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How Technology Will Shape Our Future: Three Views of the Twenty-First Century

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According to the EDUCAUSE Core Data Service, 80.5% of higher education institutions include information technology in their strategic plans, and a full 73.0% have stand-alone IT strategic plans.¹ While it is apparent that higher education values technology planning, such plans typically have three- to five-year horizons, and we are often reluctant to think even that far ahead. Who knows where technology will take us 20, 30, even 50 years from now? Impossible as that future visioning may seem to those of us laboring in today's colleges and universities, there are thinkers whose vision extends that far. Of course, they do not all agree, and only a genius or a fool would attempt to say definitively what will transpire. Still, in a time of unprecedented, rapid technological change, we would be wise to consider where technology might take us, whether we want to go there, and whether we even have a choice.

This research bulletin explores three of the most compelling views of our longer-term future, the role of technology in those possible futures, and the impact these alternative futures might have on higher education. The alternatives range from a future of extreme constraint and possible collapse (Richard Heinberg's "peak oil" scenario) to one of unprecedented abundance, where most of the current work of higher education will be automated (Ray Kurzweil's singularity). Between these extremes is the more immediate future of globalization and the intensified competitive and collaborative world its proponents espouse (Thomas Friedman's flat world).

Underlying each of these future scenarios is a view of technology and its ability to transform human society. For Friedman, the globalist, technology is an enabler, changing economic and social landscapes by leveling the international playing field and breaking the monopoly of power held by national and regional entities. For Heinberg, the temporary abundance of fossil fuels has powered the growth of a technological society that cannot be sustained, and humanity will find itself forced to relinquish most of its technological riches and to restore a less complex and less energy-intensive lifestyle. Kurzweil, on the other hand, envisions information technology as the primary driving force of historical change, leading to unprecedented advances that will lead with unexpected speed to a world of abundance.

There are, of course, many other possible future scenarios. Perhaps none of the futures described in this bulletin would rank highly if the question were put to a global referendum. Among much of the world's population, faith-based perspectives predominate, some of them featuring end-of-world future scenarios. A condition for inclusion in this bulletin is that the scenario be based on evidence and reason. A further condition is that technology plays a key role in determining the future.

This research bulletin does not attempt to declare a winner among the three future scenarios, but it does present core concepts and critically evaluate each. If any of the scenarios emerges as essentially correct, it will dramatically impact higher education. The disasters at Tulane and Virginia Tech Universities, although fundamentally different from one another, have created a heightened awareness of the need for emergency planning, even though the likelihood of either situation's developing at any one campus

may be small. In contrast, these future scenarios, if they occur, will create crises of varying degrees throughout higher education. They challenge us, as with disaster planning, to think about consequences outside the norm. As such, they can help focus our planning beyond the next list of technology projects and sharpen our awareness of fundamental issues in a time of profound change. Deciding which future will occur may be a gambler's choice. Considering the implications of all three futures is responsible leadership.

Highlights of Technology Futures

In order to evaluate these future scenarios in a reasonably fair and consistent manner, I identified the following questions as fundamental to understanding the authors' perspectives:

- What are the main drivers of change in the author's worldview?
- What are the author's primary information sources?
- What are the stages of history that shape the author's future vision?
- What timeline does the author use in projecting the future?
- What are the implications of the future scenario?
- What can we do to prepare for the scenario?
- What could derail the scenario?
- What is the role of technology?

First Scenario: Friedman's Flat Earth (Globalization)

Published in 2005, Thomas Friedman's *The World Is Flat* has spent more than a year on the *New York Times* best-seller list. It provides a good starting point for a review of technology and the future, in part because of its enormous influence, which makes it almost a baseline vision, but also because it is the least ambitious and least far-reaching of the three scenarios. For Friedman, the main drivers of change are economic competition and technology. Although there is extensive literature on globalization, he relies mainly on journalistic sources, interviews, and anecdotal accounts.

Friedman establishes an historic framework for his view by articulating "three great eras of globalization":²

- Globalization 1.0 (1492–1800) is characterized by brawn—the raw strength of industrialization and growth of powerful nation states.
- Globalization 2.0 (1800–2000) is the era of multinational companies.
- Globalization 3.0 (2000–present) is the beginning of the flat-world era.

