

GLOBAL CONFERENCE 2026

FROM CHAOS TO COMMAND:
RISK LEADERSHIP IN INDUSTRY 6.0

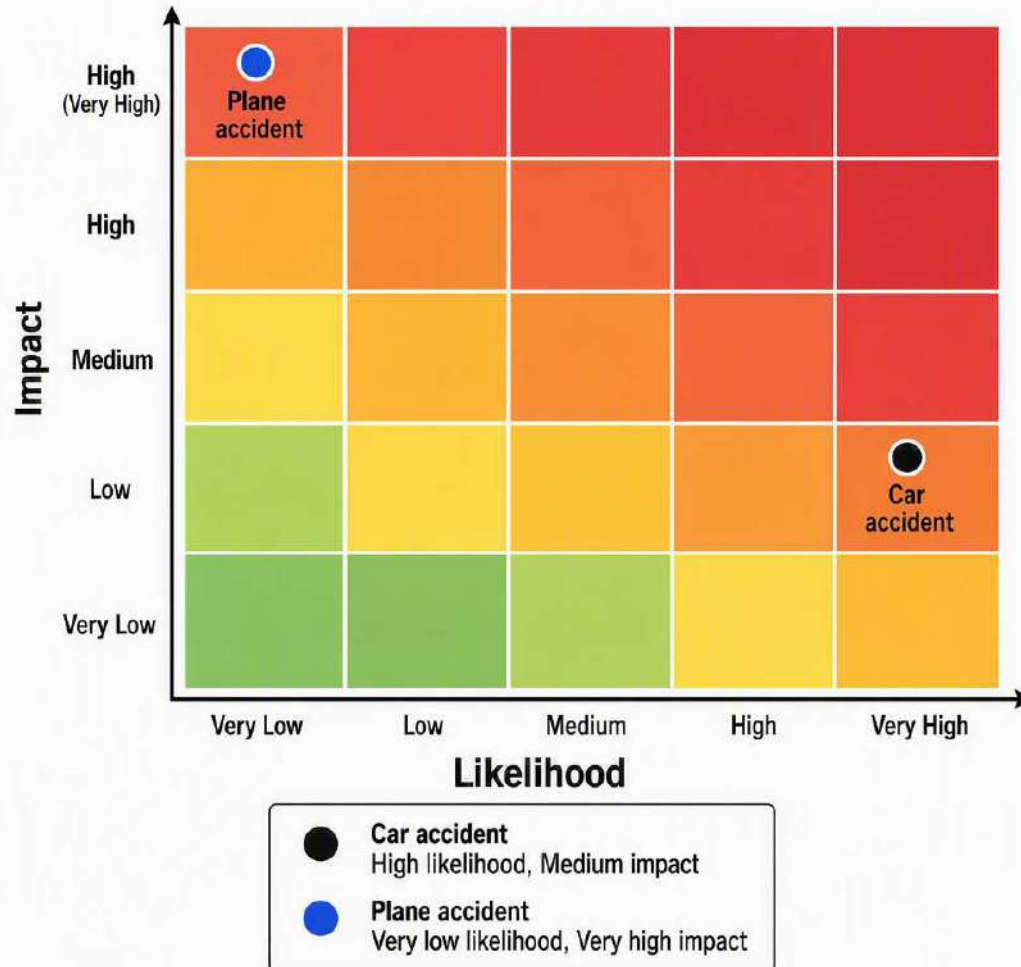
QUANTUM RISK AND THE ENTERPRISE:
FROM THREAT TO STRATEGIC
ADVANTAGE

Dr. Manas Mukherjee
Principal Investigator,
Centre for Quantum Technologies

Risk

Figure-of-merit quantification

Risk Matrix: Car Accidents vs Plane Accidents



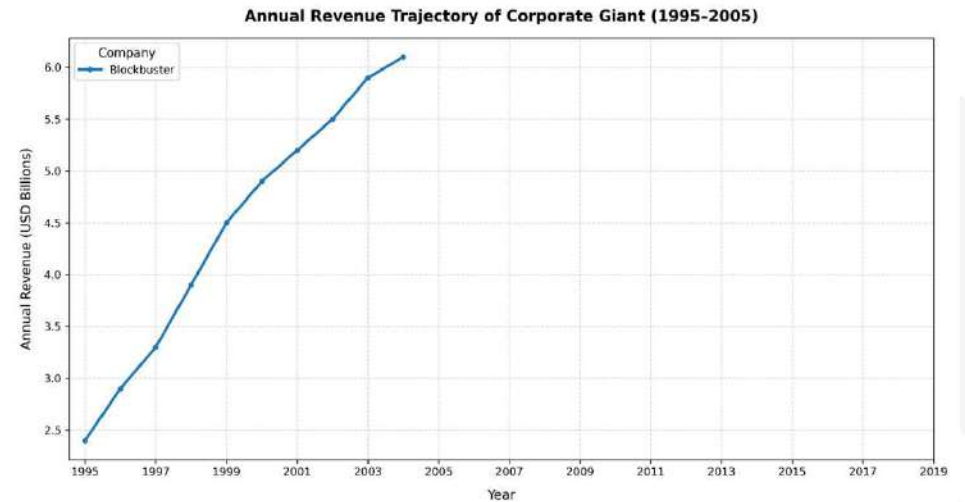
*AI assisted

Risk matrix

Case I

Kill or get killed by new technology

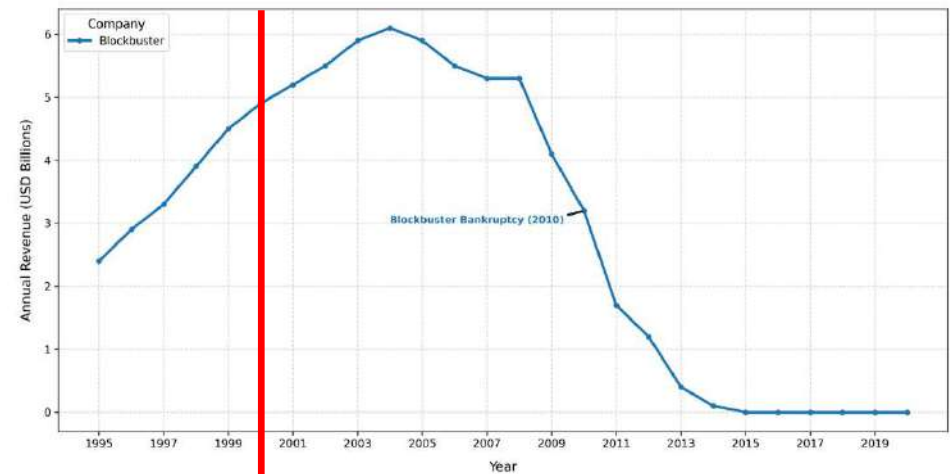
Video renting stores





Video renting stores

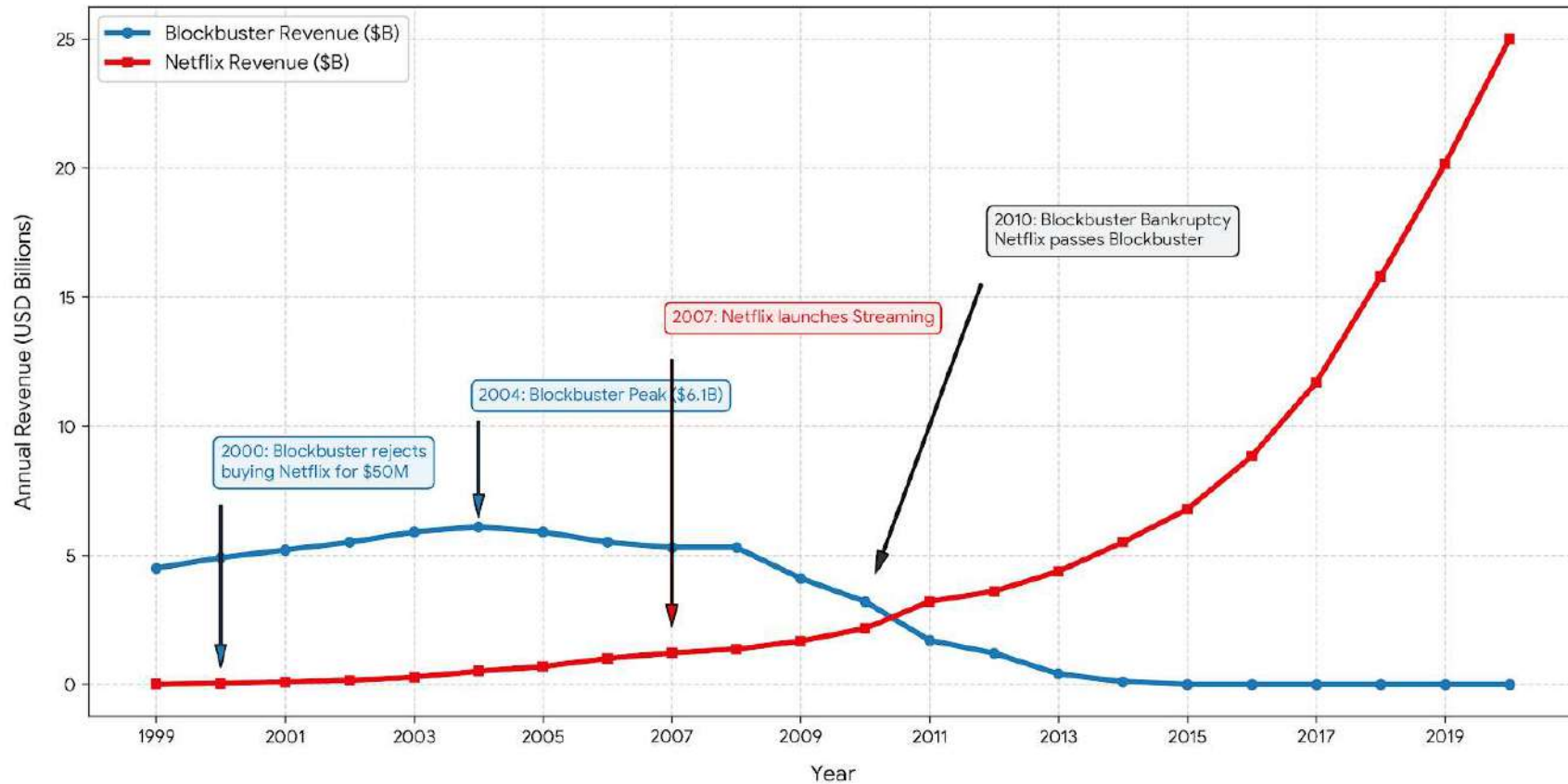
Annual Revenue Trajectory of Corporate Giants in Decline (1995-2020)



