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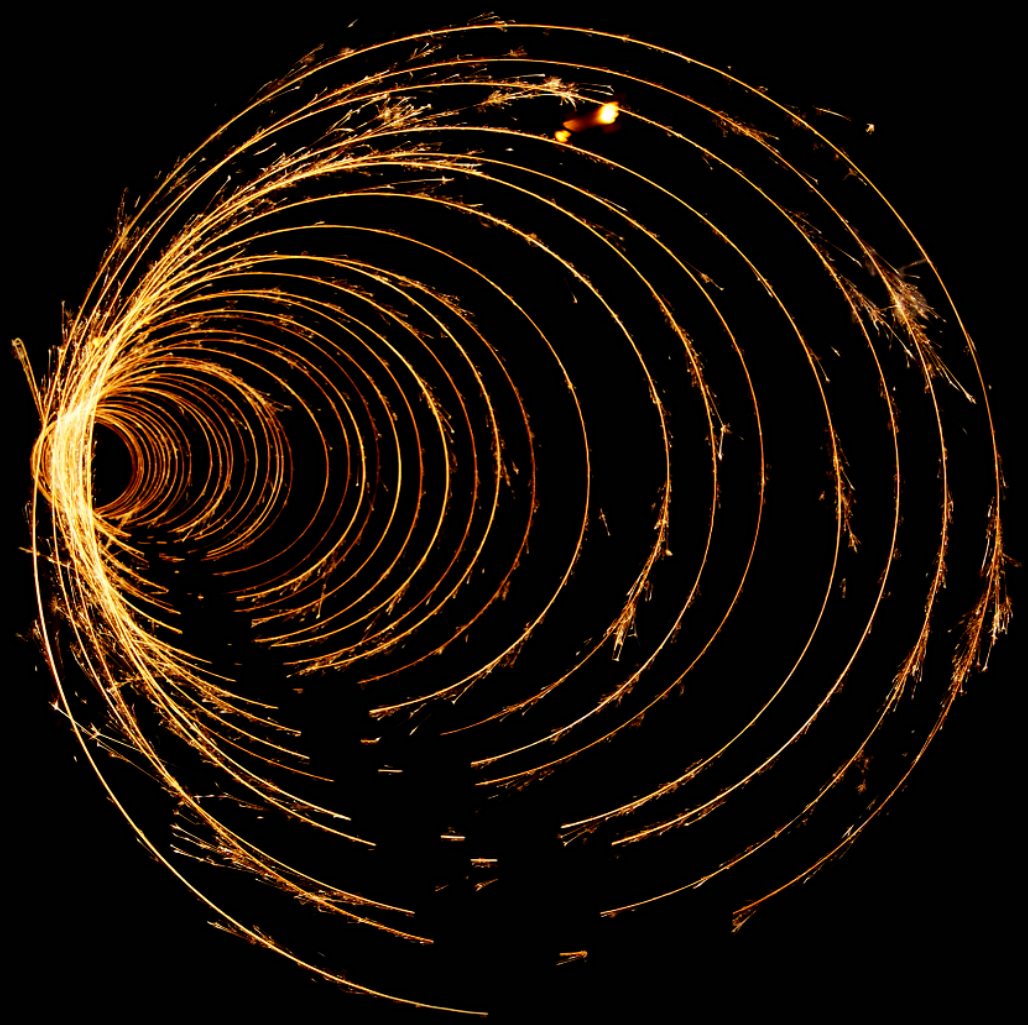


Technology futures report 2021

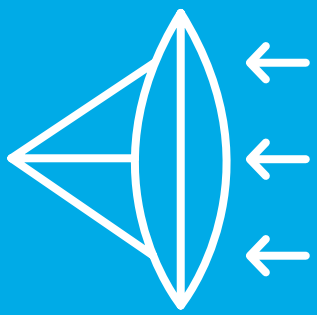
Projecting the possible. Navigating what's next.

