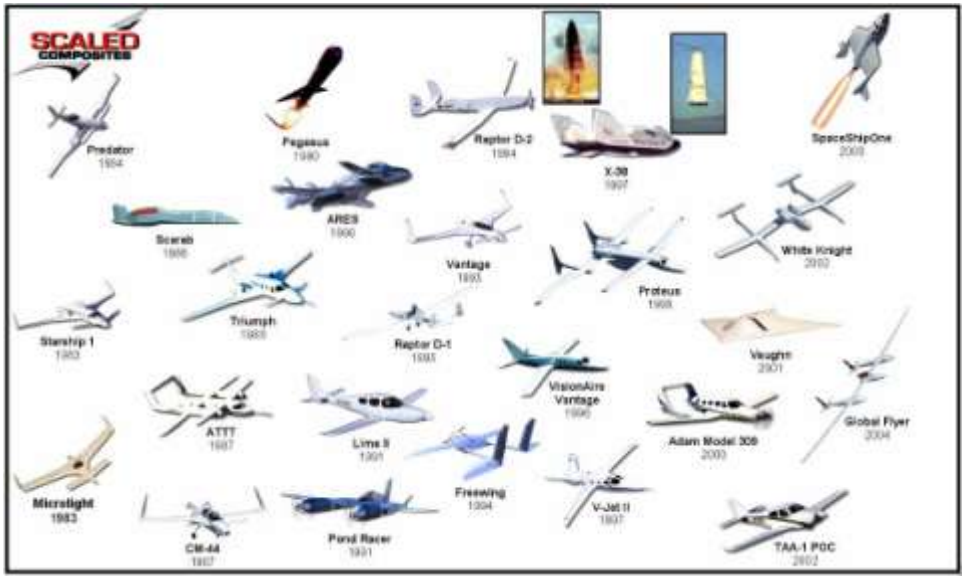
Innovation
Creativity
Motivating our Kids

An Oshkosh 2010 presentation

By Burt Rutan

This presentation's content is based on Burt Rutan's own work experiences and hobbies.



Aviation's Renaissance
1908 to 1914

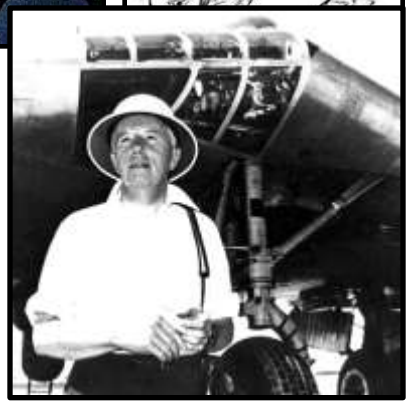
- Early 1908, < 12 pilots
  - Then, "I can do it".
- By 1912
  - Hundreds of aircraft types in 39 countries.
  - Aircraft invented by 'Natural Selection'.

Exposure During Childhood Leads to Adult Creativity

Inspiration begins early – Kids ages 3 to 14

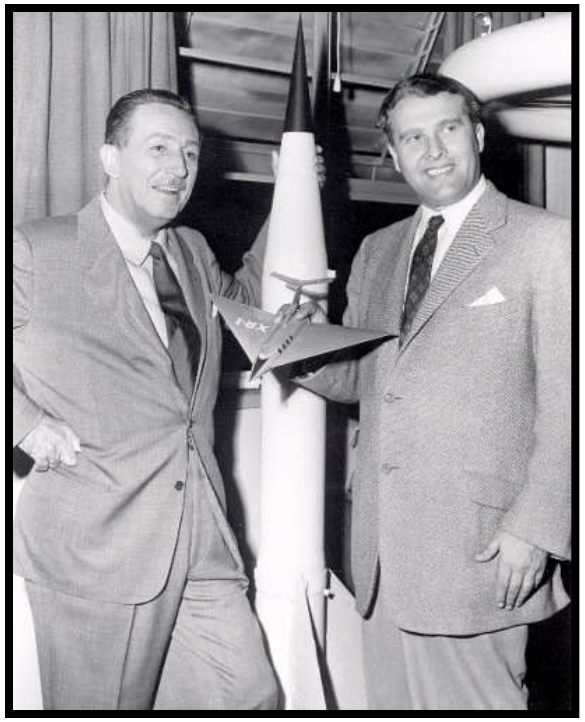
Kids Were Inspired by Aviation's Renaissance – these kids

- **Every one** of those that inspired **me**.
  - Wernher von Braun
  - Kelly Johnson
  - Charles Lindbergh
  - Jack Northrop
  - Ed Heinemann
  - Howard Hughes
  - Sergei Korolev
  - Alexander Lippisch
  - Bill Lear
- They were **all** kids during aviation's Renaissance.



