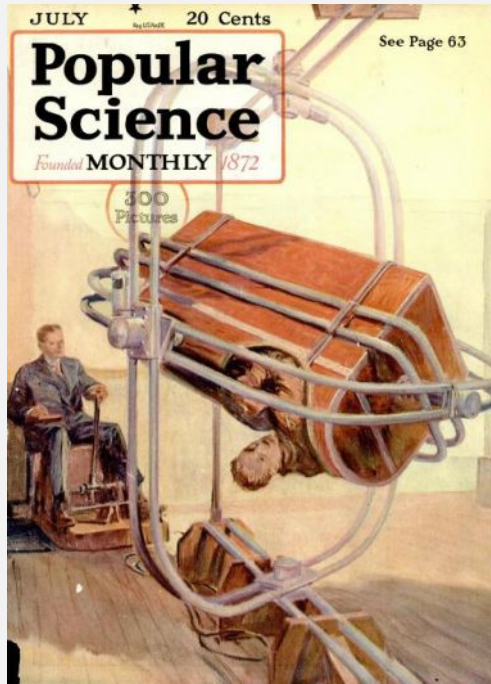




Simulation Past and Future?



Andy Fawkes

Why this talk?

This talk is about the History of Simulation and thoughts on its Future but it is also about:

Technology and Innovation

Background

- Not definitive history
 - Key Highlights
 - Other important work being carried out
- Focus on training and air training until last 20 years
- Will look at parallel developments outside simulation

Outline

- A History of Simulation
- The Future?
- Lessons from History?

Why Use Simulation?



Improve
Training



Safety



Reduce
Costs



Reduce
Environmental
Impact



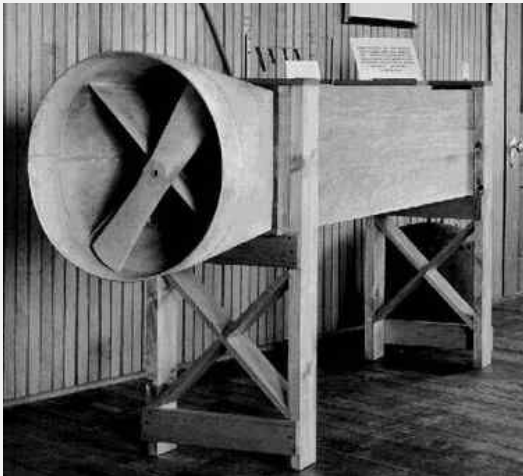
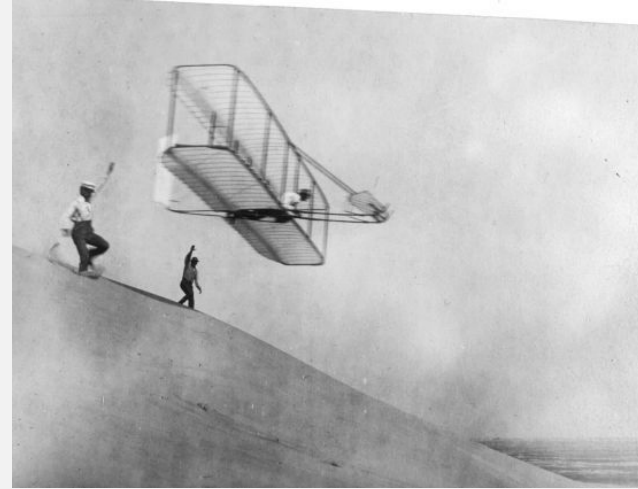
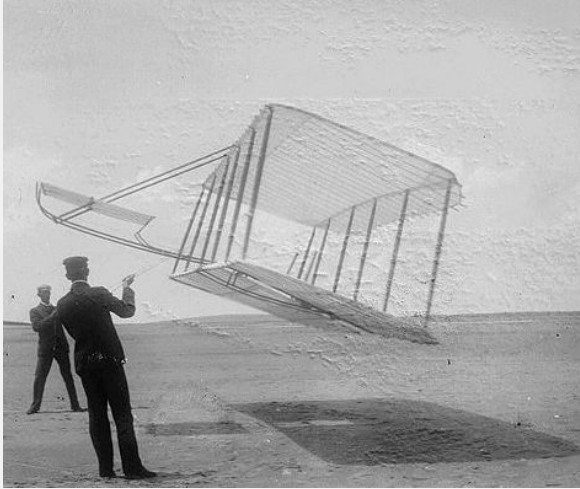
Reduce Time
to Train



THE AUTUMN MANŒUVRES—OFFICERS PLAYING AT KRIEGS SPIEL, OR THE "GAME OF WAR"

