

RISK AND FINANCIAL DECISION MAKING

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Agenda

- Introduction / Observations
- How Financial Markets Price Risk
- Risk vs Uncertainty: What is the difference?
- Decision Making, Risk & Behaviorist Finance
- BOEING 367-80: A Case Study in Betting it All
- Lessons Learned
- Author Notes / Closing Thoughts
- About the Speaker
- Reference Sources

Introduction / Observations

- In Finance, risk adjusted return is measured by the **Coefficient of Variation (CV)**. This is **mathematically expressed as: $CV = \sigma / \bar{r}$**

*where σ = standard deviation of historic return
and \bar{r} = mean average historic return.*

- In Finance, rational decision making (RDM) is where market participants seek to minimize risk in relation to return (i.e., a lower CV) or conversely, maximize return in relation to risk (i.e., the inverse of the CV or \bar{r} / σ).

How Financial Markets Price Risk

- The present value (V) of an initial end-of-year perpetuity payout of $\$C$ (growing at $g\%$) per period with a required return of $r\%$ is:

$$V = C / (r - g)$$

Explanatory Notes: (1) When calculating value into perpetuity, the “ g ” is less than “ r ” because as a practical matter it is embedded into the “ r ” as natural rate of growth governed by mathematical limitations associated with base “ e .” (2) Risk premiums are included in “ r ” where higher risk lowers “ V ” and vice versa. *Therefore Financial Markets price risk via required return “ r ” (aka cost of funds).* 😊

Risk vs Uncertainty

- In Finance, “risk” and “uncertainty” are two distinctly different concepts.
- **Risk** implies that decision makers can form a probability distribution on future outcomes.
- **Uncertainty** implies that decision makers are not able to form a probability distribution on future outcomes.
- Probabilities are established based on a fusion of historic data, comparables and intuition.
- *Uncertainty lowers Value more than increased risk due to unknown probabilities. Investors overcompensate for the unknown vs known probabilities.*

Behaviorist Finance & Decision Making

- In Finance, a Rational Decision Maker (RDM) may be faced with situations having both known and unknown probabilities, and often across multiple time periods.
- In these situations the RDM will most certainly act as though he or she is seeking to maximize return in relation to risk or minimize risk in relation to return, even when probabilities are unknown. Behaviorist Finance is applied here to understand the motivations, culture, norms and disposition in relation to risk-taking.
- This can be especially useful with situations where transformative concepts are involved.

BOEING 367-80

A Case Study in Betting it All



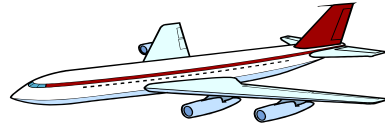
Background on 367-80

- Since helping launch the commercial jet aircraft age with its prototype 367-80 model in the 1950s, the Boeing Company has taken very large risks on developing new generations of wide-body commercial jet aircraft. This approach has historically been known as a “bet the company strategy.”
- Despite a few close calls, Boeing has emerged successfully from each cycle, enabling it to maintain industry leadership and generate satisfactory long-term financial returns. In this presentation, as part of our ongoing research on risk-taking behavior we focus on the 367-80 model that formed the template for Boeing’s “betting it all” corporate strategy associated with the launch of new generations of wide-body aircraft over the ensuing decades.
- The prototype 367-80 is the airframe from which the 707 commercial airliner and military KC-135 tanker aircraft were built.

