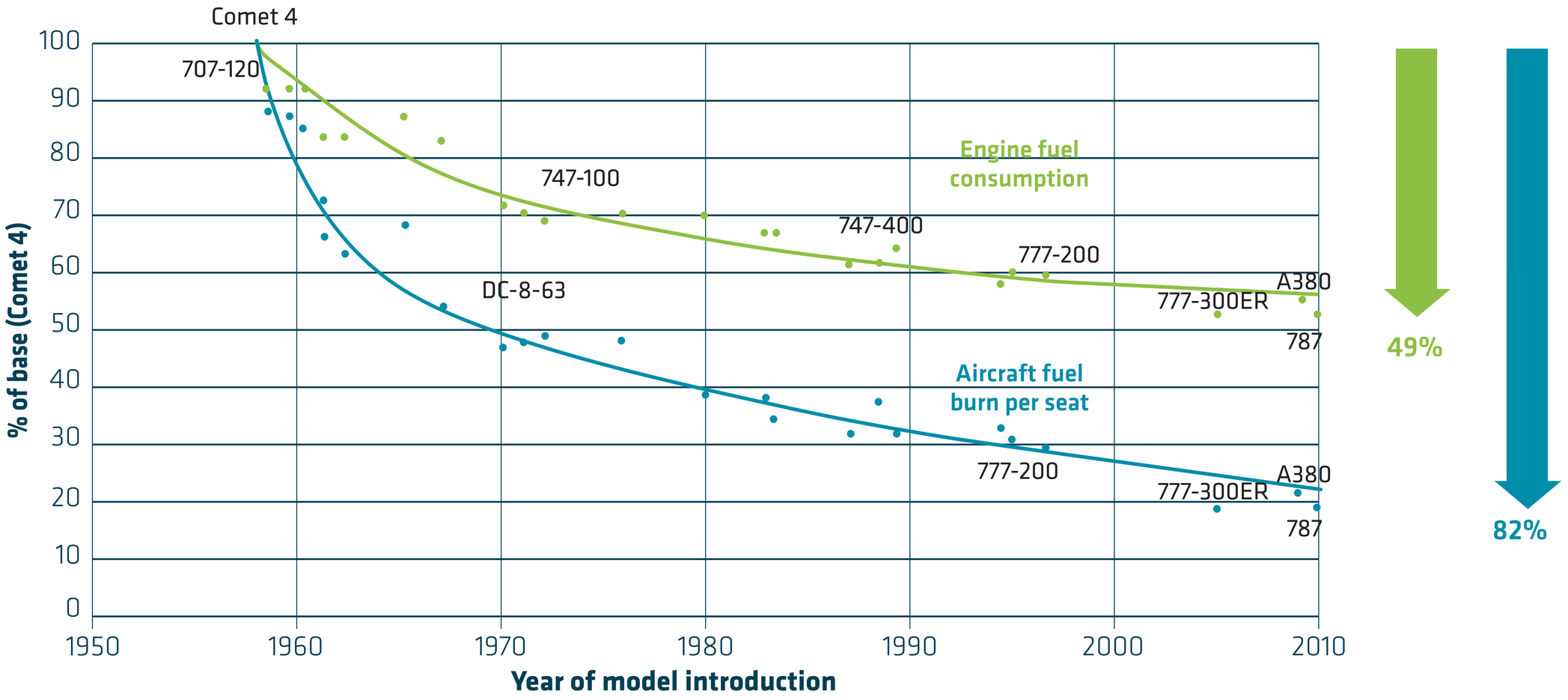

Deaths per billion passenger miles (USA)
217
6
4.5
3
1.5
0
Motorcycles
Cars & Trucks
Commuter Rail
Subways
Bus
Plane

