

6th Annual SMi
UAV Technology Conference
27/28 September 2021

The Human Dimension of UAV Operations

Andy Fawkes
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U.S. Air Force photo/Staff Sgt. Vernon Young Jr.

THINKE



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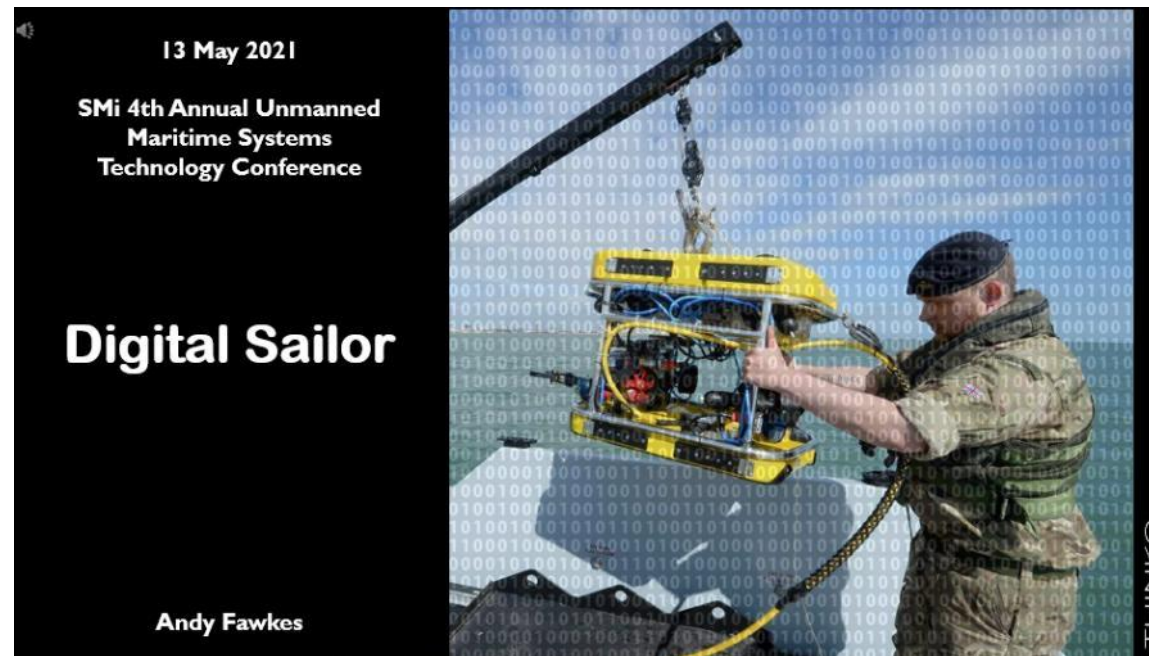
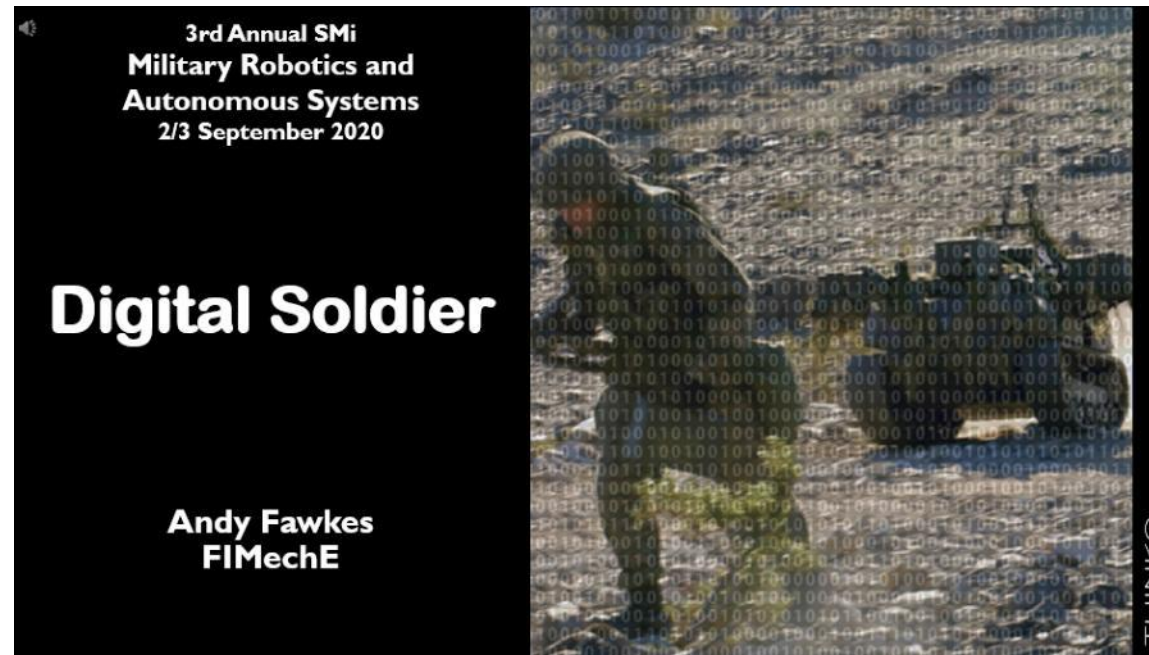
Before

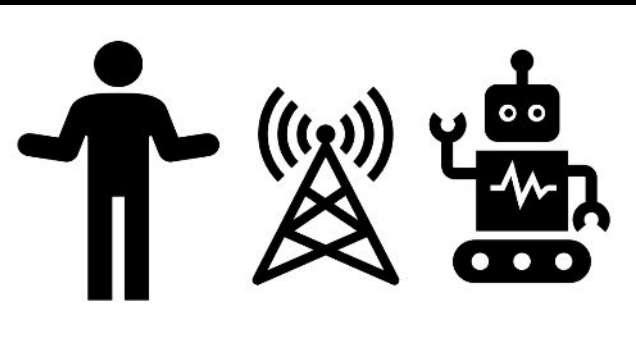


Now



Recent Presentations





Some Questions

- Where best to put the human(s)?
- Optimal human-machine synergy?
- How best to prepare the human(s) (and machine)?

Outline

- **Past**
- **Present**
- **Future**



Past

Information Warfare over 100 years ago...



A few hundred aerial photographs had been taken during the opening six months of the war, by 1918 well over five million were produced in just nine months

UK National Archives

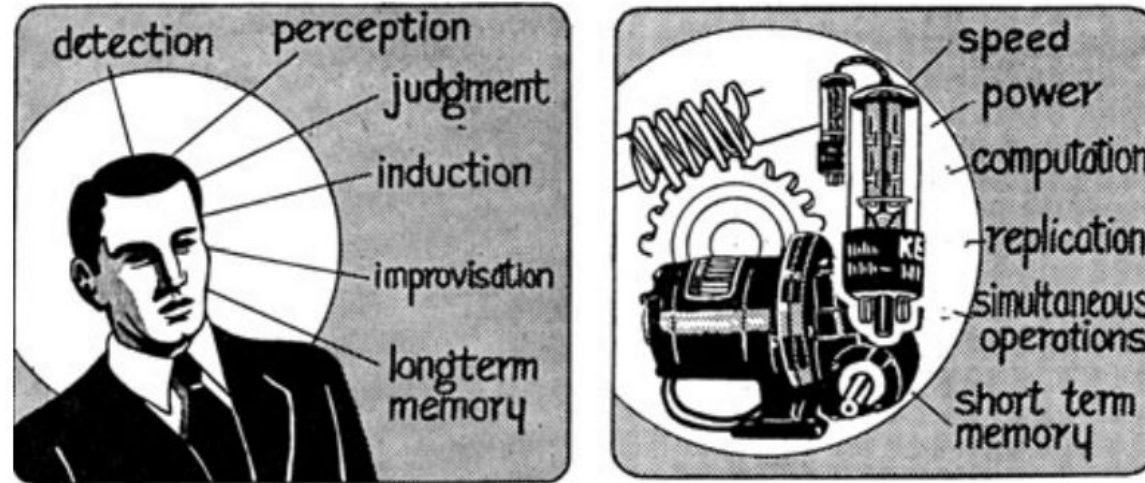
People and Process + Technology

Queen Bee Target Drone – 1930s/40s



Paul M Fitts (1951)

