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FROM MY PERSPECTIVE

The state of technological and social change: Impressions ☆

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ABSTRACT

As the long-wave theory has predicted, we are seeing a period of consolidation in which the pace of radical technological innovation seems exceeded by the pace of social change. Peter Drucker's dictum, that technology changes faster than society, appears now to have been reversed. The article offers research and anecdotal support for these assertions, linking them to specific trends and trend interactions, including patents and intellectual property litigation, new product development, and politics and revolution.

1. Introduction

This is my first perspective as editor-in-chief of *Technological Forecasting & Social Change*. It is an opportunity to assess, informally, the state of technological and social change.

Why informally? Extant formal assessments make for an embarrassment of riches. A partial list would include UNDP's Technology Achievement Index [1]; the Eurobarometer measurements of public attitudes to science and technology [2]; the many papers submitted to TFSC proposing new technology development indices; the entrepreneurship and economic freedom indices published by the Kauffman Foundation and the Heritage Foundation, respectively; the Global Entrepreneurship Monitor; the World Economic Forum's competitiveness tracking; and the new Global Entrepreneurship and Development Index [3]. The Economist Intelligence Unit tracks national business environments, and Transparency International measures corruption on an ongoing basis. Last (but hardly least) is the rigorous State of the Future Index (SOFI) [4] produced by TFSC's own Ted Gordon.[1] All use idiosyncratic data definitions, and many face methodological hurdles. Reconciling them, or even cataloging their methodologies, would be a major research task; the world awaits an Index of Indices. Meanwhile, this column's impressionistic overview, combined with its several research citations, may offer a tentative synthesis and guide for future research.

It begins with a view of the forces inhibiting new technologies in the US and worldwide. The second part of the column responds to an interesting query from a researcher at the University of Manchester, concerning "weak-signal" issues that will shape the future of innovation. Both sections advance the view that in today's multi-polar, globalized world, social change is outpacing technological change for the first time in many decades — sometimes creating incentives for technological advance (as in US–China cooperation on coal decarbonization) and sometimes creating uncertainties that inhibit investment in new technologies.

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[1] SOFI's authors also noted in 2007 that "the world is improving, but not as rapidly as it did in the past twenty years" (p. 6), an observation in line with those I'll offer here.

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Technological change seems to be in a slow-down phase of its cycle. The reasons appear to be (i) an odd combination of incentives; (ii) some industrialists hanging on to obsolete business models until the very last hurrah; and, above all, (iii) changes in the political economies on which innovation policy and funding depend. Wu [5] adds that government regulations, standards, and hence court decisions often favor technological incumbents. Social change, meanwhile, proceeds at hyper-speed.

A framework to surround these observations and issues is suggested by the analogy between the ICT boom at the turn of this century and the telegraph- and automobile-driven economic transformations a century earlier. Was there a similar slowdown after 1900, with investors jockeying for control of the new technologies, rather than backing still further innovation? I am not enough of a historian to answer this, but it does seem certain that we are now experiencing a Schumpeterian experimentation with institutional forms: Even as the above-mentioned industrialists resist it, other sectors and firms (like youth clothing, an example I'll return to) re-organize to absorb a substantial backlog of new technologies. This is consonant with a long stream of literature suggesting that innovation is cyclic [6–10], driven by occasional very basic (paradigm-busting) discoveries and inventions. I suspect, though, that technology fusion now plays a greater role than it did in earlier cycles, as it is now easier to find and hook one's own invention into another innovation from a distant country or from a disparate research discipline.

It also seems certain that a phenomenon Peter Drucker noted in 1985 — that for several decades social change had been slower than technological change, and that then-extant institutional forms (hospitals were one of his examples) had persisted unchanged for long periods — has been turned on its head. Social change is now the hare and tech change the tortoise, relatively speaking. The innovation slowdown is consistent with K-wave theory [8]; the speed-up of social change is, again, the impression of one who keeps up with the press. This column will explore some of the detailed forces at play.

