

V T O L

Vertical **T**ake-**O**ff and **L**anding

(The future of travel)

by

John Crocco, Mariusz Kuczaj, Arvind Nagarajan & Tina
Reynolds

Outline

- Objective
- Brief history
- Market study
- Design proposal
- Simulation
- Model construction
- Conclusion

Objective

Create the “flying car” predicted for the 21st century.

- Inexpensive
- Reliable
- Safe



Brief history

- Predecessors:

Bell / Boeing V-22 Osprey

- Fairly modern design, which first flew in 1989.
- Uses two tilting rotors, which provide the power for VTOL capabilities.
- Mainly used for transport purposes by US Marine Corps.



Brief history

MD / BAe AV-8B Harrier II

- Originated in Great Britain as Hawker P.1127 (1960).
- Known as the world's first successful VTOL aircraft.
- The design features thrust vectoring, which enables the four nozzles to transform the aircraft from horizontal to vertical flight, thus enabling it to land and/or take-off vertically.



Brief history

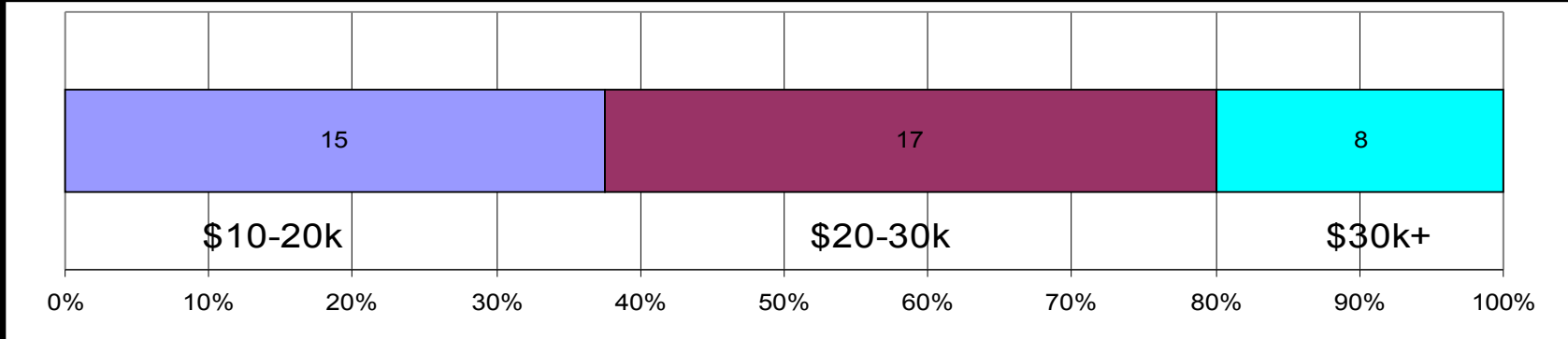
Convair XFY-1

- This particular design featured two counter rotating propellers.
- First flown in 1954.
- Due to its disadvantages over jet power, further development was stopped.

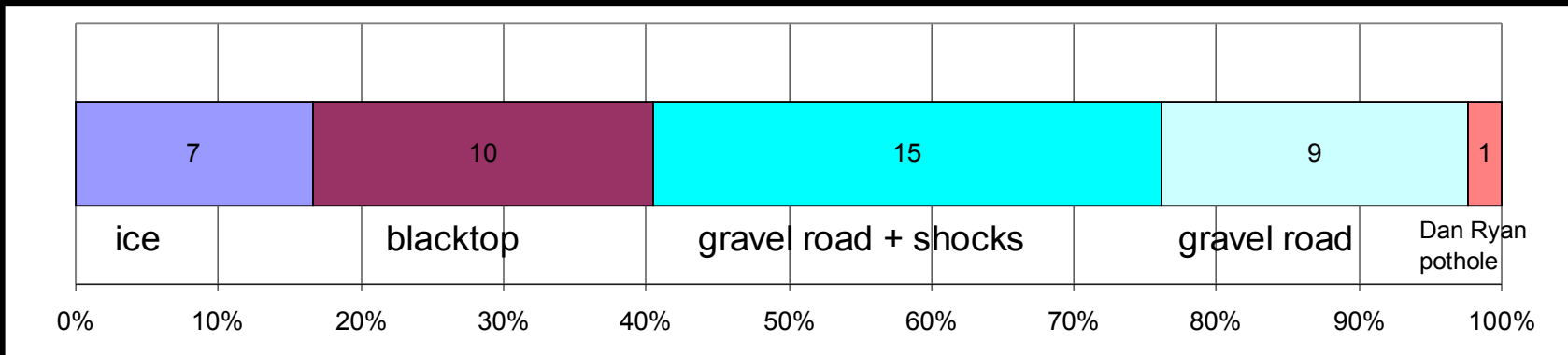


Market study

What is the most you are willing to pay?