Human Engineering for an Effective Air Navigation and Traffic Control System

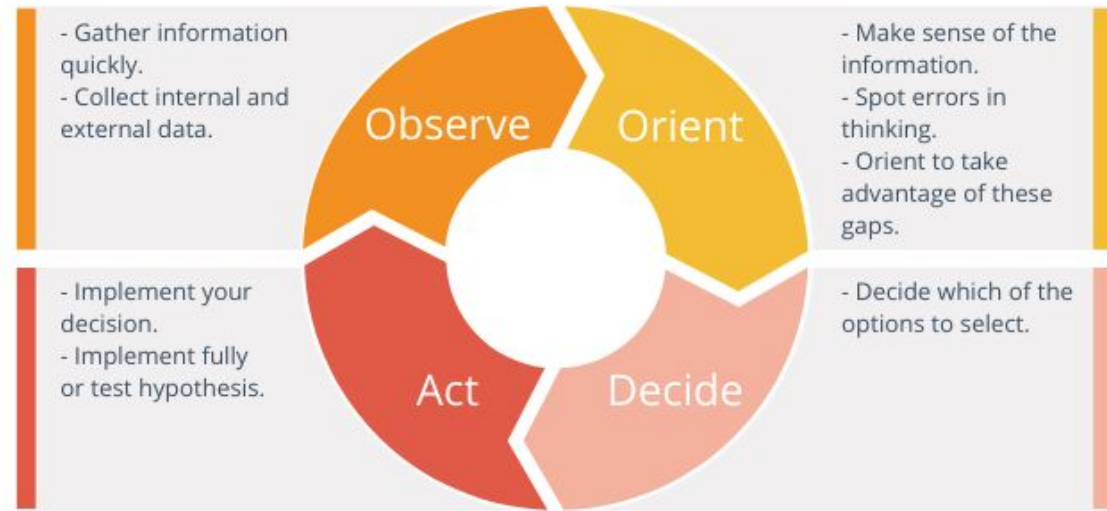


- “great caution be exercised in assuming that men can successfully monitor complex automatic machines and take over if the machines break down”
- “engineers should seriously consider systems in which machines would monitor men and prevent them from making dangerous



**USAF Colonel
John Boyd
(1960s)**

The OODA Loop



“In order to win, we should operate at a faster tempo or rhythm than our adversaries ... or get inside [the] adversary’s OODA loop.”



In the Loop ...

"If I'm in the loop mentally I can respond more quickly than if I have to watch an automatic system and take over and then get my mind into the loop.

So I was more comfortable in flying a manual descent than an automatic descent... my mental computer is already running at full speed."

**David Scott
Apollo 15 Commander (1971)**

USAF Capt Jack Thorpe (1978)



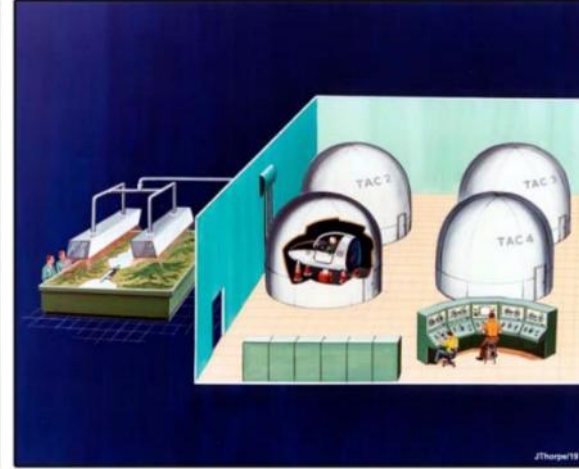
1

Enemy aggression
detected by overhead
sensor



2

Planning a response
using the holographic
electronic sand table



3

Air crews rehearse
the plan and planners
assess suitability



4

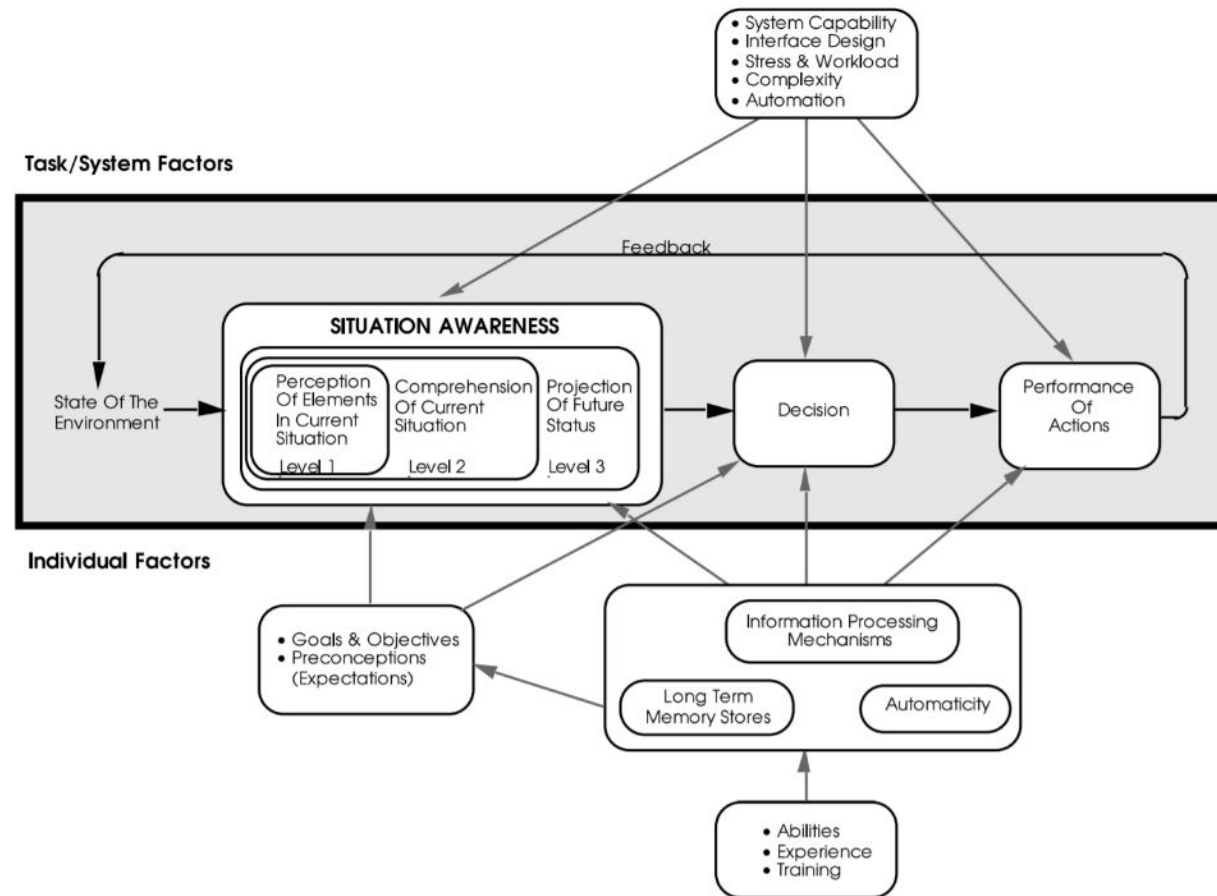
Mission execution
with real time
observation

I/ITSEC 2010 "Trends in Modelling, Simulation and Gaming: Personal observations about the past 30 years and speculating about the next 10" Jack Thorpe PhD



The Three Level Model of Situation Awareness (Endsley 1995)

Situational awareness is the perception of environmental elements and events with respect to time and/or space, the comprehension of their meaning, and the projection of their future status.



Monitoring Systems



The Register

{* INTERNET OF THINGS *}

Army Watchkeeper drone flopped into tree because crew were gazing backwards

Live footage of runway and grass verge more compelling than actual flight instruments

Thu 29 Aug 2019 // 10:11 UTC

98 GOT TIPS?

Gareth Corfield BIO EMAIL TWITTER

SHARE

The latest British Army Watchkeeper drone crash happened because its crew became fixated on live footage from an onboard camera instead of their instruments, a Ministry of Defence report has revealed.

An internal Defence Accident Investigation Branch (DAIB) report detailed why the semi-autonomous aircraft, tail number WK050 and flown on the day by two Royal Artillery operators, crashed in June 2018.

