HP's Commercial VR Strategy

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7. Februar 2018

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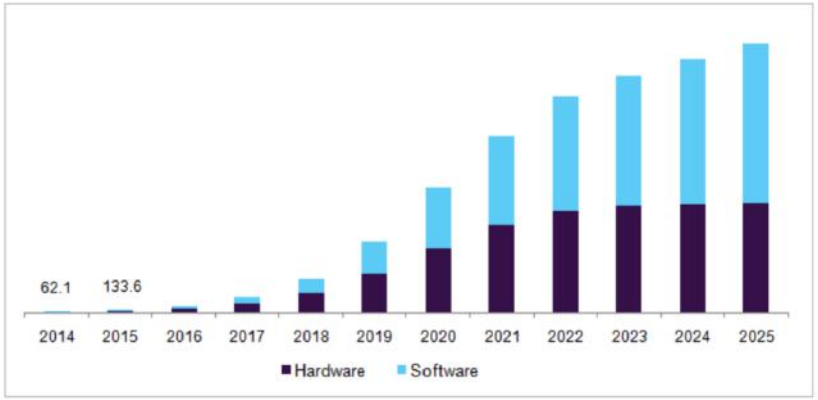
"Games make up 76% of all virtual reality content, with tens of millions of users."



VR $25 Billion by 2021
AR $83 Billion by 2021

- Digi-Capital

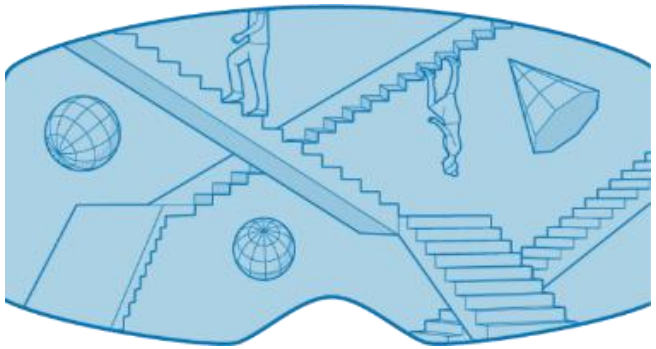
We see an even larger OPPORTUNITY in commercial VR…

UNREAL ENGINE

Image courtesy of McLaren

VR, AR and MR

Virtual Reality

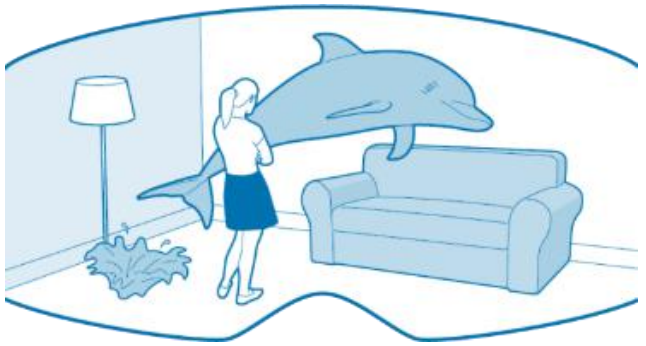


Complete immersion in a 3D rendered virtual world.

Augmented Reality

Natural world is overlaid with a layer of digital content
(images or text)

Mixed Reality



Virtual objects that appear real are integrated into the natural world.

"XR" (Extended Reality) used to describe all the above

Images Source: Wired Magazine, "Real Worlds", Blanca Myers, May 2016 issue.

VR ready today, long term shift towards AR and MR use cases

	Virtual Reality Immerses user in completely synthetic reality	**Mixed Reality** Digital content interacting with real world objects	**Augmented Reality** Overlays digital information on the real world
Primary Adoption Drivers	← **Experience Enhancement**	**Interacting digital and real**	**Efficiency Improvement** →
Use Cases	← **Entertainment**	**Product & Architecture** — **Training** — **Construction & Manufacturing**	**Field Service** →
Technology Stack Focus	**GPU, CPU**, Input controllers	CPU, GPU, **Analytics**, **Natural Interaction**	Display, Natural Interaction, **Object Recognition**
Challenges	Workflow integration, Visual Quality and Ergonomics	Real world mapping, HMD Miniaturization	HMD Miniaturization (Light-weight, untethered)
Dominant Value Chain Element	Content and Distribution Platform	Software and Analytics	Software and Distribution Platform
Mainstream Adoption	2-5 years	5-10 years	5-10 years
TAM 2017	$3B	$2B	

Near term options for HP: AR versus VR?