The Context for Betting the Company

- Capital investment decisions at Boeing are unique and—to some degree—risky. In the mid-1950s, despite failing to profit on civilian planes in two decades, **Boeing spent \$185 million** to develop the 367-80 for the commercial aircraft market, despite not having made money in a non-military plane in twenty years.
- To put this in context, **this capital investment was \$36 million or 25% more than Boeing's total net worth of \$149 million in 1956!**

Cost of Launching the 367-80



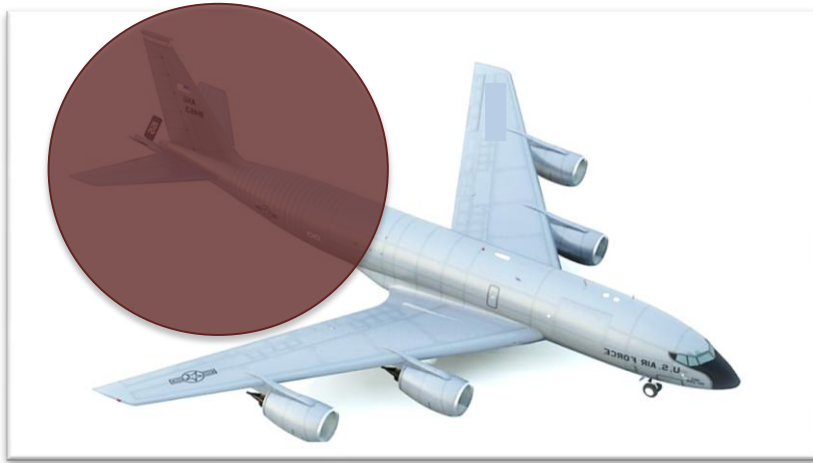
FINANCIAL CATEGORY	AMOUNT (US \$ Millions)	BREAKDOWN in % TERMS
PROTOTYPE	16	9 %
ENGINEERING & TOOLING	100	54 %
PLANT & EQUIPMENT	35	19 %
THRUST REVERSER & SOUND SUPPRESSOR	7	4 %
ADVERTISING & SALES	4	2 %
FLIGHT TEST & RESEARCH	23	12 %
TOTAL	\$185 Million	100 %

Financial Outcomes

- Boeing did “risk the company,” as measured by the cost to develop the program (\$185 million) versus its net worth (\$149 million) with the cost for the prototype exceeding its average annual Net Income by 33% (\$16 million versus \$12 million) over the same period.
- This risk was tempered by leveraging the cost over two end-user markets rather than one PLUS 70% commonality of major components for military and civilian variants. Boeing established a sales-and-earnings platform on an already strong, well-established business (defense/military) that could be adapted for creating a global civilian commercial segment.
- With the military variant (KC-135) having recovered the original investment, *the subsequent commercial variant (707) led to a 2.5x increase in Net Income (late 1950s/early 1960s versus mid-1950s) and by 1967-68, Net Income was 2x higher than its 1961 level.*

DESIGN FOR COMMERCIAL SUCCESS

GREAT PROTOTYPE = COMMON PARTS 70% = REDUCED COST!!



COMMON PARTS



MILITARY

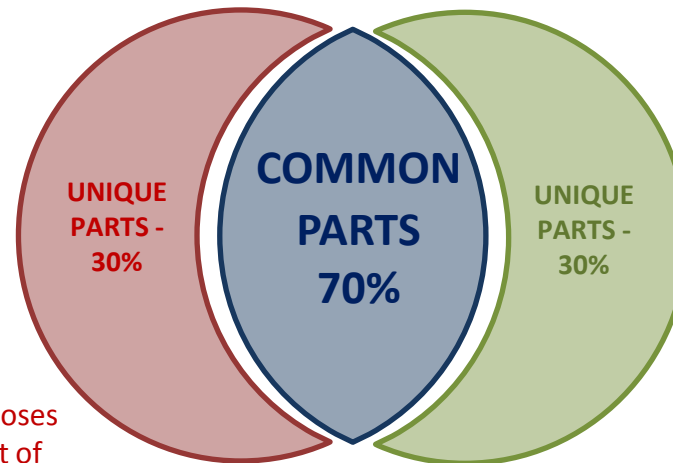


COMMERCIAL



The Legend: Boeing 367-80

- Proof of concept prototype model: Jet propulsion engines
 - Units manufactured: 1
- CTC: \$16 million in 1950's (\$149 M in 2018)
- Legend: 1st jet aircraft in USA
- Served as the base design for:
 - KC 135 – Military variant
 - 707 – Commercial flight