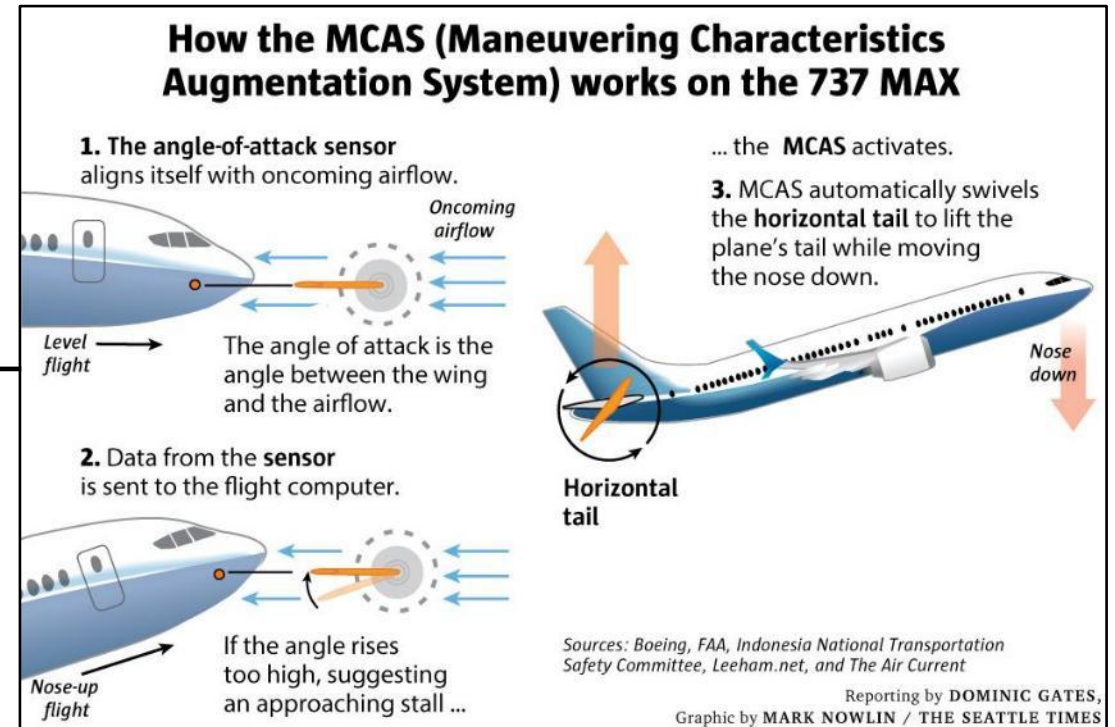
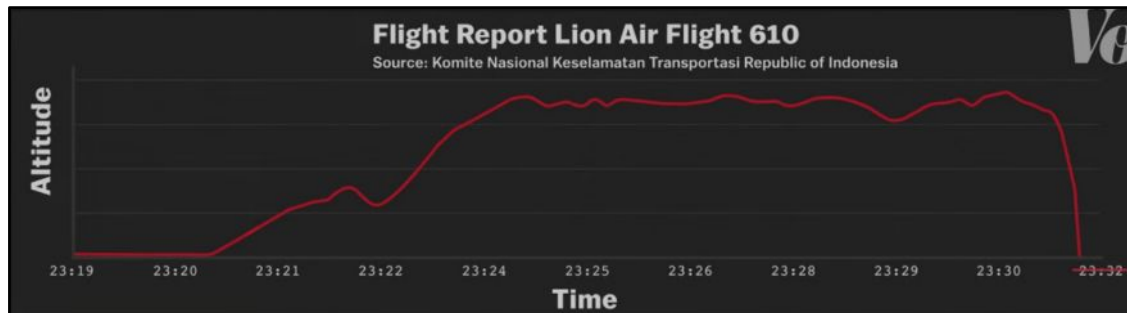
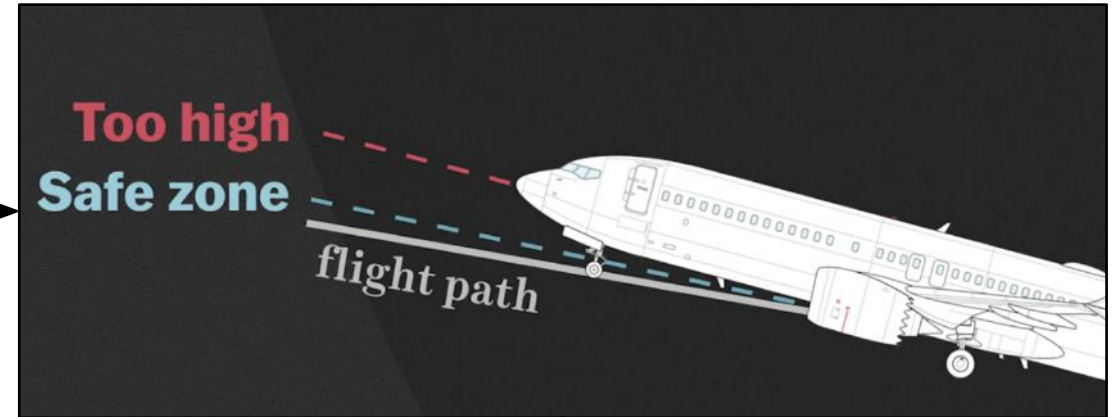
The report, dated February 2019, was [published online](#) by the MoD after the BBC made a Freedom of Information request for it, leading to [news reports](#) over the past few weeks.

WK050 flopped into a tree just beyond the runway of Aberporth airport on the Welsh coast after its Army operators, under the supervision of contractors from a Thales joint venture company, cut its throttle immediately after the drone had landed and lifted off again.

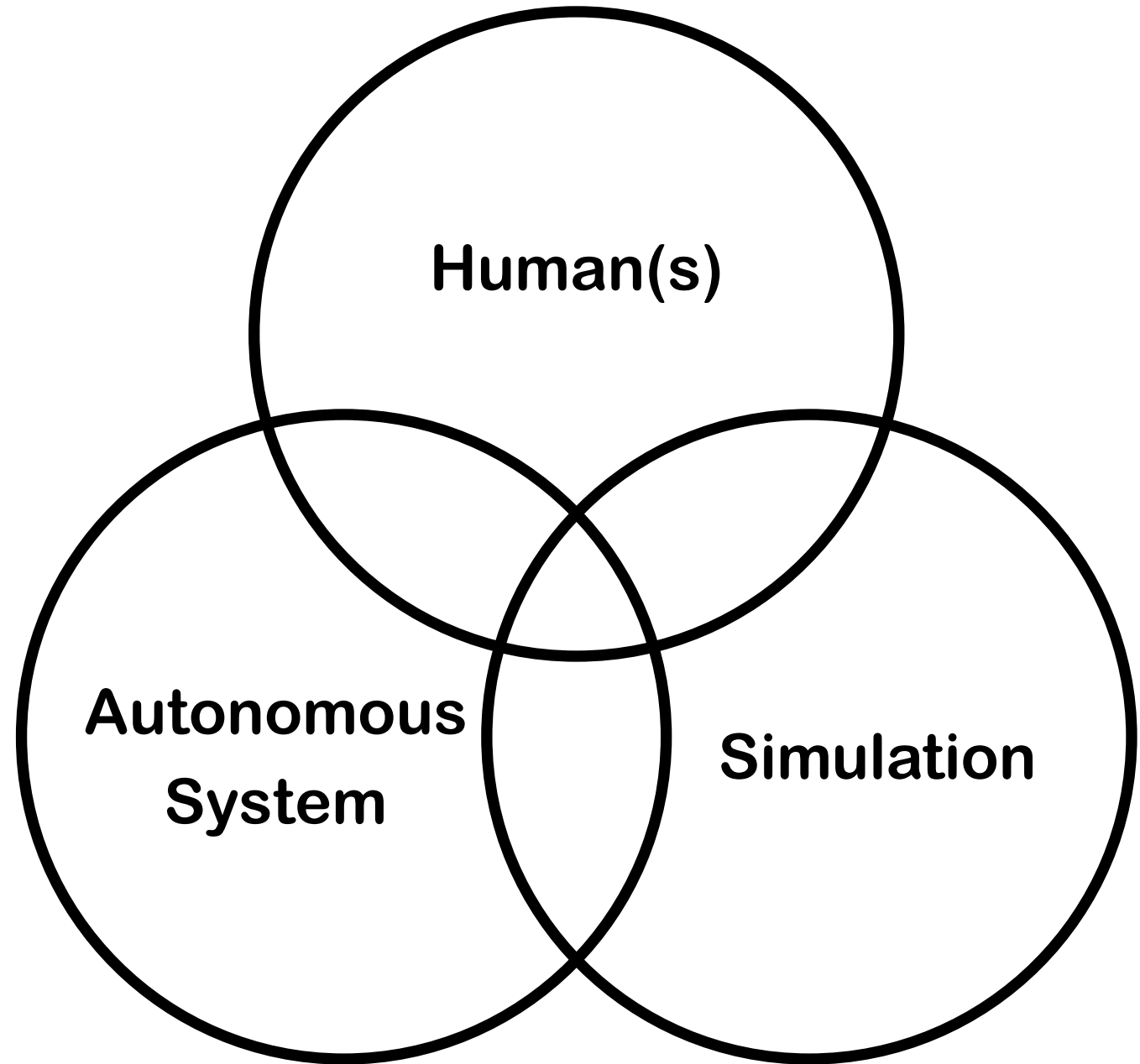
"Had no action been taken, the [Watchkeeper] would have completed its automatic go-around from which it could have been commanded to conduct a further approach," said the DAIB in its Safety Investigation Report, which was written by a major and a Warrant Officer 1 (WO1).