1900s

- Wright Brothers



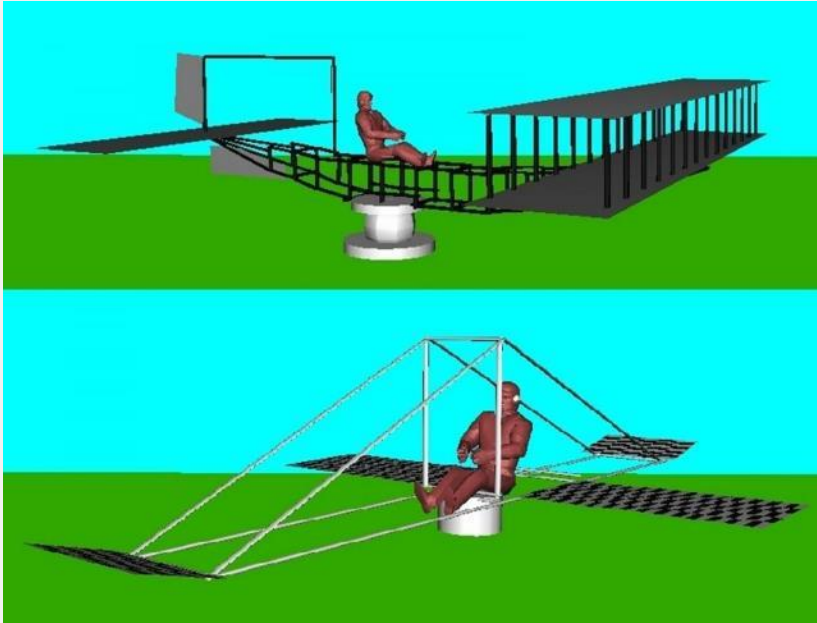
1910s

- Leon Levavasseur's Antoinette Barrel – France 1910



1910s

Sanders Teacher

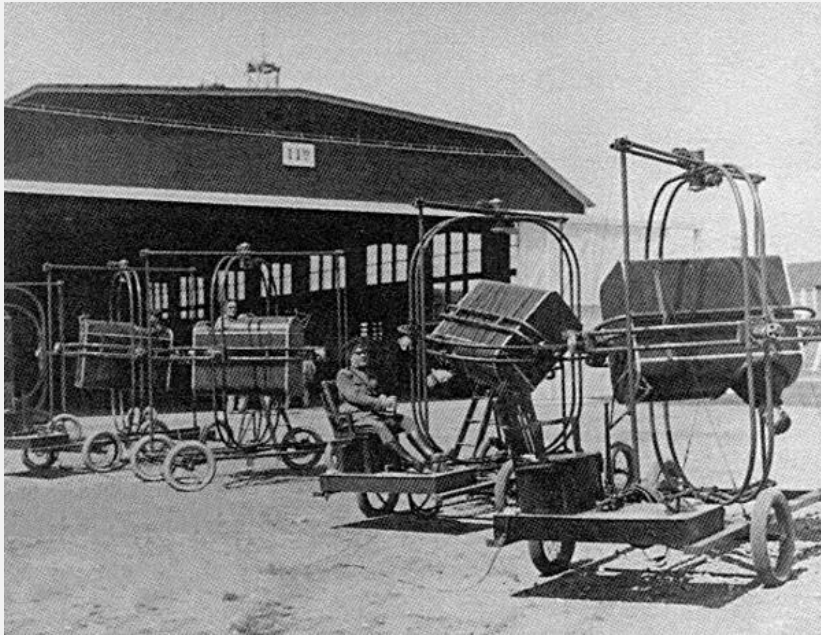


Penguin System



1910s

- Ruggles Orientator

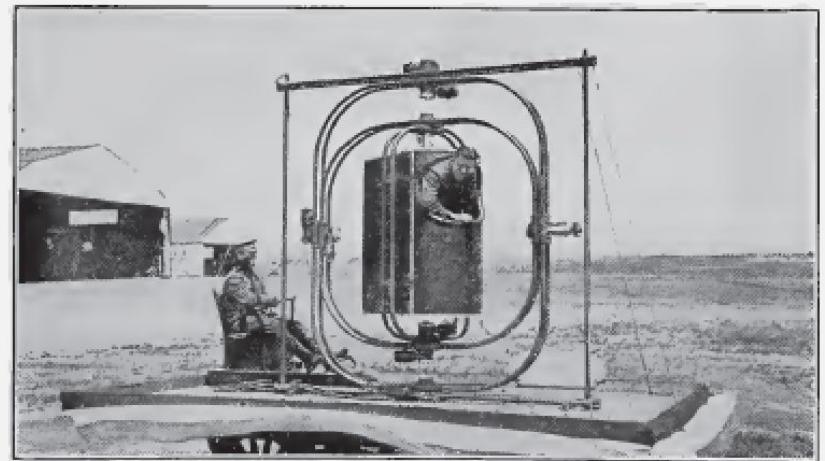


Popular Science - Jul 1919

“Maj.-Gen. George W. Squier said recently that 90% of the flying casualties during the war were caused not by bullets, or badly built machines, but by "the failure of the man"”



RUGGLES ORIENTATOR. NORMAL FLYING.



RUGGLES ORIENTATOR. SIMULATING NOSE DIVE.

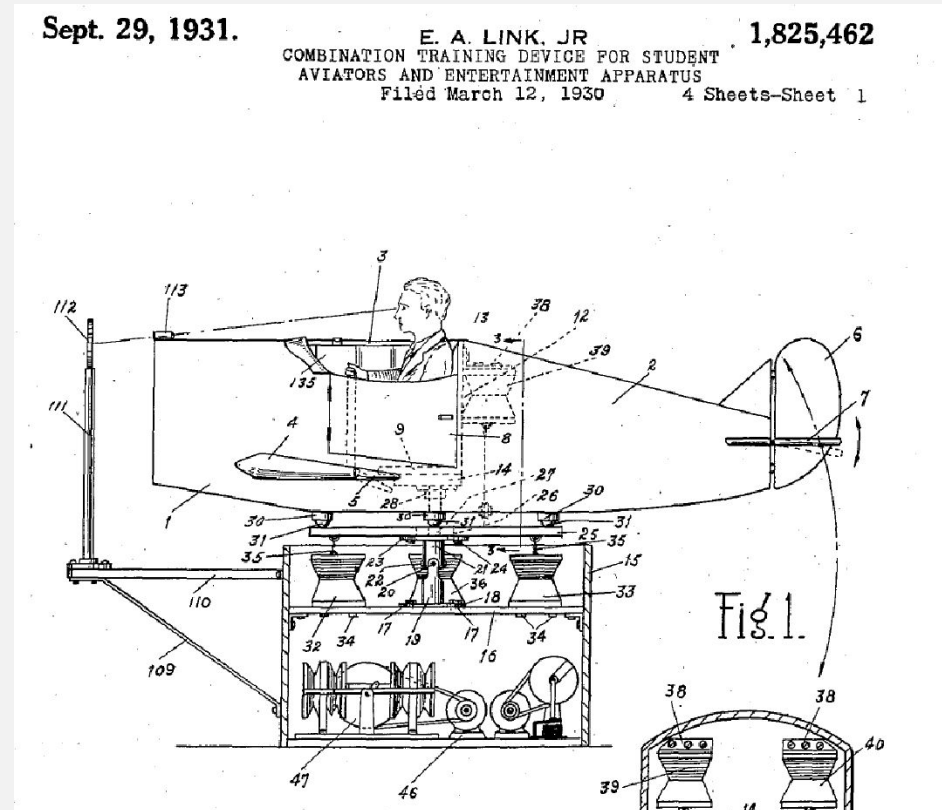
1920s – Edwin A Link (born 1904)

- 1920 - First Flying Lesson
- 1926 - First Solo Flight
- 1928 - Purchased Cessna
- 1929 - First Link Pilot Trainer
- 1929 - Link Aeronautical Corp formed



1930s – Edwin A Link

- Trainer found early acceptance in amusement parks as a coin-operated ride
- 1931 Patent “Combination Training Device for Student Aviators and entertainment Apparatus”
- Link Flying School in 1930, featuring the Link Trainer as the core of the curriculum

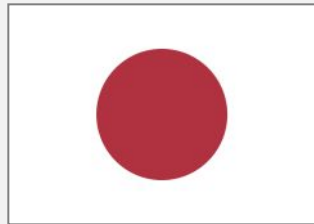


1930s – Link Trainers

- The U.S. Army Air Corps, which had taken over air mail routes in February 1934 with disastrous results, placed an order for six fully-instrumented trainers (\$3,500 a piece)
- They were used principally for “Blind” or Instrument Training



6



10



4

- In 1937, the first Link Trainers were delivered to the RAF
- By 1940 trainers had been shipped to over thirty-five countries around the world
- A Luftwaffe bomber pilot of 1940 spent 50 hours in a Link Trainer

1940s

- The Link Trainer came into widespread use during WWII
- 10,000 “blue box” trainers were used to improve safety and shorten training time for over 500,000 pilots
- The trainers were used preceding actual flight training and as an opportunity to sharpen skills



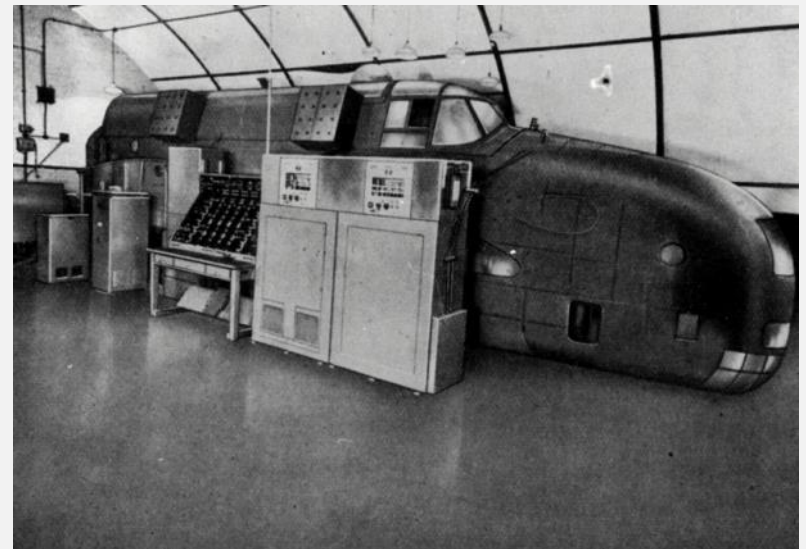
Crail Airfield, Scotland, Torpedo Attack Training Building 1940s