INTERNET

Why the decline?

Home Entertainment Disruption: Blockbuster vs. Netflix Revenue (1999–2020)

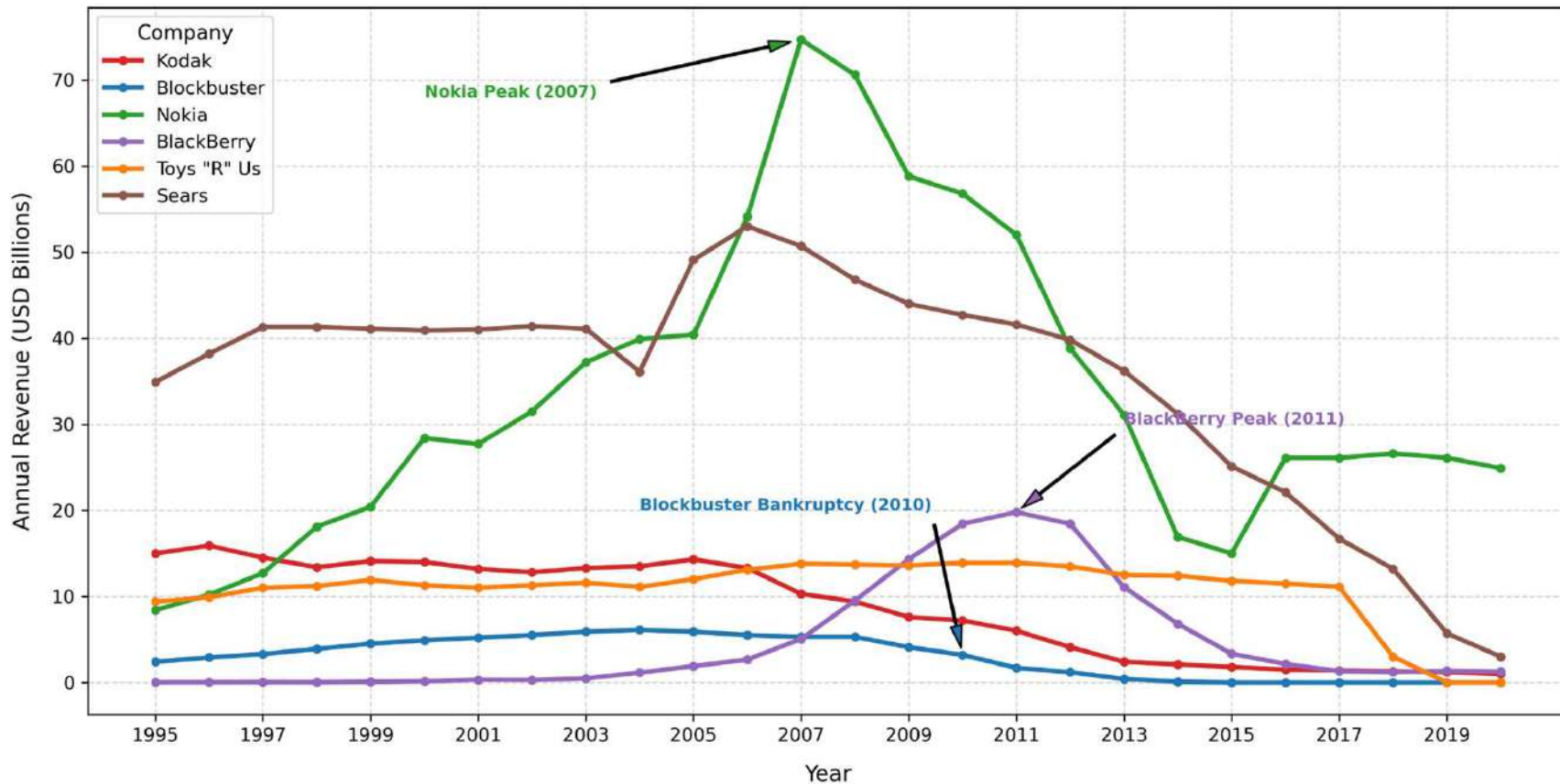


Case N

Kill or get killed by technology

Forgot to learn from history

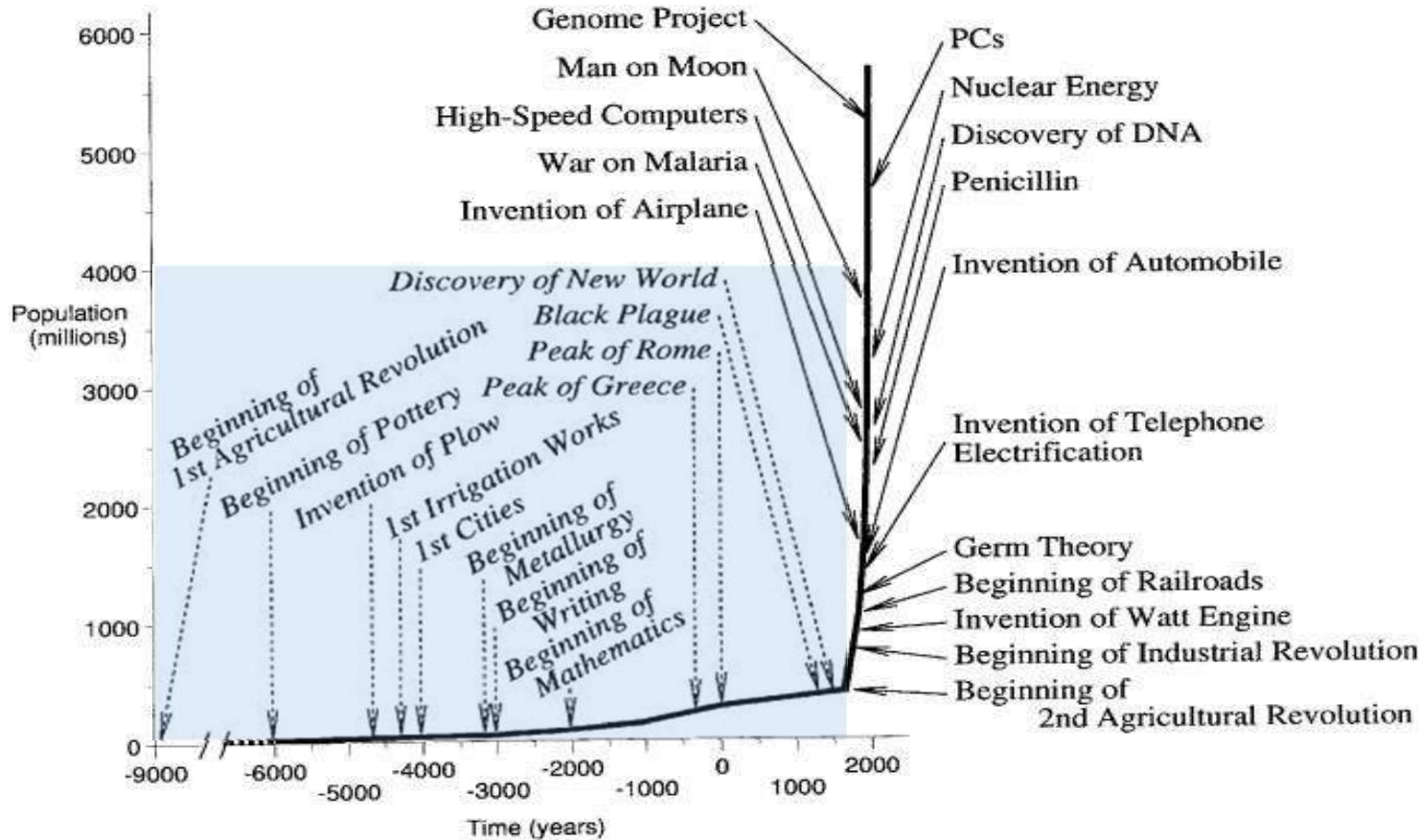
Annual Revenue Trajectory of Corporate Giants in Decline (1995-2020)