Boeing 737 MAX (2018/19)



**Test & Train
Test & Train
Test & Train**





Present

Simulation

Simulations imitate the real world over time, and in doing so enable the military and their stakeholders to prepare for the future and enhance their readiness

Why Use Simulation?



Toward Net Zero Carbon (13 Sept 21)

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News releases Multi-million pound investment in synthetic training capability for Typhoon pilots

Multi-million pound investment in synthetic training capability for Typhoon pilots

13 Sep 2021



The Ministry of Defence (MOD) has awarded BAE Systems contracts valued at more than £220m to deliver advanced synthetic training for pilots training to fly Typhoon, one of the world's leading combat aircraft.

Under the Typhoon Future Synthetic Training (TFST) contracts, BAE Systems is leading work to deliver ten high fidelity, immersive simulators, together with highly-secure state of the art training facilities at RAF Coningsby in Lincolnshire and RAF Lossiemouth in Moray.

The new training environments will be linked together providing an integrated environment for pilots to train and carry out complex combined training exercises using real world mission software and tactics.

The investment by Defence Equipment and Support, the MOD's procurement arm, reflects the Royal Air Force (RAF)'s ambition to increase its use of synthetic training, delivering cost, time and sustainability benefits over live training. This technology will also provide students with a more complex and secure training experience tailored to the individual which are often difficult to achieve in live training environments.

Richard Hamilton, Typhoon Programme Director, Europe – BAE Systems Air, said:

"We pride ourselves in delivering world-class training capability as we understand how critical it is to deliver the highest quality skills and capabilities to the front line. This contract builds on existing work to deliver synthetic training to the RAF's Typhoon Force, which will eventually enable pilots from different locations to fly virtual missions together and provide the ability to 'plug into' other assets across air, land and sea."

"The investment will deliver a number of valuable operational benefits for the RAF, alongside the positive impact that the increased use of synthetic training will make to reduce carbon emissions. With 9.6 tonnes of carbon saved by every synthetic flight, it will help reduce the current carbon footprint of live training, supporting the net zero ambitions held by our customers and ourselves."

The contract will support approximately 120 jobs in the delivery of new infrastructure at two RAF bases with a further 60 engineering jobs sustained at BAE Systems and many more with a number of specialist UK companies throughout its supply chain.

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Air Training

We help unlock talent giving individuals the personal skills to master different disciplines, taking students from the classroom to the frontline.

Find out more

DSEI 14-17 September 2021

Find out more about our presence at the show

Visit event page

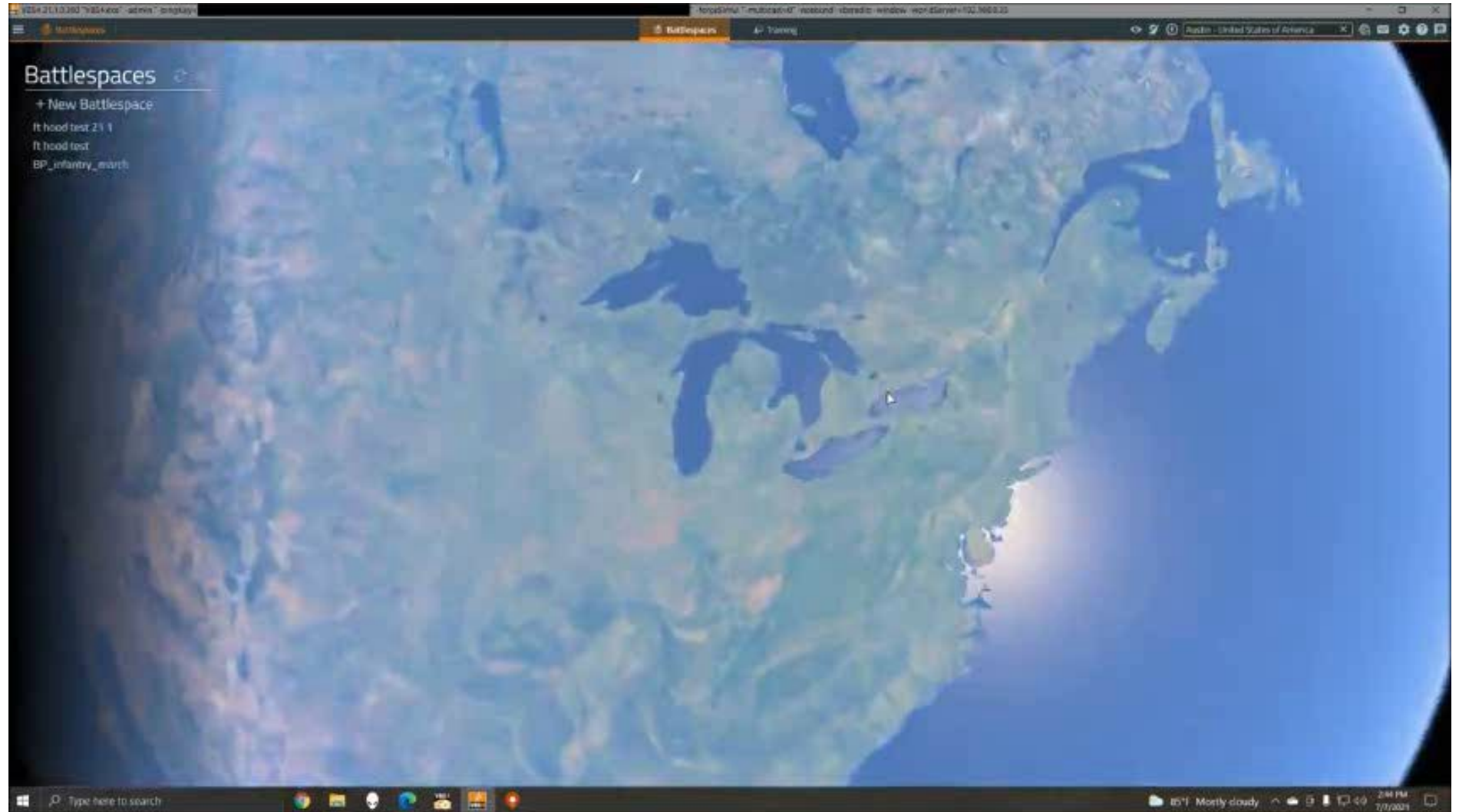
“With 9.6 tonnes of carbon saved by every synthetic flight, it will help reduce the current carbon footprint of live training, supporting the net zero ambitions held by our customers and ourselves.”

Simulation Now - Land, Sea, Air, Anywhere



Austin, Texas

**BISim
VBS4
Simulation
+
Microsoft
Bing Data**



Decision
Support

UK MoD
“Single
Synthetic
Environment”



**Air Chief Marshal
Sir Stephen Hillier
Jan 18**

**“teenagers playing on
their Xbox at home
should take their
gaming to the next
level and join the RAF
to operate real drones”**

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Join the RAF for the real thing, Xbox teenagers are told: Head of the air force says young gamers should take it to the next level by operating drones

- Air Chief Marshal Sir Stephen Hillier wants more young people to join the RAF
- The service will be celebrating their 100th anniversary with events this year
- Among the major events planned is a flypast along the Mall before the Queen
- RAF chiefs hope a display of military might could provide a boost to recruitment

By LARISA BROWN FOR THE DAILY MAIL
PUBLISHED: 00:32, 12 January 2018 | UPDATED: 00:53, 12 January 2018

387 shares 194 View comments

Teenagers playing on their Xbox at home should take their gaming to the next level and join the RAF to operate real drones, the head of the air force said yesterday.

Air Chief Marshal Sir Stephen Hillier said the RAF's next 100 years will see a huge shift towards unmanned flying machines as he outlined plans for centenary celebrations.



