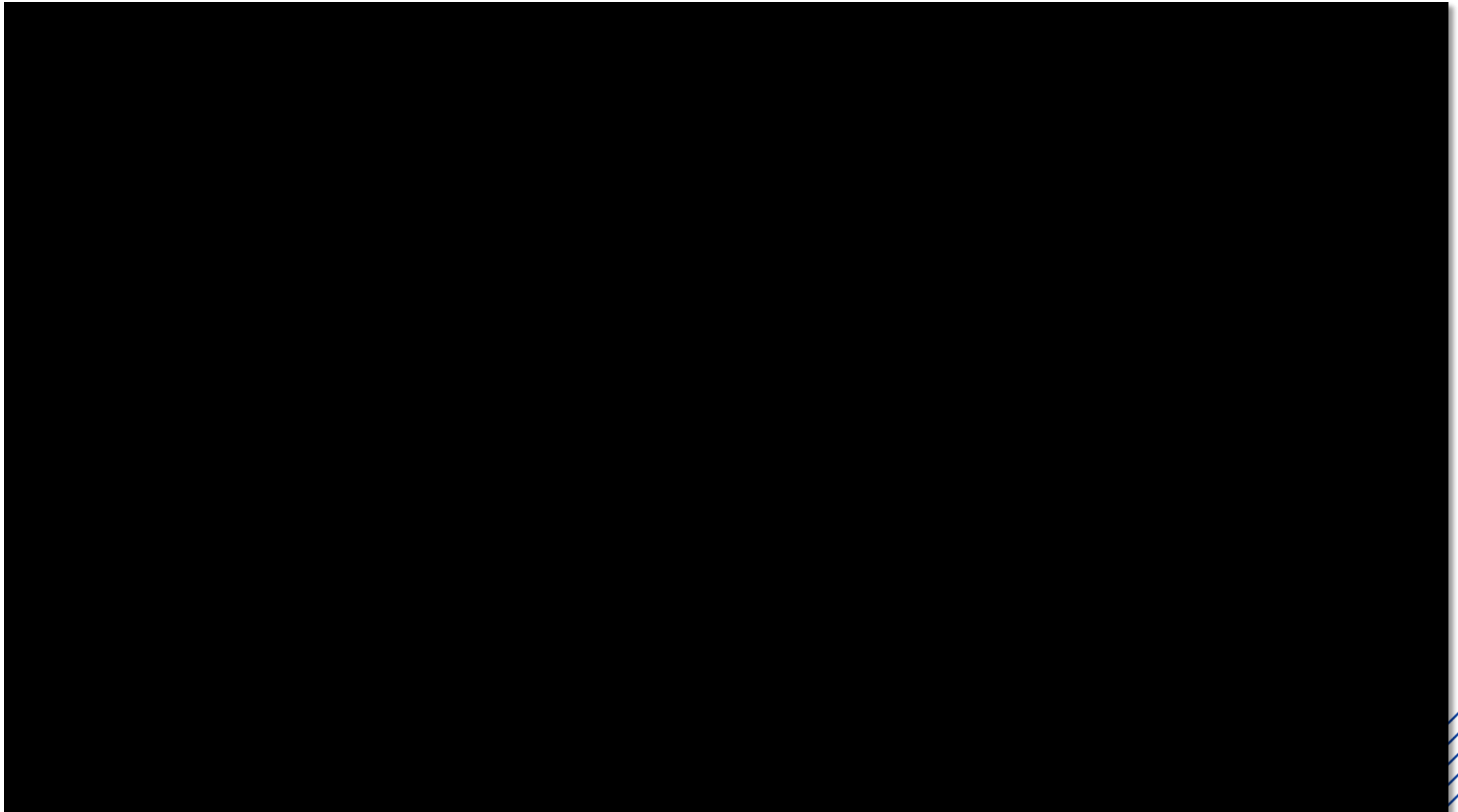




Virtual Reality in aviation training

Aaron Snoswell, Boeing Research & Technology Australia

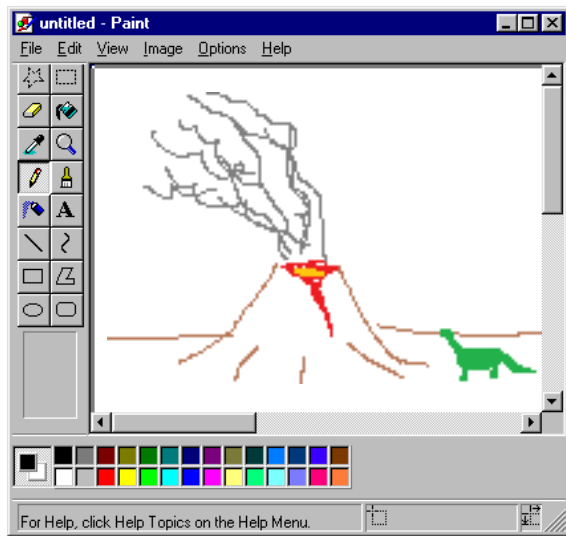


Valve, Virtual Reality - SteamVR featuring the HTC Vive

Paradigm Shift

Step Change

- A step-change in digital content from **abstractions** to **immersion**