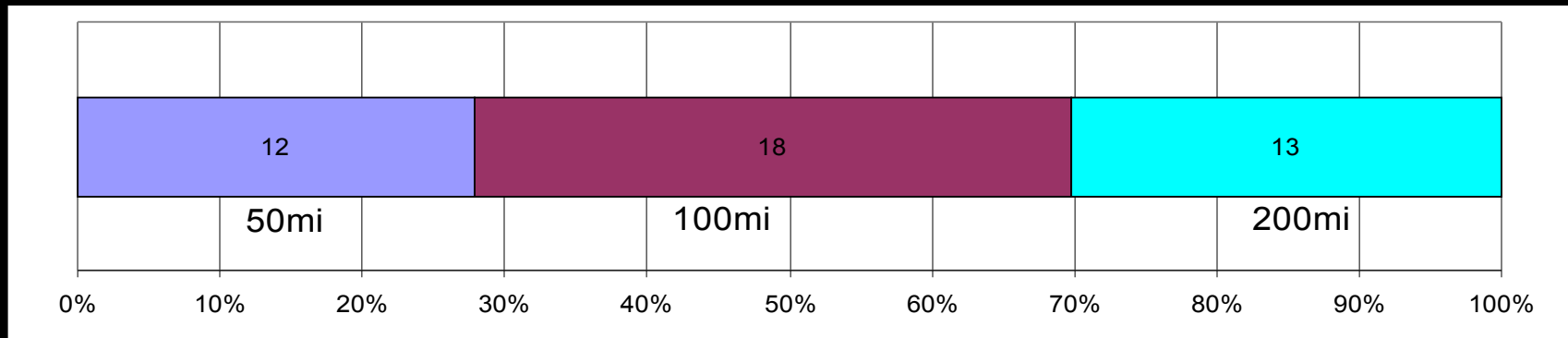


What is the most roughness of transition that you are willing to accept?

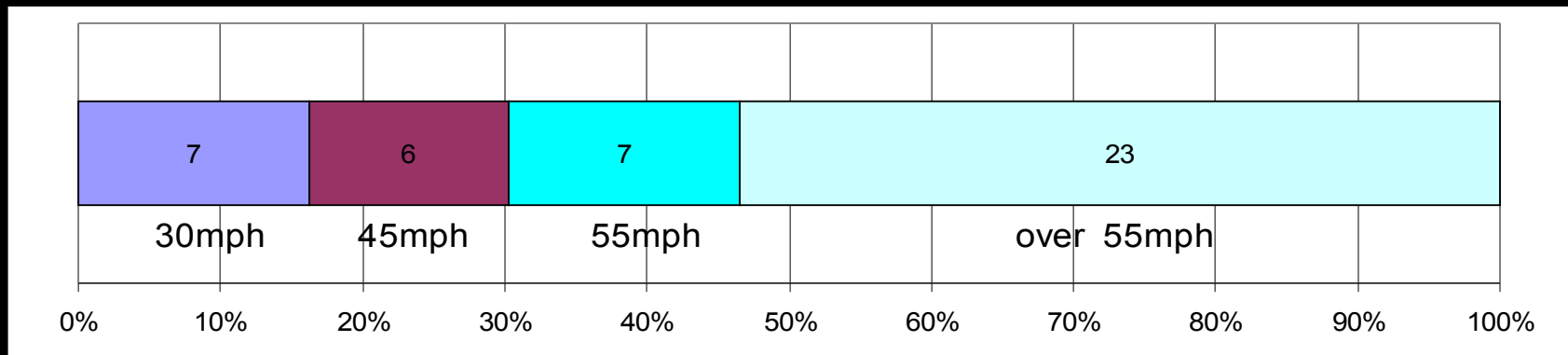


Market study (Cont'd)

What is the minimum acceptable range you would require (mi)?



What is the minimum acceptable speed (mph)?



