

**Second Machine Age or Fifth Technological Revolution?
Different interpretations lead to different recommendations –
Reflections on Erik Brynjolfsson and Andrew McAfee’s book
The Second Machine Age (2014).**

Part 1

Introduction: the pitfalls of historical periodization

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This is the first instalment in a series of posts (and a Working Paper in progress) that reflect on aspects of [Erik Brynjolfsson and Andrew McAfee’s](#) influential book, [The Second Machine Age](#) (2014), in order to examine how different historical understandings of technological revolutions can influence policy recommendations in the present. Over the next few weeks, we will discuss the various criteria used for identifying a technological revolution, the nature of the current moment, and the different implications that stem from taking either the ‘machine ages’ or my ‘great surges’ point of view. We will look at what we see as the virtues and limits of Brynjolfsson and McAfee’s policy proposals, and why implementing policies appropriate to the stage of development of any technological revolution have been crucial to unleashing ‘Golden Ages’ in the past.

Introduction: the pitfalls of historical periodization

Information technology has been such an obvious disrupter and game changer across our societies and economies that the past few years have seen a great revival of the notion of ‘technological revolutions’. Preparing for the next industrial revolution was the theme of the [World Economic Forum](#) at Davos in 2016; the European Union (EU) has strategies in place to cope with the changes that the current ‘revolution’ is bringing. Yet between these two institutions, as amongst academics, there is disagreement: on the number of revolutions; on when one has ended and another begun; on what have been the drivers and the immediate and long-term consequences. The most common classification identifies three revolutions to date, often focusing on the dominant technologies-as-inventions: the steam engine that powered the nineteenth century; electricity and the automobile in the twentieth; and ICT at present.¹ More multi-faceted analyses recognize ‘technological revolutions’, as I do, not as dependent on single entities or energy sources but as interconnected clusters of new and dynamic inputs, processes, products and industries. Such analyses also include organizational and institutional innovation, in an attempt to understand how and by what means the new technologies diffuse and profoundly change our economies and societies.

One might argue that this is all academic; that these ‘revolutions’ are, after all, just theoretical constructs that allow us to grasp both the recurring patterns and the irregularities of history. The point that I wish to make with this blog series is that, if we are to use our understanding of history to inform our actions in the present, then the which, when, how and by what means are, in fact, crucial. It is not that I feel compelled to defend my own system of classification.² It is rather that, in reading the work of others, I have been struck by how a mis-framed interpretation of techno-economic history has led either to pessimism for the future – of a sort that I found recurs at this precise moment in each cycle – or to very timid or obsolete policy recommendations. The most damaging of them are the ones mired in the previous paradigm, rather than boldly responding to the new present and the open potential future. In those cases, history has served to blind rather than illuminate.

The example that I wish to discuss in this piece is one of the more recent attempts at industrial periodization: the division of industrial history into two stark ‘machine ages’ made by [Erik Brynjolfsson](#) and [Andrew McAfee](#) of [MIT](#). In their book [The Second Machine Age](#) (2014), they argue that we are now in a new age in which machines are replacing human brain power, and contrast this with a first period of industrialization in which machines replaced human and animal muscle-power. The book is the product of wide-ranging

¹ Made by Mokyr ([The British Industrial Revolution: An Economic Perspective](#), Westview Press, 1993), Gordon ([The Rise and Fall of American Growth](#), Princeton University Press, 2016), Landes ([The Unbound Prometheus: Technological Change and Industrial Development in Western Europe from 1750 to the Present](#), Cambridge University Press, 1969) and others. It is what underlies Schwab’s expectation of a fourth revolution, as discussed at Davos 2016 ([The Fourth Industrial Revolution](#), Penguin, 2017).

² Perez, C. (2002) [Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages](#), Cheltenham: Edward Elgar

research and in-depth consultations with those involved at the frontier of technical change, focusing particularly on the potential of robotics and artificial intelligence (AI). It diligently maps out not only the nature of foreseeable digital technologies, but also their capacity for wealth creation and their possible impacts on the nature of work and the workforce, on the economy and across society, looking at both their positive and negative effects. I have chosen it as a focus precisely because I think that, despite being such a complete analysis of the prospects of job losses and of the revolutionary nature of the technologies, it still fails us when it comes to policy recommendations in the face of those changes to come.