The “flat world” is Friedman’s metaphor for the current global economy and culture, which empower individuals and societies to compete globally. Technology drives the flat world by disaggregating production stages from geography, providing tools for collaboration and enabling instant communication across the globe. As a result, there is a “triple convergence—of new players, on a new playing field, developing new processes and habits for horizontal collaboration—that I believe is the most important force shaping global economics and politics in the early twenty-first century.”³

Although he is an unbridled fan of globalization, Friedman recognizes validity in some opposition concerns. Critics of globalization cite the displacement of individuals without an effective social safety net, and religious fundamentalism and poverty threaten to undermine globalization’s promise. Nevertheless, Friedman says, “I start with the assumption that, barring some geopolitical explosion, the world is going to get more and more globalized.”⁴ To answer globalization’s disruptive tendencies, he advocates a program of “compassionate flatism” in five areas:

- Leadership—to provide hope and challenge, emphasizing basic research, science, and engineering
- Muscles—to empower individuals through portable benefits and lifelong learning
- Cushions—to provide social security and wage insurance
- Social activism—to promote ecology and labor standards
- Parenting—to push education and performance

Although he admits that he is “a technological determinist,”⁵ Friedman is not a visionary in projecting future technologies. Regarding future energy needs, he acknowledges that “we are, at best, going to experience a serious energy shortage. At worst, we are going to set off a global struggle for natural resources.”⁶ Energy, in Friedman’s view, is just one aspect of a larger environmental concern, a concern that appears to be growing in importance for him, judging from his *New York Times* work since publication of *The World Is Flat*.

As an influential best-seller, *The World Is Flat* has been reviewed extensively. One of the harshest reviews comes from Roberto J. Gonzales, an anthropology professor at San Francisco State University. Gonzales finds the book “culturally misinformed, historically inadequate and intellectually impoverished.”⁷

Second Scenario: Heinberg’s Peak Oil Scenario

Unlike Friedman, Richard Heinberg, a faculty member at New College of California, has not yet found a mass audience, although he has emerged as the most prominent proponent of the peak oil threat to our future. He has written three books devoted to the topic. In his first, *The Party’s Over: Oil, War and the Fate of Industrial Societies*, Heinberg identifies two interrelated drivers of social change: energy and complexity. The more fundamental of these is energy because it is a prerequisite for the development of complexity. A key concept for Heinberg is EROEI—Energy Return on Energy Invested. Fossil fuels provide the greatest EROEI and have enabled the most complex societies in

history. Human history for Heinberg is defined by fairly conventional technology stages ranging from the Stone Age to the Industrial Age, or the Petroleum Era, which he prefers to call the “Petroleum Interval” or “Industrial Bubble.”⁸

The future envisioned by Heinberg and others who share similar views is generally associated with the term *peak oil*, which refers to the point at which maximum oil production has been achieved. Presumably, about 50% of the world’s useful petroleum supplies have been depleted, and we have begun the descent toward a world with inadequate and, eventually, nonexistent fossil fuels. The term is somewhat misleading because it implies a sudden cataclysmic event and omits the other important fossil fuels—natural gas and coal. Nevertheless, the term has gained a life of its own. The main information source for the peak oil argument comes from petroleum geologists building on the work of M. King Hubbert. As Kenneth S. Deffeyes notes in *Beyond Oil: The View from Hubbert’s Peak*, “Most of us who predict an imminent decline in world oil production regard M. King Hubbert (1903–1989) as our patron saint.”⁹ Hubbert developed a methodology that allowed him to accurately predict that U.S. oil production would peak between 1966 and 1972. Extending Hubbert’s methods, Deffeyes estimates that the world peak occurred in 2005–2006,¹⁰ while Heinberg cites a range of 2006–2016.¹¹ Similar predictions are made for natural gas. Both Heinberg and Deffeyes present extensive discussions of alternative resources, including coal, nuclear, and various renewable sources. These alternative sources, they contend, cannot replace oil and natural gas in time to forestall the effects of declining supplies.

Among peak oil advocates, Heinberg presents the most detailed and distressing view of the future. Ultimately, he predicts,

The prospects for maintaining the coherence of large nation states like the U.S....appear dim. Lacking an industrial infrastructure of production, transportation, communication, and control, large nations may eventually devolve into regional enclaves.¹²

Inevitably, “globalization collapses for lack of energy resources.”¹³ In *Power Down: Options and Actions for a Post-Carbon World*, Heinberg describes the total collapse of modern industrial and technological civilization, noting that,

By the start of the next century, the survivors’ grandchildren are entertained by stories of a great civilization of the recent past in which people flew in metal birds and got everything they wanted by pressing buttons.¹⁴

Heinberg acknowledges that “the daily operation of information technologies is not, to any appreciable degree, directly dependent on oil”¹⁵; however, when the electrical grids fail, “the information infrastructure of industrial societies will collapse and virtually all electronically coded data will become permanently irretrievable.”¹⁶ He seems to assume either that electricity is forever unavailable or that data stored is lost when power is lost. The first assumption seems unrealistic, and the second is factually incorrect. Assuming the loss of nearly all modern technology, Heinberg writes favorably of “The Primitive Technology Movement,” which illustrates how preservationist communities might adopt skills “of the Stone-Age lifestyle” to survive in the postindustrial world.¹⁷

Not all peak oil proponents take such extreme views of social collapse. Although James Howard Kunstler in *The Long Emergency* echoes Heinberg's perspective, both Deffeyes in *Beyond Oil* and Mathew Simmons in *Twilight in the Desert* present more moderate scenarios. These differences, however, are not acknowledged by the authors as explicit disagreements, perhaps because all share a common goal of awakening us to the problem.