MAKING AN IMPACT THAT MATTERS since 1845

Introduction

The COVID-19 crisis is shining a klieg light on the immense challenge leaders face in planning for the future amid extreme uncertainty. In parallel, new technologies of the fourth industrial revolution, such as artificial intelligence (AI), cloud, and robotics, are changing the way we live, learn, and do business at a rate unprecedented in human history. These historic changes, considered within the increasingly urgent context of shifting political landscapes and environmental instability, suggest that now, more than ever, leaders need tools that can help them understand the future beyond the near term and then plan accordingly.

With this in mind, the World Economic Forum collaborated with Deloitte to produce a first-of-its-kind report that equips today's readers with the insights and foresight critical to tomorrow's leaders. Taking a research-driven approach, the full report opens with a business case for futurism as a pragmatic, strategic discipline and moves on to a recognition that the buzzword-laden history of emerging technology innovation in fact follows enduring trajectories that we can use to fashion a practical taxonomy for technology change. The report proceeds to project historical technology and socioeconomic trends through a newly introduced foresight model to showcase the spectrum of possible (and probable) futures facing tomorrow's organizations. We take things a step further by bringing the possibilities and personalities of these possible futures to life through a series of speculative fiction short stories. Finally, we converge on calls to action intended to help leaders understand how to best plot a path toward their preferred tomorrow.



This executive summary focuses primarily on two of the report's key contributions:

First: LEnS – A novel framework for foresight

Newly introduced in this report, the LEnS (longitudinal emergence scatterplot) framework accepts historical technological and socioeconomic trend lines and projects plausible futures based on the aggregation and extrapolation of the data at hand. The framework further accounts for domain-specific filters, allowing leaders to focus on specific issues most relevant to their foresight exercise. This report specifically considers the future(s) of education, information, locality, and economy.

Second: A taxonomy for technology change

From the first computer design in the early 19th century to the present day, three enduring "eternities" have characterized the trajectory of information technology emergence: interaction, computation, and information. We propose three recommendations for leaders in light of technology's continued convergence along these three paths.

LEnS–A novel framework for foresight

In the diagrams below, we employ three discrete tools (historical trend lines, forward-facing projections, and domain-specific filters) to compose what we call a longitudinal emergence scatterplot (LEnS). As seen throughout the report, this framework provides stakeholders with a clear and compelling rubric for thinking about where domain-specific futures are headed.

For the purposes of the report, we've created four broadly applicable LEnSes that, taken together, demonstrate the breadth of applicability inherent in the framework: information, locality, economy, and education. It is not our intention to establish a MECE (mutually exclusive, collectively exhaustive) series of domains, but rather to illustrate how individual filters provide focus and multiple filters, depth. These LEnSes project and detail a few relatively noncontroversial *probabilities*, along with a handful of oppositional *possibilities*.

The information LEnS

Data lies at the heart of the information layer.[1] Today, with help from next-generation networks that reduce latency and cloud computing that expands processing and storage capabilities, data drives just about everything. Data volumes are exploding. Not only is the rate of data generated per individual increasing, but so is the rate at which we share information.[2]

Today, lawmakers, organizations, ethicists, and many others worldwide are trying to envision data's future. Will information remain centralized, as it largely is today? Or will we shift toward a distributed and open model of data distribution and sharing?