	Attractiveness	Right to Win	Investment Requirement	Risks
Virtual Reality	High	High	Medium	Medium
	Offensive • High profitability • Higher technology maturity • $3B TAM growing at 65% **Defensive** • Revenue cannibalization risks: − Dell, Lenovo: VR Share gains − Google, Apple, MS: Extension of consumer to commercial	• High Compute/ graphics requirements • Integrate / certify solutions, manage partners • Leverage DaaS infrastructure, security infrastructure and touchpoint management • Sustain differentiation through contextual IP (Haptics, ID, Experience)	• Building sprinkles of magic • Scaling of vertical solutions • Proof of concepts and deployment	• Time to scale / hockey stick shape • Sufficiency of IP • Disintermediation by Microsoft®, Oculus™, others
Augmented Reality	Medium	Medium	High	High
	• Medium profitability (commoditized hardware) • Emerging technology • $2B TAM growing at 177%	• Distributed compute • Lower graphics requirements • Limited leverage of existing infrastructure due to distributed nature of compute • Differentiation factors dependent on evolution of technology	• Significant AR ecosystem investment (e.g., ARKit) • Investment in non-traditional mobile form factors with difficult technical challenges – heat, batteries, displays	• Technology breakthroughs required • Realization of economic value

HP Focus on VR

What does a Commercial VR Experience Demand?

Head-mounted display (HMD)

- 90 Frames per second
- Hi resolution
- Wide field of view (>95 deg)

VR Ready computer

- High clock rate CPU with at least 4 cores
- High-end graphics (GPU)

Tracking & Controllers

- Accurate HMD & controller position tracking, at least 90 updates per second
- Hand Controllers or hand gesture recognition

VR Immersive Experience

- Well-designed immersive content
- Convincing interactivity with experience
- Collaboration opportunity

White spaces in value chain with varying level of profit pool access

Value Chain	HMD	HUMAN COMPUTER INTERFACES	COMPUTE	GAME ENGINE	APP / CONTENT	ANALYTICS / MGMT	SYSTEM INTEGRATION	DISTRIBUTION CHANNEL
Description	**Head Mounted Display**, user interface & interaction	Interfaces that control and provide feedback environment	Processing and rendering capabilities	Operating systems and rendering engines	Software applications and interactive tools	Tools that collect and monetize user and fleet environment	Value add integration of hardware, software and services into	Service and sales of off the shelf solutions
Major Players	HTC®, Oculus™, Microsoft®, HP, Lenovo™, Dell™	Intel®, Leap Motion, Nod, Eonite, FOVE	HP, Dell™, Lenovo, Intel®, NVIDIA®, Qualcomm, Google, Apple	Unity, Unreal, Autodesk Stingray, Cryengine	Autodesk, Dassault, Disney, Motion Reality, Dreamscape	HP, Facebook, Google, Oculus™, VirtualSky, VRsenal, CognitiveVR	No clear leader	No clear leader
Competitive Intensity	High	Med	High	High	Very High	High	Low	Low
Profit Pools	Med	Med	Med	High	High	High	Med	Med
TAM ($M) 2017	$200 (7%)	$100 (3%)	$750 (25%)	$400 (13%)	$1,000 (35%)	$150 (5%)	$250 (8%)	$100 (4%)
Technology Maturity	◑	◑	●	●	◔	◔	◔	◔

