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

Mach

Orbit

Research

Military

Commercial

Burt, 3 to 14 yr
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)
Small Endurance Controline 1956 (age 13)

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

Controline Stunt 1957 (age 14)
WAM Contests
San Francisco Bay Area
1956 to 1959 (age 13 to 16)
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

<table>
<thead>
<tr>
<th>Factors</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Survival</td>
<td>From a real or perceived threat</td>
</tr>
<tr>
<td></td>
<td>- A conquering adversary</td>
</tr>
<tr>
<td></td>
<td>- Business survival - McCready Kremer prize</td>
</tr>
<tr>
<td></td>
<td>- Environmental crisis</td>
</tr>
<tr>
<td>To avoid embarrassment</td>
<td>of perceived defeat</td>
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<tr>
<td></td>
<td>- Apollo moon program</td>
</tr>
<tr>
<td>Enjoyment</td>
<td></td>
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<tr>
<td></td>
<td>- ‘Fun’ to accomplish difficult goal</td>
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</tbody>
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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 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

<table>
<thead>
<tr>
<th><strong>Productivity</strong></th>
<th><strong>Creativity</strong></th>
</tr>
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<tbody>
<tr>
<td>Managed by: Spec/Schedule</td>
<td>Managed only by: Goal</td>
</tr>
<tr>
<td>Involves: Analysis/Iteration</td>
<td>Involves: invention/thought</td>
</tr>
<tr>
<td>Process must be defined</td>
<td>Process cannot be defined</td>
</tr>
<tr>
<td>Accuracy is critical</td>
<td>Accuracy unimportant</td>
</tr>
<tr>
<td>Mistakes are bad</td>
<td>Multiple failures expected</td>
</tr>
<tr>
<td>Many can be trained to design</td>
<td>Unclear who can create</td>
</tr>
<tr>
<td>Can grade progress</td>
<td>Can only grade goal (y/n)</td>
</tr>
<tr>
<td>Sensible approach is desired</td>
<td>Confidence in Nonsense is ok</td>
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# How to Achieve Breakthroughs: Creativity requires a specific environment

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<th><strong>Creativity</strong></th>
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<td>– Equipment: Extensive analysis Hardware/Software</td>
<td>– Equipment: Sketchpad or SketchCAD</td>
</tr>
<tr>
<td>– Engineers need indirect shop interface</td>
<td>– Creators have authority in laboratory</td>
</tr>
<tr>
<td>– Continuous data access</td>
<td>– Occasional research info</td>
</tr>
<tr>
<td>– Typical office distractions are expected</td>
<td>– Extensive solitude/relaxed environment required (nature)</td>
</tr>
<tr>
<td>– Continuous schedule tracking</td>
<td>– No schedule, no time focus</td>
</tr>
<tr>
<td>– Boring environment requires human interaction</td>
<td>– Innovators must have <em>fun</em></td>
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</table>
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.”

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-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

Take Big Risks
The Most Impressive Spaceship - Lunar Module
Designed in 1964, three years after Gagarin.
First flight 1968.
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?