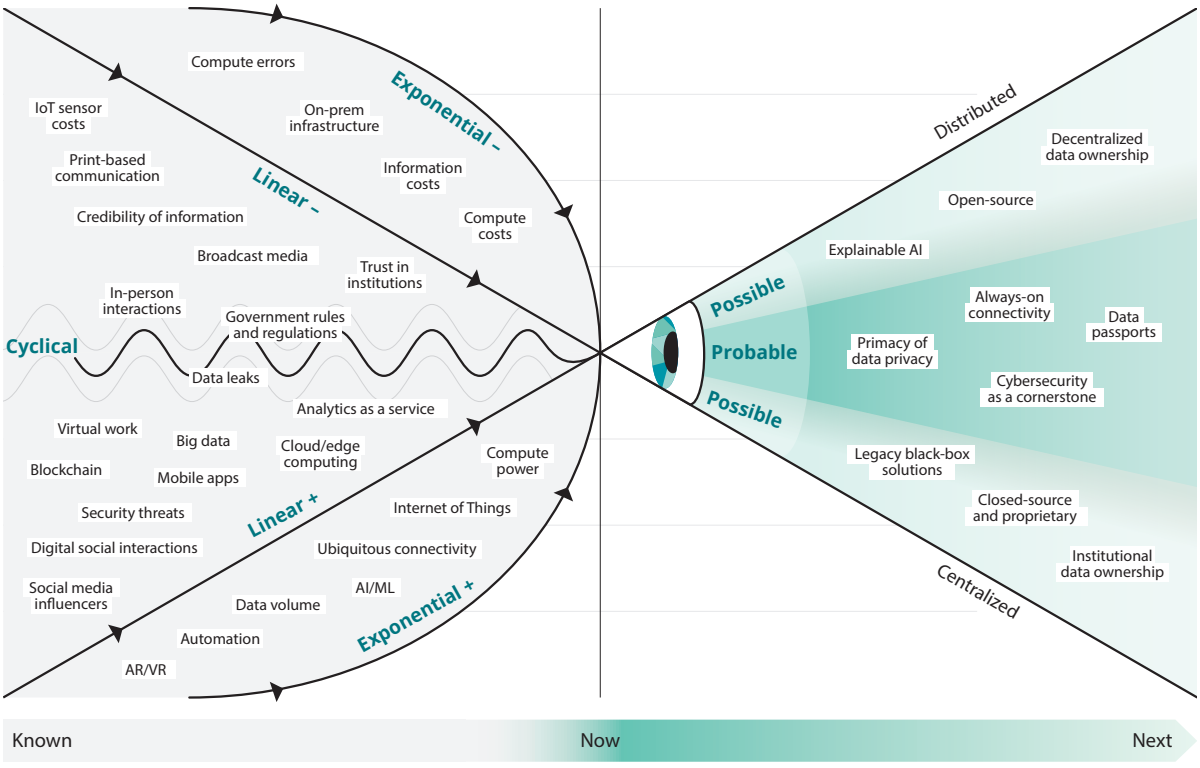


Figure 1. Information LEnS (longitudinal emergence scatterplot)

The locality LEnS

Over the years, the idea of locality has evolved from mere physical spaces to include virtual ones as well. Thus, we have come to define locality as the physical spaces and virtual platforms where individuals live, work, connect, and learn.

Innovation and the ongoing COVID-19 pandemic have accelerated shifts in how human beings experience locality.[3] Against this backdrop, we see two potential extremes in the future of locality. Shown in the figure below, the first (a virtual extreme) represents an ongoing technological shift that favors digital and virtual interaction over the physical. The second, a physical extreme, places value on physical experiences and an underlying social discomfort with entirely virtual experiences.