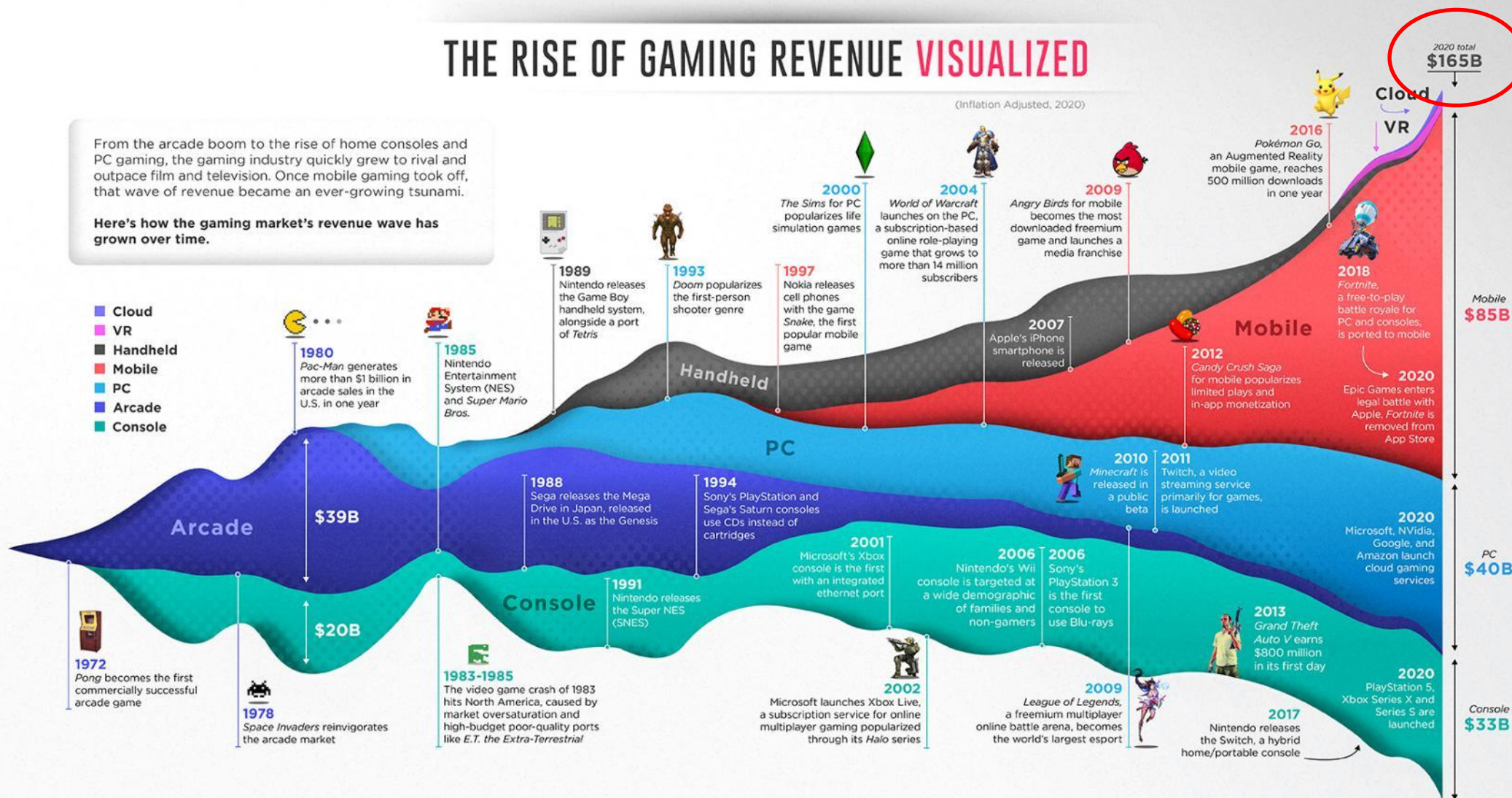
50 Years of Gaming History, by Revenue Stream (Nov 2020)

THE RISE OF GAMING REVENUE VISUALIZED

(Inflation Adjusted, 2020)

From the arcade boom to the rise of home consoles and PC gaming, the gaming industry quickly grew to rival and outpace film and television. Once mobile gaming took off, that wave of revenue became an ever-growing tsunami.

Here's how the gaming market's revenue wave has grown over time.



SOURCE: Pelham Smithers
COLLABORATORS: RESEARCH • WRITING: Omni Wallach | DESIGN • ART DIRECTION: Clayton Wadsworth

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THINKE

**UK Dstl
Gaming
Ecosystem
Study
(2021)**

- **Games Engines**
- **Cloud Gaming**
- **Community**
- **Data and Analytics**

Tip of the Spear Innovation



Combat Recce
@CombatRecce



WngO 2 for our Virtual Distributed Training event. Detail via our DC page and H Hr is 1900 on Wed 27 May 20 [#online](#) [#training](#) [#skills](#) [#distancelearning](#)



12:45 PM · May 26, 2020 from Tullibody, Scotland



45



See Combat Recce's other Tweets

THE SCOTTISH AND NORTH IRISH YEOMANRY



Microsoft Flight Simulator 2020



Search





Olli43
1.46M subscribers



Microsoft Flight Simulator 2020 - London Update Pack & Viewer Suggestions!

114,410 views • Streamed live on 18 Aug 2020

 3K  95  SHARE  SAVE 

Live chat replay ▾

 £4.99  US\$9.99  US\$4.99

Fly through tower bridge

 Craig Davies: HIGH END CPU : Ryzen 7 Pro 2700X or Intel i7 9800X GPU : Radeon VII or Nvidia RTX 2080 VRAM : 8 Gb RAM : 32 Gb SSD : 150 Gb Solid State Drive Bandwidth: 50 Mbps

 Navdeep Singh: @Olli43 disable Hpet on your computer for smoother gameplay look it up on YouTube.

 Siddhant Bhirud: thats me

 Jackson Scaletta: do a roll

 Hunt3r: - Fly over some stadiums in london

 SpursFan214: omg i found you

 Kentucky Fried-Chicken: Who else live near southampton

 DodgeGt8: such a cool gamer moment!

 SplIT pErSoNaLiTy: GTA 5 car meet

 TheGamingBluejay: Did he download London or is this streamed?

 Slow mode was enabled 

HIDE CHAT REPLAY

Off the Shelf Technology (2021)



Microsoft Flight Simulator (live Hurricane Laura)



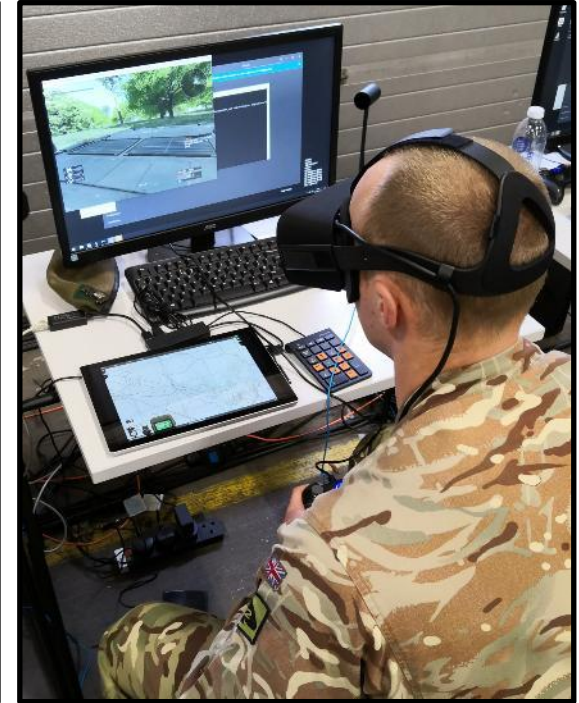
Oculus Quest 2 (\$299)

XR

eXtended Reality (XR)

Reality	Augmented Reality	Mixed Reality	Virtual Reality
The real world	Information layered over vision	Blend of real & digital information to enhance reality	Fully virtual world
			

“In Virtual Simulation
you look at the
Virtual World,
in VR you are in it”



Rift Drone (2014)

AR.Drone 2.0 + Oculus Rift + Unity + Xbox 360 Controller



Rift Drone is open source: <https://youtu.be/nD2a0OHRmoM>

Viper Wing F-16 Cockpit Varjo XR-3 MR Headset (Prepar3D Software)

Mixed
Reality



XR is now
good
enough

EASA Pro

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EASA approves the first Virtual Reality (VR) based Flight Simulation Training Device

 26 Apr 2021

SUGGESTED



COLOGNE, April 26, 2021 - The European Union Aviation Safety Agency (EASA) has granted the first certificate for a Virtual Reality (VR) based Flight Simulation Training Device (FSTD).