Nascent → Emerging → Developing → Mature

HP COMMERCIAL VR PORTFOLIO

DESKTOPS

HP Z240, Z440, Z640 & Z840
HP Z4, Z6, Z8 G4
HP EliteDesk 800 Tower

MOBILES

HP ZBook 17 G4

BACKPACK

HP Z VR Backpack

HEAD-MOUNTED DISPLAYS

HTC Vive BE
HP Windows Mixed Reality Headset

Film HP Z VR Backpack

Commercial VR is rife with opportunities for HP

Commer-cial VR Drivers

Incremental Efficiency

Workflow improvements to create economic value

Enhanced Experience

Desire to differentiate based on immersive experiences

Impacting existing and new workflows…

	From	To
Digital/ Existing Workflows	Design reviews conducted using workstation	Design reviews using VR
Analog/ New Workflows	Sales using product pamphlet	VR enabled immersive sales

… across verticals & use cases

Verticals	Use Cases
AEC/ Product Design	Design Reviews
Media & Entertainment	Training
Healthcare	Sales /Presentation
Education	Entertainment
First Responder	Content Creation

HP Z VR Backpack Use Case Affinities

Arena Training/LBE's

AEC Walkthrough/Review

Collaborative Product Review

Mfg Assembly Sim/Design & Training

HP Certified Commercial VR solutions

Training & Simulation: First Responders

Example

HMD	HCI	COMP	GAME ENGINE	APP / CONTENT	ANALYTICS/ MGMT	SYSTEM INTEG	DISTRIB CHANNEL
Biometrics Eye Tracking Tracking	3D Printed	Z VR Backpack	unity	Dauntless	Mgmt and Analytics Dauntless	HW Integration	HP Direct

Design Review & Presentation: AEC

Example

HMD	HCI	COMP	GAME ENGINE	APP / CONTENT	ANALYTICS/ MGMT	SYSTEM INTEG	DISTRIB CHANNEL
I/O Tracking Biometrics Eye Tracking	3D Printed	Z Workstations Comm Desktop	AUTODESK STINGRAY	AUTODESK Revit SKANSKA	Mgmt and Analytics	HW Integration	Vertical Specific VARs

Location-Based Entertainment: Arcade

Example

HMD	HCI	COMP	GAME ENGINE	APP / CONTENT	ANALYTICS/ MGMT	SYSTEM INTEG	DISTRIB CHANNEL
Color Accuracy Biometrics Eye Tracking OptiTrack Tracking	3D Printed tools	Z VR Backpack	unity UNREAL ENGINE	THE VOID	Mgmt and Analytics	HW Integration	Disney

What do these have in common?

They care about:

Faster, better design decisions

Convincing stakeholders

Winning business

Saving money

Making a bigger impact

Boeing: Starliner training simulator

Problem:

- Minimizing training costs
- Simulating space is complex

Solution:

- Virtual simulation minimizes time spent with physical mock-up
- Interfaces can be experimented with real-time changes

Image courtesy of Boeing

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SWOSC: LCS Engine Plant Training

Problem:

- Minimizing training costs
- Ships are deployed, don't want to tie one up for training

Solution:

- Virtual simulation accelerates learning and is effective in learning the control systems

Image courtesy of SWOSC

BMW: driver interface design

Problem:

- Physical prototypes are expensive and take time to build
- Need to evaluate many possible designs

Solution:

- Virtual environment can change in real-time at almost no cost
- Real-time feedback drives better design

Image courtesy of BMW

Toyota: sales configurator

Agency: Rotor Studios

Problem:

- Letting customers see their choices when stocks are limited
- Engaging customers in the purchasing process

Solution:

- A showroom sales configurator that lets prospects virtually experience their selected car