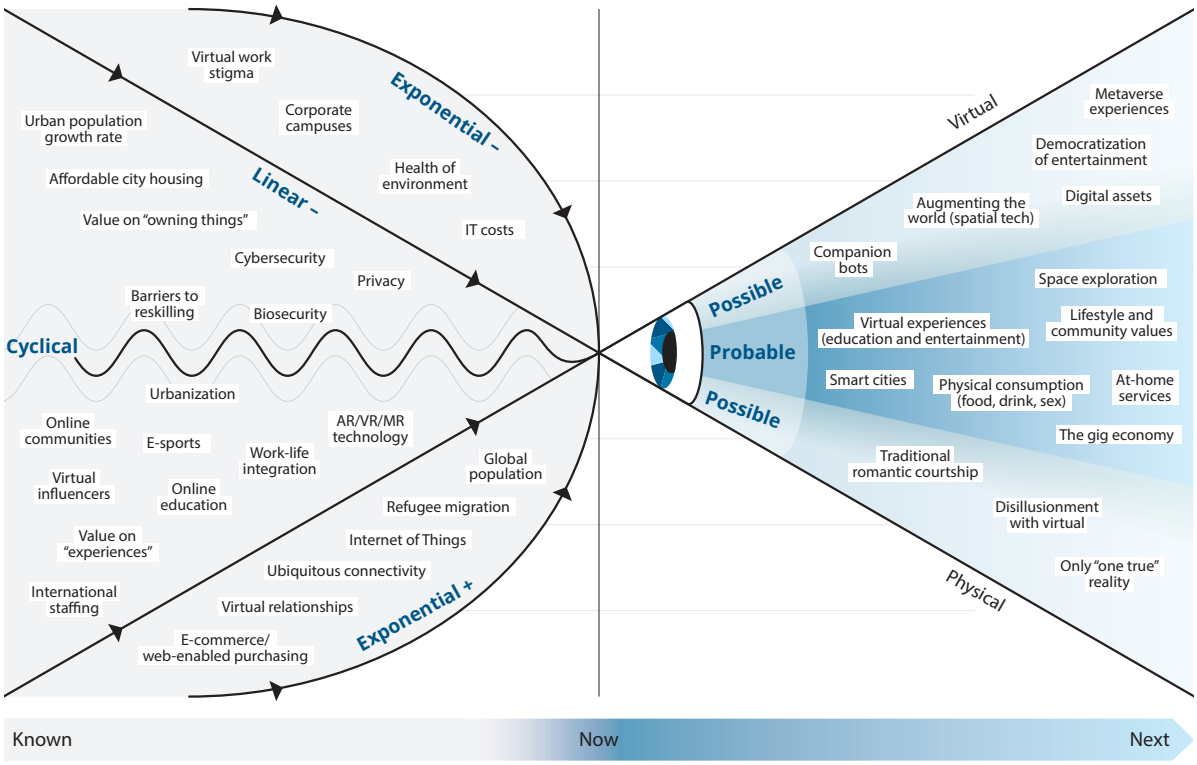


Figure 2. Locality LEnS (longitudinal emergence scatterplot)

The economy LEnS

The economy LEnS looks at finite raw materials and their development into higher-order economic outputs. Resources (e.g., energy, infrastructure, clean water, etc.) are necessary for humans to survive and thrive. Economy covers the value-added creations developed from those materials (e.g., jobs, trade, production, etc.).

In a world where technological change is constantly disrupting the availability and usefulness of resources, the ways in which we embrace technology innovation can often matter more than the point technologies themselves. Will our world be characterized by abundance, with resource availability and economic growth rising along with the tide of our global technological prowess? Or will we find ourselves in a world of scarcity, where global inequality and tribalism result from a dearth of access to resources?