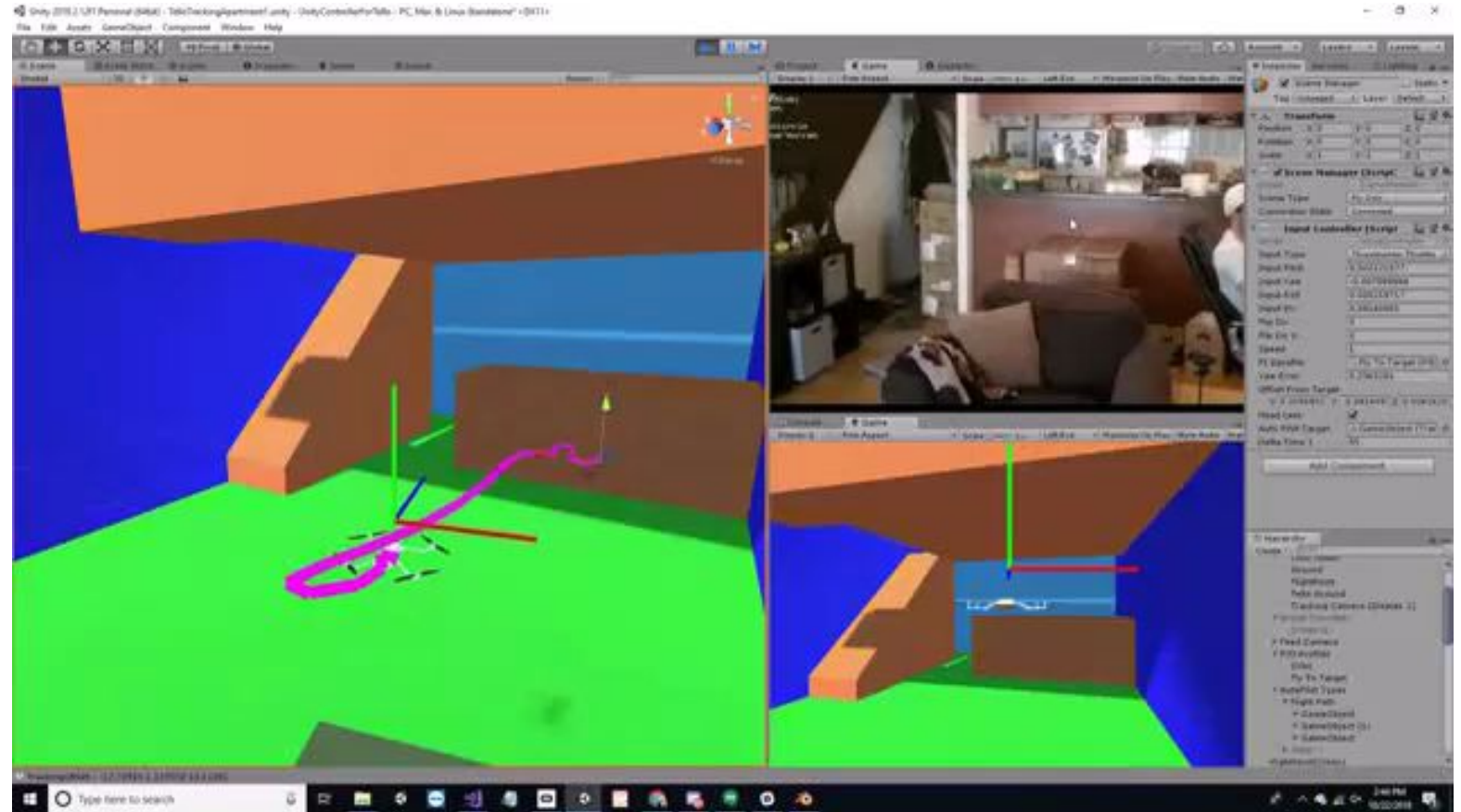
The device, for rotorcraft pilots, enhances safety by opening up the possibility of practising risky manoeuvres in a virtual environment. This addresses a key risk area in rotorcraft operations, where statistics show that around

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Varjo Reality Cloud



Flight Path Programmed in, and Controlled by, Unity Game Engine



Just Art?



SIGGRAPH 2021

Skoltech
Skolkovo Institute of Science and Technology

DronePaint: Swarm Light Painting with DNN-based Gesture Recognition

Valerii Serpiva, Ekaterina Karmanova, Aleksey Fedoseev,
Stepan Perminov, Dzmitry Tsetserukou
Skolkovo Institute of Science and Technology
Moscow, Russia.

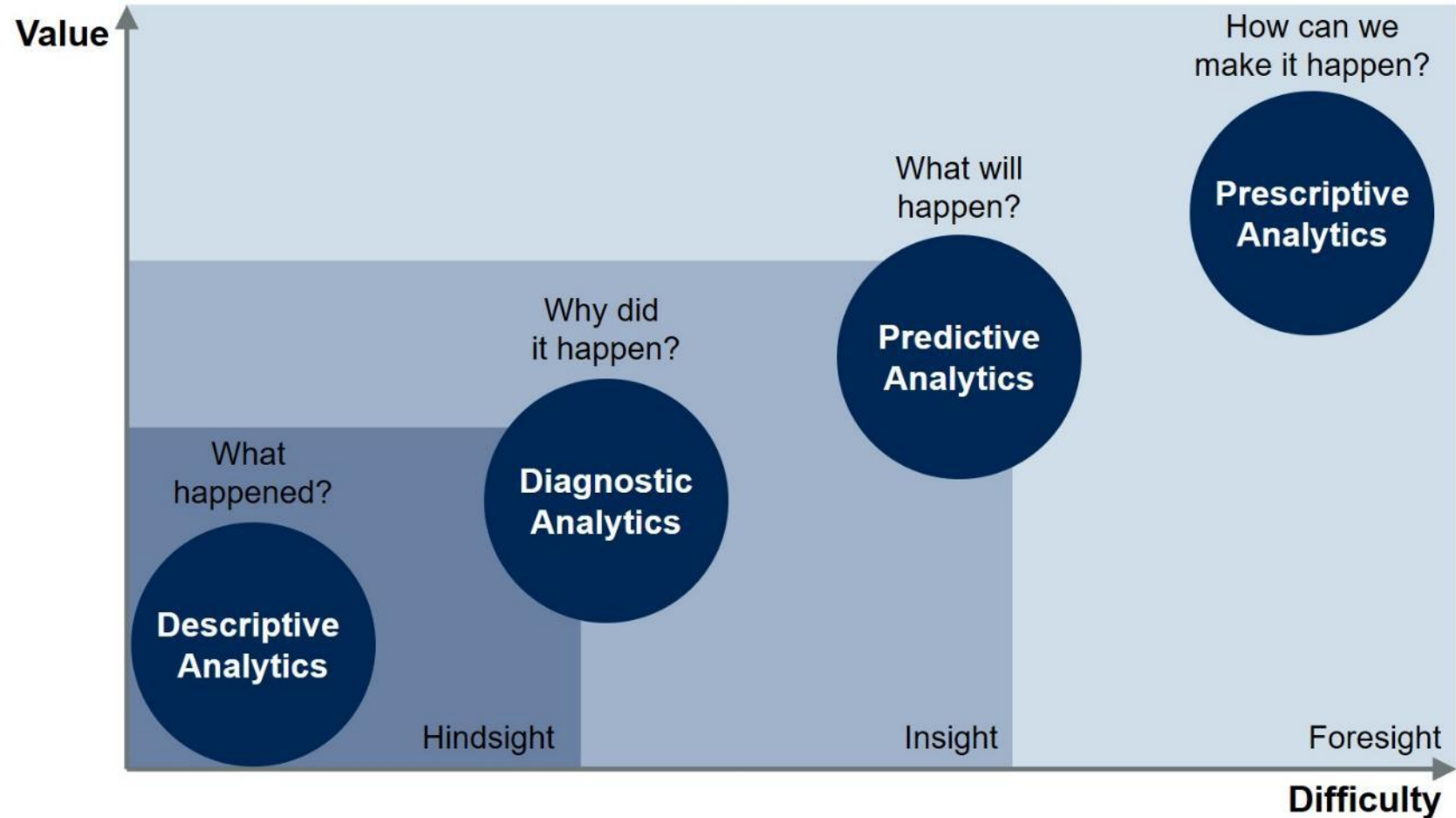
- Authors: V. Serpiva, E. Karmanova, A. Fedoseev, S. Perminov, D Tsetserukou
- Laboratory: Intelligent Space Robotics and VR/AR Lab.
- University: Skolkovo Institute of Science and Technology, Russia
- Conference: ACM Siggraph 2021, Emerging Technologies

Juliane Gallina, Chief Information Officer, CIA

AI in Support of Decision Making



Back to the OODA Loop





What about the Threat?