Standout Memories
The Real Inspiration

- The Disney-Werner von Braun Vision, Disneyland television 1955
- The “Moonliner” at Tomorrowland 1954



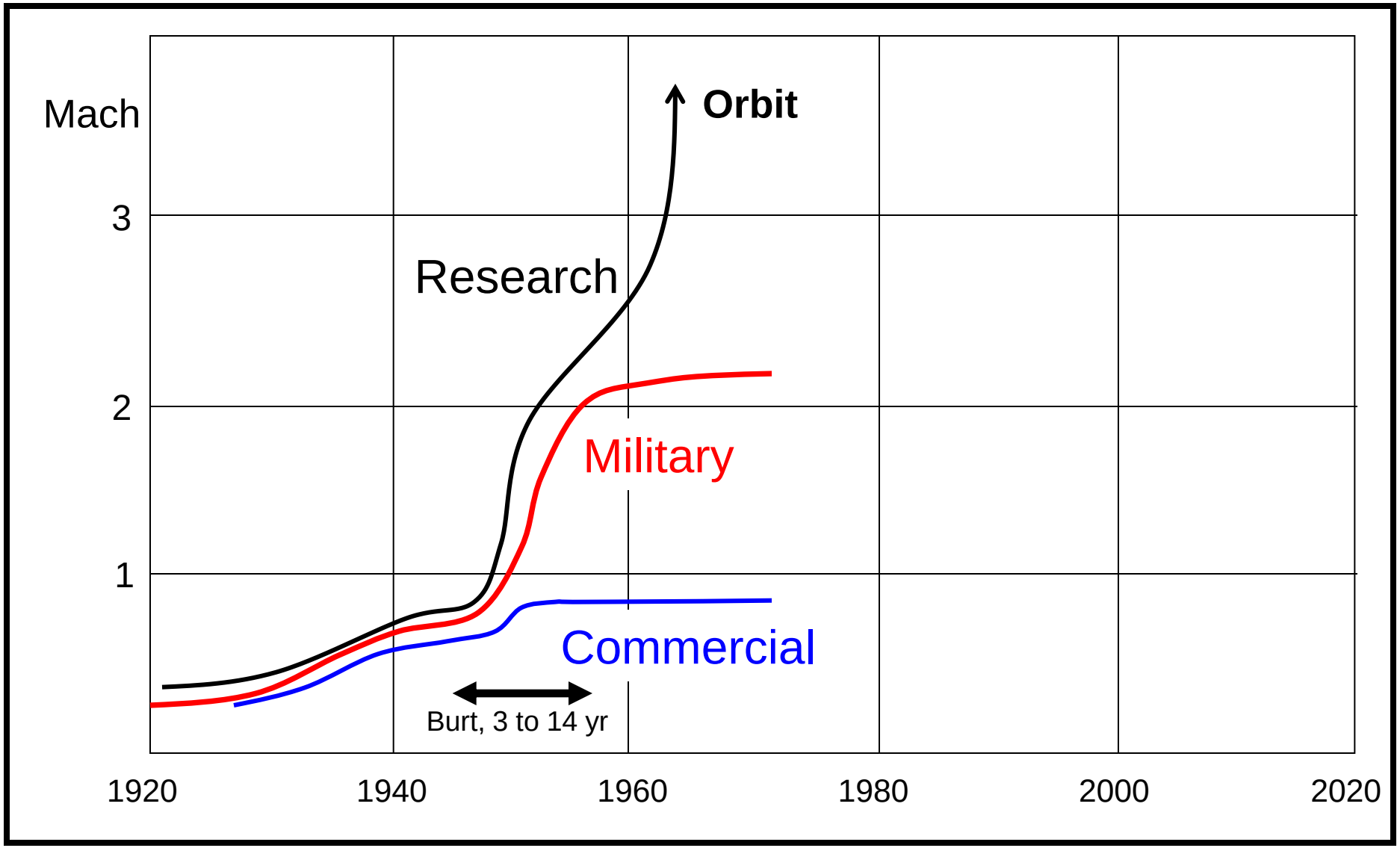
Aerospace Activity 1946 to 1957

During my Childhood (age 3 to 14)

The Jet Age starts. The Missile Age starts.