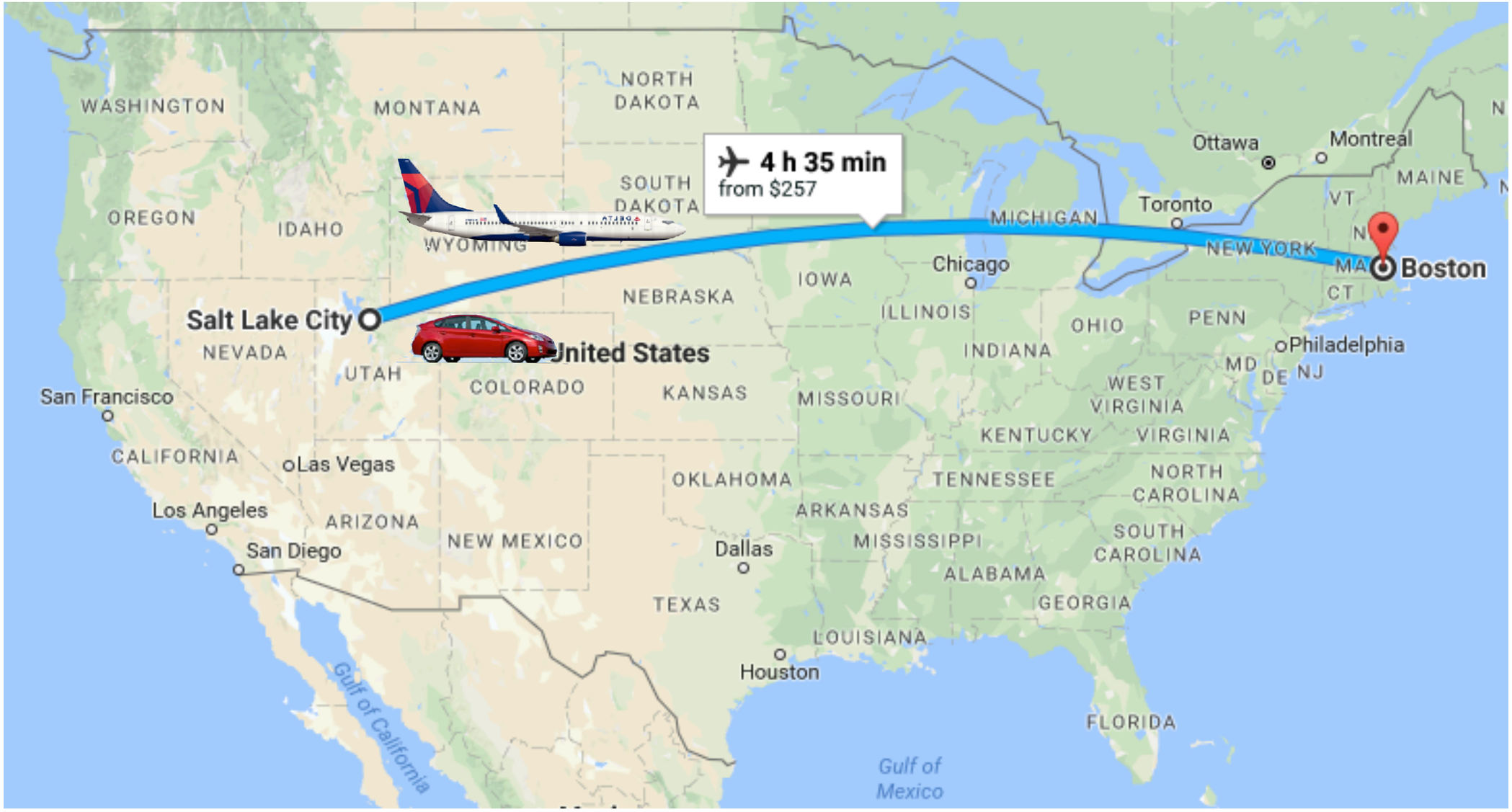
Air Transportation Efficiency



Source: IHS Global Insight

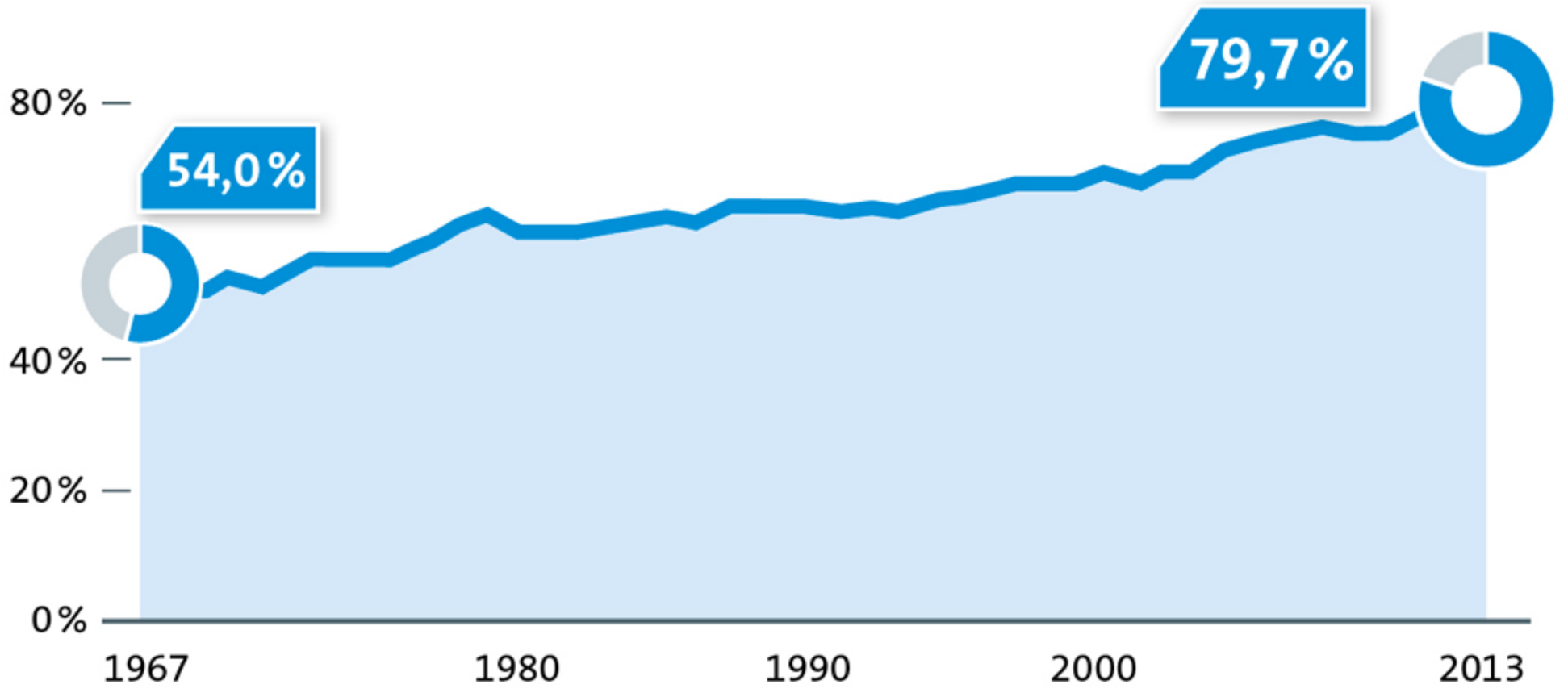
Fuel efficiency gains since the early jet age




4 h 35 min
from $257
Salt Lake City
Boston
United States
WASHINGTON
MONTANA
NORTH DAKOTA
SOUTH DAKOTA
OREGON
IDAHO
WYOMING
NEBRASKA
IOWA
Chicago
MICHIGAN
Toronto
Ottawa
Montreal
MAINE
VT
NEW YORK
MA
CT
NEVADA
UTAH
COLORADO
KANSAS
ILLINOIS
INDIANA
OHIO
PENN
Philadelphia
MD
DE
NJ
WEST VIRGINIA
VIRGINIA
KENTUCKY
San Francisco
CALIFORNIA
Las Vegas
Los Angeles
San Diego
ARIZONA
NEW MEXICO
OKLAHOMA
TENNESSEE
NORTH CAROLINA
ARKANSAS
MISSISSIPPI
SOUTH CAROLINA
Dallas
ALABAMA
GEORGIA
TEXAS
LOUISIANA
Houston
FLORIDA
Gulf of California
Gulf of Mexico