The epidiastroscope visual system for the Torpedo Attack Trainer was produced by Strand Electric, better known for stage lighting

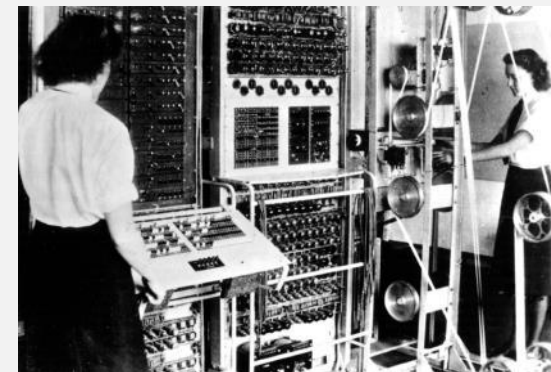
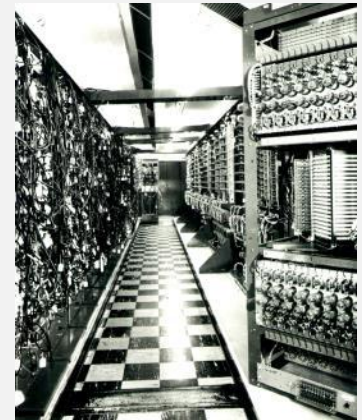
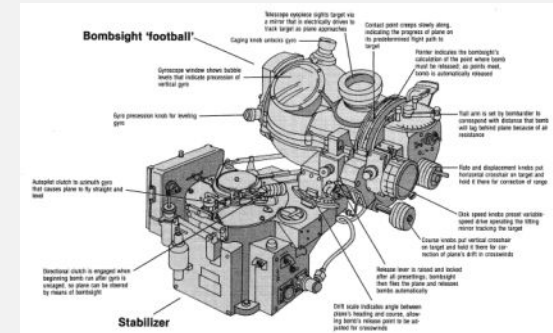
1940s - RAF Instructor Initiatives

- RAF Silloth Trainer (c.1940) for the Halifax
- Designed for the training of all members of the crew
- Primarily a type familiarization trainer for learning drills and the handling of malfunctions
- All engine, electric and hydraulic systems simulated
- An instructor's panel was provided to enable monitoring of the crew and malfunction insertion
- All computation was pneumatic, as in the Link Trainer



Rise of Computers

- World War II era gun directors, gun data computers, and bomb sights used mechanical analogue computers
- **1943** - Project Whirlwind begins. US Navy approaches the Massachusetts Institute of Technology to build a flight simulator to train bomber crews
- **1944** - The first Colossus is operational, designed to break the complex Lorenz ciphers used by the Nazis during WWII



Curtiss-Wright P-3 Ground Instrument Trainer

- This trainer was developed about 1945 and is equipped with a very early electronic analogue AC and DC computer.
- The trainer simulates the B-25J bombing plane but is equipped with a single engine and a single seat.
- Ad hoc methods used to achieve the desired aeroplane characteristics
- Debate in late 1940s about need for motion



1950s

- It was realised from the earliest days of programmable electronic digital computers that a potential application would be in real-time digital simulation.
- At the same time aircraft manufacturers began to produce much more complete data and to perform more extensive flight development programmes.
- US Navy funded the Universal Digital Operational Flight Trainer which (by 1960) demonstrated the feasibility of digital simulation
- In 1958, Redifon received a contract from BOAC for the production of a pitch motion system as part of a Comet IV simulator.



1960s

- Early 60's Link developed a special purpose digital computer, the Link Mark I, designed for real-time simulation
- By late 60's general purpose digital computers were suitable for simulation
- Visual Systems were typically based on a "model board" system

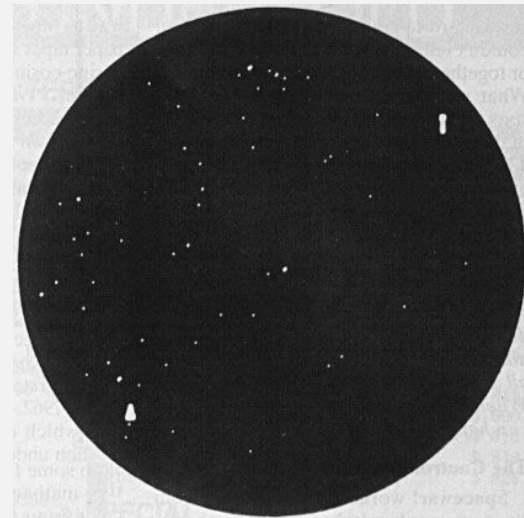


1960s - Mobile Simulation for B52s



1960s

- 1962
- Spacewar! Ran on a DEC PDP-1 mini-computer and generally considered the first Shooter game

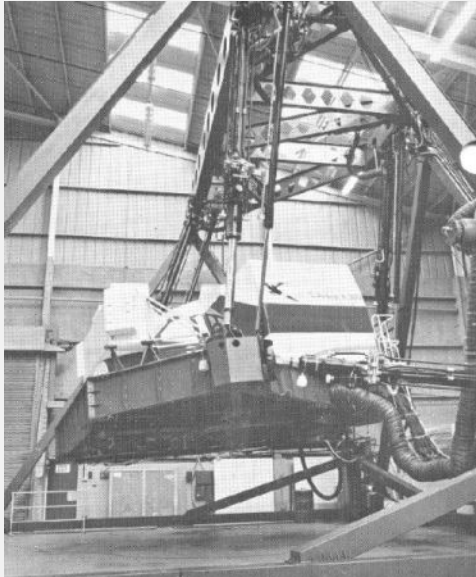


1960s – Internet Origins

- 1960 - J. C. R. Licklider inspired the early ARPANET work, calling for a global network through his paper, Man-Computer Symbiosis:
 - "A network of such [computers], connected to one another by wide-band communication lines [which provided] the functions of present-day libraries together with anticipated advances in information storage and retrieval and [other] symbiotic functions."
- 1969 - The first ARPANET link was established between the University of California, Los Angeles (UCLA) and the Stanford Research Institute