Childhood Activities Were Driven by Aviation Progress

A Jump in Aviation Performance: My inspiration during childhood



Next, A life with Toy Airplanes

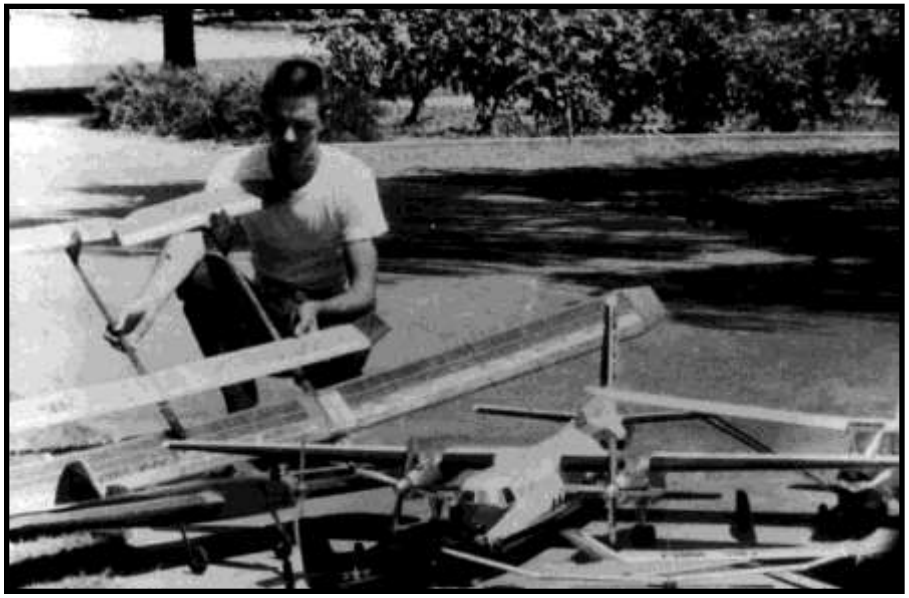
An AMA Presentation, Jan 2010

1948 (age 5)

2009 (age 66)

The Early Years - 1950s

A Passion for Airplanes and Competition



First Controline Stunt Model
~1955 (age 12)

Controline Stunt
1957 (age 14)

Small Endurance Controline
1956 (age 13)

Record Endurance Controline
Nine-foot span
1956 (age 13)

WAM Contests

San Francisco Bay Area
1956 to 1959 (age 13 to 16)


DEC 1957

Modeling Pop's Bonanza

Controline Scale 1957 - 1959
Flown in 1959 Nationals at Los Alamitos

AMA 1960 Nationals at Dallas (age 17)

Nine events entered

Nordic Towline glider A-1 and A-2; inspiration for SS1 Feathered reentry?

Fairchild F-27 Scale Model

Won Senior CL Scale

1960 Nationals at Dallas

The demise of the F-27

Rutan's first Canard Design:

Push-Pull Twin RC

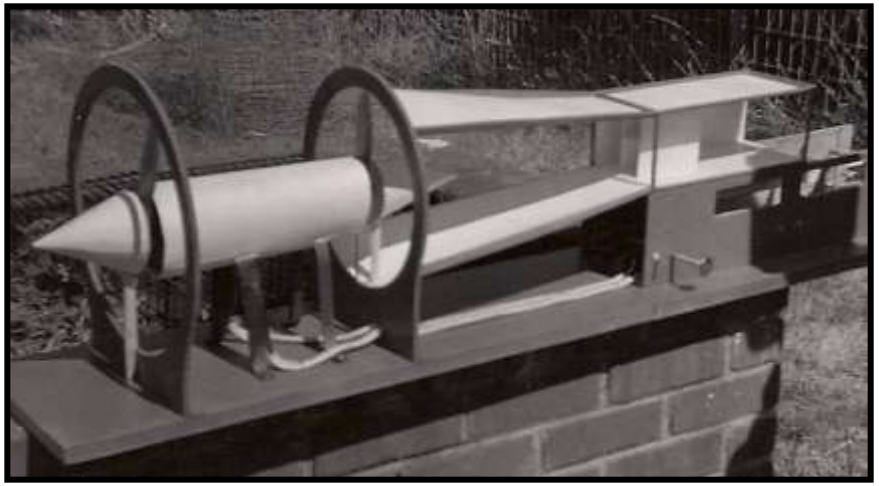
1962 at Cal Poly SLO (age 19)

