Date: May 27, 2025

Source: https://aipolicylab.se/aipex/

Time Out of Joint: Historical reflections on AI

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Artificial Intelligence. The very term conjures images of futuristic robots and sentient machines for some, and images of climatic collapse and existential risk to others. This AI hype represents a disjoint in time with both risks and promises. It signals a paradigm shift marked by unprecedented capabilities in information processing, autonomous reasoning, and pattern recognition, challenging traditional notions of progress and sustainability while demanding a nuanced approach to harness its potential responsibly & ethically.

The Three Technological Paradigms: From water wheels to apps:

Human technological evolution can be understood through three major paradigms. The first focused on the transformation of materials, spanning from the Stone Age through the Bronze and Iron Ages(1), where humans developed increasingly sophisticated ways to manipulate their physical environment. The second paradigm, also known as the Industrial Revolution, centered on the transformation of energy. The first industrial revolution (1770–1850), as identified by Schumpeter(2), was driven by water-powered mechanization, including mills and irrigation systems. The following long wave (1850–1900) was enabled by steam-powered technology, revolutionizing transportation with trains and transforming industrial machinery. Around 1900, the Third Kondratieff Cycle began(3), marked by the electrification of society and production from 1900 to 1940. Each revolution introduced new tools, industries, and fundamentally impacted lifestyles.

Today, we stand at the cusp of an era defined by the transformation of information. Late 20th-century digital electronics fueled ICT digitalization, leading to AI disruption. But what does this *disjoint in time* truly entail? History reveals three fundamental mechanisms that have been central to major technological transitions: transmission, storage, and processing. These mechanisms have propelled every major technological shift: from the wheel and rope of transport to smoke signals and the internet for transmission; from containers and reservoirs to photography and magnetic media for storage; and from fire-making to electronic computation for processing(4).

In 1990, less than 0.05% of the global population used the internet. By 2020, over 59% of humanity was connected (10). Networks now move exabytes monthly, enabling unprecedented global information flow. Storage has mirrored this progression: from physical media like books, we've advanced to digital systems that store humanity's collective knowledge on infinitesimal footprints—a leap from 1% digital in the late 1980s to 99% by 2012. AI compute has completed the picture, with processing power showcasing the most striking leap forward. Today's supercomputers operate at exaflop speeds, solving in seconds problems that would take humans decades. These leaps in transmission, storage, and processing power form the bedrock of AI, enabled by infrastructure that facilitate information transmission, storage, and processing at unprecedented levels. However, these accelerations come at a cost - both to human societies and the planet.

Continuity and Discontinuity in AI Development

Unlike past technologies that built upon human abilities, AI promises autonomous reasoning, planning, and pattern detection beyond human limits. This shift, especially with the rise of agentic AI systems, challenges traditional augmentation concepts, introducing self-referential mechanisms that redefine intelligence, creativity, and technological agency.

This transformation can be framed through the concept of autopoiesis, where technological systems evolve to create themselves, or sympoiesis, where AI is built upon human knowledge to enable novel futures(6). These theoretical lenses help us understand not only the abstract nature of AI's development but also its tangible manifestations in the evolution of computational hardware. While computational hardware has experienced profound changes, marked by incremental efficiency gains and increased capabilities, the nature of AI's advancements, particularly its generative capacity, introduces a new dimension. AI's generative capacity, as it currently stands, challenges human cognitive boundaries and increases technological opacity, introducing a fundamental break from previous technological trajectories. It is not merely an extension of human capabilities but a transformative force capable of generating insights and futures untethered from human precedent.

Untethered from Planetary Health: Rebound Effects and Sustainability Challenges

Current research warns of potential "rebound effects," where gains in efficiency paradoxically lead to higher overall consumption—an abundance without limits that could undermine sustainability goals by constraining decarbonization efforts or generating waste through unrestricted growth in AI development(7). Addressing this requires policy interventions and investments in sustainable infrastructure prioritizing accuracy, frugality, proven impact assessments for electricity demand growth—and circular economy practices for both hardware and software. To align AI development with planetary (and by virtue of that human) resilience, guardrails need to be designed within the architecture of AI technologies, at the very heart instead of as an afterthought. This would entail a shift away from a focus on efficiency and optimisation alone, towards a more integrated perspective that considers the entire value chain of AI(8). Furthermore, the environmental impact of AI, including the energy

& water consumption of large language models and resource depletion from hardware production, must be addressed via caps and transparent open architecture for data sharing.

From Extraction to Global Common: Resetting AI Development

Another critical discontinuity stems from historical notions—dating back to early industrial revolutions—that “human progress” exists outside of nature, which then reduces our environment to a resource for extraction. Today’s dominant discourse around scaling larger AI models risks perpetuating this extractive mindset despite rising environmental costs like energy & water crises caused by mismatched demand on infrastructure or resource depletion.

We call for a "Global Commons" approach (drawing on the seminal work of Elinor Ostrom(9), which would mean sharing benefits across borders while challenging protectionist development paradigms through sustainable practices. This includes optimizing software, improving models, evaluating environmental impacts, and promoting circular economies. We must also in parallel build global governance, set AI standards, and boost digital literacy through international collaboration. The fundamental question remains: when not to use AI? In other words, we must dare to imagine futures with and without AI, rather than accept it as a fait accompli.

To responsibly leverage AI, we must center its design and direction towards nature aligned principles, address potential risks and harms head on, and foster global collaboration in the face of an increasingly polarizing world. Sustainable strategies require long-term vision, while short-term profits shackle us to false promises of shared progress, which history reveals to be mere mirages.

References

1. Roos, R. A. (2019). The Stone Age, Bronze Age and Iron Age Revisited. HISTO THOMSEN V2-. J. Terrestrial Electrostatics.
2. Schumpeter, J. A. (1939). Business Cycles: A Theoretical, Historical, and Statistical Analysis of the Capitalist Process. McGraw-Hill.
3. Korotayev, A. V., & Tsirel, S. V. (2010). A Spectral Analysis of World GDP Dynamics: Kondratieff Waves, Kuznets Swings, Juglar and Kitchin Cycles in Global Economic Development, and the 2008–2009 Economic Crisis. Structure and Dynamics, 4.
4. Arthur, W. B. (2009). The nature of technology: What it is and how it evolves. Simon and Schuster.

5. Maturana, H. R., & Varela, F. J. (1980). Autopoiesis and cognition: The realization of the living. D. Reidel Publishing Company.

6. Haraway, D. J. (2016). Staying with the trouble: Making kin in the Chthulucene. Duke University Press.

7. Paccou, R., & Wijnoven, F. (2024). Artificial intelligence and electricity: A system dynamics approach. ResearchGate.

8. Crawford, K. (2021). *Atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University[1] Press

9. Ostrom, E., Burger, J., Field, C. B., Norgaard, R. B., & Policansky, D. (1999). Revisiting the commons: local lessons, global challenges. *science*, *284*(5412), 278-282.

10. "Data Page: Share of the population using the Internet", part of the following publication: Hannah Ritchie, Edouard Mathieu, Max Roser, and Esteban Ortiz-Ospina (2023) - "Internet". Data adapted from International Telecommunication Union (via World Bank). Retrieved from https://ourworldindata.org/grapher/share-of-individuals-using-the-internet [online resource]

Keywords:
Artificial Intelligence, Sustainability, Geopolitics, Environment, Automation, Equity