1970s



1977

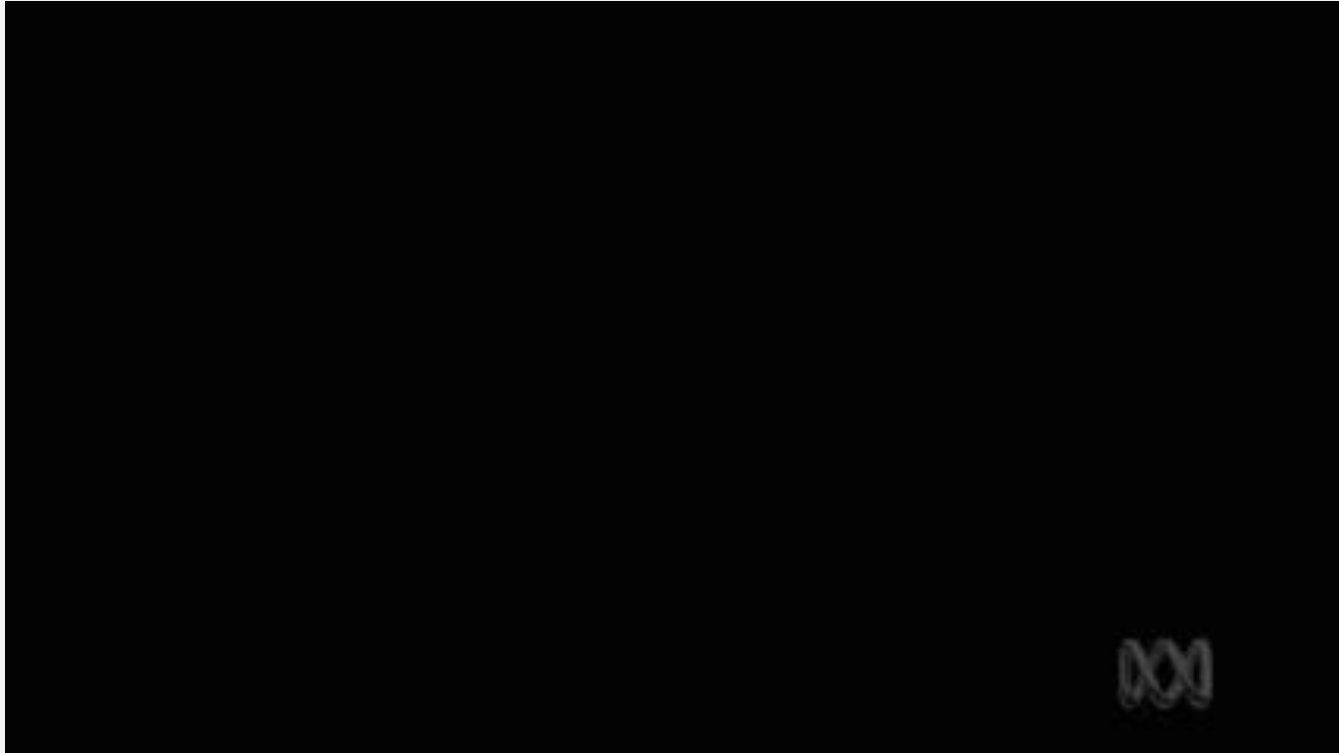


1979

1973 – First Mobile Call



Looking Forward in 1974



Arthur C. Clarke

1970s - Internet

- 1974 - The term "internet" was first adopted as an abbreviation of the term internetworking
- 1978 - TCP/IP emerges in nearly final form

1970s - SIMNET

- 1978, Captain Jack A. Thorpe, Air Force Office of Scientific Research (AFOSR) “Future Views: Aircrew Training 1980-2000”
- "advances which are seen on the horizon are not simple improvements in teaching techniques or higher fidelity simulators, but rather bold concepts which tightly align training systems with real combat readiness and make them indistinguishable."