Military Variant: KC 135

- Units manufactured: 820
 - (732 no. used as tankers, 88 no. modified and used for special purposes such as reconnaissance & transport of high level government officials.
- Current status: Production discontinued. Older models have been refurbished for used until 2040
- Major difference:
 - Fuselage shape and capacity
 - Cargo hold

Commercial Variant: 707

- Units manufactured: 1010
- Current status: Decommissioned
- Major difference:
 - Fuselage shape and capacity
 - Windows
 - Passenger Seats
 - Luggage

Time Line & Basis for Making it Work

- In 1955, Boeing secured production order of 400 military units from the US Air Force (Strategic Air Command) for its 367-80 airframe.
- With this strong endorsement and burgeoning world travel, commercial airlines started to express interest. Airline executives were sold on the 707 after seeing its double-barrel roll demo flight.
- Boeing differentiated itself from both foreign and domestic competitors by maintaining flexibility with its own customers. Specifically, Boeing was able to widen its cabin space by four inches with minor engineering and tooling costs plus retain the core features incorporated into its military prototype.
- *This enabled Boeing to have faster time-to-market deliveries and higher absorption rate of fixed overhead for both military-and-commercial aircraft assembly operations.*
- Boeing achieved breakeven with its 707 commercial variant in late 1956 due to USAF production order for the KC-135 variant. Commercial deliveries (e.g., Pan-Am, American, TWA & BOAC) provided further increase to corporate net income.

How Investors Viewed Boeing's Betting the Company on Launching the Jet Age

- Investors initially responded positively to military shipments (KC-135) and while taking a “wait-and-see” on burgeoning commercial interest. Boeing's stock price reached a high of \$79.63 in 1955 and then fluctuated for the next three years going down to \$36.62 in 1957 and then up to \$45.62 the following year.
- The surge in commercial shipments (707) enabled Boeing to fly high. **Stock price achieves high of \$166.75 in 1966, anticipating peak net income in 1967-68 [driven by triple-digit unit shipments in same period].** Author Note: *Boeing's stock price tends to track shippable order rate rather than corporate net income.*

Lessons Learned

- Boeing's success in commercial jet aircraft stemmed from its military aircraft business in terms of *risk sharing* (e.g., 707 and its military KC-135 version) and *diversification* PLUS *efficiency* through commonality of major components for both variants.
- When faced with unknown probabilities Boeing bet its entire corporate financial fortune on *transformative* aircraft technology where the return or payoff was ownership if not dominance of the new market it helped to create! 😊

Author Notes / Closing Thoughts

- Research Support: Sonal Badavaram Surendranath. Financial Research/Analytics. University of California at San Diego – Extension Division. Graduate Assistant – Finance Certificate.
- This presentation is dedicated in blessed memory of Dr Vassilios Elias Haloulakos (1931-2019) whose pioneering work on rapid explosive decompression with wide-body jet aircraft helped to make commercial air travel safer for millions of global travelers.

About the Speaker

- George Haloulakos is a Chartered Financial Analyst (CFA), university instructor, author and entrepreneur [DBA Spartan Research and Consulting] who provides strategic financial insights on various historic aircraft.
- George's signature books are *CALL TO GLORY*, an economic reappraisal of the Convair B-58 Hustler nuclear strike bomber, and *HIGH FLIGHT*, a compendium of case studies on various American and British aircraft from World War II through the Cold War.
- *CALL TO GLORY* (ISBN 9780692475454) and *HIGH FLIGHT* (ISBN 9780100727380) are available at: www.ucsandiegobookstore.com or phone order 858-534-7326.
- Other books by George are *Dollars and Sense: A Workbook on the ABCs of Investments* and *Directed Studies in Advanced Financial Analysis*. These titles are also available from the same source.

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