Peak oil authors recognize that they are arguing against conventional wisdom as represented by government agencies and oil industry spokespeople. Simmons provides an impressive, detailed analysis of Saudi oil supplies based on technical reports published by the Society of Petroleum Engineers, finding in these specialized documents information that contradicts the optimistic forecasts of Saudi representatives. A counterargument to the peak oil scenario is presented in Marc Jaccard's *Sustainable Fossil Fuels: The Unusual Suspect in the Quest for Clean and Enduring Energy*.

Third Scenario: Kurzweil's Singularity

Ray Kurzweil is an inventor, entrepreneur, and author. In *The Singularity Is Near: When Humans Transcend Biology*, he presents a provocative future scenario in which humans are the creators of a new machine-based civilization that will spread from earth to the galaxies.

Change for Kurzweil is driven by evolutionary principles, which he extends to the evolution of technology. He views history as a series of six information-based epochs:

- Physics and chemistry (information in atomic structure)
- Biology (information in DNA)
- Brains (information in neural structures)
- Technology (the current period, in which information resides in hardware/software design)
- Merger of technology and human intelligence, including reverse-engineering of the human brain, years 2000–2050
- Universe wakes up (patterns of matter and energy saturated with intelligence), years 2050 and beyond

Kurzweil proposes three core premises:

- Ideas matter, and we can solve problems. At the root of Kurzweil's personal philosophy is a profound optimism.
- The law of accelerating returns is based on historic evidence of technological change, which is presented in detail. That change is shown to be exponential rather than linear. As a result, Kurzweil observes, "we won't experience one hundred years of technological advance in the twenty-first century; we will witness on the order of twenty thousand years of progress" by our current standards.¹⁸ He recognizes that "the law of accelerating returns is fundamentally

an economic theory” in which technology replaces traditional economic measures as drivers of development.¹⁹

- Evolution moves toward order. Usually this is accompanied by increased complexity.²⁰ Unlike Heinberg, who sees complexity presaging collapse, Kurzweil sees it as a natural phenomenon accompanying progress.

Kurzweil defines the singularity as “a future period during which the pace of technological change will be so rapid, its impact so deep, that human life will be irreversibly transformed.”²¹

Current and near-future changes will be dramatic as we enter the fifth epoch and exponential change intensifies. Key to this period is the genetics-nanotechnology-robotics (GNR) revolution:

- Genetics will lead to gene therapies at the cellular level. Technologies will be developed to reverse degenerative diseases and aging.²²
- Nanotechnology “will...ultimately enable us to redesign and rebuild, molecule by molecule, our bodies and brains and the world with which we interact.” As a result, scarcity will be eliminated.²³
- Robotics will lead to intelligent machines and human-machine hybrids, providing “the most significant transformation, because intelligence is the most powerful ‘force’ in the universe.”²⁴ Key to robotics is strong artificial intelligence (AI), which Kurzweil defines as exceeding human intelligence.²⁵ Further, “The advent of strong AI is the most important transformation this century will see. Indeed, it’s comparable in importance to the advent of biology itself.”²⁶

The speed of progress predicted by Kurzweil is astonishing based on his law of accelerating returns: “By the 2020s molecular assembly will provide tools to effectively combat poverty, clean up our environment, overcome disease, extend human longevity, and many other worthwhile pursuits.”²⁷ Kurzweil’s expectations for nanotechnology are based on the acknowledged pioneering work of Eric Drexler. Kurzweil’s unique contribution is the projected timeline.

Kurzweil is an excellent guide to his critics because he systematically answers them throughout the book. The criticisms have two major dimensions. First are claims that we face inherent limits to human knowledge that will prevent achievement of Kurzweil’s vision. Second are assertions that Kurzweil underestimates the difficulty of reaching his goals. An example of the critics is Jaron Lanier, who believes we will face complexity ceilings and that software is the limiting factor for the foreseeable future.