SIMNET Concept - 1978

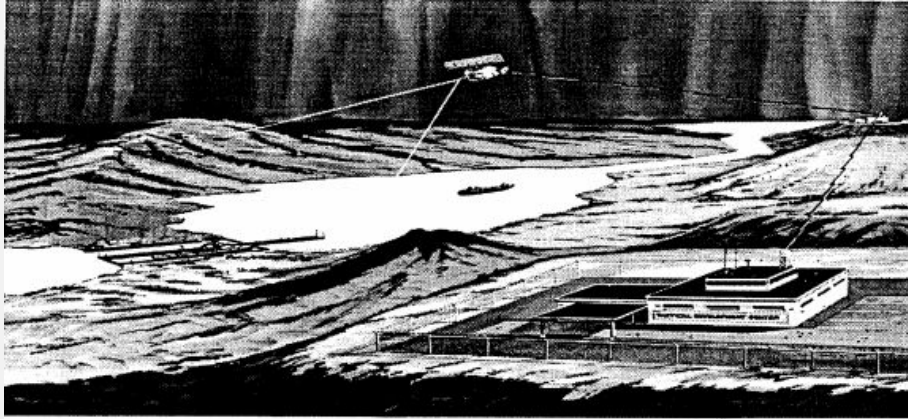


Figure 1. Collecting the Data

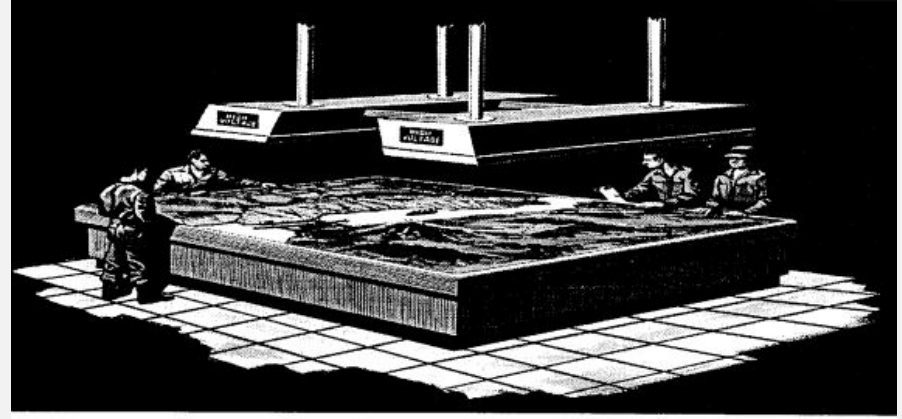


Figure 2. Analyzing the Collected Data

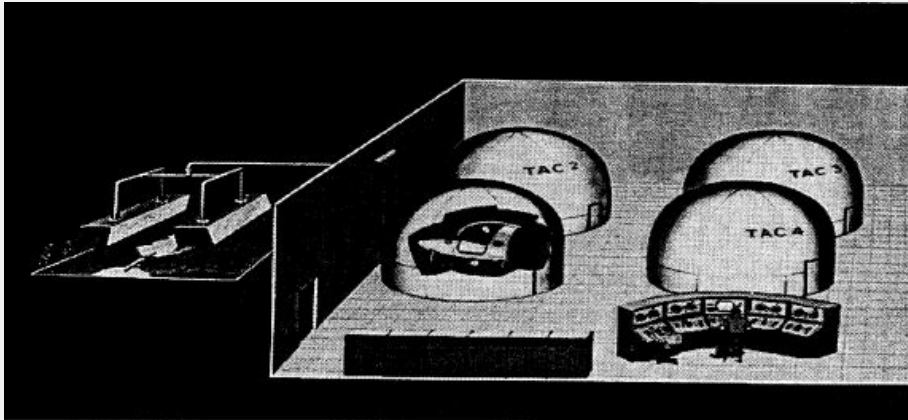


Figure 3. Executing the Plan in a Virtual Mode

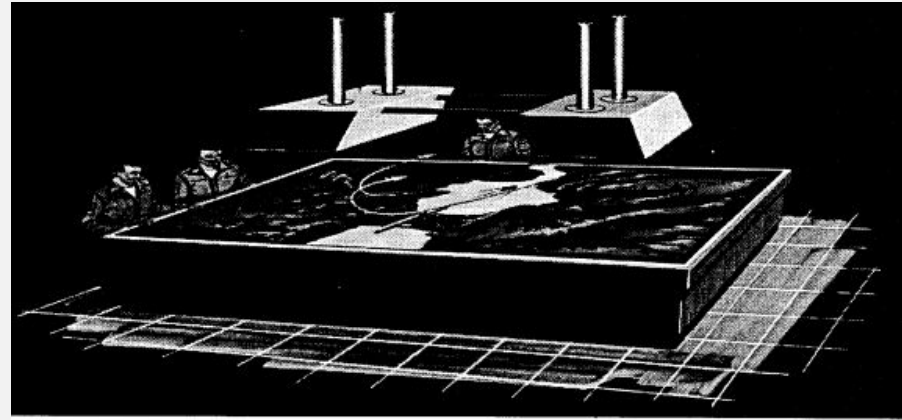
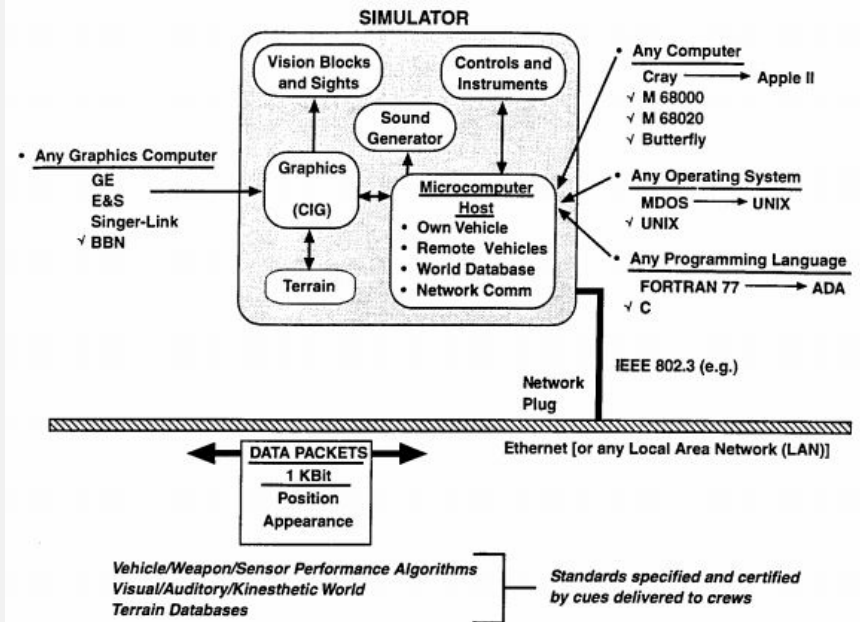


Figure 4. Assessing the Plan for Real-Time Execution

SIMNET: An Insider's Perspective: Neale Cosby - March 1995



The Basic Network Architecture

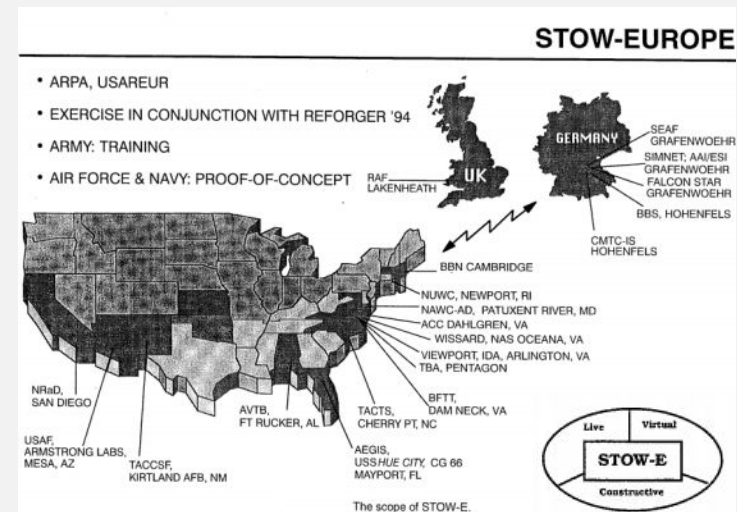


1980s - Internet

- 1981 – ARPANET number of hosts 213
- 1982 – TCP/IP protocol suite formalized
- 1983 – MILNET split off from ARPANET
- 1985 – First .COM domain name registered
- 1986 – US NSFNET with 56 kbit/s links

1990s

- 1983 - *SIMNET* - simulator networking
- 1990 - Distributed Interactive Simulation (DIS)
- 1994 - STOW (Synthetic Theater of War)
 - STOW-E (94) – Instrumented live, virtual DIS/SIMNET simulators, CGF/constructive (LVC)
- 1995 – High Level Architecture
- 1997 – STOW-A (inc UK)
- 1998 – UK SeBA

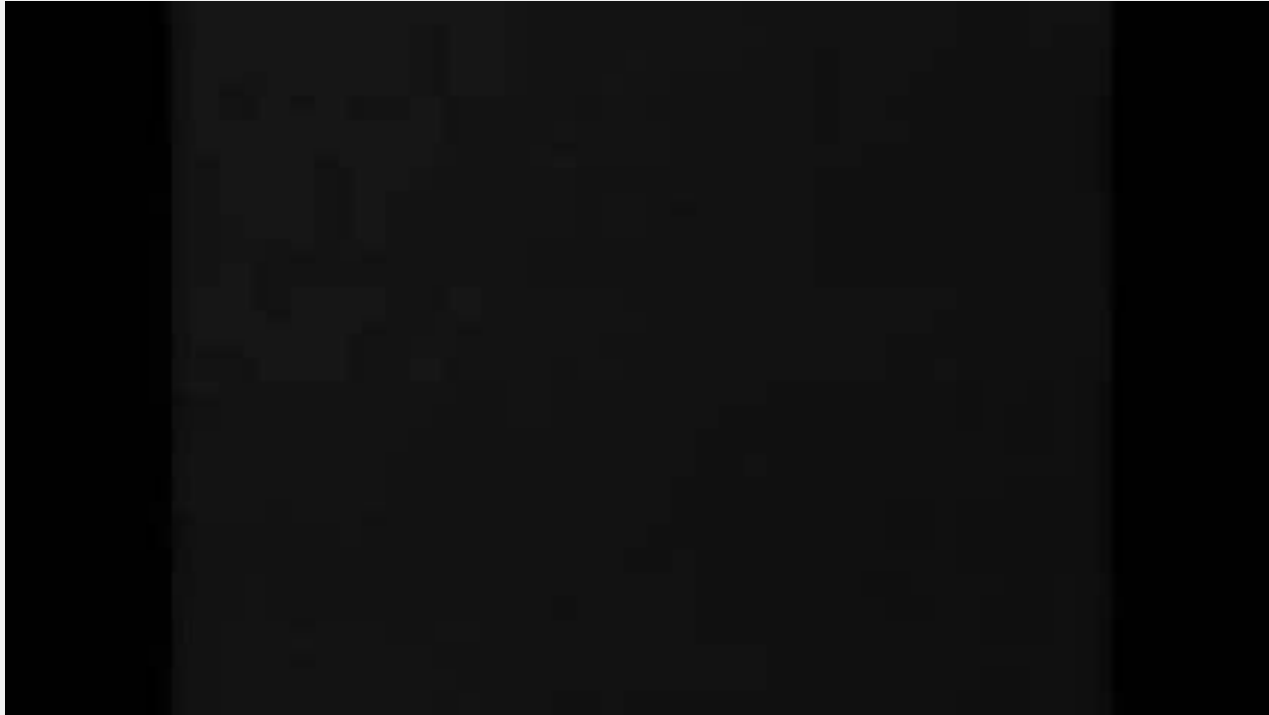


1990s - Internet

- 1990 – WWW concept published
- 1991 – First server outside Europe
- 1993 – Mosaic Browser
- 1995 – Amazon.com online retailer
- 1995 – eBay online auction and shopping
- 1998 – Google Search



Looking Forward in 1993



2000s

BBC
CATEGORIES TV RADIO COMMUNICATE WHERE I LIVE INDEX SEARCH
Go

BBC NEWS

You are in: UK: England
Thursday, 24 January, 2002, 18:06 GMT

War simulator unveiled



Soldiers sit inside a replica tank to use the simulator

One of the largest war simulators in the world has been unveiled by high-ranking officers from the British Army.