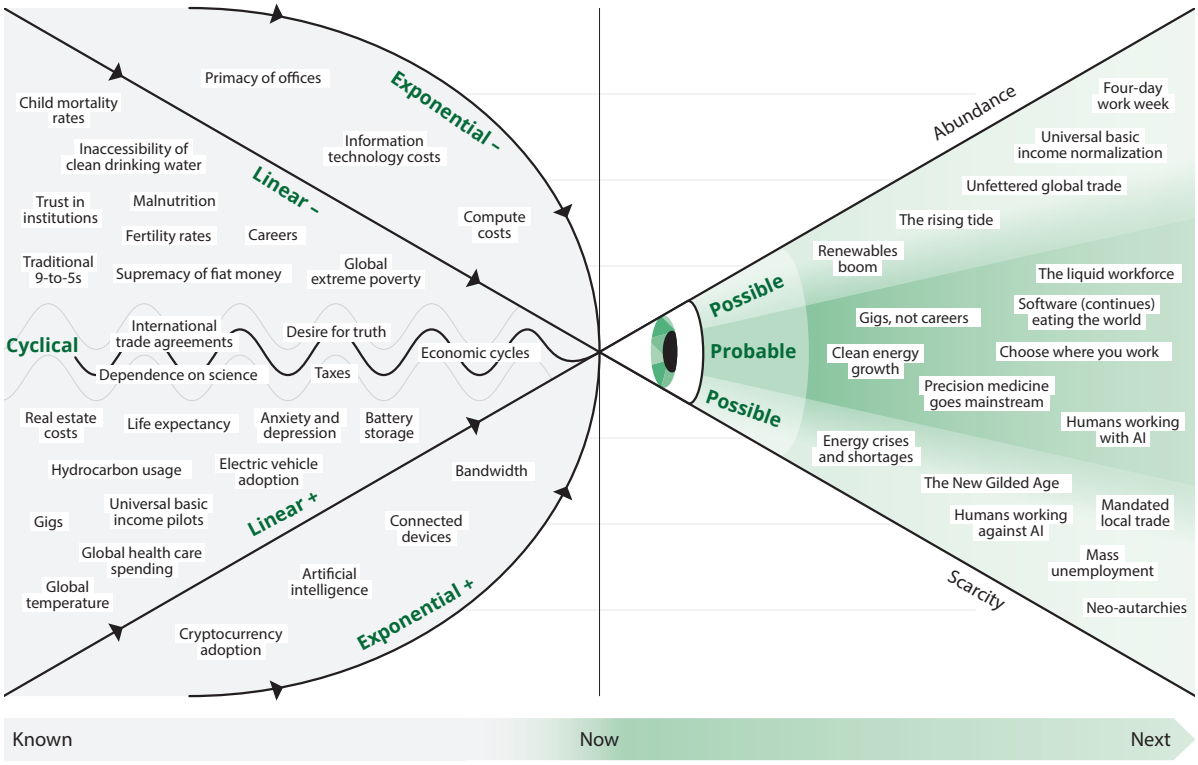


Figure 3. Economy LEnS (longitudinal emergence scatterplot)

The education LEnS

Malcolm X famously mused that "education is the passport to the future."[4] We broadly define our "passport to the future," education, as the way individuals learn and how we teach the skills these individuals need to build successful careers.

Advanced modes of information access are driving dramatic shifts in the ways people learn and institutions teach, revealing two plausible future outcomes. In one, "institutional credentials": the kind of structured education traditionally offered by school systems and universities will remain in place, but with new tools and teaching methods. In another, more disruptive scenario, traditional education, with its emphasis on formal accreditations, will give way to a more meritocratic system of "self-taught skills" that prizes demonstrable competency, real-life problems solved, or measurable value created.