Design proposals - The Volor

- Passenger capacity – 2
- Twin-rotor system
 - Fixed pitch blades
 - Cyclic rotor-disk control
- Lift provided by wings in forward flight
- Better fuel efficiency (~25 miles/gallon)



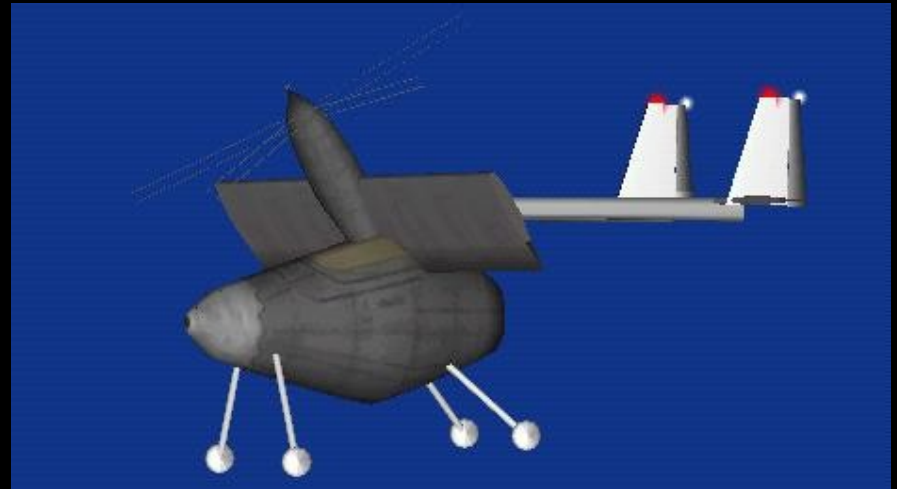
Design proposals – The X-2

- Passenger Capacity – 2
- Four ducted fans
- Standard control systems
- Advantages:
Mechanically less complicated
- Disadvantages:
Expecting higher fuel consumption



Design proposals – XVM3

- Passenger capacity – 2
- Counter-rotating propellers
- Tilt-wing controls for flight & hover
- Still in the experimental phase