VariViggen design

tested in

Homebuilt Wind Tunnel

1962 at Cal Poly SLO

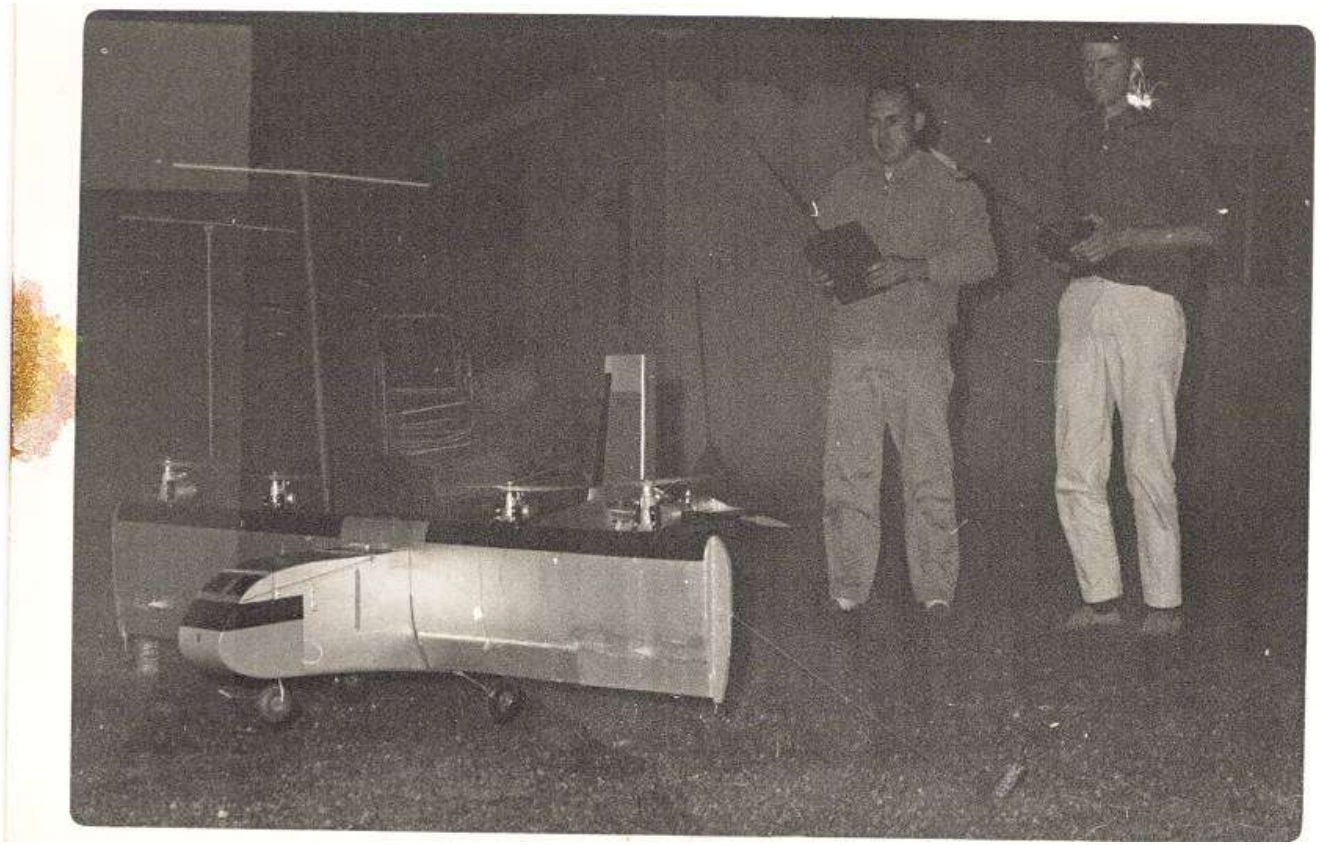


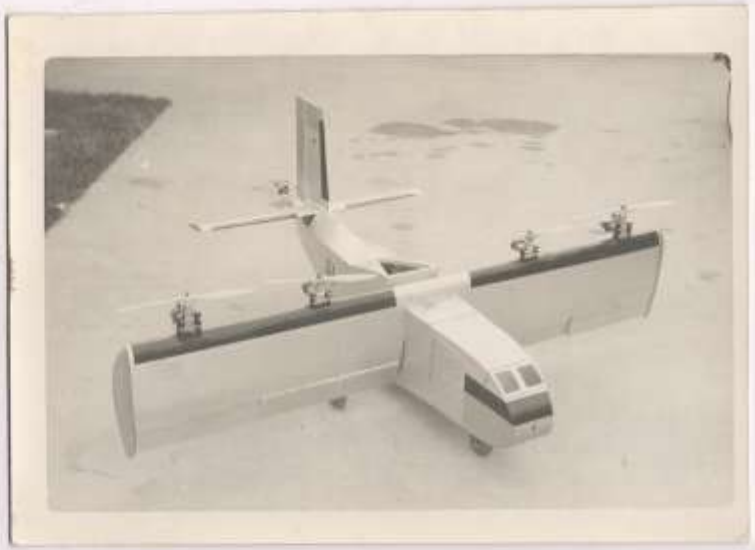
Tilt-Wing VSTOL XC-142A

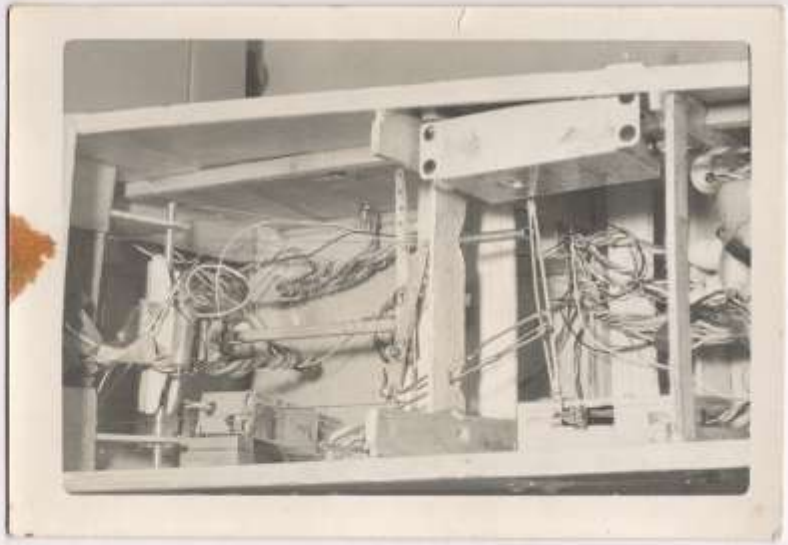
Five Engine RC

Two Receivers and Two RC Pilots

At Edwards AFB - 1965







Another Homebuilt ‘Wind Tunnel’

Car-top testing of VariViggen aerodynamics

1967

Model-type structure
Used on first homebuilt

VariViggen fabrication
1967-1971

Director of Development, Bede Aircraft

1972 to 1974

Design Projects: BD-5J and BD-5 Trainer

RAF
1973 to 1985

The Models of RAF

1973 to 1985

The Classic Film, ‘Death Race 2000’

featured the VariViggen - 1974