	Time (hr)	Speed (mph)	efficiency (pmpg)	cost ($/pax)
B737-800				
Your Car				

Average passenger load factor for aircraft worldwide



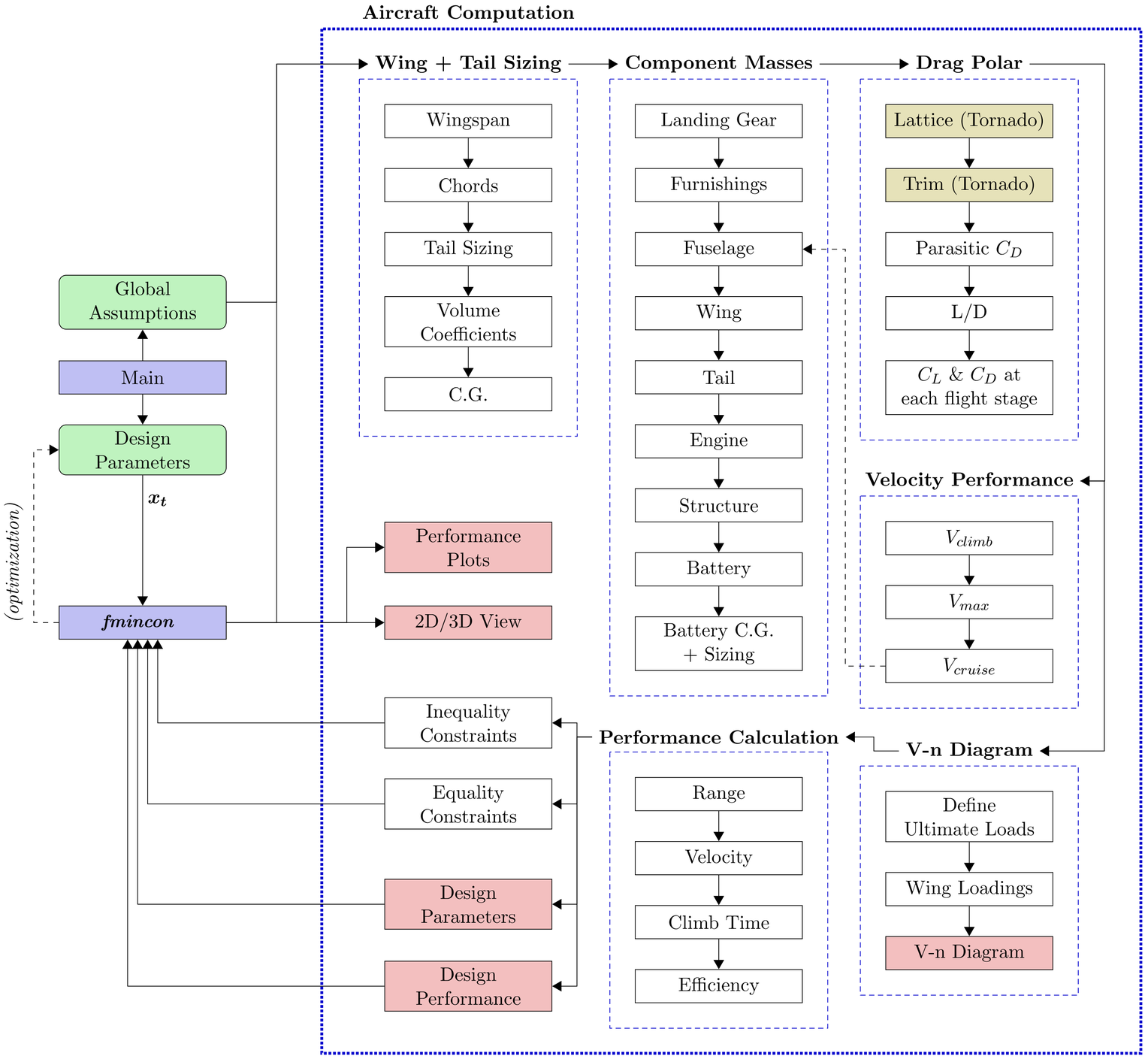
Source: International Air Transport Association (IATA)