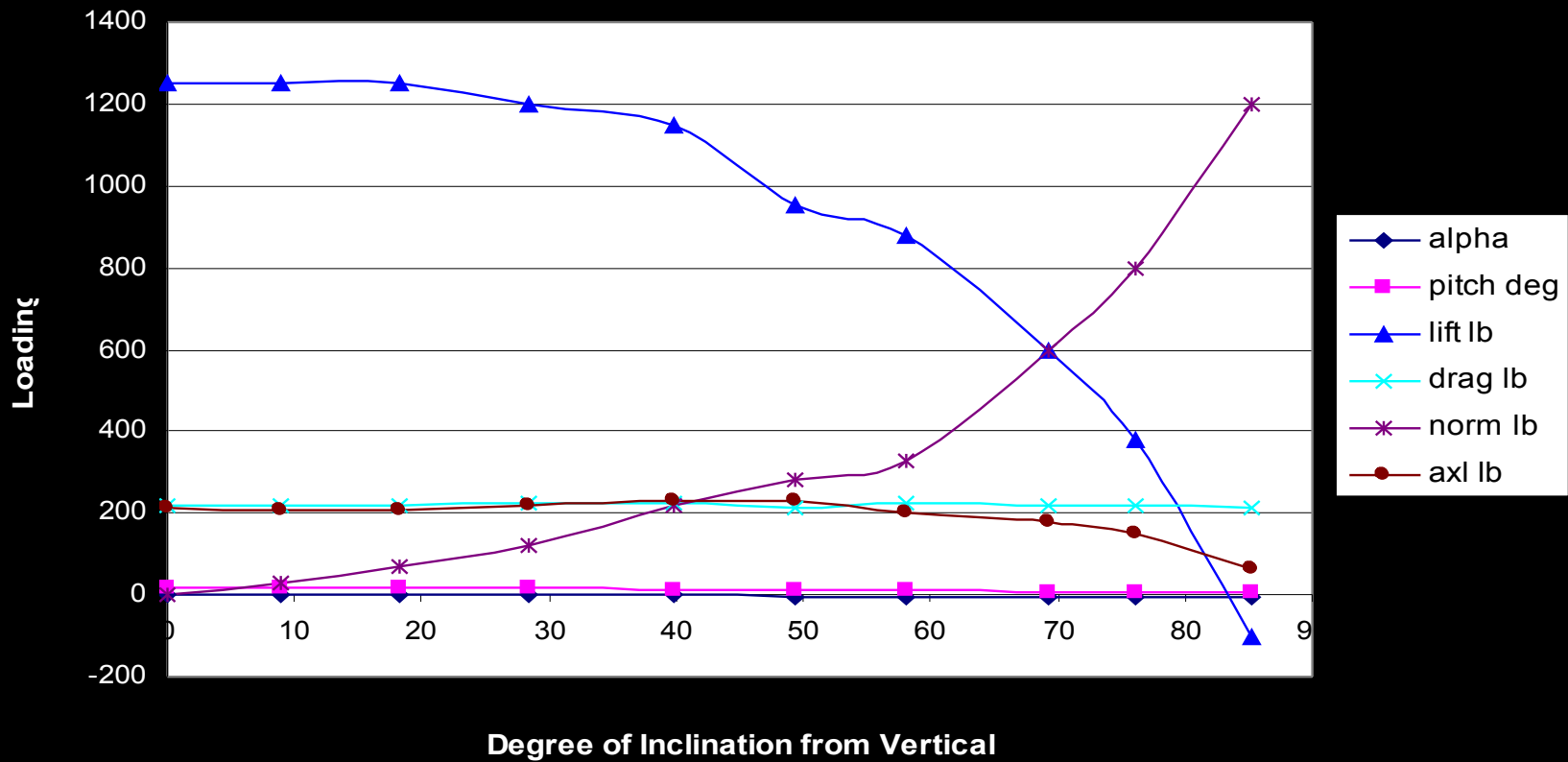


Simulation & Testing

- Software used: X-Plane
- Modeling concepts in software
 - Basic: Thrust, weight, lift & drag
 - Detailed: Aerodynamic forces, prop-wash
- Design process: Theoretical estimations to trial & error

Simulation & Testing (cont'd)

Values at Full Throttle



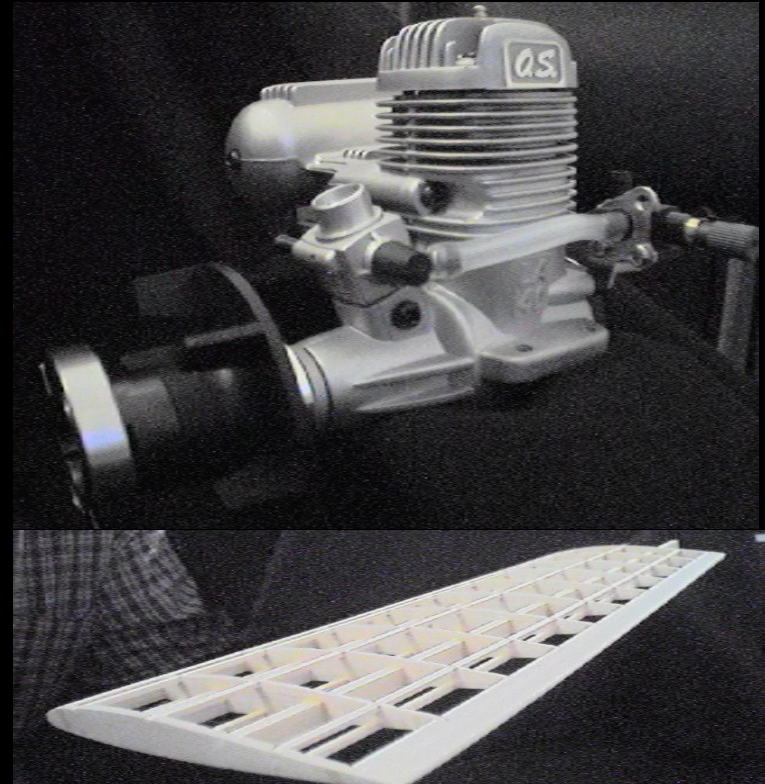
Model construction

- Chosen design:
Volor
- Scaling: Length
based on weight
- Part selection:
Modify a pre-
existing helicopter



Model Construction (Cont'd)

- Engine: OS Max .40LA (1 hp@16000 rpm)
- Scale ratio – 1:10
- Wing material – Balsa wood & plywood
- Frame – Hardened plastic



Conclusion

- What has been accomplished
 - Market research
 - Design stability has been verified
- What still has to be done
 - Formalize a design for the rotor head
 - Model testing
- Questions and comments