Google, Tilt Brush: Painting from a new perspective

VR enables naturalistic interaction

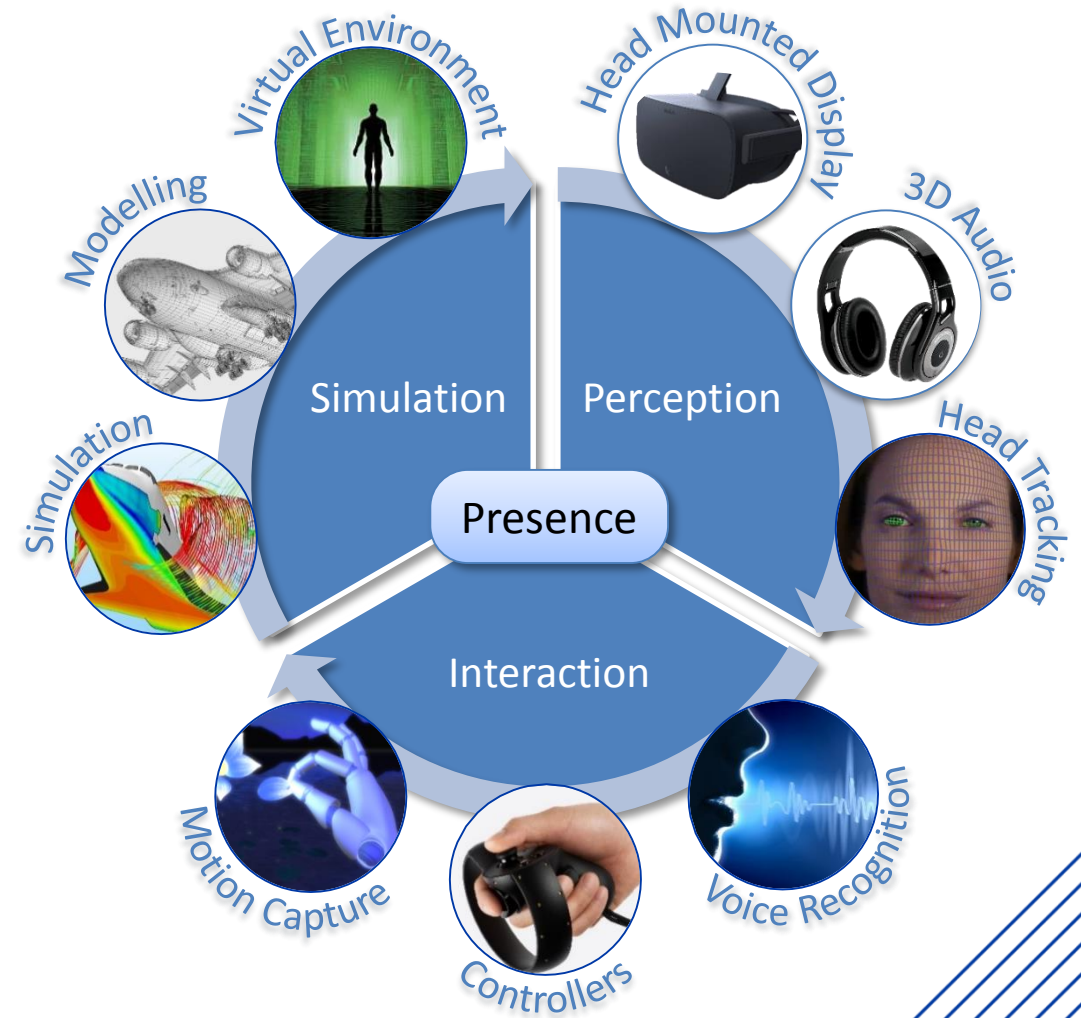
Defining Virtual Reality

Application

- Complex interaction of technology to achieve **presence**



VR Zone, Project I Can



Why is engagement important?