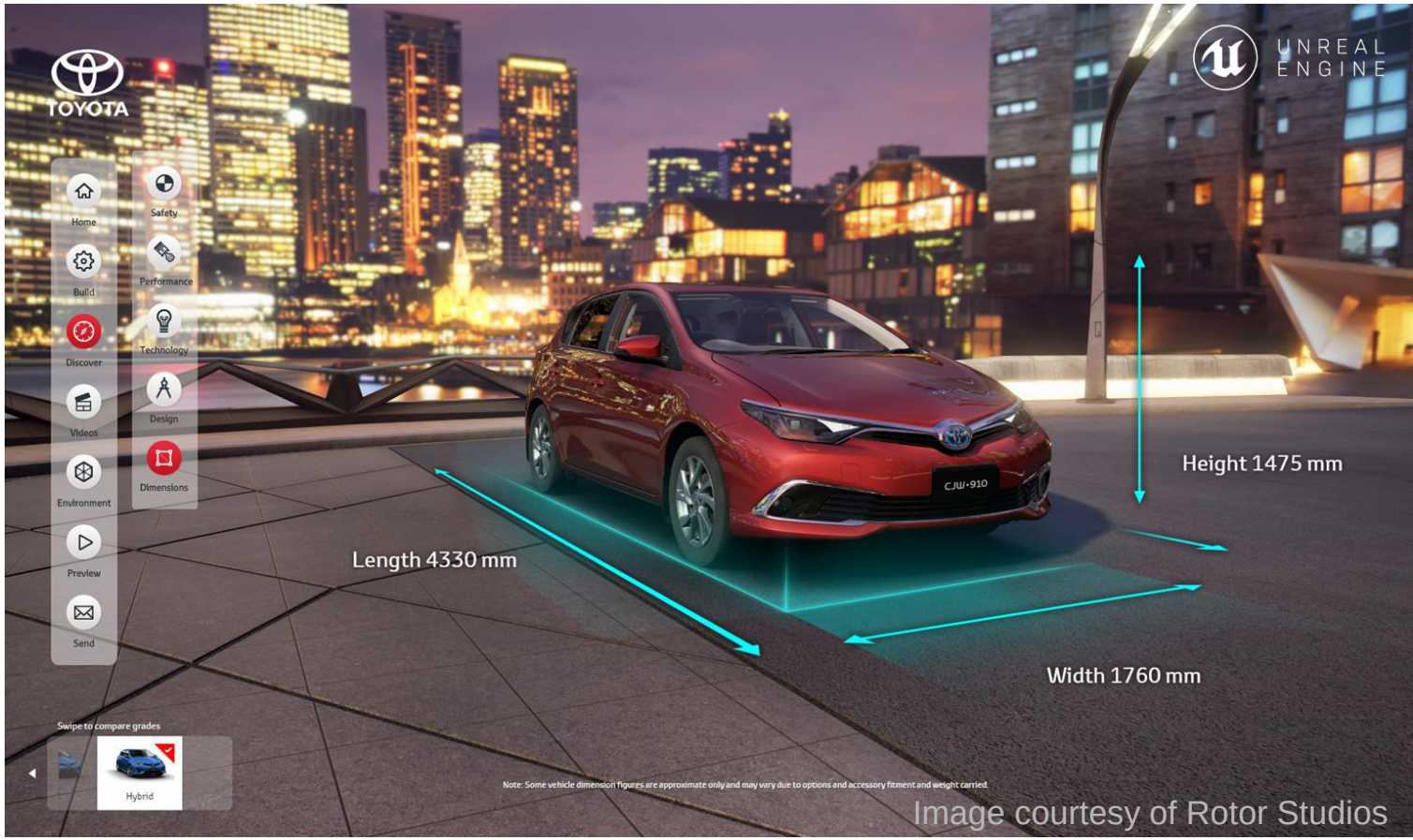
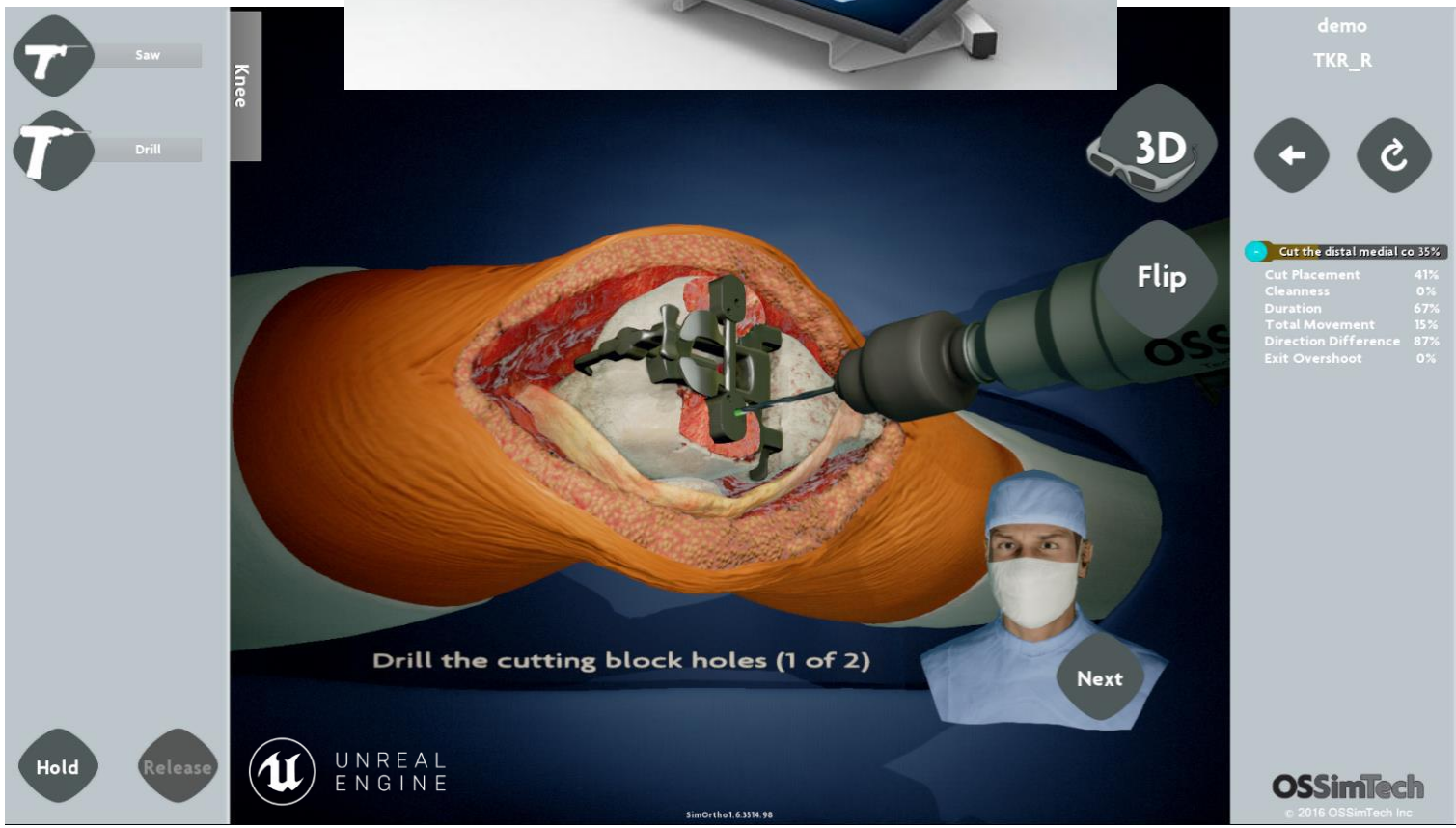


Image courtesy of Rotor Studios

OSSimtech: surgery simulator

Problem:

- Complex and expensive to train on real people
- Barrier to adoption of new surgical techniques



Solution:

- A mechanical and virtual simulator that realistically depicts the interaction with sound, tactile and visual feedback

HNTB: subway design visualization

Problem:

- Communicating large complex projects to stakeholders requires visualization
- Building physical mockups is impossible

Solution:

- Virtual experiences allow “test-driving”
- Exploring alternatives in real-time

Images courtesy of HNTB

Executive Summary

Market	$5B TAM for Commercial AR and VR today $3B Commercial VR TAM growing to $14B by 2020 (65% CAGR)
HP's Role	Be the preferred VR solution provider for commercial customers while continuing to monitor AR
Strategy	Create a VR Franchise for Commercial Customers by: • Major: Move upstream in Commercial VR to deliver End-to-End Solutions for highly immersive use cases • Minor: Extend premium hardware products to VR through sprinkles of magic while continuing VR ready workstations
Right to Win	**Vertical expertise** GTM capabilities, **ISV Partnerships** **Optimized hardware and software solution integration**