The £290m unit, at the Warminster army barracks in Wiltshire, can recreate a tank battle involving 1,000 armoured vehicles in virtual reality.

The army hope the training simulator will give British troops the edge over any enemy in combat.

The combined arms tactical trainer, CATT, is also designed to reduce the massive costs of live military exercises.

Training 'watershed'

The simulator can reproduce vast sections of terrain from Salisbury Plain and other regions across Western Europe.

BBC Wiltshire
WHERE I LIVE >>

Internet links:

- The British Army
- Defence Procurement Agency

The BBC is not responsible for the content of external internet sites

Top England stories now:

- Tories attack Brixton drugs scheme
- Police shoot man on the M6
- Leanne killer jailed for life
- IVF mix-up heads for court
- Inquiry into warship accident
- Britain 'sheltering al-Qaeda leader'
- Venables named Leeds boss
- Transplant first for cancer patient

Links to more England stories are at the foot of the page.

COMMONWEALTH GAMES

BBC SPORT

BBC Weather

SERVICES

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- News Ticker
- Mobiles/PDAs

Feedback

- Help
- Low Graphics

BBC
CATEGORIES TV RADIO COMMUNICATE WHERE I LIVE INDEX SEARCH
Go

BBC NEWS

You are in: Science/Nature
Thursday, 20 June, 2002, 13:58 GMT 14:58 UK

Troops in virtual combat



Up to eight soldiers can play together

The British Army is using a specially developed version of the celebrated computer game Half-Life to train its troops.

With the first-person shoot-em-up soldiers can try out new weapons and new tactics without encountering real bullets and bombs.

The Ministry of Defence hopes the system may help reinforce some of the lessons learned on more traditional training exercises.

Like the popular modification, or mod, of Half-Life known as Counterstrike, the army version allows up to eight soldiers to go into virtual combat at any one time.

See also:

- 24 Jan 02 | England War simulator unveiled
- 23 May 02 | New Media US military reveals computer game
- 21 Dec 01 | Reviews Half-Life revives for new generation

Internet links:

- QinetiQ

The BBC is not responsible for the content of external internet sites

Top Science/Nature stories now:

- Date for first Australians
- Fifth closest star discovered
- Mona Lisa smile secrets revealed
- The gene that maketh man?
- Gravity wave detector all set
- Robots get cheeky
- The big and the bizarre
- Botox 'may cause new wrinkles'

Links to more Science/Nature stories are at the foot of the page.

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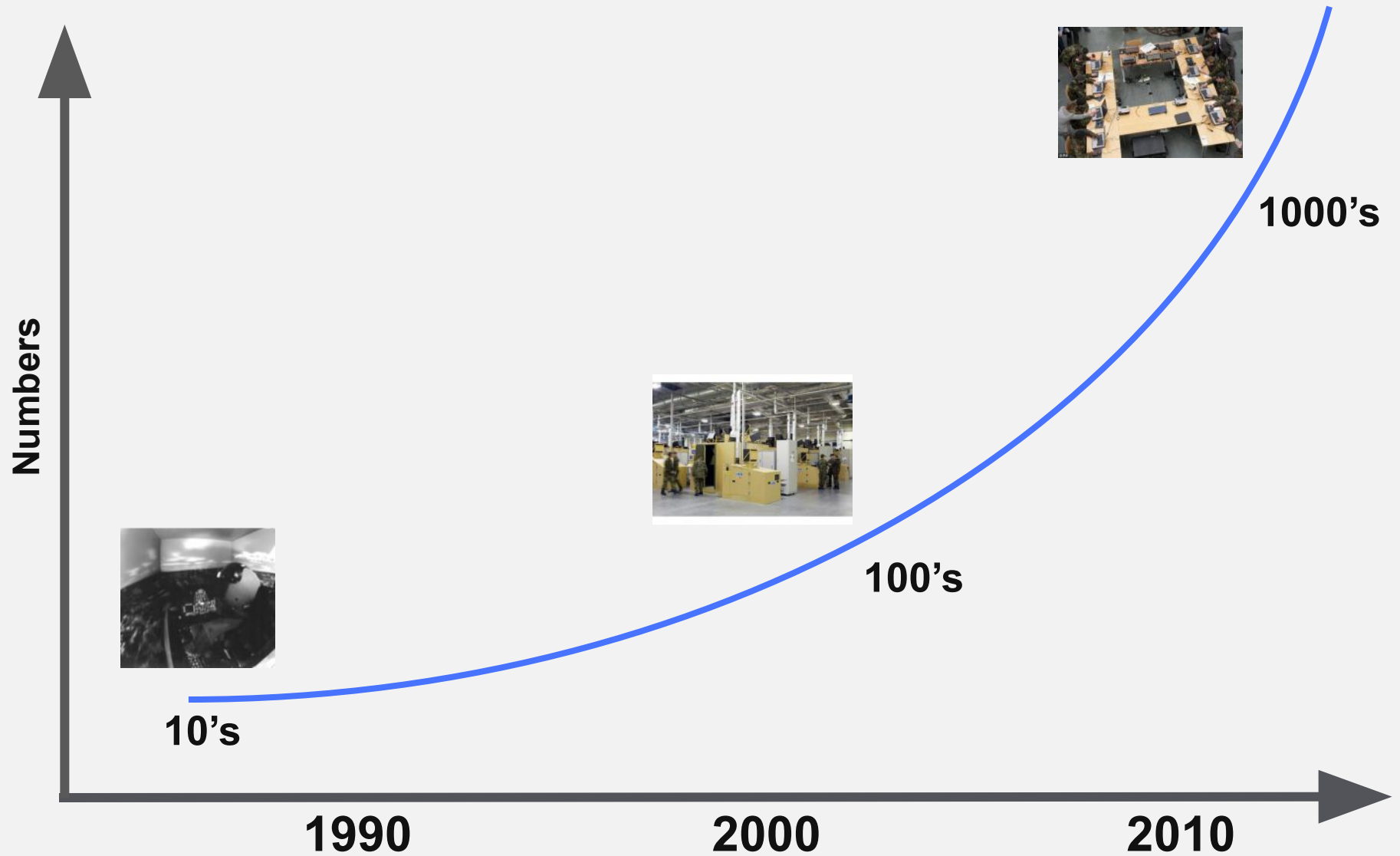
Obviously, being killed in the virtual world isn't quite so serious