Better Learning Outcomes

- Merrill, M. D. (2002). *First principles of instruction*. Educational technology research and development, 50(3), 43-59.
- Mayer, R. E. (1992). *Thinking, problem solving, cognition*. WH Freeman/Times Books/Henry Holt & Co.
- “... students learn better when engaged in solving problems”

Embodied Learning

- Learning Theory developed by Arizona University SMALLab – a fusion of Human Computer Interaction, Cognitive Science and Learning Theory
- Learning should be kinesthetic, collaborative, and multimodal

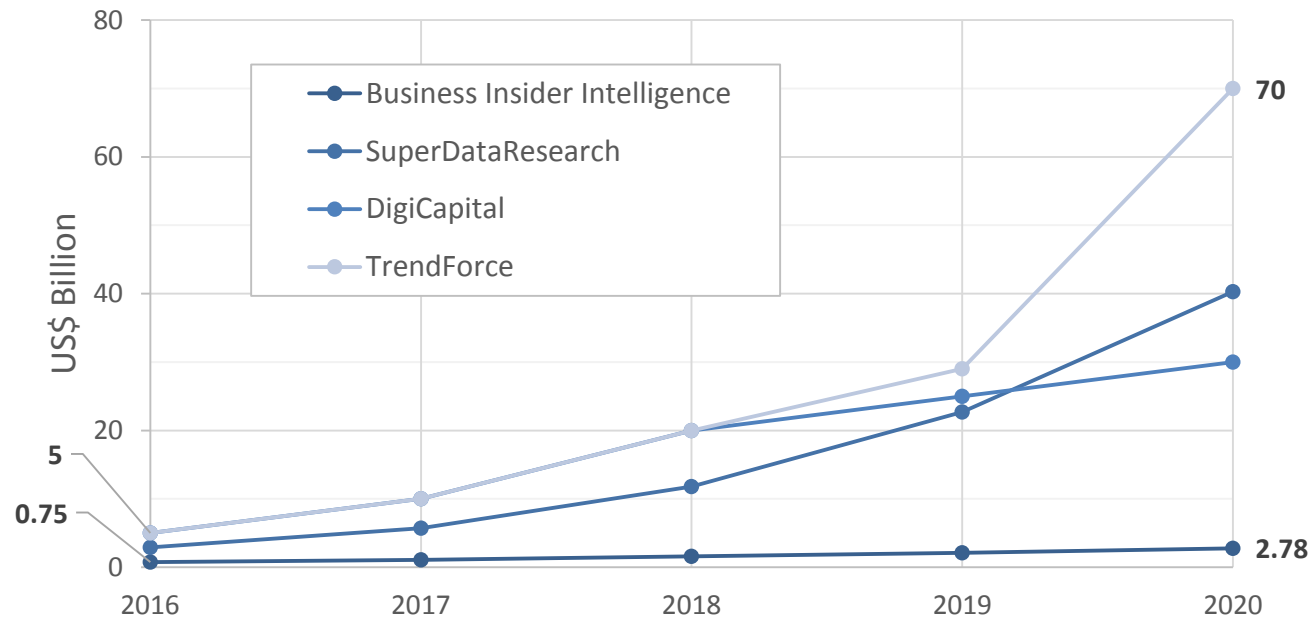
VR can provide a very immersive and engaging environment for learning