Manned Flight Test

Scaled Composites

1982-2009

Some Models at Scaled

"Land Shark" for SpaceShipOne tail stall modifications 2003

Display Models
1987

The Very Best Place to Store an Old Airplane

Innovation

Getting results from research efforts

Observations from a lifetime doing R & D

Air Force Flight Test 1965 to 1972

The “whole-package” experience.

Best training for an aircraft designer

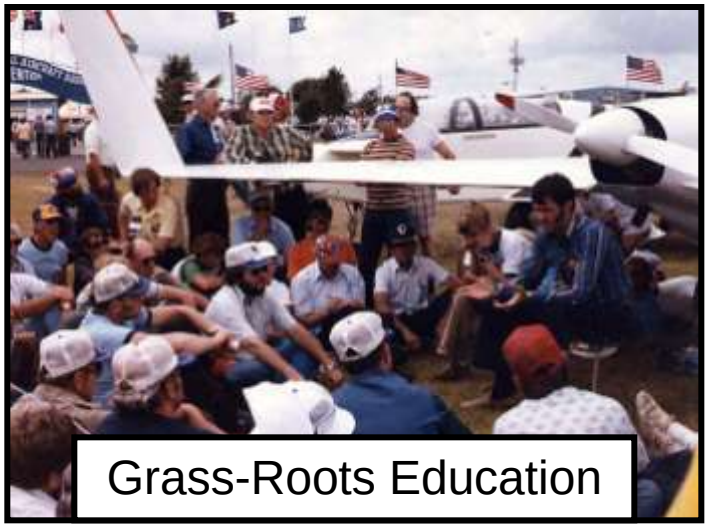
A ‘Jump Down’ - 1972

Founded Rutan Aircraft Factory

The entrepreneur can control his destiny

The Rutan Aircraft Homebuilts

Small Business - based on Fun



Grass-Roots Education

Scaled Composites Company

Founded 1982, now employs 380.