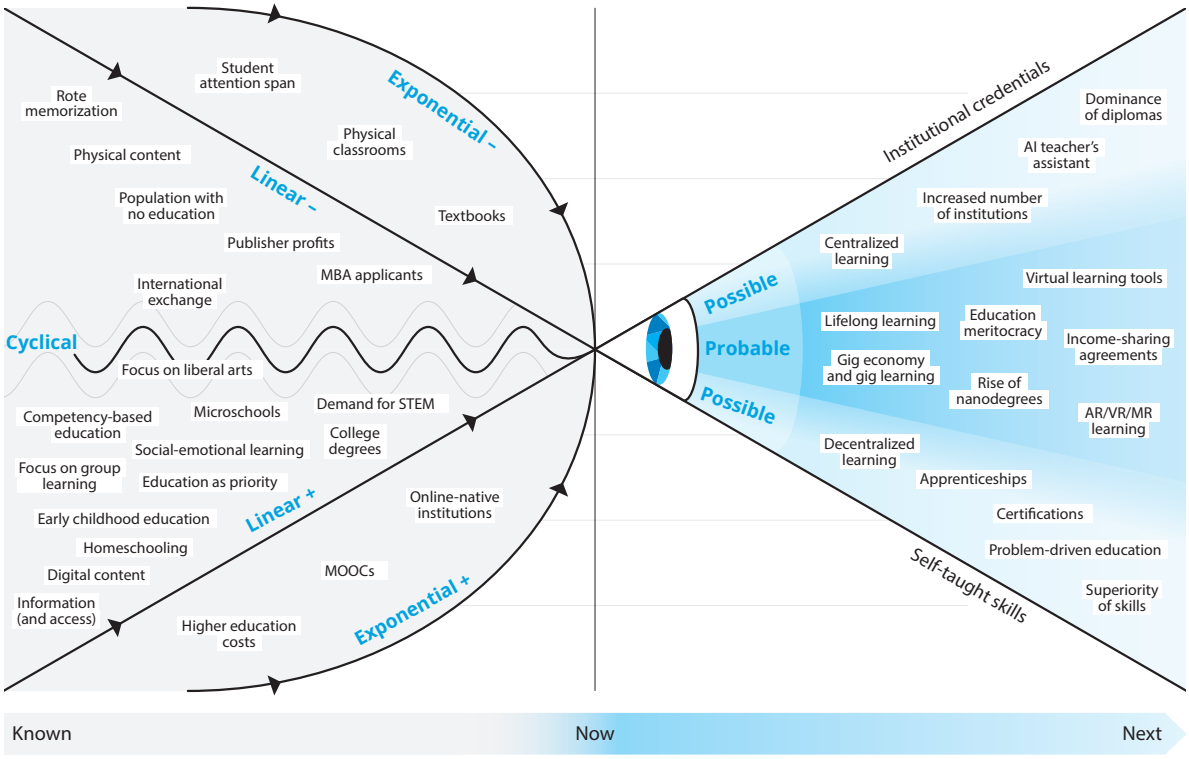


Figure 4. Education LEnS (longitudinal emergence scatterplot)

A taxonomy of technology change

Transcendentalist author Henry David Thoreau famously left the hustle and bustle of urban civilization to live alone in Walden Woods. His was an effort not just to slow down, but to "ladder up" above ephemera and glimpse the enduring; to, as he said, "Read not the Times," but rather "Read the Eternities."[5]

By way of similar abstraction, we can ladder up to see that the entire history of information technology, from Charles Babbage and Ada Lovelace's design for the first general-purpose computer in 1821 to the current day, has been a surprisingly clear story of progress along three enduring layers: interaction, information, and computation.

We would further assert that the entire future of information technology will continue to be a story of progress along these same three enduring layers. A Walden-inspired long view lets us slow things down and see the forest for the trees. Consider the diagram below, which elevates technology emergence from "blizzard of buzzwords" to boardroom relevance:

Eternities	Babbage's design	First digital computer	Mid 20th century	Late 20th century	Early 21st century	2021: Today	Horizon next	Furthest stars	Endgames
Time (years)	t–175	t–75	t–50	t–25	t–10	t	t+10	t+n	t=∞
Interaction	Reader	Punched cards	Command-line	Graphical user interface (GUI)	Mobile devices	Virtual reality	Ambient experiences	Brain-computer interfaces	Simplicity
Information	Store	Arithmetic calculation	Relational databases	Descriptive analytics	Predictive analytics	Cognitive automation	Affective AI	General AI	Intelligence
Computation	Mill	Mainframe	Minicomputer	Client server	Cloud architectures	Distributed platforms	Spatial web	Quantum computing	Abundance

Table 1. A taxonomy of technology change: From eternities to endgames

Our full report explores these discrete technology evolutions in detail, but the executive summation is as follows:

Interaction, the ways we interface with machines, has been, and will continue to be, a story of increasing simplicity. The technologies get more complex, but the user experience gets simpler and, with that, ubiquitous. As such, leaders should plan for a future where virtually all interactions are digitally mediated and, in turn, ensure that those without digital affordances are not left behind.

Similarly, machines' facility with information has been, and will continue to be, a story of increasing intelligence. From arithmetic to analytics to AI, and on to empathic, charismatic, and even spiritual machines, leaders must ensure that we develop machine intelligences that embody our explicitly stated, shared financial, social, and ethical values—teaching them to do as we say, not necessarily as we've done.

Finally, computation has been marked by our knack for creating abundance whenever scarcity threatens. As transistor miniaturization threatened Moore's

Law, networking technologies, the cloud, and now distributed computing technologies have brought about new bounties. The puzzles we face may be getting increasingly harder, but we are getting exponentially smarter. Leaders should therefore continue allocating time, mindshare, and money for moonshots—those projects that might not help us compete today, but that, given enough inspiration and perspiration, help us create tomorrow.

You can read the **full report** on the World Economic Forum website.

Endnotes

1. Computer Hope, "What Is Data?" March 6, 2020, https://www.computerhope.com/jargon/d/data.htm.
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5. Henry David Thoreau (1817–1862), *Life Without Principle*, London, Arthur C. Fifield (1905, print).

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