Background

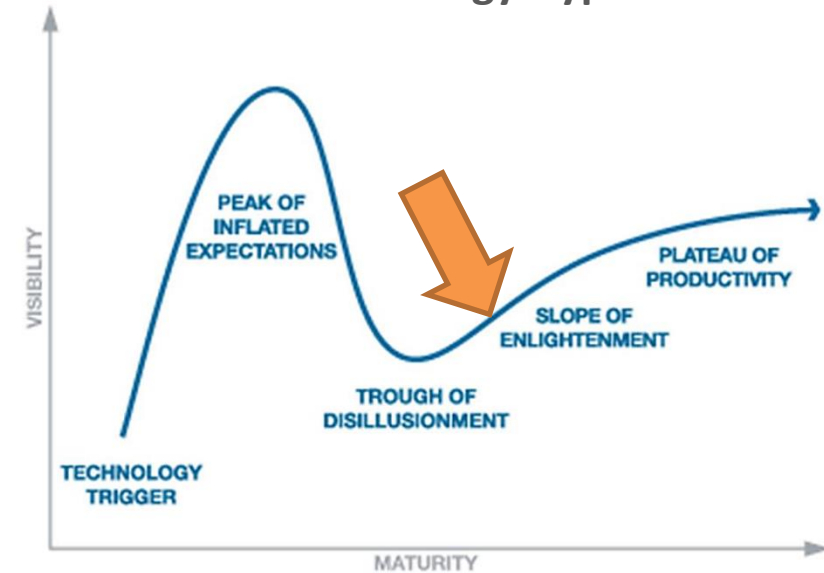
More than just hype

- First VR systems were created in the 70s
- Smartphone displays, accelerometers and graphics processor advances – 2016 is the year of commercially available, high-quality VR
- **Very rapid growth** driven by the computer games industry