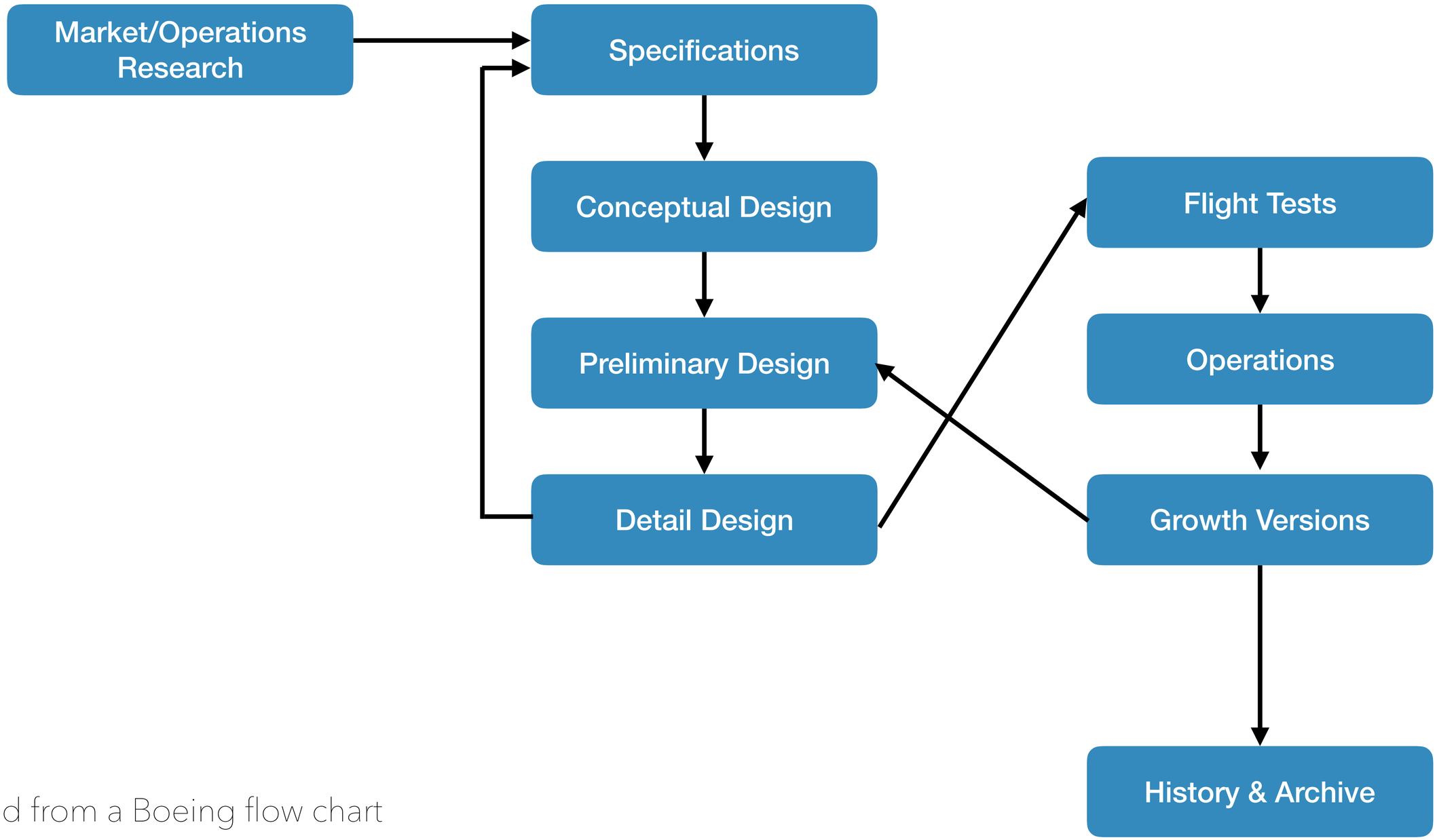
www.bdl.aero

Design

The Future of Airplanes

The Future of Space Exploration


Aircraft Computation
Wing + Tail Sizing
Component Masses
Drag Polar
Wingspan
Chords
Tail Sizing
Volume Coefficients
C.G.
Landing Gear
Furnishings
Fuselage
Wing
Tail
Engine
Structure
Battery
Battery C.G. + Sizing
Lattice (Tornado)
Trim (Tornado)
Parasitic C_D
L/D
C_L & C_D at each flight stage
Velocity Performance
V_{climb}
V_{max}
V_{cruise}
Global Assumptions
Main
Design Parameters
x_t
(optimization)
fmincon
Performance Plots
2D/3D View
Inequality Constraints
Equality Constraints
Design Parameters
Design Performance
Performance Calculation
Range
Velocity
Climb Time
Efficiency
V-n Diagram
Define Ultimate Loads
Wing Loadings
V-n Diagram



Adapted from a Boeing flow chart