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/RT Afghanistan | 12 MIN READ

The Drone Unit that Helped the Taliban Win the War

The work of a drone unit, reported in detail here for the first time, shows how the Taliban were able to win the war against the U.S.-backed forces in Afghanistan



Fazelminallah Qazizai

Fazelminallah Qazizai is an Afghan journalist and co-author with Chris Sands of "Night Letters: Gulbuddin Hekmatyar and Afghan Islamists who Changed the World"

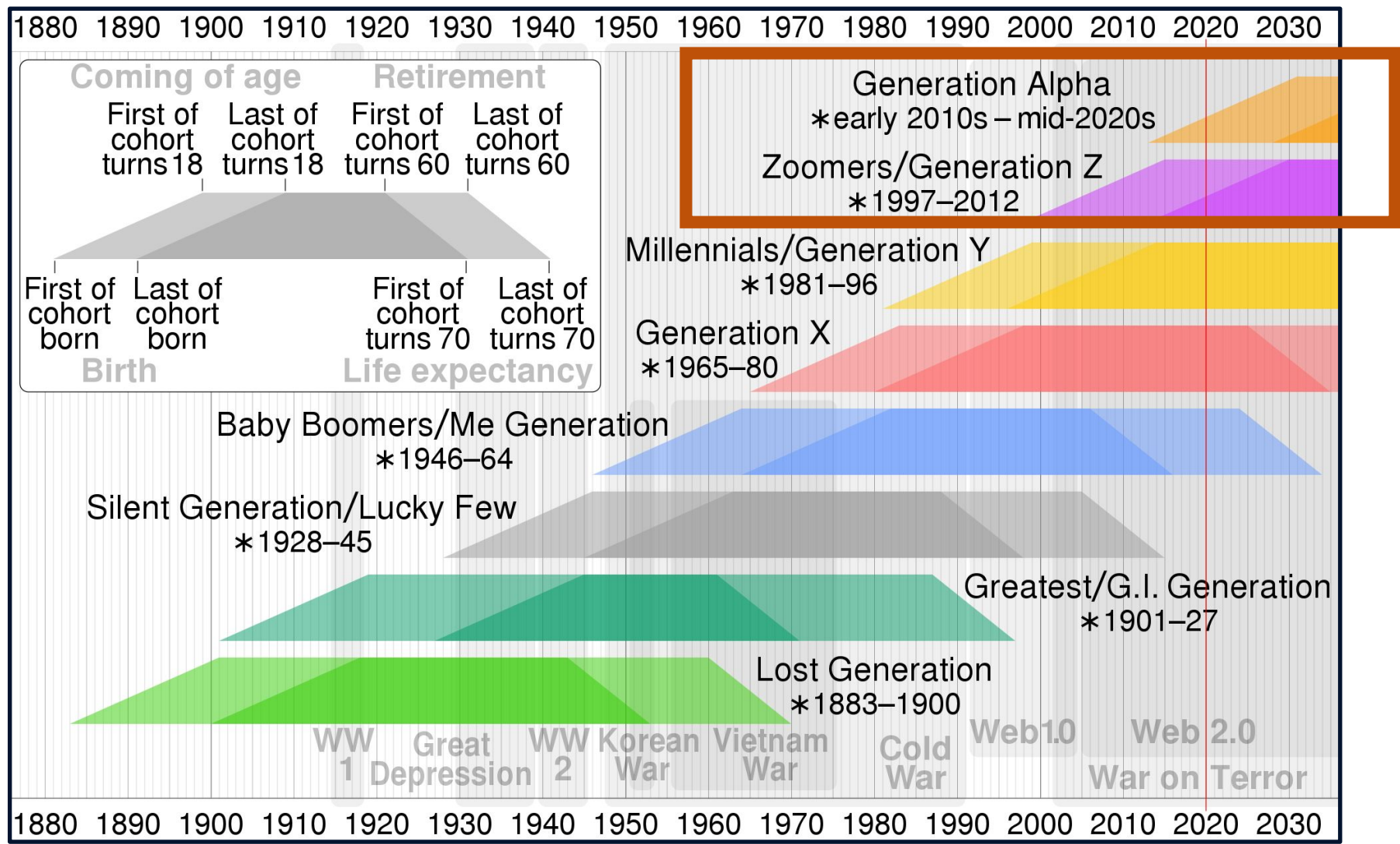
September 15, 2021

07:58 EST



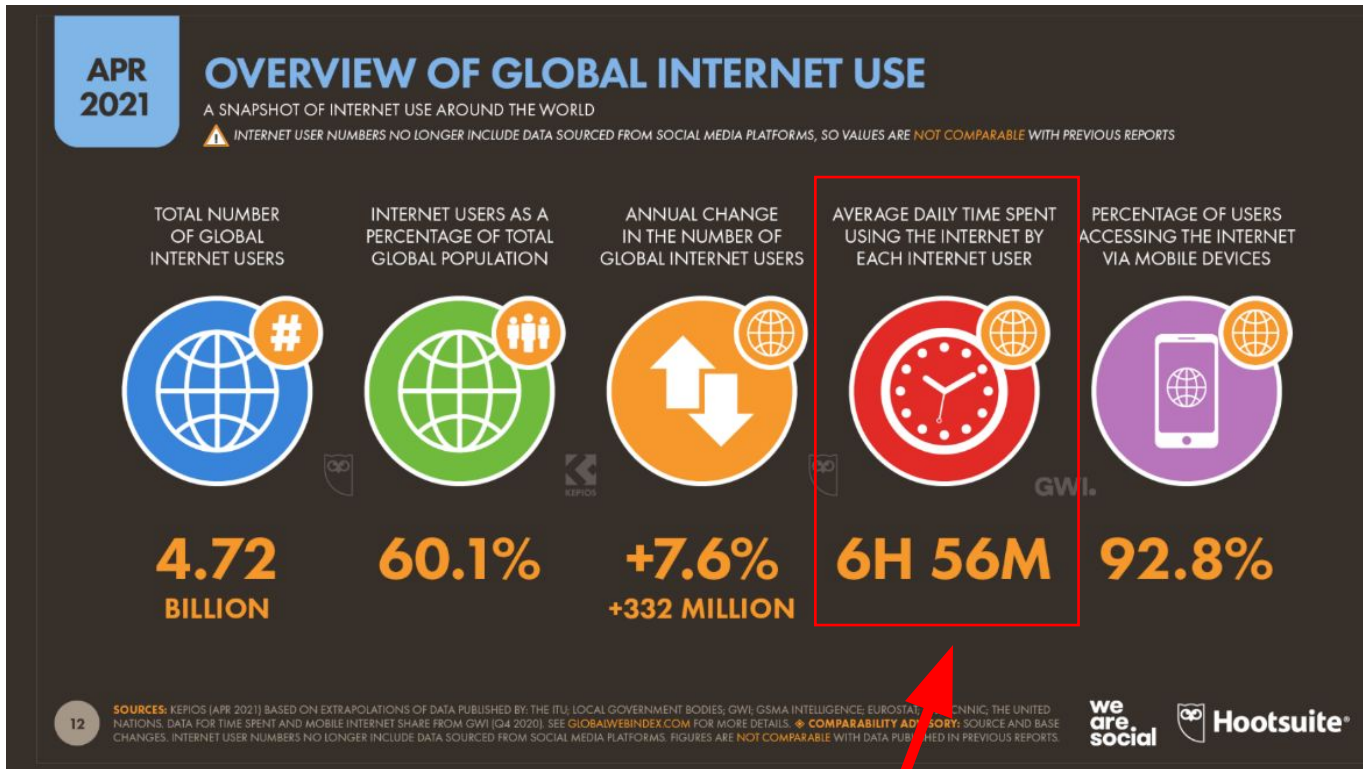
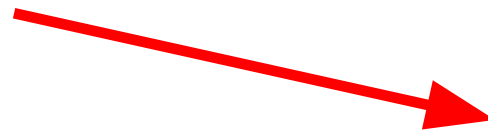
Future