As electronics become cheaper, resources that might have been devoted to R&D are diverted to implementing existing ICT in still more industries, for example, mobile communication devices in medical care. As in the early 20th century, the absorption of new technologies accompanies (and to some extent causes) a wave of globalization and a geopolitically multi-polar world — in our current case, a post-Cold War world complicated by a severe recession and a resurgence of Asian economies as well as state capitalism in a number of important countries.

The two century marks also share a tension between technological optimists and those pushing more naturalistic solutions to society's problems. Then, it was (to oversimplify) automobiles vs. God's will. Now, it is geo-engineered environmental solutions on the one hand vs. clean energy and an ethic that Mother Nature's own solutions are most promising, on the other. As an example of the latter, Cavanaugh [11] describes a new biomimicry industry cluster initiative here in San Diego. I hope both approaches are judiciously pursued, with minimal time spent arguing.

It is small surprise that the complexity of the political economy and (as I will argue below) the interaction of new and old technological-economic trends has led to a reduced rate of radical innovation.[2] One may expect and hope that this is temporary, but betting against the long wave would most likely be unwise. Nonetheless, much good research is underway in communities worldwide, and — though at present few people seem to want to pay for it — these communities' leaders seem to apprehend that in the long run it is innovation that will sustain us.

2. Technology in crisis; social change quickens

Were we to put aside, for a moment, our sophisticated understanding of cycles, technology would appear to be in crisis. The US civilian space program is in a sorry state. Gene therapy has not lived up to its hype, in terms of medical benefit. Offshore oil drilling (as it is currently practiced) has deservedly fallen into disrepute. No mass-market alternatives to polluting automobiles have appeared. The much-anticipated Web3.0 has been displaced by the smartphone “app”, which is essentially a revenue model and not a technical innovation. Financial engineering (both the faulty and, through misuse, the good), has driven a stake through the heart of America's middle class, and has few remaining fans.[3]

The electoral successes of the anti-intellectual Tea Party movement are as yet few, but frightening. The Obama administration's innovation policy, strong on entrepreneurship and industrial clusters, emphasizes a search for the “next trillion-dollar trigger”, the ensemble of technologies that will spur a trillion dollars in investment, as IT and the Internet did in the Clinton years.[4] Now as then, America will be criticized for seeking the home run while forgoing the benefits of the base hit. This time, though, US policymakers and industrialists have an excuse for batting for the fence: They very much fear the trillion-dollar trigger will be pulled in another country, for the first time.[5]

Fewer US youngsters are entering STEM-related[6] college majors, and those who do run the PhD-plus-postdoc gauntlet face long odds of finding a tenure-track position [17]. Carlson [18], noting reduced federal grants budgets and cash-strapped US

[2] Korotayev et al. [10] find that incremental innovations (as opposed to radical innovations) actually rise during the upswing. This is shown by the increase in patents and reflects the exploitative (as opposed to exploratory) nature of R&D during the upswing.

[3] Press stories continue to claim these products are “almost here, just around the corner”: Clinical applications of nanotech [12]; commercial passenger space flight [13]; nuclear power [14]; and mass-market electric cars [15]. These articles are no doubt factual, but I believe they place the facts in the most optimistic possible light.

[4] Public Policy Forum: The Administration's Innovation Policy — A new era of innovation. September 30, 2010, La Jolla, California. The cited information was offered by speakers Peter Cowhey (former senior counselor to the US Trade Representative) and Assistant Secretary of Commerce John Fernandez. In a private communication, Hal Linstone raised the possibility that the trillion-dollar trigger will not be pulled until the next K-wave transition.

[5] The metaphor is mixed, but I trust the message is clear. A discontinuous advance in battery technology is one candidate for the trigger [16]. Progress toward and beyond the theoretical $/KWH limit of lithium-ion batteries is impressive in many different countries, with China, South Korea, and Japan among the foremost.

[6] Science, technology, engineering, and mathematics. The decline in vocational education in the US should be emphasized also.