

## Residential Construction in the Longue durée of the Industrial Revolution, the 1750s to the Present Day

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The Industrial Revolution has unfolded in four stages, each marked by significant technological and societal transformations. The first stage (1750-1840) saw the shift from agrarian economies to industrial and urban societies driven by mechanization with steam engines and textile machinery. James Watt's refinement of the steam engine in 1776 facilitated its adoption in many industries, notably textiles, where innovations such as the spinning jenny and power loom drastically improved production. This era also saw infrastructural advancements like canals and improved road networks, enhancing transportation and commerce.<sup>1</sup>

During the second stage (1870-1914), technological advancements spanned from steel production to the invention of electricity. The Bessemer Process allowed

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<sup>1</sup> Arnold Toynbee, *Lectures on the Industrial Revolution in England* (Boston: Beacon Press, 1884); P. A., "The Origins of the Industrial Revolution," *Past & Present*, no. 17 (1960): pp. 71-81. Eric Hobsbawm, *The Age of Revolution: 1789-1848* (London: Penguin Group, 1962); Hobsbawm, *Industry and Empire: The Birth of the Industrial Revolution*, ed. Chris Wrigley (London: Penguin Group, 1967); William H. Goetzmann, *Exploration and Empire: The Explorer and Scientist in the Winning of the American West* (New York: Knopf Press, 1966), p. ix; Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (Austin: Texas State Historical Association, 1995, original 1986), p. vii; Donna Gabaccia, "A Long Atlantic in a Wilder World," *Atlantic Studies*, vol. 1, no. 1 (2004): pp. 1-27; R. M. Hartwell, "The Causes of the Industrial Revolution: An Essay in Methodology," *The Economic History Review* 18, no. 1 (1965): 164-82, [link](#); Daniel Walker Howe, *What Hath God Wrought: The Transformation of America, 1815-1848* (New York: Oxford University Press, 2007), pp. 3-6; José C. Moya, "Modernization, Modernity, and the Transformation of the Atlantic World in the Nineteenth Century," in Jorge Cañizares-Esguerra and Erik R. Seeman, eds., *The Atlantic in Global History, 1500-2000* (Upper- Saddle River, NJ: Pearson, 2007), pp. 179-198.

for mass steel production, leading to the construction of railways, skyscrapers, and bridges. The propagation of electricity revolutionized industries and households, with Edison's development of the electric light bulb and distribution systems making electricity accessible and commonplace. Concurrently, inventions like the telegraph, telephone, and internal combustion engine transformed transportation and communication.<sup>2</sup>

The third stage, known as the Digital Revolution or the Age of Information (1960-present), witnessed a transition from analog electronic and mechanical devices to digital technology. The invention of the integrated circuit paved the way for miniaturized electronic circuits, enabling innovations like personal computers and cell phones. By the late twentieth century, the internet had become a dominant force, connecting individuals globally and reinventing business models. The transformative effects of this revolution continues to shape communication and information access.<sup>3</sup>

The fourth stage (2000-present) features the fusion of physical, digital, and biological systems. Advances in artificial intelligence, robotics, the Internet of Things

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<sup>2</sup> David S. Landes, *The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present* (Cambridge: Cambridge University Press, 1969); Claire Zimmerman, "Albert Kahn in the Second Industrial Revolution," *AA Files*, no. 75 (2017): pp. 28-44. Lynwood Bryant, "The Beginnings of the Internal Combustion Engine" in *Technology in Western Civilization*. vol. 1, edited by Melvin Kranzberg and Carroll W. Pursell, Jr., (New York: Oxford University Press), pp. 648-663; David C. Mowery and Nathan Rosenberg, *Technology and the Pursuit of Economic Growth* (Cambridge: Cambridge University Press, 1989), [link](#).

<sup>3</sup> Josef Taalbi, "Origins and Pathways of Innovation in the Third Industrial Revolution," *Industrial and Corporate Change* vol. 28, no. 5 (October 1, 2019): pp. 1125-48, [link](#); Daniel Bell, *The Coming of Post-Industrial Society: A Venture in Social Forecasting* (New York: Basic Books, 1973); Jianxiao Wang et al., "Review and Prospect of Integrated Demand Response in the Multi-Energy System," *Applied Energy* vol. 202 (15 September 2017): pp. 772-82, [link](#); Matthieu Belarouci, "Outline and Impact of Firms Related to the Third Industrial Revolution: Investigation through Big Data," *Smart Cities* vol. 5, no. 2 (June 2022): pp. 522-538, [link](#).