We are hiring! See Jen and Elliot

- Aircraft Research and Development.
- Concept Design through Manned Flight Test.
- Varied Customers, including Aerospace Primes.

The Importance of Technical Innovation

Our need for breakthroughs

- Key factor in the development of intelligence
- Satisfies desire for continuous improvement
- Technical progress defines our species

Exposure During Childhood Leads to Adult Creativity

- Inspiration begins early – Kids ages 3 to 14

Breakthroughs: Factors that drive our creativity

- Survival - From a real or perceived threat
  - A conquering adversary
  - Business survival - McCready Kremer prize
  - Environmental crisis
- To avoid embarrassment of perceived defeat
  - Apollo moon program
- Enjoyment
  - 'Fun' to accomplish difficult goal

Breakthroughs: When

- When do breakthroughs occur?
  - During or shortly after:
    - Crisis, chaos, “bad” times.
  - Not:
    - During tranquil, stable, “good” times.
    - When highest priority is equal status of populous.
- We are creative when threatened.

Breakthroughs: When

- We did not go to Mars in 80s & 90s (“good” times).
- But, we went to the Moon in 60s “bad” times:
    - Highest fear period of Cold War.
    - Bay of Pigs & Cuban Missile Crisis.
    - Chaos of unpopular Vietnam war.
    - Political murders: JFK, MLK, RFK.
    - Domestic race riots.

Breakthroughs: How

- ‘Confidence in Nonsense’ is allowed.
- Breakthroughs occur by:
  - Risk; trying things that may not work.
  - Looking for something else – stumble into it.

Breakthroughs: How

- Breakthroughs cannot be specified by massive funding.
  - Example: Low cost space access was the **goal** of the Space Shuttle Program.
- Breakthroughs occur due to the working environment.
  - Kelly Johnson ‘Skunk Works’.

Breakthrough Observations

R & D experience has **inverse** relationships.

- Value of product….Self-perceived sophistication of customer.
- Content of new technologies….Program timeline – Apollo vs. Ares/Orion.
- Product's worth….Risk-averse role of managers – Saturn/Apollo vs. Ares/Orion.

How to Achieve Breakthroughs
Creativity vs. productivity elements

- **Productivity**
  - Managed by: Spec/Schedule
  - Involves: Analysis/Iteration
  - Process must be defined
  - Accuracy is critical
  - Mistakes are bad
  - Many can be trained to design
  - Can grade progress
  - Sensible approach is desired

- **Creativity**
  - Managed only by: Goal
  - Involves: invention/thought
  - Process cannot be defined
  - Accuracy unimportant
  - Multiple failures expected
  - Unclear who can create
  - Can only grade goal (y/n)
  - Confidence in Nonsense is ok

How to Achieve Breakthroughs:
Creativity requires a specific environment

- **Productivity**
  - Equipment: Extensive analysis Hardware/Software
  - Engineers need indirect shop interface
  - Continuous data access
  - Typical office distractions are expected
  - Continuous schedule tracking
  - Boring environment requires human interaction

- **Creativity**
  - Equipment: Sketchpad or SketchCAD
  - Creators have authority in laboratory
  - Occasional research info
  - Extensive solitude/relaxed environment required (nature)
  - No schedule, no time focus
  - Innovators must have *fun*

The Management of Innovators

Manager's **only** tasks: Set goal and get funding.

- Set difficult goal (50% should say impossible).
- Reward achievement of goal (power of a prize).
- Let the innovator decide what risks to take.
- Leave them alone and keep others out.
- Applaud courage and expect multiple failures.
- Allow *fun.*

Managers:
Want Innovation?
Do **not** "manage".

"If you want to build a ship, don't drum up people to collect wood and don't assign them tasks and work, but rather teach them to long for the endless immensity of the sea."

-***Antoine de Saint-Exupery***

Our Responsibility Now - Create Progress to Inspire our Kids

- Our Technology leaders had their inspiration in exciting times.
- Periods of extreme technical progress:
  - Aviation's Renaissance, 1908 to 1912
  - My inspiration, 1946 to 1957, post WWII
  - Gagarin to Skylab, 1961 to 1973