Brynjolfsson and McAfee hold that the spread of the steam engine in the nineteenth century was a radical break in human history, infinitely greater in impact than the advent of agriculture. They show, based on work by Morris³, that both human social development and population made a remarkable leap, from very slow to extremely rapid increases, due to the new possibilities provided by the replacement of human muscle-power by machines. That is their 'first machine age', which lasts until the late twentieth century. They then define the present as the beginning of the second machine age, arguing that replacing human brain-power with machines is an equivalent technological leap forward.

Cutting the history of capitalism into only two periods, the first covering almost two centuries and the second beginning now, leads them to discard the lessons learned during the long and eventful intervening historical period. The result is a paradox. Although Brynjolfsson and McAfee assert that we face a momentous transformation, the policies that they propose are rooted in the economic orthodoxy of the past few decades, which neither understands technical change nor takes it into account. In fact, their recommendations are extremely timid when compared with the widespread economic and policy changes that were needed to address instances of what to them was just continuous change during the first machine age. For example, in the 1930s and 40s, when Roosevelt and Keynes were facing the job losses due to the introduction of mass production in manufacturing and by the mechanization in agriculture, they proposed a radical and ultimately successful institutional and policy transformation that brought full employment and stable growth in economies threatened by structural unemployment. Rather than accepting 'secular stagnation'⁴, they proposed and applied changes as radical as the Welfare State and the direct intervention of government in the economy. Yet, facing what according to Brynjolfsson and McAfee are even greater challenges to jobs and incomes, the authors maintain the sacrosanct respect for 'free market' dynamics as it stands today and envision just minor changes in the already diminished role of government.

Furthermore, while their thorough understanding of the ICT revolution allows them to see its consequences for the outdated production methods and lifestyles associated with the

³ Morris, I. (2010) *Why the West Rules—For Now: The Patterns of History, and What They Reveal About the Future*, New York: Farrar, Straus and Giroux

⁴ The term was initially used by Alvin Hansen precisely in the 1930s

mass production revolution, their lack of attention as to how previous technological transformations have disseminated across society limits them in envisioning the possible role of ICT in enabling truly new directions for both economic growth and institutional and social change on a global scale. And further still, Brynjolfsson and McAfee remain locked into a world that regards the United States as the central player on the global stage – a role that it did not hold for the first 150 years of industrialization, and which a closer analysis of history would make clear is by no means a given for the future.

Over this series of posts, I will contrast Brynjolfsson and McAfee's periodization of history with my own neo-Schumpeterian version of five great surges of technical change, based on observed regularities in the process of social and economic assimilation of each new technological revolution. I will also demonstrate why it is key to gain a thorough understanding of the roles that the state, finance, and businesses (both innovators and incumbents) play at different points in the transformation brought about by each revolution, and how this can serve as a basis for designing adequate and effective policies. I will show how the profitable propagation of each new technological paradigm has always required appropriate direction at the appropriate time, and argue that those societies that achieve a 'positive-sum' solution benefitting both business and society have been the most stable and successful. I will suggest that confronting the current pressing 'problems' of environmental damage and sustainability – which Brynjolfsson and McAfee fail to address in their analysis – can be the solution to the unemployment threat ahead. Indeed, policies systemically favouring 'smart green growth' can become such a positive-sum direction for the unleashing of ICT's transformative power. I will also examine how their failure to look beyond the US is not merely an oversight but lies at the basis of their (self-recognized) inability to provide long-term solutions to mitigate the inequality brought about by disruptive technological change. Adequate solutions to the current risk of jobless and low growth need to consider globalization as the new development space for all nations, the US included. While accepting Brynjolfsson and McAfee's description of the technological advances afoot, I propose that such an interpretation demands a deeper assessment of the policy changes required and a bolder view of the types of futures that may lie ahead.

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In the next instalment, I will discuss the present vogue for acknowledging the importance of technological revolutions and why the concept is both useful and risky. I will delve more deeply into the various criteria used for identifying a technological revolution and why it is important to recognize their regular patterns of deployment. I will compare the 'machine ages' of Brynjolfsson and McAfee to my theory of great surges of development, which describes the path followed by the interactions between technology, finance, government and society in the process of adopting a technological revolution. It is through observing these recurring processes of diffusion, assimilation and social shaping of major waves of technological potential that the useful lessons needed for facing today's socio-political challenges can be identified.