Major Bruce Pennell

VBS

- 1999 - Bohemia Interactive is Founded
- 2001 - Bohemia's Operation Flashpoint launches
 - top selling game in the UK, Ger, FR, Aus, Czech Rep and other countries
 - large scale detailed terrain areas and maps, a small team C2 system, game engine flexibility, connectivity and user driven content
- 2001 - VBS1 development commences with US Marines as first customer
 - Customers US, UK, NL, Can, Aus, Israel, NZ and others
- 2007 - VBS2 launches
 - View distances five times greater than VBS1
 - HLA/DIS
- 2013 - VBS2 is now a General Purpose Simulation for the Joint Battlespace.
- It has changed the simulation landscape by its accessibility, cost effectiveness and user acceptance

2010s - Access to Simulation



Never Replace Live?

theguardian

News | Sport | Comment | Culture | Business | Money | Life & style

News > World news > US military

US grounds F-35 fighter jets over cracked engine blade

Problem discovered at Edwards Air Force Base prompts critics to slam 'gigantically disappointing performance' of new plane

Associated Press in Washington
guardian.co.uk, Saturday 23 February 2013 14.00 GMT

 [Jump to comments \(182\)](#)



The US has grounded its fleet of F-35 fighter jets. Photograph: Handout/Reuters

The Pentagon has grounded its fleet of F-35 fighter jets, after discovering a cracked engine blade in one plane.

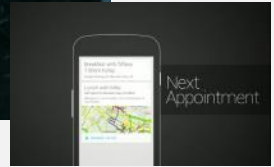
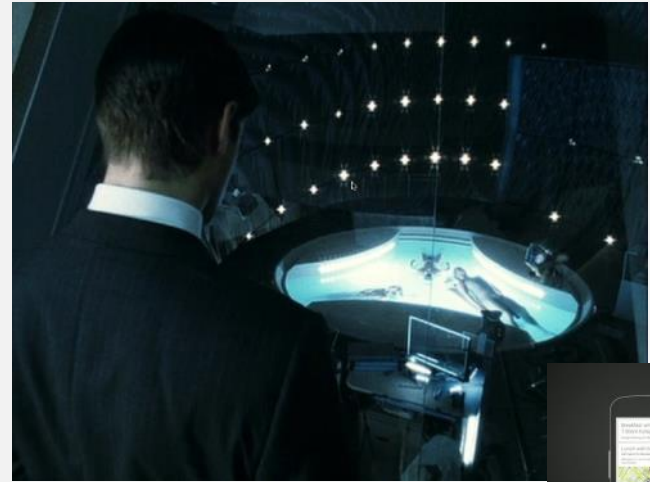
The Future?

Futurists (1964)



Arthur C. Clarke

Minority Report (2002)



Putting Technology in Perspective



Your age

0	5	10	15	20	25	30	35	40	45	50	55	60
2013	2008	2003	1998	1993	1988	1983	1978	1973	1968	1963	1958	1953

What Happens in an Internet Minute?



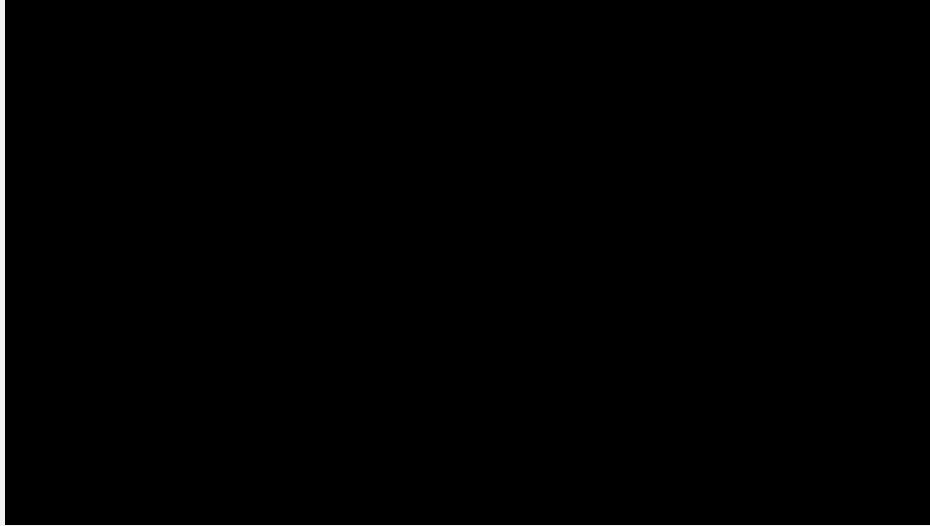
And Future Growth is Staggering



Are things changing?



Arts and Science



Simulacrum - Kimatica
<http://youtu.be/n0dyXfzTMWA>

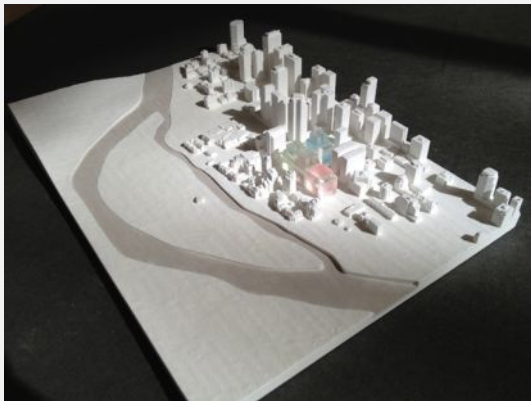


Microsoft Research
<http://youtu.be/MvP4cHfUD5g>



Looking Ahead?

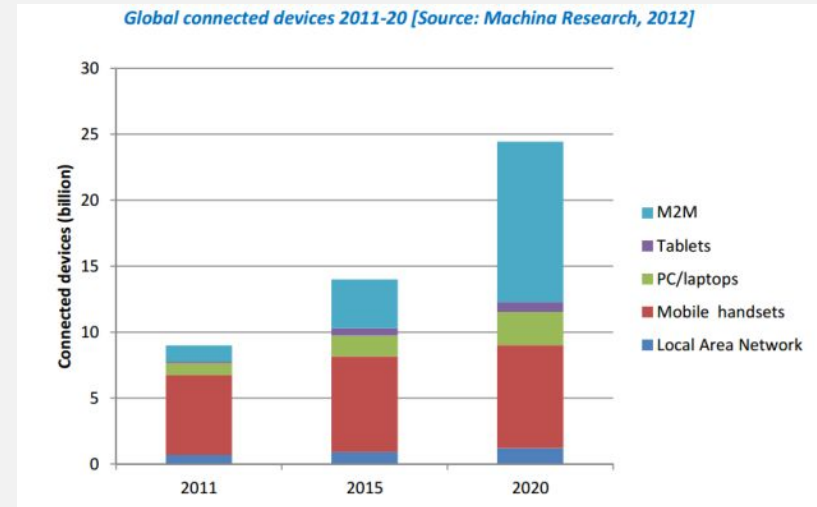
- Robots/AI
- Internet of Things/"Connected Life"
- Wearable Computers
- Sensors
- Augmented Reality
- 3D Printing/3D Scanning
- "Generation C"



Internet of Things/Connected Life

“Internet 2”

- “Hot” Applications
 - Cars
 - By 2020 expected that 90% of new passenger cars sold will be connected to the Internet
 - 75% of cars on the road by 2040 will be autonomous
IEEE (Sep 12)
 - Health and Assisted Living
 - Smart Meters
 - Security
 - Building Automation



Digital and Online Classrooms

South Korea 2015



Florida 2015

Stanford University



2012 - 23,000 Graduates

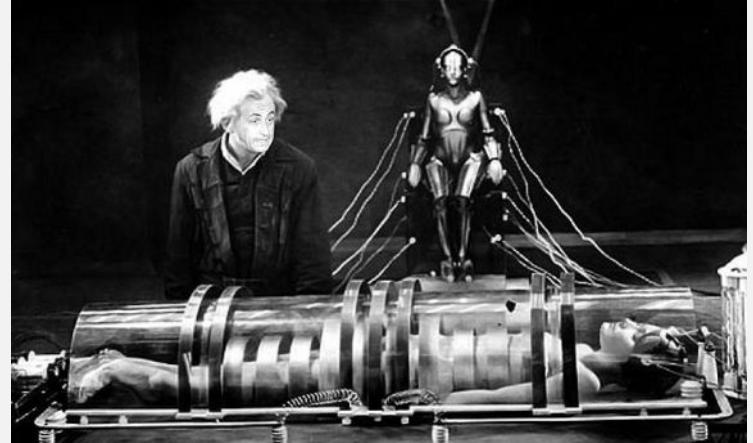
Train Less.. Train at All?