The Inspiration for Space Exploration

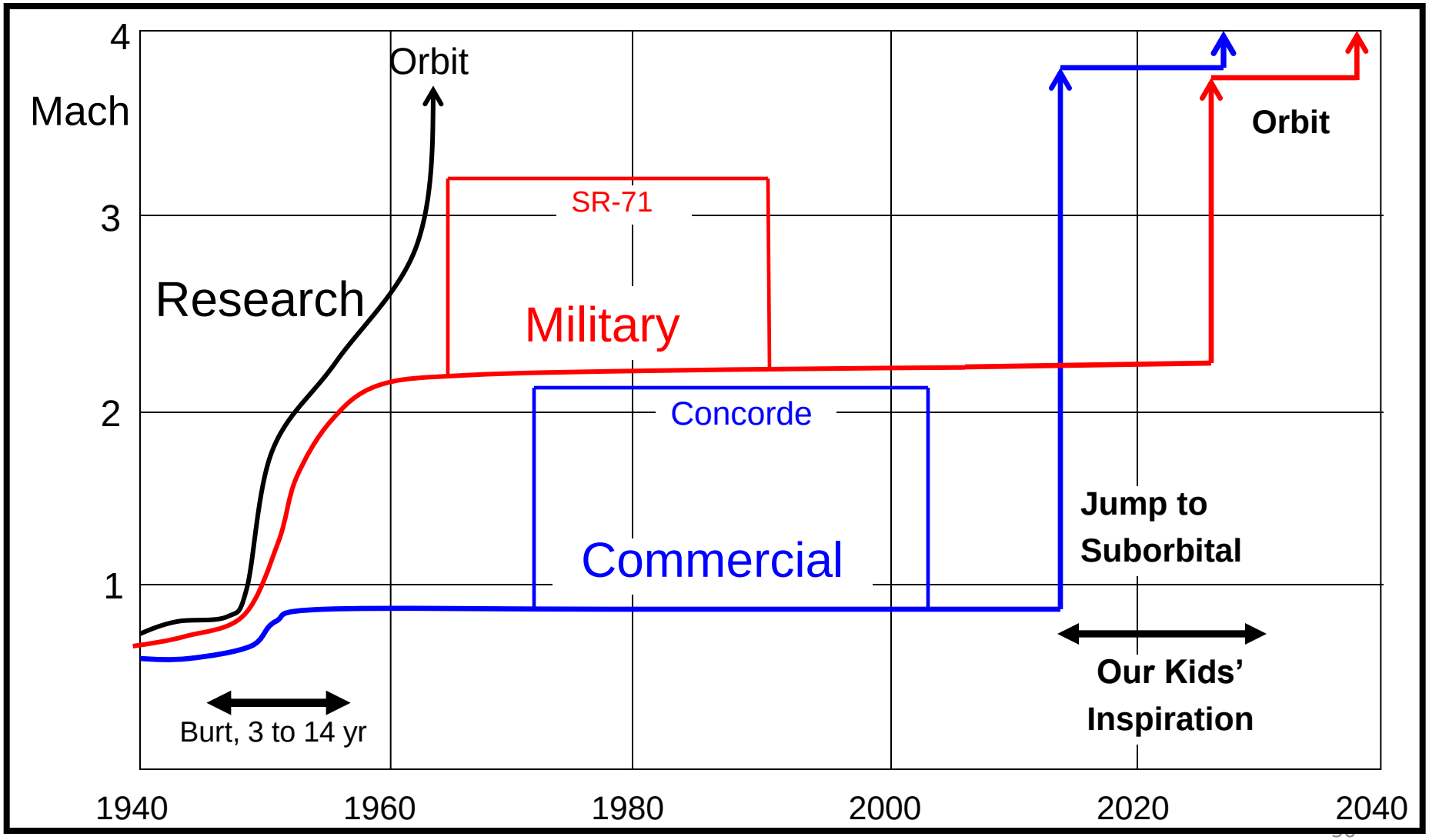
Restructuring of Government manned spaceflight

- Competitive 'New-space' can do LEO, but NASA must do forefront exploration.
- Move to commercial sounds attractive, but does it have real advantages? The tech oversight and the ISS safety requirements limit innovation.
- Clearly SpaceX and Orbital will succeed on LEO access, but will it end at the Gemini capability? (1965), or will they really explore?

Sorry about that, kid.