What It Means to Higher Education

In Friedman’s globalized future, science, engineering, and technology education are the keys to successful competition. He praises the U.S. capacity for research but is sharply critical of the fact that “we simply are not educating, or even interesting enough of our

own young people in advanced math, science, and engineering.”²⁸ Because technology has globalized the research and development functions of companies, multinational corporations will not necessarily favor U.S. universities. As more high-level jobs become available outside the United States, China and India, especially, will compete for students, aided by a U.S. environment less hospitable to international students since 9/11. Most of Friedman’s concerns and recommendations are the standard fare of national panels and reports. As such, they will be familiar to higher education leaders, although not necessarily easily addressed.

The peak oil scenario presents a more novel set of challenges for higher education. Higher education would be impacted, of course, by a widespread economic collapse. Extreme budget impacts could be expected, along with shifts in the application patterns of those students still able to attend. Similarly, extended resource wars would impact enrollments and funding. In the extreme version of peak oil put forth by Heinberg, universities will be in such crisis that they cannot be relied upon to independently preserve our cultural and intellectual heritage. Citing Roberto Vacca’s *The Coming Dark Age: What Will Happen When Modern Technology Breaks Down*, Heinberg hopes for committed preservationists, whom he calls the “new monks,” who would “need to conserve both abstract knowledge...as well as understandings of how things are done.”²⁹ This preservation will be very selective. Without our technological tools, “most of the symbolic content of industrial societies will vanish within a century or two.”³⁰

Colleges and universities are not mere victims in the peak oil scenario. Many moderate suggestions appear in the peak oil literature. Institutions can discourage auto travel, a major source of intense fossil fuel use, through innovative parking policies, bus systems, distance learning, and telecommuting for faculty and staff. Using local products, especially local food, reduces fuel use, and attention to the means of shipment for university purchases can help. In order of *increasing* fuel use, water (ships and barges), train, truck, and air yield differing fuel impacts. On a larger scale, the University of New Hampshire is engaged in a \$45 million landfill gas project that “will provide 80%–85% of the energy needed to meet campus needs from a renewable, non-fossil based source by providing processed landfill gas in lieu of commercial natural gas as the primary fuel source.”³¹ Finally, technology professionals can contribute by promoting energy-efficient data centers and desktop computers.

Kurzweil’s scenario presents the most fundamental challenge to higher education. If technology develops as he projects, “[W]e will ultimately move toward a decentralized educational system in which every person will have ready access to the highest-quality knowledge and instruction.”³² He goes on to observe that “in the early part of the second decade of this century visual-auditory virtual-reality environments will be full immersion, very high resolution, and very convincing” and that “the nature of education will change once again when we merge with non-biological intelligence.”³³

For the near term, these suggest dramatic and expensive technology enhancements. For the curriculum these trends mean less emphasis on factual knowledge, which will be immediately available on handheld devices (or, later, human-machine interfaces). As Roger Shank notes, “Anything obtained easily is devalued in society, and it will be the

same with knowledge. What will be valued will be good questions.”³⁴ Technology has already transformed research in most disciplines. But we may face a more generalized version of Steven Strogatz’s question, “Will we still enjoy doing theoretical science when computers become better at it than we are?”³⁵

Along with these profound changes will come profound ethical questions: What is privacy in a world so connected? What psychological stresses and behaviors will be generated by these transformations? What traditional values should be retained and how will we retain them? These too will be part of the challenge for higher education.

Key Questions to Ask

The flat world scenario...

- Will we, strategically, try to compete with rising higher education opportunities throughout the world, especially in Asia?
- In what areas of research and teaching excellence are we most likely to excel?
- What technology resources will be required to fulfill our missions?
- How do we motivate students to prepare for the global challenge?

The peak oil scenario...

- How can we prepare for energy shortages, including brownouts and electrical grid failures?
- How can we safeguard electronic knowledge repositories against profound power failures?
- Can technology provide alternatives to declining oil supplies in order to reduce energy requirements?

The singularity scenario...

- How will artificial intelligence (strong AI), knowledge transfer (human-machine-human), and virtual worlds impact traditional teaching, learning, and research roles?
- How will higher education as a rite of passage and as a lifelong phenomenon be impacted by automated, pervasive knowledge access?
- How will university roles in knowledge creation change as machines outpace human capacity at higher cognitive levels?

Where to Learn More

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Endnotes

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7. Roberto J. Gonzalez, "Falling Flat: As the World's Boundaries Are Worn Smooth, Friedman Examines Changing Horizons," *San Francisco Chronicle*, May 15, 2005, <http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2005/05/15/RVGHCL11V1.DTL&type=books>.
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11. Heinberg, *The Party's Over*, 266.
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