VR Market Revenue Forecasts



Gartner Technology Hype Curve

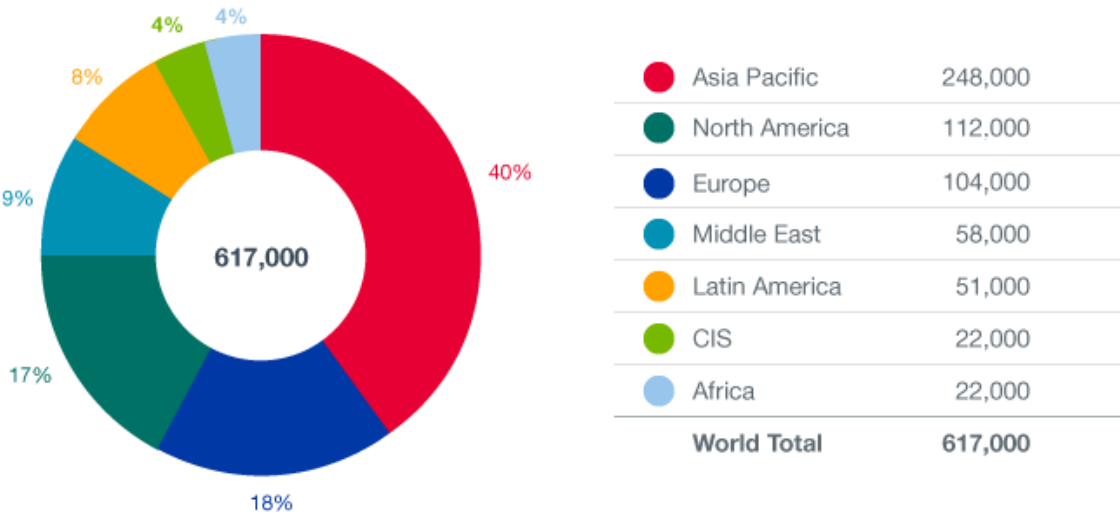


Why Aviation? Need to innovate

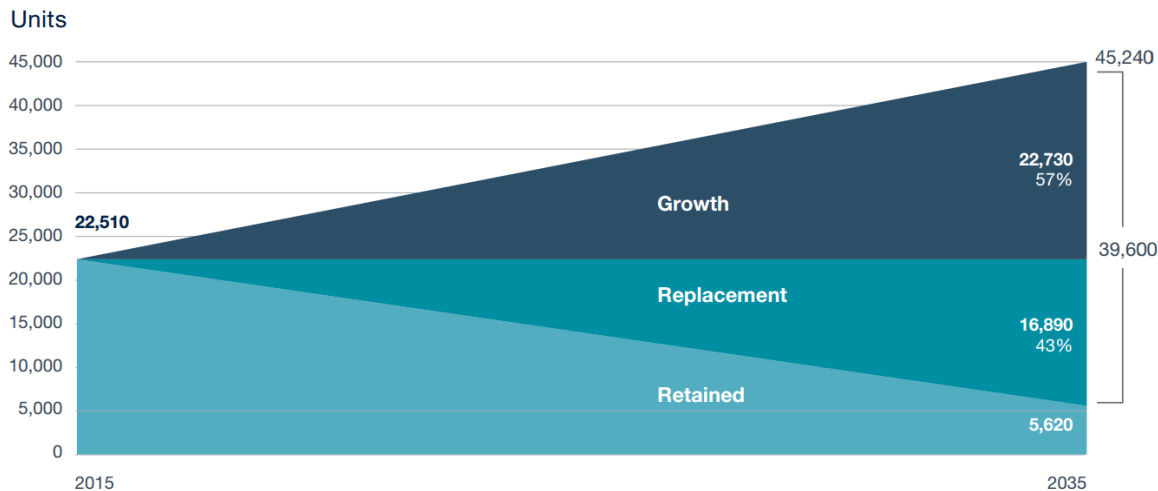
In need of disruption

- Annual Boeing Current Market Outlook (2016-2035)
- Global simulator fleet cannot meet demand
- Significant need for **more efficient** training pipeline

New pilots by region



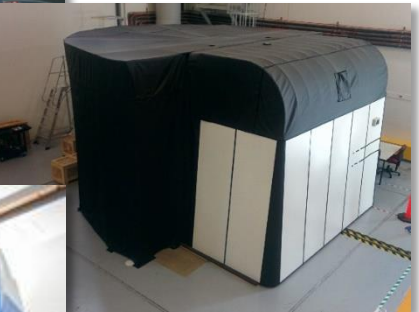
Global fleet will double



Why Aviation? Cost-fidelity trade-off



~ \$50k



~ \$50m



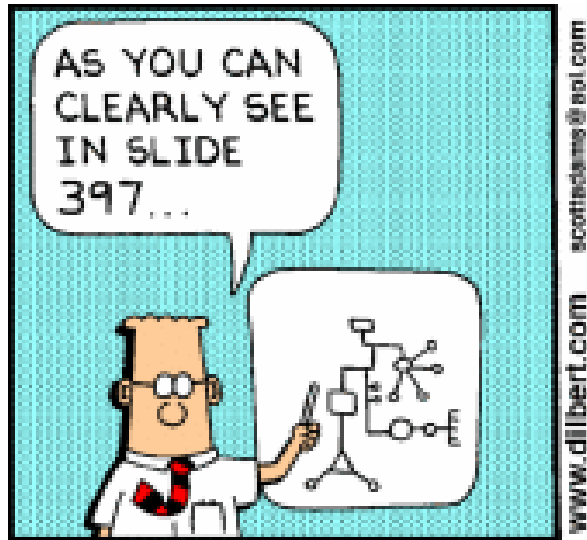
mdbuehler, War Thunder - VR Simulator with Oculus Rift / Full Set of Controls

\$5000 home setup

Why Aviation? Engagement

Classrooms are boring

- Overuse of Powerpoint
- VR is interactive and develops muscle-memory
- Younger generations expect more engaging educational experiences
- Broader trend of **gamification**





[mdbuehler, Real life flying vs Virtual Reality - Oculus Rift DK2 / FSX / FlyInside FSX](#)

What about motion?

VR Sickness

- **VR sickness** - motion perception problem
- Caused by ocular-vestibular conflict and vergence-accommodation conflict (imperfect sensory substitution)
- Improved technology can counter this
- Good design can counter this

Adding motion to VR

- Cheap motion platforms
- Galvanic Vestibular Stimulation research
- Is motion necessary for VR?



[Motion-Sim, www.motion-sim.cz](http://www.motion-sim.cz) 4x4 Simulator is released for sale