(IoT), and biotechnology define this era. Klaus Schwab, founder of the World Economic Forum, notes that this revolution differs from previous ones because of its velocity, scope, and systems impact, altering almost every industry globally and affecting human identity. Innovations like gene editing, augmented reality, and advanced wireless technologies show the expansive potential of this revolution. Positioned between these last two stages, the U.S. construction sector must seize this moment to redefine its practices and integrate cutting-edge digital technologies.<sup>4</sup>

The Digital Revolution comprises both the third and fourth stages of the long Industrial Revolution. While both stages share many commonalities, there is a crucial difference that demarcates the third stage from the fourth. For nearly two decades, the “move fast and break things” axiom popularized by Facebook’s founder, Mark Zuckerberg, in 2009 has defined our approach to technology.<sup>5</sup> Disruption was the name of the game. The more a technology could disrupt standard operating practices and the status quo, the better. This attitude emphasized the rapid development

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<sup>4</sup> Klaus Schwab, *The Fourth Industrial Revolution* (Geneva, Switzerland: World Economic Forum, 2016), [link](#); Hana Begić and Mario Galić, “A Systematic Review of Construction 4.0 in the Context of the BIM 4.0 Premise,” *Buildings* 11, no. 8 (August 4, 2021): p.337; Schwab, Nicholas Davis, and Satya Nadella, *Shaping the Fourth Industrial Revolution* (World Economic Forum, 2018); J. G. de la Vega Meneses and R. D. Garcia Hernandez, “Fourth Industrial Revolution: Trends and Prospects,” in *12th International Technology, Education And Development Conference (INTED)*, ed., L. G. Chova, A. L. Martinez, and I. C. Torres (12th International Technology, Education and Development Conference (INTED): pp. 7624-7630, [link](#); Guoping Li, Yun Hou, and Aizhi Wu, “Fourth Industrial Revolution: Technological Drivers, Impacts and Coping Methods,” *Chinese Geographical Science* 27, no. 4 (August 2017): pp. 626-37, [link](#); Hyuk Chung, “Adoption and Development of the Fourth Industrial Revolution Technology: Features and Determinants,” *Sustainability* vol. 13, no. 2 (January 2021): p. 871, [link](#).

<sup>5</sup> Hemant Taneja makes this point in his recent article in the *Harvard Business Review*. Hemant Taneja, “The Era of ‘Move Fast and Break Things’ Is Over,” *Harvard Business Review*, January 22, 2019, [link](#); Henry Blodget, “Mark Zuckerberg On Innovation,” *Business Insider* (01 October 2009), [link](#).

and release of technologies at the expense of thorough testing and oversight. The ethos facilitated unprecedented technological advancement and market transformation but also neglected broader societal impacts, leading to issues such as privacy breaches and regulatory challenges. As public concerns with data protection and humans' relationship with artificial intelligence continues to mount; the "move fast and break things" approach becomes less tenable. As the third stage of the long Industrial Revolution ends, so does the "move fast and break things" approach to digital innovation.

An emblematic example of this paradigm shift appears in Larry Fink's "[Letter to CEOs: Power to Capitalism](#)" (2022). Fink, the Chair and CEO of BlackRock, the world's largest asset manager, co-founded the firm in 1988, and it has since become a major player in global finance, managing trillions in assets. As a result, Fink has become one of the major players in the global financial sector, garnering public attention for his annual letters to CEOs, where he addresses key themes and issues affecting the domestic and international markets.

In "Power of Capitalism," he discusses the importance of transparency and the development of new technology, focusing on how these factors contribute to stakeholder capitalism. He emphasizes the need for companies to be transparent about their goals and processes, particularly in relation to sustainability and climate change. Fink also notes that technological advancements reshape industries and that companies need to adapt to these changes to remain competitive and sustainable in the long term. He writes:

The pandemic has turbocharged an evolution in the operating environment for virtually every company. It's changing how people work and how consumers buy. It's creating new businesses and destroying others. ***Most notably, it is dramatically accelerating how technology is reshaping life and business*** [emphasis mine]. Innovative companies looking to adapt to this environment have easier access to capital to realize their visions than ever before. And the relationship between a company, its employees, and society is being redefined.<sup>6</sup>

As this statement shows, the “move fast and break things” approach is no longer tenable. As a result, we are currently undergoing a paradigm shift that marks the onset of the Fourth Industrial Revolution. This change prioritizes accountability, transparency, and social responsibility with the creation and launch of new digital technologies. This transformation will take time, effort, and investment. But make no mistake: the demands for greater accountability, transparency, and responsibility will drive the development of digital technology for generations to come.

The United States construction sector stands at a pivotal juncture where embracing digital construction technologies offers not merely an opportunity but a compelling imperative for the future. We must actively and enthusiastically harness these innovations to shape our practices or risk a prolonged struggle against the tide of digital evolution. The era of “move fast and break things” has given way to a demand for responsible, sustainable technological advancement. As we transition from the third to the fourth stage of the Industrial Revolution, it is crucial that we foster an environment of accountability and transparency in the deployment of digital technologies.

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<sup>6</sup> Larry Fink, “Letter to CEOs: The Power of Capitalism,” 01 January 2022, BlackRock, Open Letter, accessed 27 May 2024, [link](#).

This shift represents more than a technological evolution; it is a profound transformation in the very fabric of our industry. By proactively integrating digital technologies, the construction sector can lead by example, demonstrating how industries can evolve to meet the demands of the twenty-first century without compromising ethical standards or societal welfare. In seizing this moment, we have the potential to profoundly influence not only our industry but also the broader societal relationship with technology for generations to come.

Let us not look back on this as a missed opportunity. Instead, let us take decisive action now, ensuring that digital construction technologies become a cornerstone of a sustainable, efficient, and socially responsible industrial future. By doing so, we will not only advance our sector but also contribute significantly to the sustainable development of our society in the age of the Fourth Industrial Revolution.