History repeats

Nokia	Delayed transition to touchscreen smartphones and modern app ecosystems
Sears	Neglected digital retail and supply chain tech in favor of physical store cuts
BlackBerry	Clung to physical keyboards and enterprise security while consumers demanded app ecosystems
Kodak	Hesitated to commercialize digital cameras to protect profitable film margins
Toys "R" Us	Surrendered digital infrastructure growth by outsourcing e-commerce to Amazon in 2000
Blockbuster	Rejected acquiring Netflix and relied on store late fees instead of digital streaming

Homo sapiens and their growth

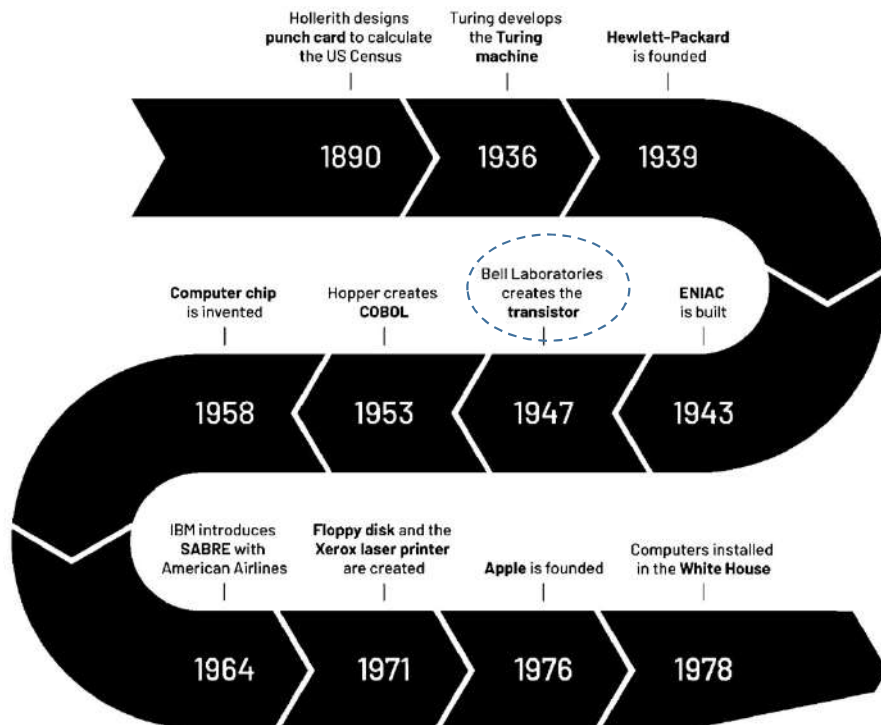


"Catching Up with the Economy" By ROBERT W. FOGEL (1999)

Advent of the quantum era

International year of quantum science and technology 2025

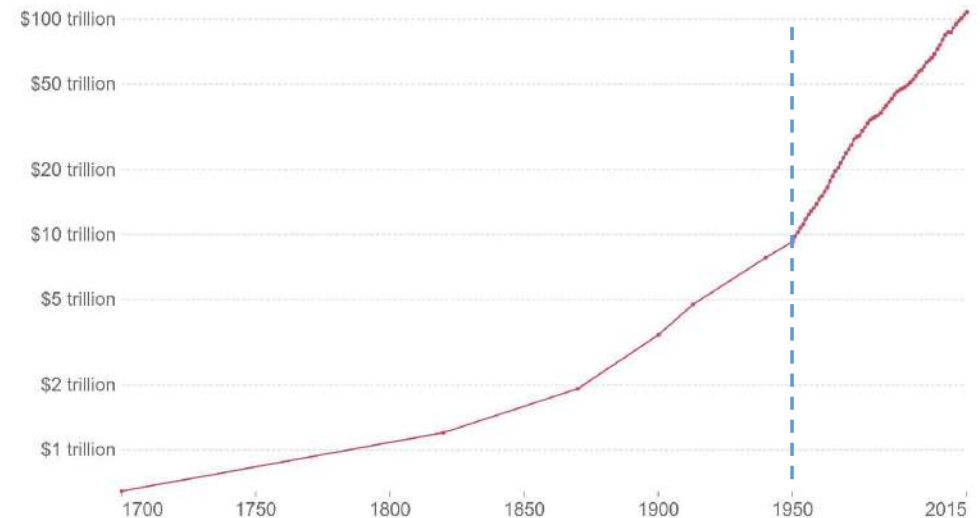
Semiconductor driven growth (Si-Age)



World GDP over the last two millennia

Total output of the world economy. This data is adjusted for inflation and differences in the cost of living between countries.

Our World in Data



Source: Our World In Data based on World Bank & Maddison (2017)

Note: This data is expressed in international-\$¹ at 2011 prices.

OurWorldInData.org/economic-growth • CC BY

1. **International dollars:** International dollars are a hypothetical currency that is used to make meaningful comparisons of monetary indicators of living standards. Figures expressed in international dollars are adjusted for inflation within countries over time, and for differences in the cost of living between countries. The goal of such adjustments is to provide a unit whose purchasing power is held fixed over time and across countries, such that one international dollar can buy the same quantity and quality of goods and services no matter where or when it is spent. Read more in our article: What are Purchasing Power Parity adjustments and why do we need them?