The Next Workforce

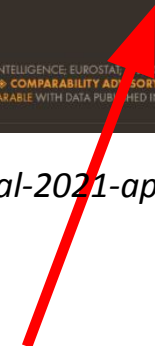


Z
α

The Internet & Gaming dominate our waking lives



<https://datareportal.com/reports/digital-2021-april-global-statshot>



TechRepublic

8 hours and 27 minutes. That's how long the average gamer plays each week

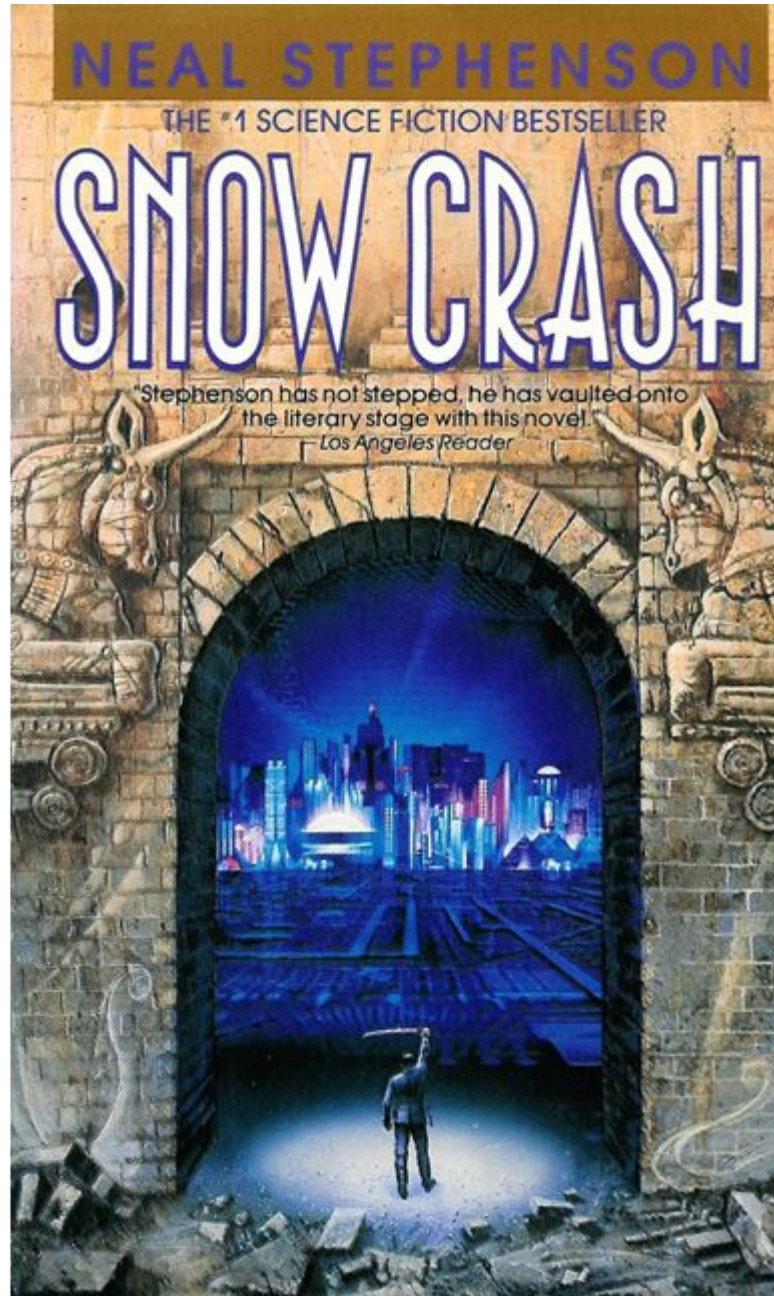
by Veronica Combs in Innovation on March 10, 2021, 6:04 AM PST

Binge gaming is up 13% over last year with some age groups playing six hours at a stretch, a worldwide survey finds.

A woman with long dark hair, wearing a blue denim jacket and large black headphones, is sitting at a desk and playing a game on a computer. She is looking at the monitor with a focused expression. The room is dimly lit with blue and orange ambient lighting. A gaming chair is visible behind her.

Image: iStockphoto/gorodenkoff

1992



- “computer-generated universe that their computers draw on their goggles and pump into their earphones ... an imaginary place known as the Metaverse”

Neal Stephenson

The Metaverse in 2021



Unity



Roblox



Microsoft



Facebook



Epic Games



Nvidia

- “A concept of a future iteration of the Internet, made up of persistent, shared, 3D virtual spaces linked into a perceived virtual universe”
 - Wikipedia
- “An expansive network of persistent, real-time rendered 3D worlds and simulations that support continuity of identity, objects, data, and entitlements, and can be experienced synchronously by an effectively unlimited number of users, each with an individual sense of presence”
 - Matthew Ball, former Amazon strategist, now futurist and venture capitalist
- “An Internet that we will live in rather than look at”

Metaverse Convergence



Technology Convergence

- Computing
- Software
- AI and automation
- Data and Analytics
- Networking
- XR
- Sensors & Haptics
- Digital Twins
- Blockchains
- Gaming
- Standards

Microsoft

“A convergence of the physical and digital worlds creating a new world of opportunity and transformative solutions ...”

Microsoft metaverse technology stack

Microsoft Mesh & HoloLens

Enable anyone across the planet to collaborate in mixed reality environments.

Microsoft Power Platform

Empower anyone within your organization to interact with and act on the data flowing through your environment. Build applications, dashboards, and intelligent chatbots that modernize workflows.

Azure AI & Autonomous Systems

Azure AI delivers breakthrough insights into all your data. Microsoft Project Bonsai provides a low-code approach to machine teaching and creating intelligent autonomous systems that learn and improve over time.

Azure Synapse Analytics

A comprehensive set of data services that work together to provide predictive analytics, the ability to analyze data across systems, and the ability to track the historical state of your environment.

Azure Maps

The location of things. Indoor private maps enable you to apply location and routing services to people and things in your private environment while keeping data locked down to your enterprise.

Azure Digital Twins

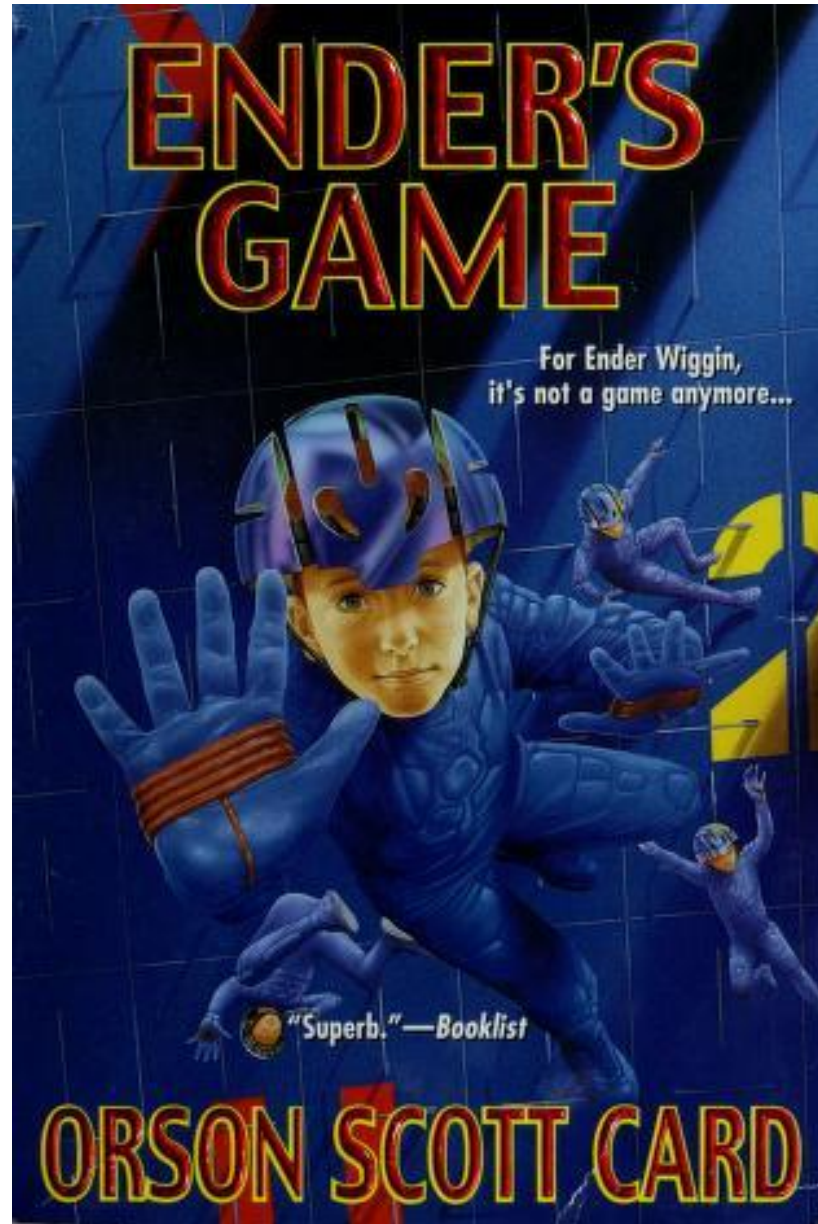
Simplify the creation of detailed, comprehensive digital models. Support for the Digital Twin Definition Language enables modeling of complex relationships between things and systems in your environment.

Azure IoT

Connect physical assets and run cloud intelligence directly on premises. Sense and monitor anything in your physical environment seamlessly and securely.

The physical world

1985



- “If you try and lose then it isn't your fault. But if you don't try and we lose, then it's all your fault.”

Orson Scott Card

Ender's Game Film (2013)



Leadership

Intuitive Interfaces



Remotely-Operated/Autonomous Agents

Ender's Game Film (2013)



Questions?