A Prediction:

Commercial Performance May Exceed Military



U. S. Competitive Position: Science and Engineering Education

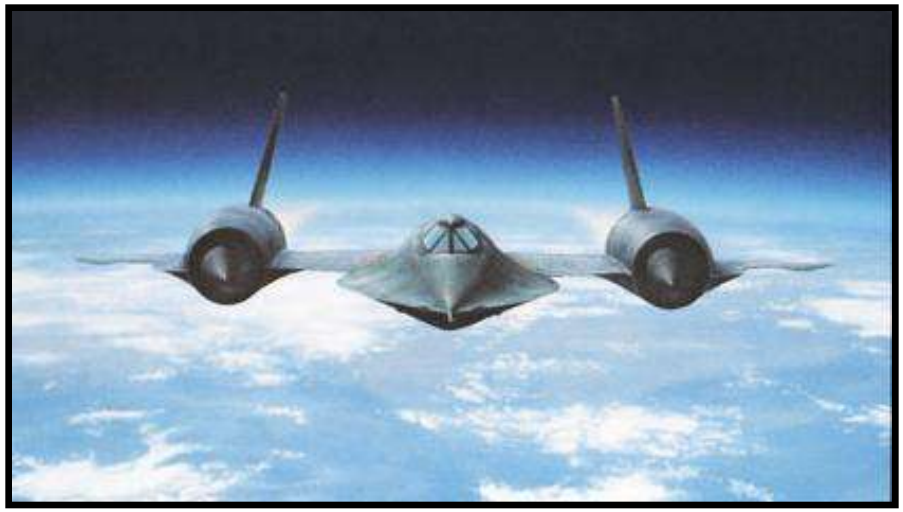
- The education statistics are bleak.
  - Science/engineering vs. lawyers/media/politicians/actors*

  * And other criminals
- The real reason – We are boring our youth.
  - Development vs. research
- The solution – take real risks, to motivate our kids.
  - Exploration
  - Adventure
  - Breakthroughs
- Strive to be great, not to be 'equal'.

Take Big Risks

Most impressive aircraft - Lockheed SR-71

Designed in 1959, only 14 years after first USAF jet.
First flown in 1963.
Abandoned in 1998, retreated to 1956 U-2.

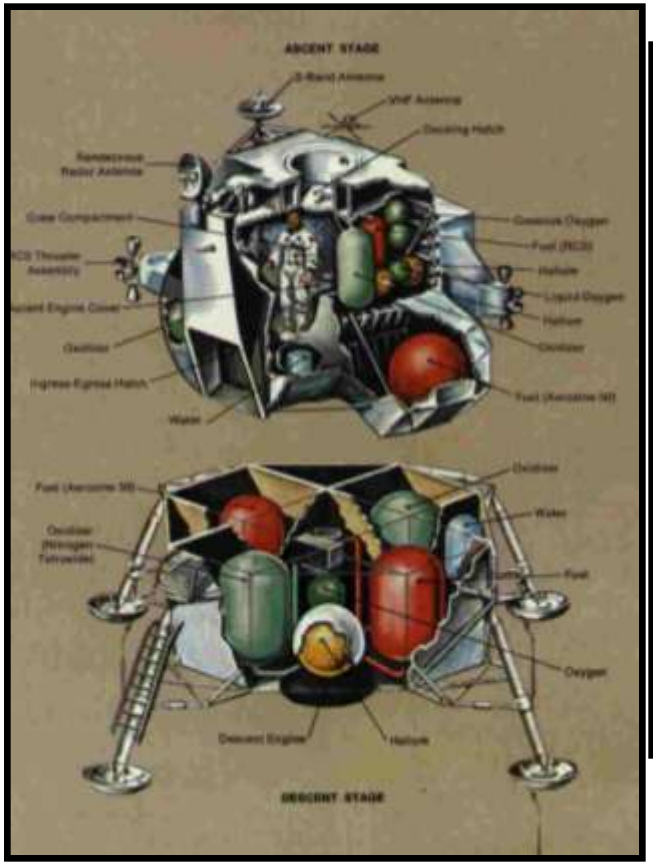


P-80
1945

Take Big Risks

The Most Impressive Spaceship - Lunar Module

Designed in 1964, three years after Gagarin.
First flight 1968.
Abandoned capability in 1973.



Gagarin's Vostok
1961

The Future

A **Super** Renaissance?

- Factors that Enabled Original Renaissance
  - Basic Physical and Chemical Science
  - Printing Press (communication)
- Recent Advances - These will enable a SR
  - Computational Explosion & Super Internet
  - Corralling Chaos, Quantum Mechanics
  - Virtual Reality…. Resolution > our human sensors
  - Manufacturing at the molecule level; home factory
  - Zero-Point Energy or another TBD energy source
- The Next 30 Years - Dramatically Different

Humanity's future in a connected world

- Our need for physical travel disappears, if a virtual mode is available – We will ‘travel’ more than before.
- Countries – defined by values and beliefs, not by geography. Chose a different ‘country’ without changing where you sleep.
- Exploration and Discovery – Increased activity is essential.
- Humanity – Its definition is a moving target. We are just getting started ‘being human’.

Questions?