Our World in Data and g2.com

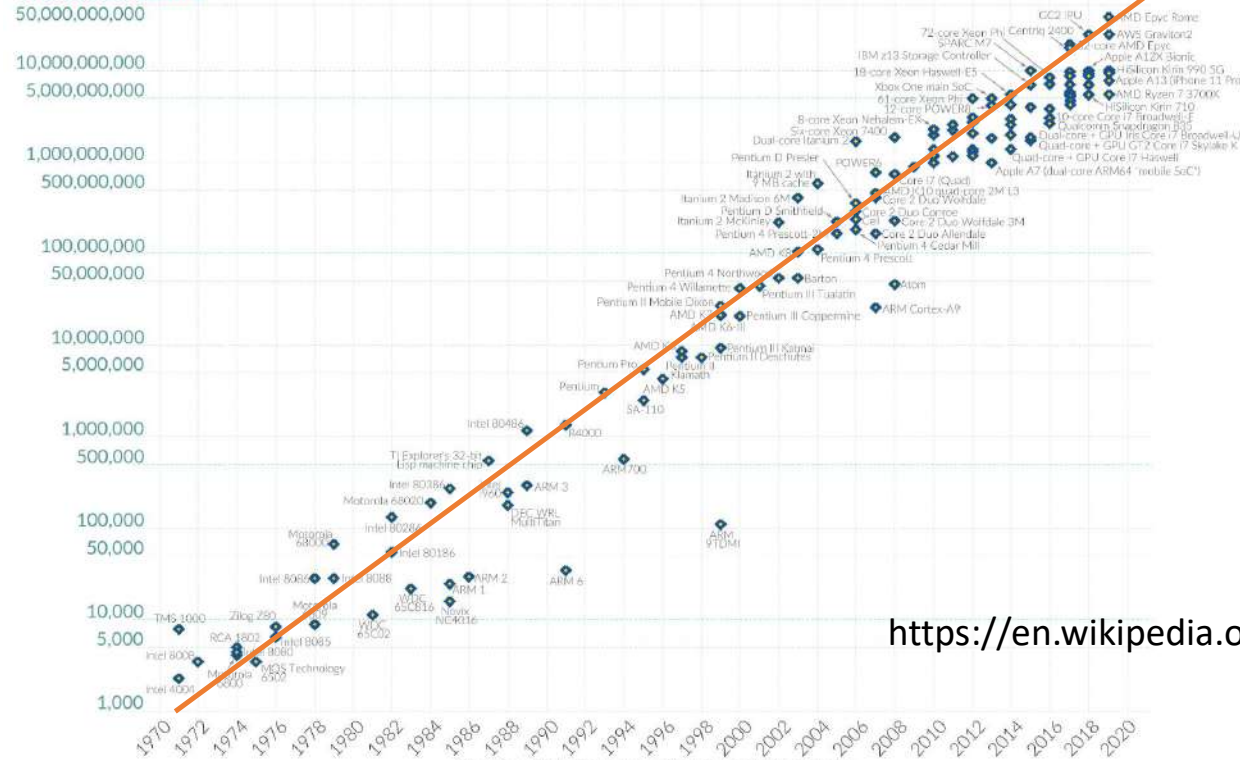
Laws fueling the information era

Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

Our World
in Data

Transistor count

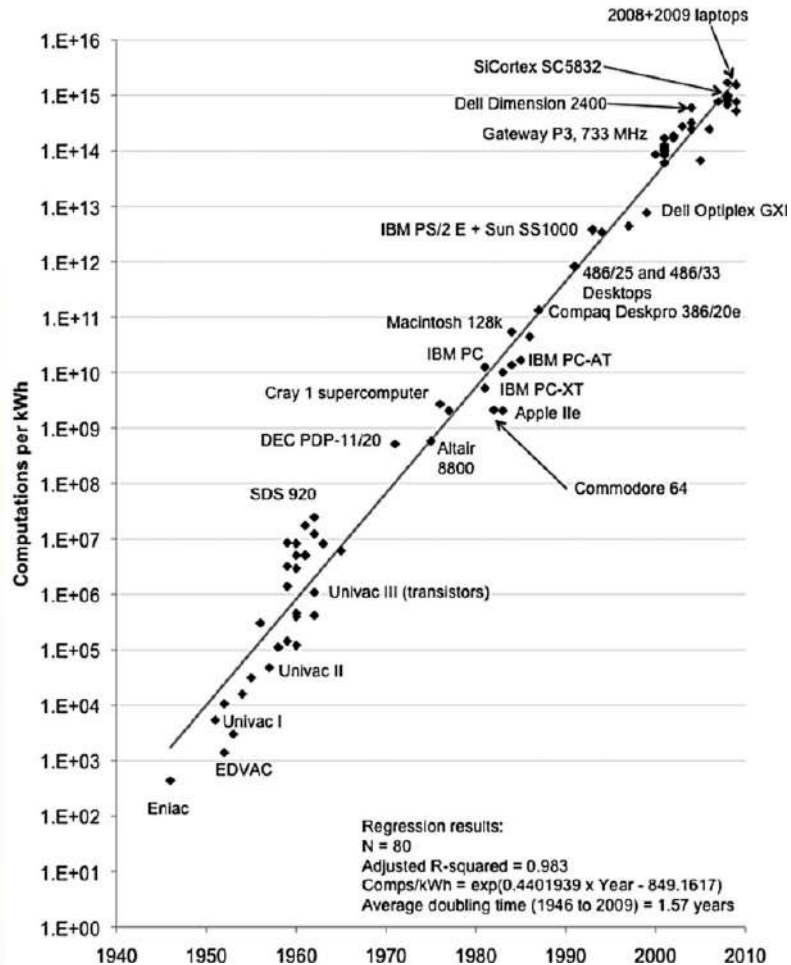


https://en.wikipedia.org/wiki/Moore%27s_law

Data source: Wikipedia (wikipedia.org/wiki/Transistor_count) Year in which the microchip was first introduced

OurWorldinData.org – Research and data to make progress against the world's largest problems.

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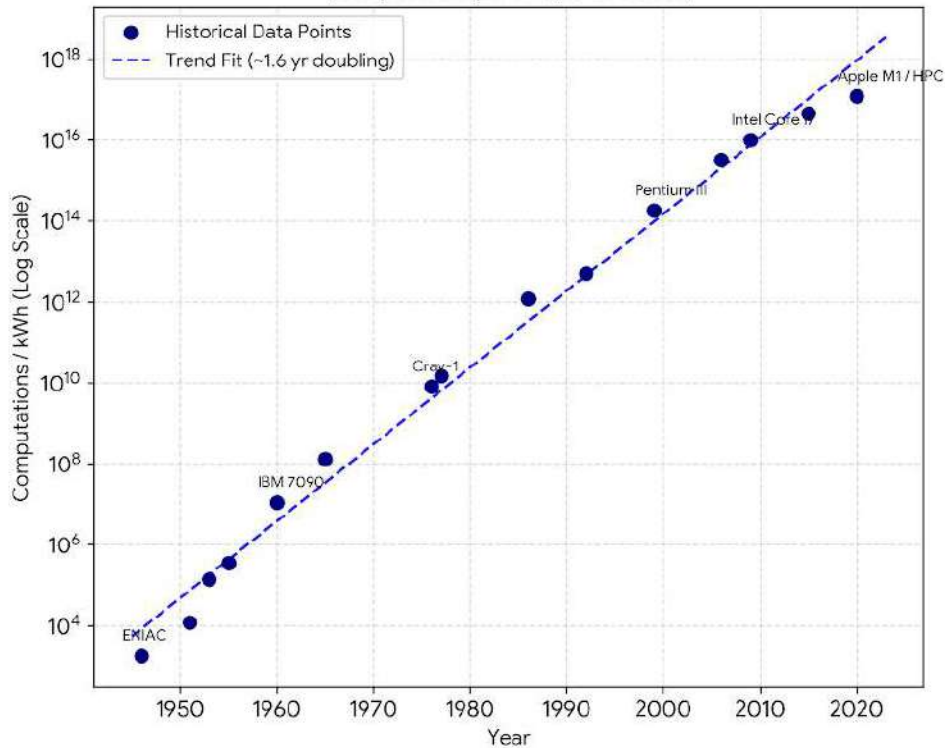


Laws fueling the information era

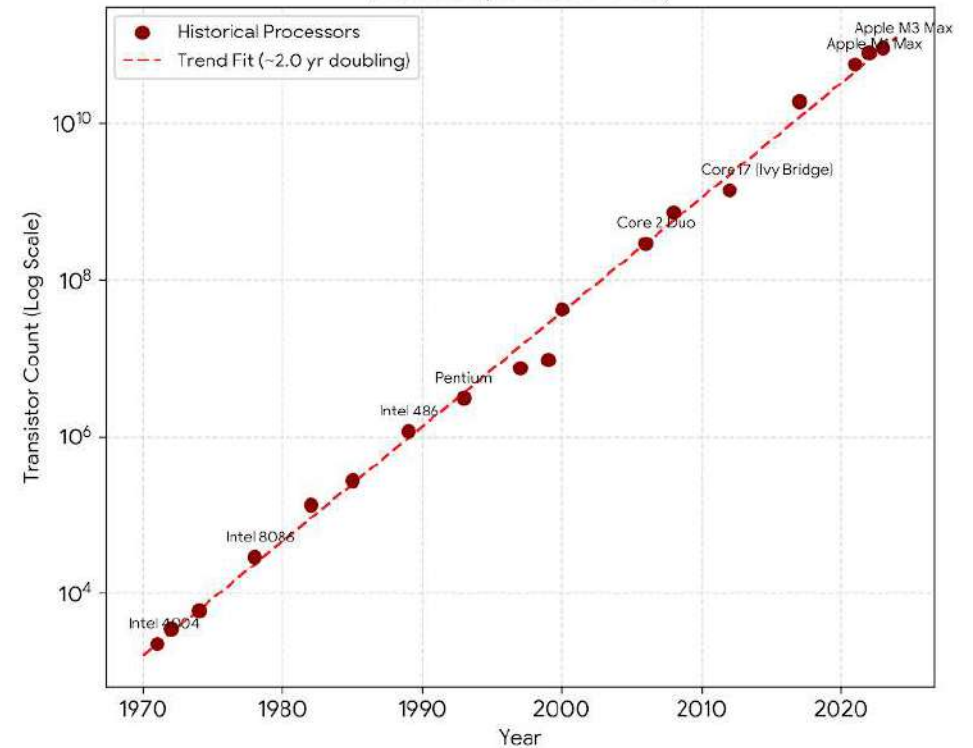
Largest supercomputer in the world runs on a electrical power that is equivalent to 50,000 home total electric power requirement

Laws fueling the information era

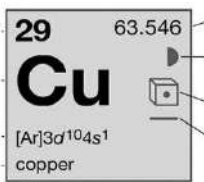
Koomey's Law: Measured Energy Efficiency
(Computations per kWh, 1946–2020s)



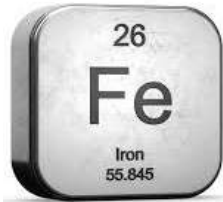
Moore's Law: Measured Transistor Counts
(Transistors per Die, 1971–2023)



What's the next driver?



Bronze
(Cu-alloy)



Stainless
Steel
(Fe-alloy)

Material transformation age
(1000s yrs)



Energy transformation age
(200 yrs)



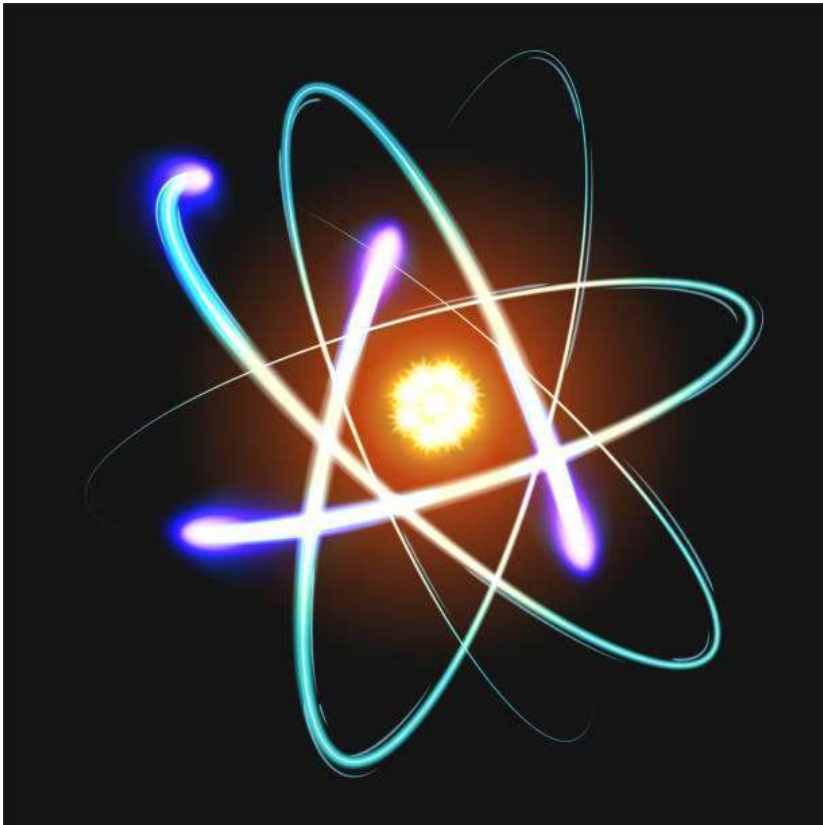
Information processing age
(70 yrs)



Experience Age /
Bio-information
Age
Quantum

What is quantum?