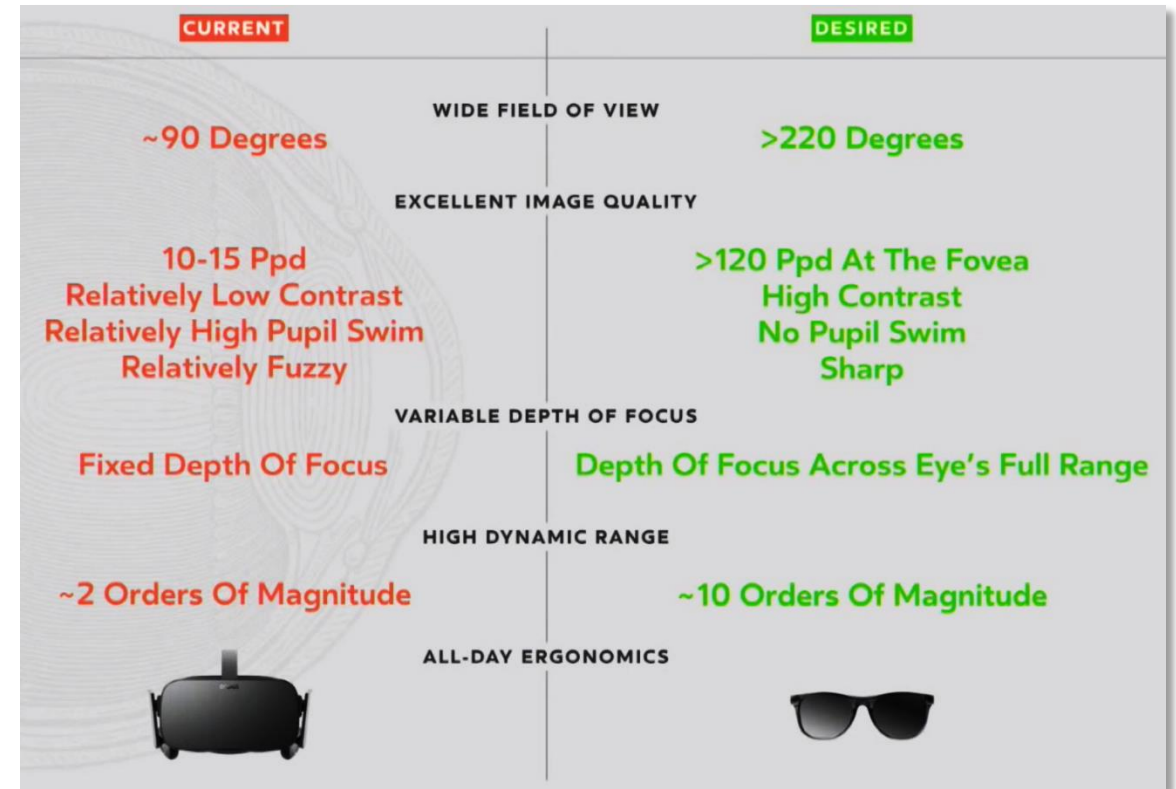
Lots of Human Factors challenges

Re-creating reality is hard!

- Field of view: currently 90°, need 320°
- Resolution: currently 1200x1080, need 26k x 38k
- Pixel density: currently 15ppd, need 120ppd
- Depth of focus: currently fixed at 2m, need variable
- High Dynamic Range: currently 2oom, need 10oom
- Very low lag, high accuracy gaze tracking is critical to achieve technical goals
- Motion capture (body, hands, face) is an open problem
- Social interaction

Comfort for extended use is hard!

- Latency: currently ~15ms
- Inside-out tracking required for use anywhere
- An untethered, wireless platform is the goal
- All-day ergonomics (sunglasses vs. bulky goggles)

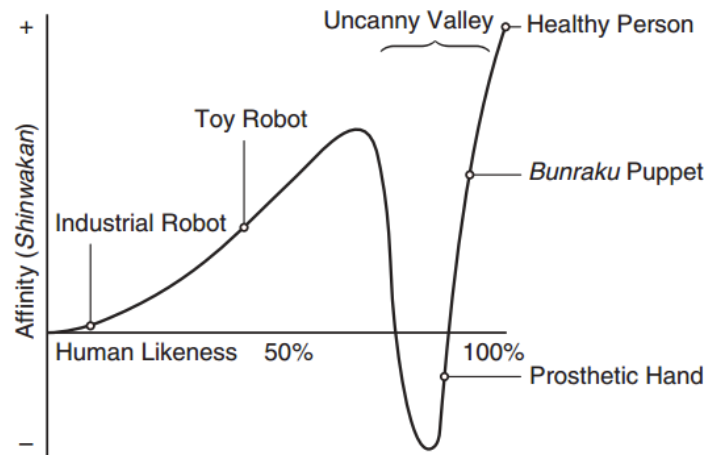


Other VR Challenges

Industry-wide challenges

- **Safety** in immersion is key
- Social experiences suffer from uncanny valley effects
- **Regulatory approval** – a long journey ahead
- Technology adoption – a broad spectrum from pragmatist to enthusiasts