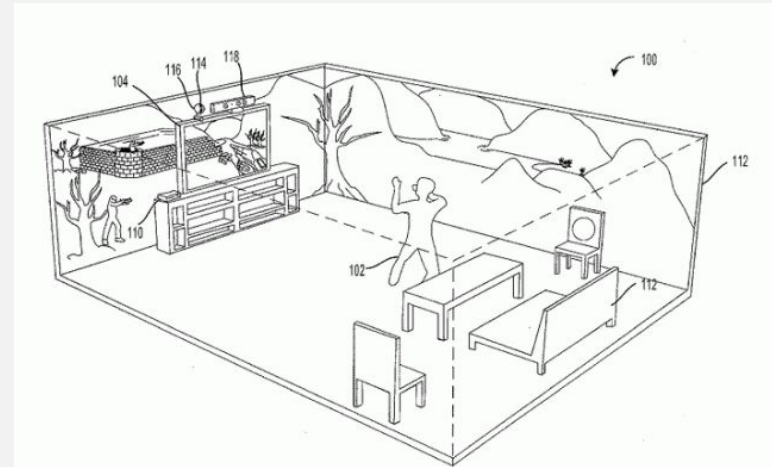
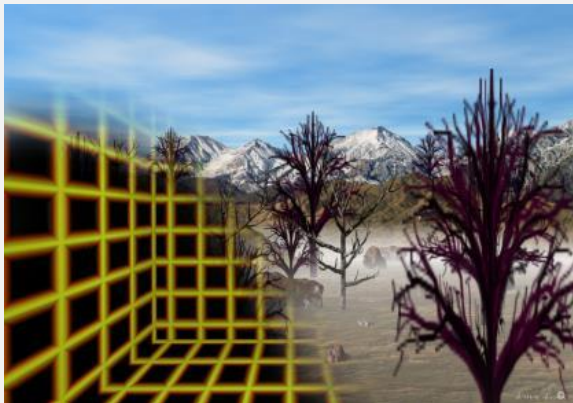
Hatsune Miku



Diluting the Human Experience?



Simulation Future – The Holodeck?



Real or Virtual?



Lessons from History?

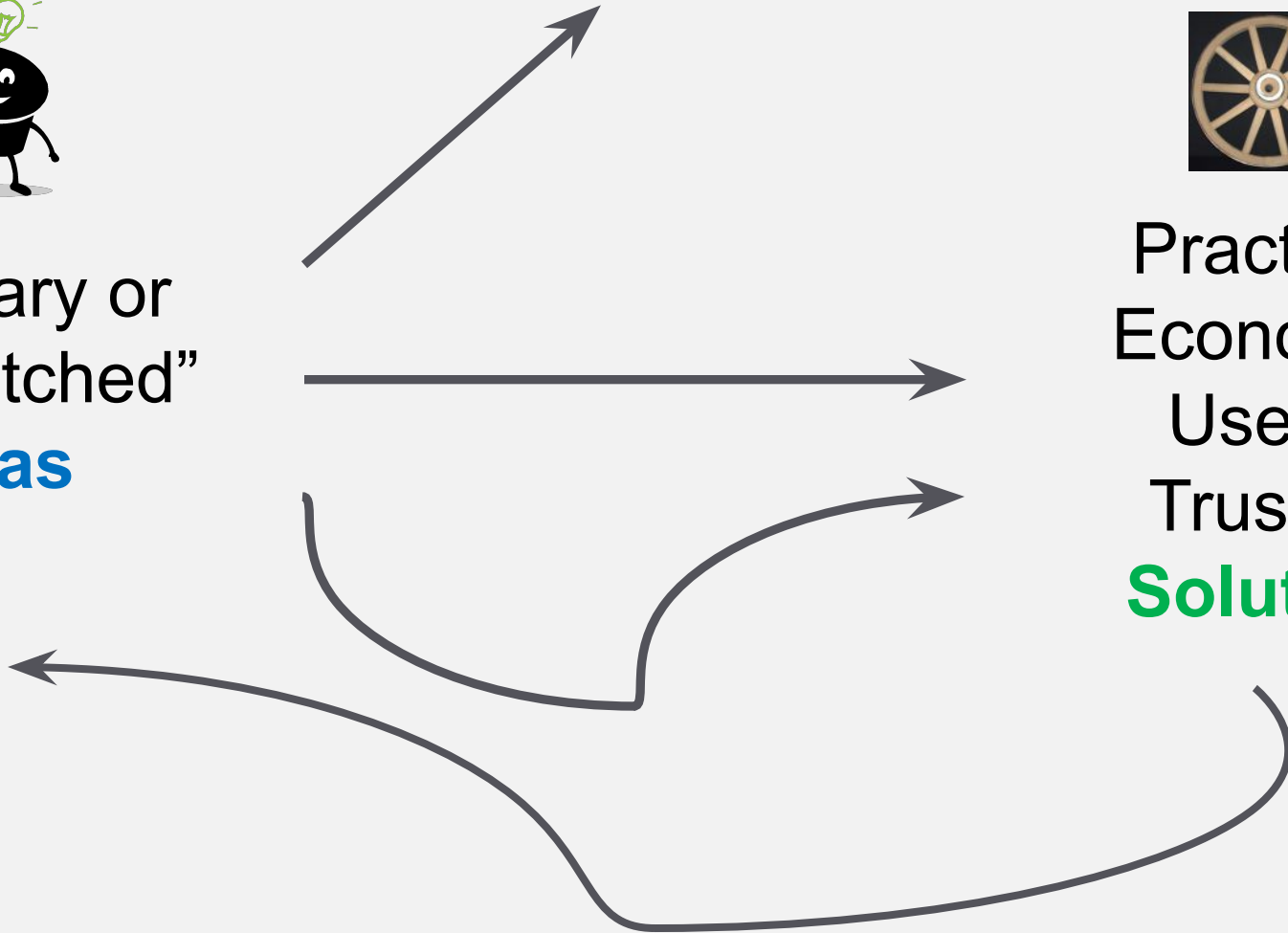
Themes of Talk – Paths to Solutions



Visionary or
“Far Fetched”
Ideas



Practical
Economic
Useful
Trusted
Solution



Themes of Talk – Serious or Fun?



“Serious”
Application



Arts and
Entertainment
Application

Themes of Talk – Digital Technology Convergence



Questions