Quantum mechanics

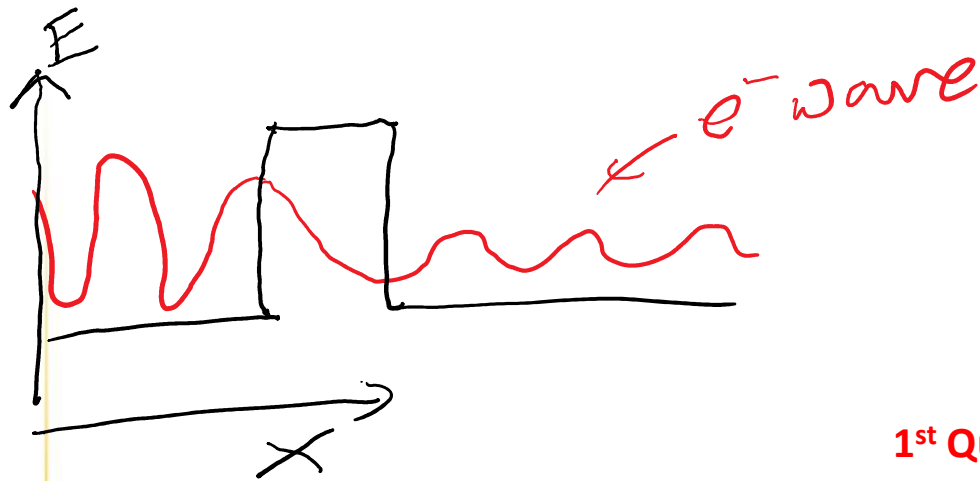


The rules that govern the world of atoms, molecules, light and other fundamental building blocks of nature

These rules are different from the rules that govern the movement of large objects

Can we harness this new fundamentally different rules for new technology

Quantum mechanics to Quantum technologies

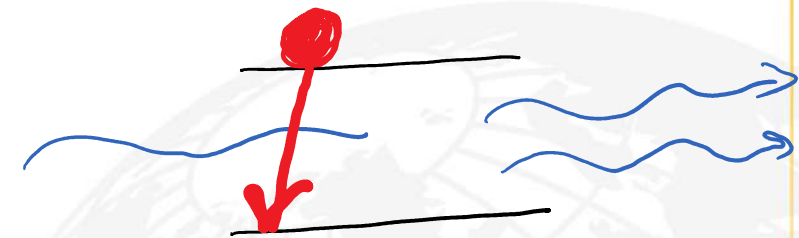


Tunnelling (1980s or earlier)

- Cold emission
- Tunnel junctions
- Scanning Tunnelling Microscope
-

Wave particle duality

1st Quantum revolution



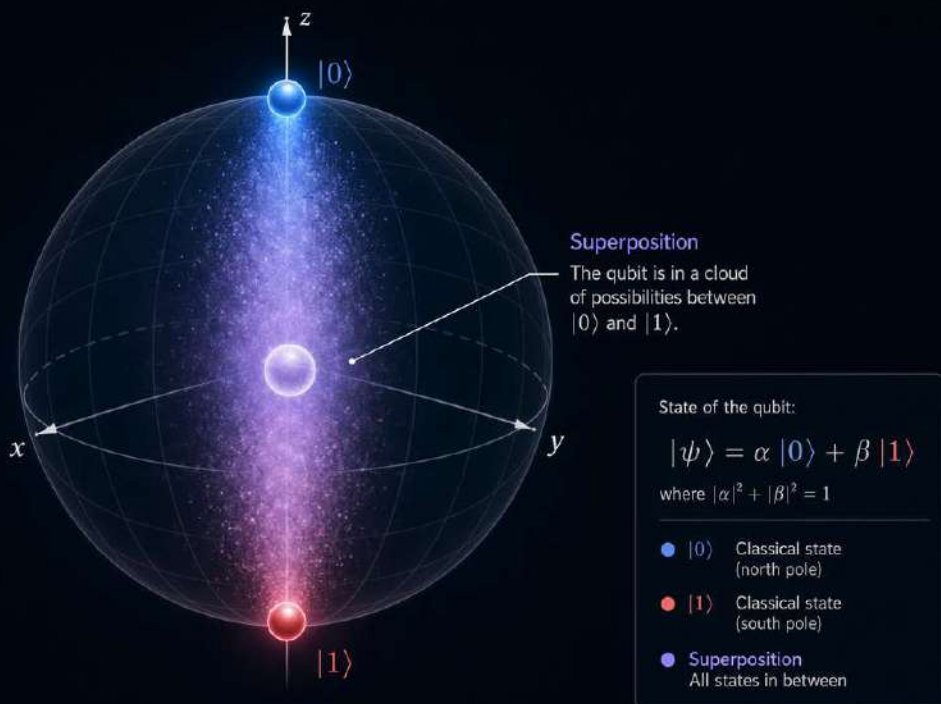
Lasing (1960s)

- Masers
- Lasers
-

Discreteness of energy

Quantum Superposition of a Qubit

The qubit exists in both $|0\rangle$ and $|1\rangle$ states simultaneously.



Measurement

When measured, the qubit "collapses" to:

$|0\rangle$ with probability $|\alpha|^2$ $|1\rangle$ with probability $|\beta|^2$

Superposition & Entanglement

Quantum Entanglement

Two particles become entangled and share a quantum state. Measuring one instantly determines the state of the other, no matter the distance.



1. Measure Particle A



Result: $|\uparrow\rangle$

Instantaneous Correlation



No signal is sent.
This is not faster-than-light communication.

2. Particle B's state is instantly determined



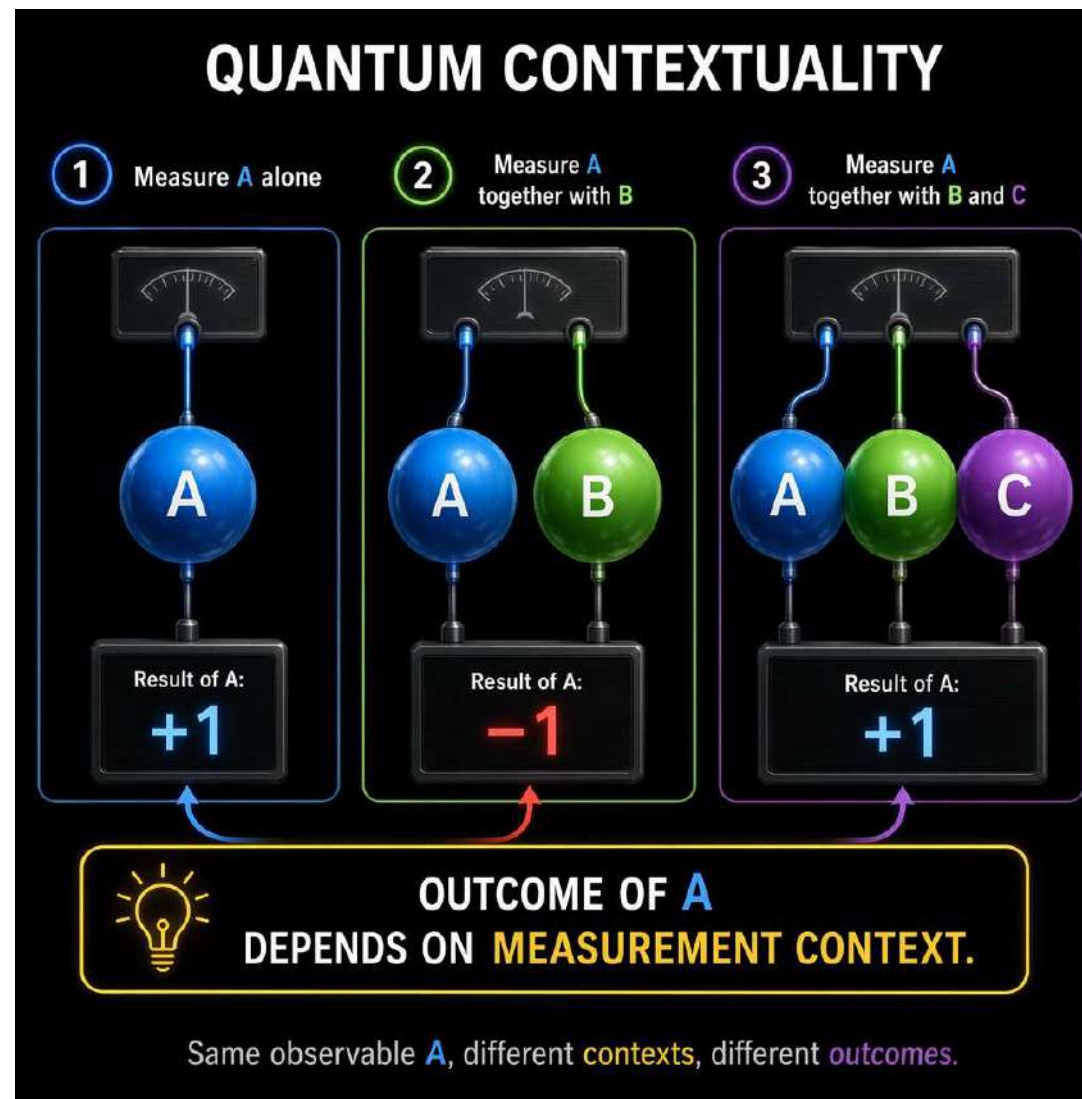
Result: $|\downarrow\rangle$
(correlated with A)