The Uncanny Valley

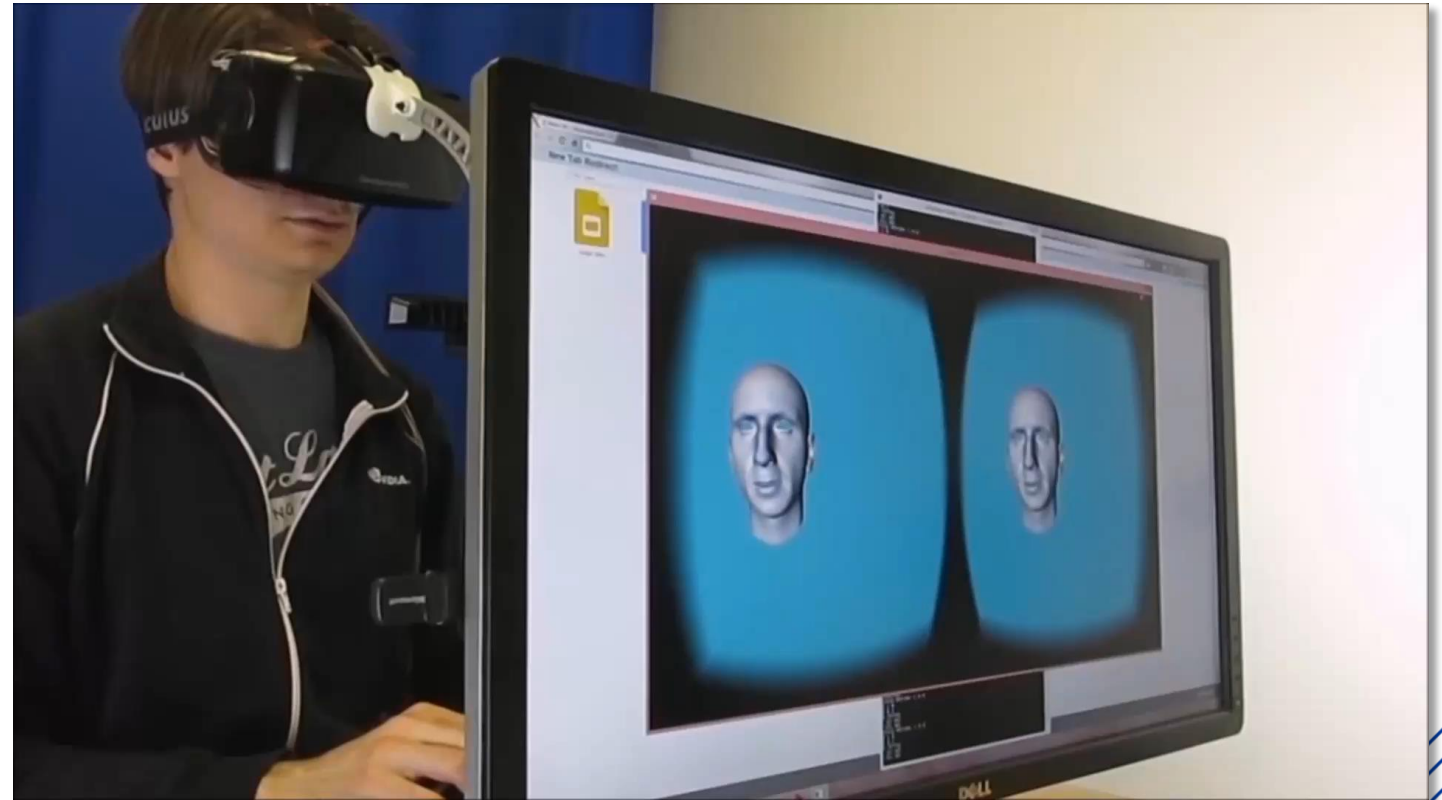


[Reddit user Arsanus, Leaning on virtual desks](#)

Research example – social VR

Many open questions

- Oculus Research: Real-time face reconstruction and tracking
- In the future, CRM training will be possible



[Oculus Research, Facial Performance Sensing Head-Mounted Display \(SIGGRAPH 2015\)](#)



Aaron Snoswell

aaron.snoswell@boeing.com