Entanglement links the particles, not by any physical connection, but by their shared quantum state.

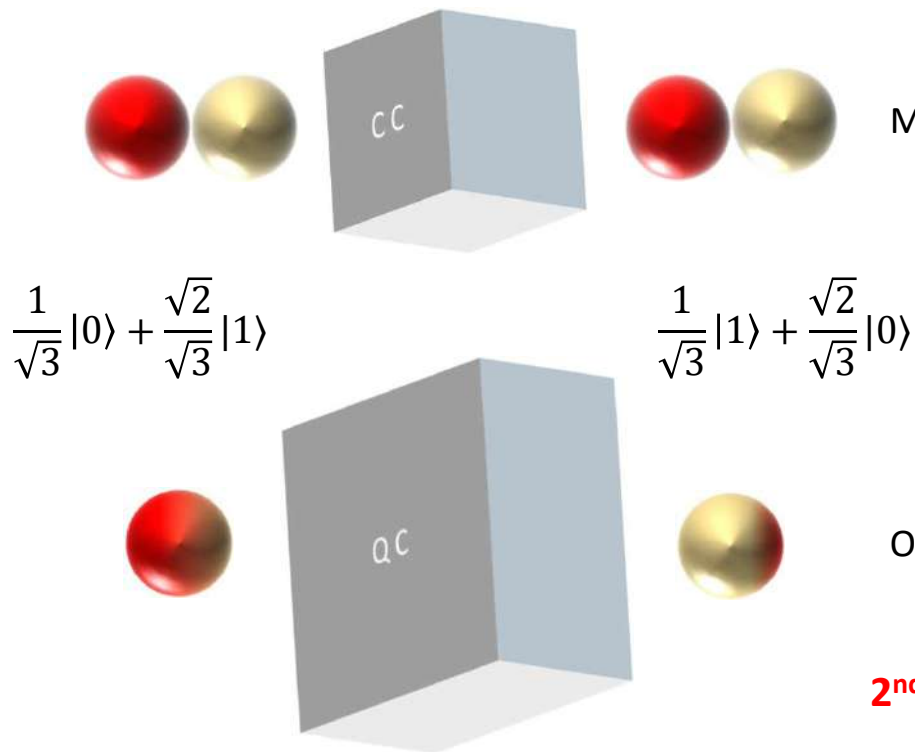
Once entangled, always entangled—no matter the distance.

Contextuality



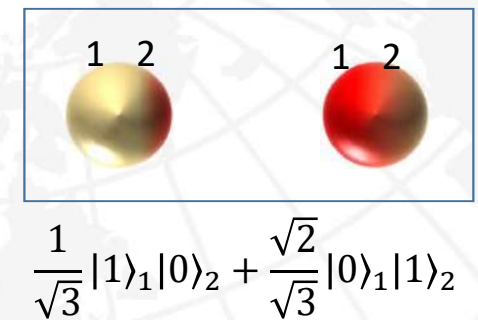
Quantum mechanics to Quantum technologies

Superposition



Parallelism

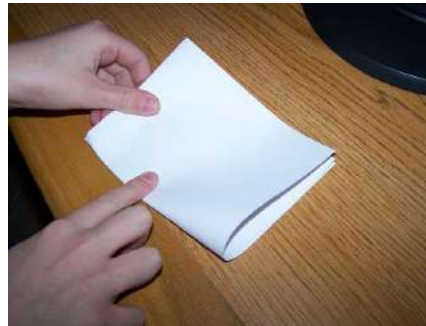
Entanglement



2nd Quantum revolution

Correlation

The power of true parallelism



100 micron thickness A4 paper
How many folds to reach moon?

Just 40 folds (2^{40})

Quantum mechanics to Quantum technologies

“We never experiment with just one electron or atom or small molecule. In thought experiments we sometime assume that we do, this invariably entails ridiculous consequencesIn the first place it is fair to state that we are not experimenting with single particle anymore than we can raise Ichthyosauria in the zoo”

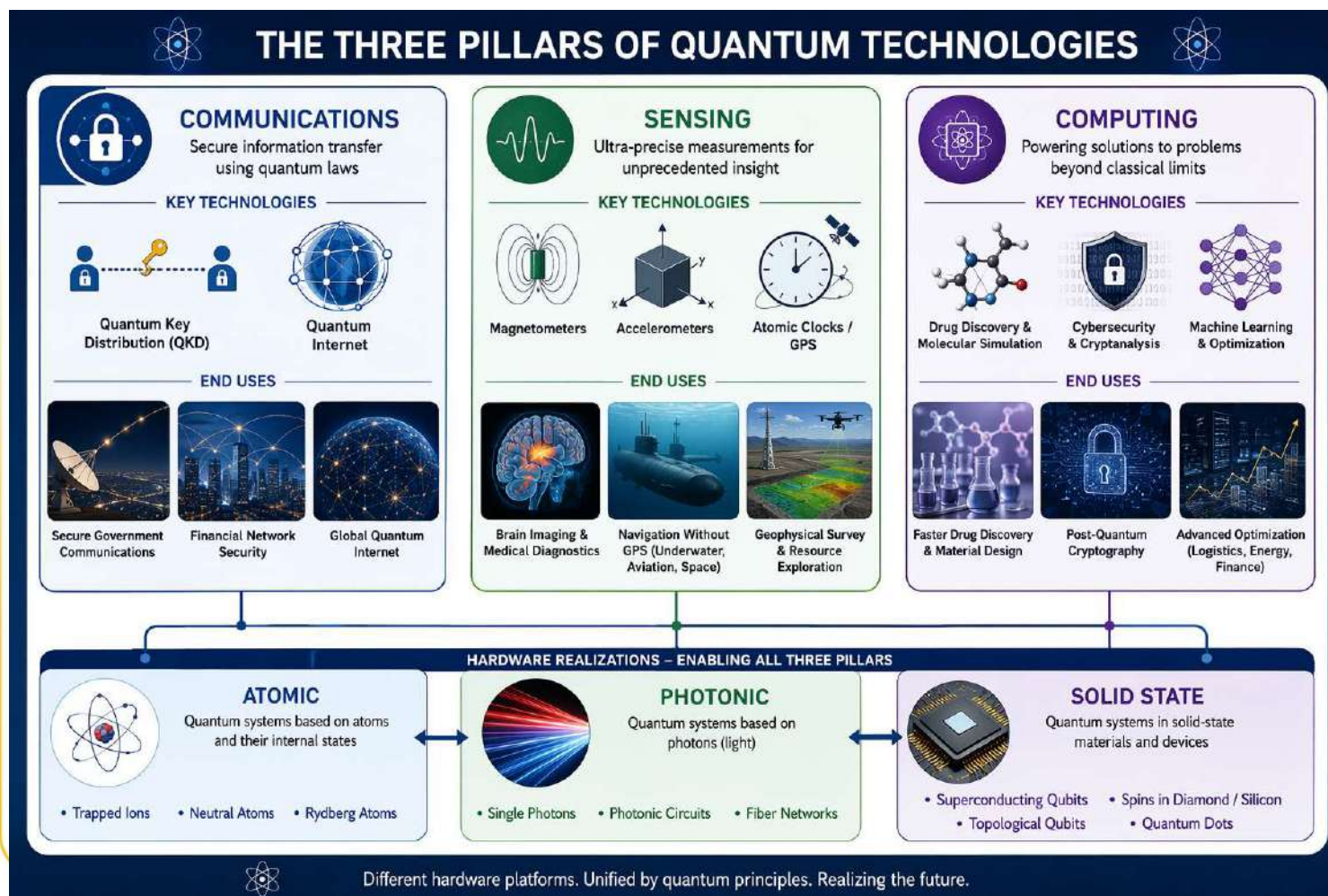
----- 1952

“Professor Dr **Wolfgang Paul**, University of Bonn, Federal Republic of Germany and Professor **Hans G. Dehmelt**, University of Washington, USA, have introduced and developed the *ion trap technique* which has made it possible to study a single electron or a single ion with extreme precision.” ----- 1989

“Serge Haroche and David J. Wineland have independently invented and developed methods for measuring and manipulating individual particles while preserving their quantum-mechanical nature, in ways that were previously thought unattainable.” ----- 2012

What can be we do with it?

Quantum technologies



Estimated market size

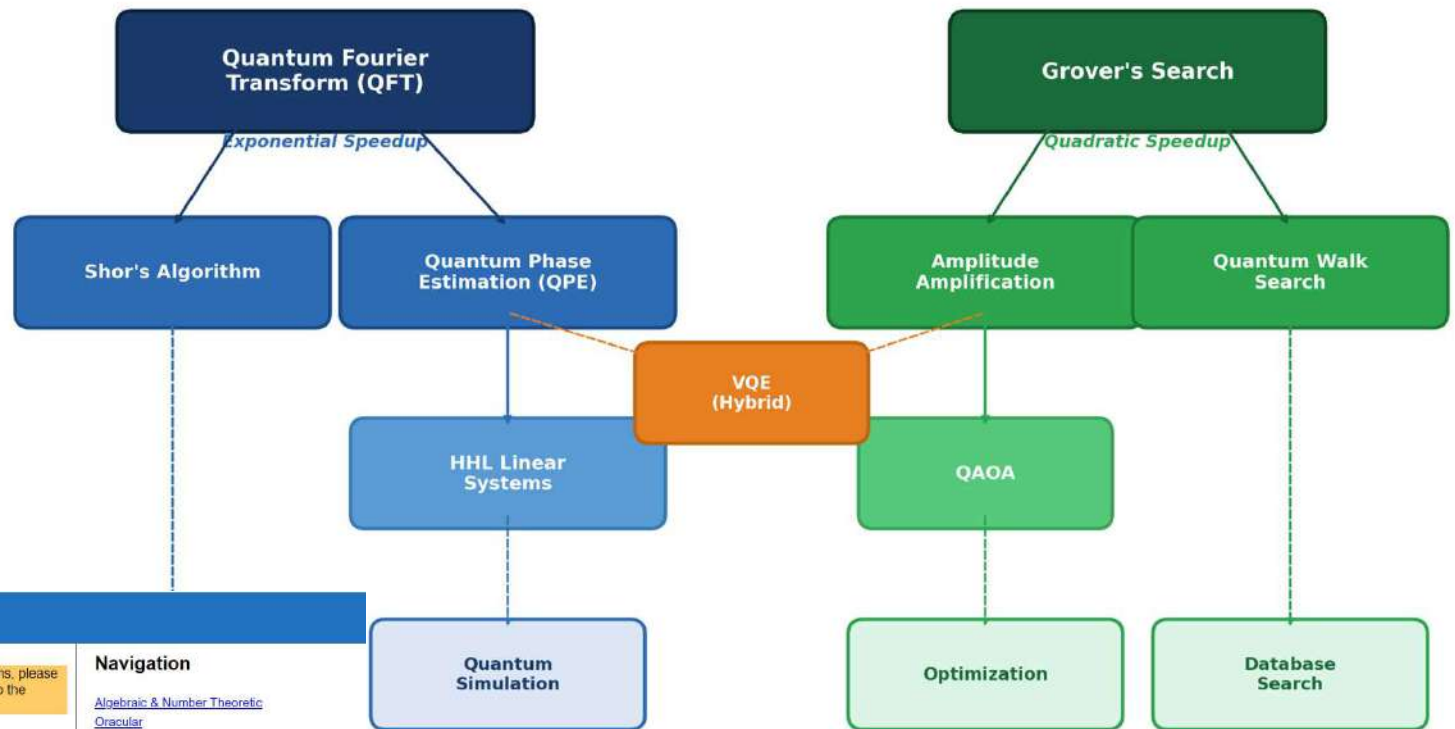
Four
Quantum-
Advantage
d Problem
Unlock
100+ Use
Case at
Tech
Maturity

Optimization	Quantum chemistry	Machine Learning	Cryptography
Finance: Portfolio Optimization (\$20-50B)	Pharma: Drug Discovery (\$40-80B)	Automotive: AI Algorithms (\$5-10B)	Encryption and Decryption: Government (\$20-40B) Corporate (\$20-40B)
Insurance: Risk Management (\$10-20B)	Chemistry: Catalyst Design (\$20-50B)	Finance: Anti Fraud, Trading, Risk (\$30-50B)	
Logistic: Network Optimization (\$50-100B)	Finance: Market Simulation (\$20-35B)	Marketing: Search Optimization (\$50-100B)	
Aerospace: Route Optimization (\$20-50B)	Aerospace: Fluid Dynamics (\$10-20B)		
Machine Learning will see application in almost all industries			

Adopted from: McKinsey & Co

Beyond classical: unique quantum algorithms

Quantum Algorithm Tree



APPLICATIONS

Quantum Algorithm Zoo

This is a comprehensive catalog of quantum algorithms. If you notice any errors or omissions, please email me at stephen.jordan@microsoft.com. (Alternatively, you may submit a pull request to the repository on github.) Your help is appreciated and will be acknowledged.

Algebraic and Number Theoretic Algorithms

Algorithm: Factoring
Speedup: Superpolynomial
Description: Given an n -bit integer, find the prime factorization. The quantum algorithm of Peter Shor

Navigation

[Algebraic & Number Theoretic](#)
[Oracular](#)
[Approximation and Simulation](#)
[Optimization, Numerics, & Machine Learning](#)
[Acknowledgments](#)
[References](#)

<https://quantumalgorithmzoo.org/>

Status of hardware

IBM Q experience (IBM) 2026

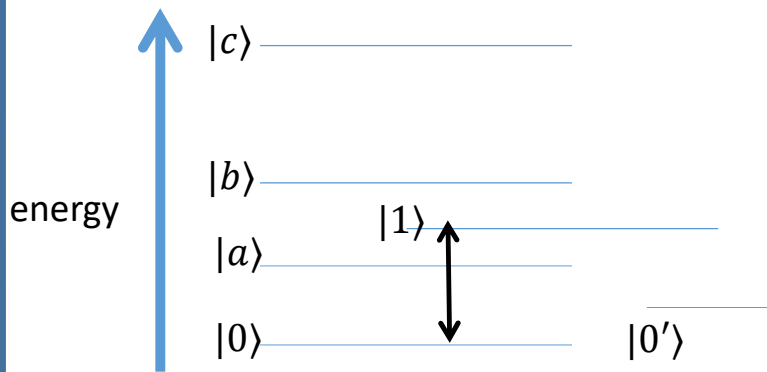
ENIAC (IBM) 1945



5Mb Hard drive 1956



Qubit



1. Initialization.
2. Long lifetime.
3. State manipulation.
4. Unique measurement.
5. Scalable.

Introduction to qubits

Physical qubit

Platforms

Atoms

Ion trap
Atom tweezers

Optical Photons

Photonic integrated circuits

Microwave Photons

Superconducting circuits
Si-donor

State-of-the-art performance (SOTA)

Status as of August 2026

Present state-of-the-art comparison

Parameter	Superconducting	Ion trap	Photonics	Silicon based	Topological (notional)	NMR (pioneer)
Qubit lifetime	~50-100 μ s	~ 1000s	~150 ms	~1-10 s	100 s	100 – 4000 ms
# qubits demonstrated	~ 20-400	~20-100	~3 $\times$ 6	~2-7	1 target	10
Gate fidelity/error	99.9%	99.99%	98%	90%	99.9999%	98%
Operation time	~10-50 ns	~3-10 ms	~1 ns	~1-10 ns	NA	10 ms
Connectivity	Partial	Fully	Partial	Partial	-	-
scalability	75%	50%	25%	25%	NA	5%
TRL	5	4	3	3	1	NA

Disclaimer: Not complete or up-to-date

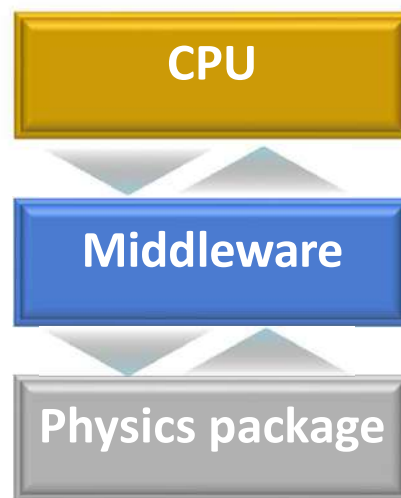
Comparative Performance Matrix

Physical SOTA Metrics Across All Four Modalities (2024–2026)

Modality	SOTA Physical Qubits	2-Qubit Gate Fidelity	Coherence Time	SOTA Logical Qubits	Primary Bottleneck
Superconducting (IBM/Google)	120 (IBM Nighthawk)	~99.9%	100–300 μ s	1 (Google Willow)	Crosstalk & cryogenic cooling
Trapped Ion (Quantinuum/IonQ)	56 (Quantinuum H2-1) 98 (Helios)	99.9% – 99.99%	Seconds–Minutes	48 (Quantinuum)	Slow gates, scaling ion chains
Neutral Atom (QuEra/Atom Comp.)	1,180+ (Atom Computing)	~99.5% – 99.73%	Seconds	96 (QuEra/Harvard)	Atom loss & shuttling latency
Silicon Spin (Diraq/Intel)	~12 (Diraq/Intel)	~99%	Milliseconds	Early demos (2026)	Fabrication variability

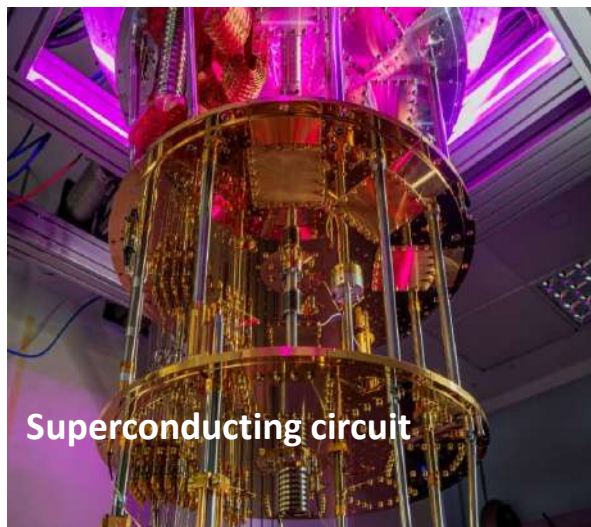
Quantum computing systems

Solid state vs ion trap



Technology stacks

1. Dilution refrigerator
2. Microwave engineering
3. Cryogenic cabling
4. Superconducting circuit

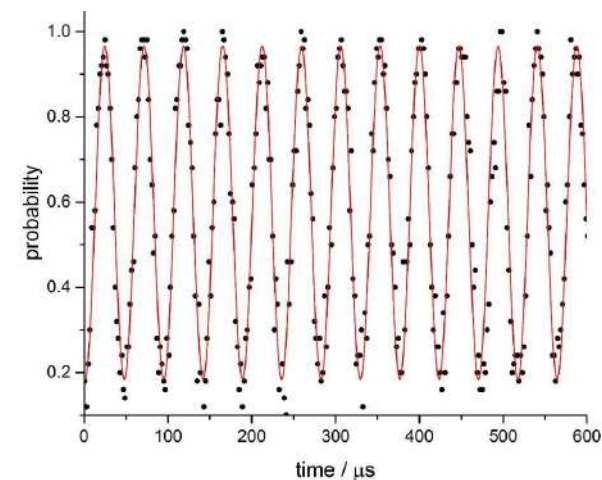


Technology stacks

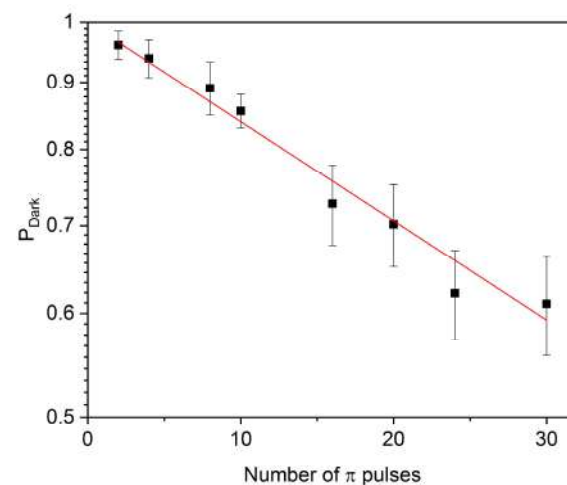
1. Vacuum Technology
2. RF technology
3. Optical technology
4. Cryogenic
5. Trapology

System performance

Gate level benchmark



Heating rate: $\sim 20/\text{sec}$

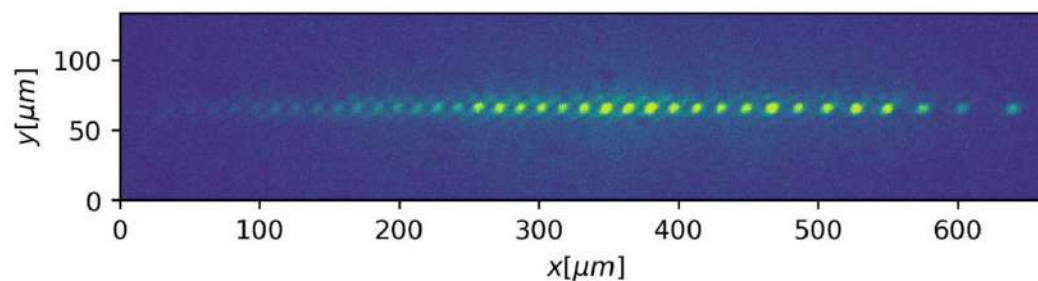
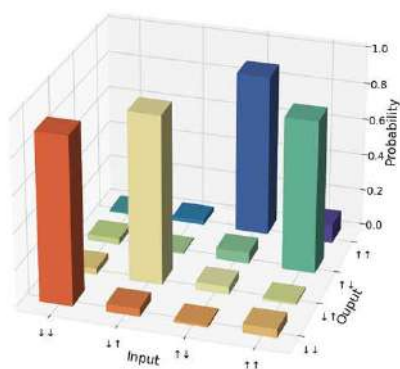


T2: over 3 ms

T1: 30 s

Gate operation times:

2-5 μs (single)
 $\sim 1\text{ms}$ (2-qubit)



Stable trapping of over 30 ions having minimum inter-ion distance of 15 μm

Fidelity:

99.95% (Single)
 95% (2-qubit)

Significant Roadmaps

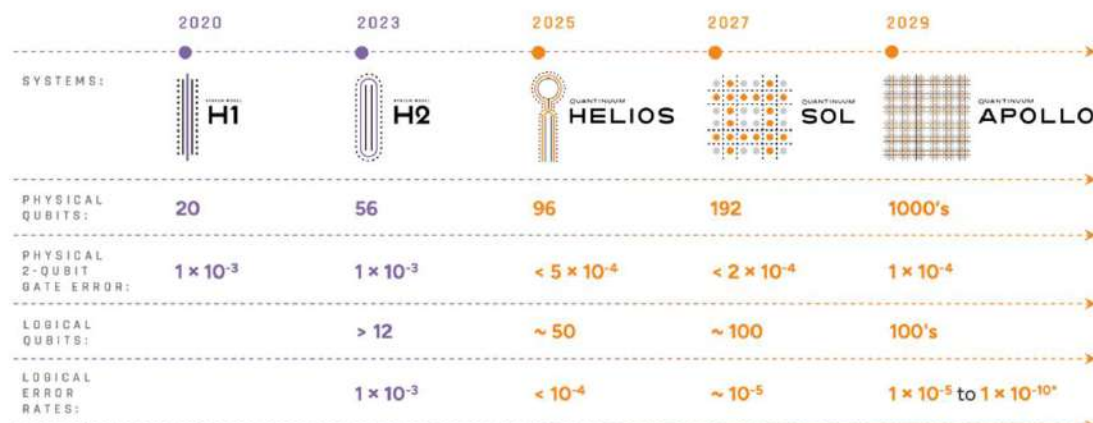


IonQ

- Updated in Jan 2026 after a series of takeovers including Oxford Ionics
- They are consistently achieving proposed targets thus far

Quantinuum

- Updated in 2025
- Has been consistent in their deliverables



Application example

Adversarial attack in machine learning

Quantum computing risk matrix

An estimate

RISK MATRIX: FINANCIAL INSTITUTIONS DUE TO OPERATIONAL QUANTUM COMPUTERS						
RISK AREA	LIKELIHOOD			IMPACT		
	LOW	MEDIUM	HIGH	MEDIUM	HIGH	VERY HIGH
 Public-key encryption failure	LOW	MEDIUM	HIGH	HIGH	CRITICAL	CRITICAL
 'Harvest now, decrypt later' attacks	MEDIUM	HIGH	CRITICAL	HIGH	CRITICAL	CRITICAL
 Payment system disruption	MEDIUM	HIGH	CRITICAL	HIGH	CRITICAL	CRITICAL
 Vendor and third-party exposure	LOW	MEDIUM	HIGH	HIGH	CRITICAL	CRITICAL
 Regulatory and compliance risk	LOW	MEDIUM	HIGH	HIGH	HIGH	CRITICAL
 Digital identity/IAM compromise	LOW	HIGH	CRITICAL	HIGH	CRITICAL	CRITICAL
 Market/trading model disruption	LOW	MEDIUM	HIGH	HIGH	CRITICAL	CRITICAL
 Reputational damage	LOW	MEDIUM	HIGH	HIGH	HIGH	CRITICAL
 Operational migration failure	LOW	MEDIUM	HIGH	HIGH	HIGH	CRITICAL
 LOW Manage with routine controls  MEDIUM Monitor and mitigate  HIGH Act and mitigate urgently  CRITICAL Immediate action required						

Assessment of risk

Choice is between

“Ignorance is bliss” vs “knowledge is power”

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FROM CHAOS TO COMMAND:
RISK LEADERSHIP IN INDUSTRY 6.0

THANK YOU



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