Innovation at work

Since the Industrial Revolution, workers have feared replacement and impoverishment at the hands of machines. But history’s major technological advancements have only led to a frantic uptick in industry that introduced a bevy of new employment opportunities.

Yet a new revolution, powered by computers and networks, is happening so quickly that economies have little time to adjust. The implications for labor and employment are unnerving.

The crisis and a potential remedy are considered in Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy, a new digital book by Schussel Family Professor of Management Science Erik Brynjolfsson, PhD ’91, and Andrew McAfee, LFM ’90, SM ’90, MIT SB ’89, MIT SB ’88, principal research scientist at the MIT Center for Digital Business.

Brynjolfsson and McAfee explain the drastic economic consequences of accelerating technology, both in terms of employment and wealth distribution. But the authors are self-described “digital optimists.” They believe humans may not need to race against the machines. Instead, they write, we should learn to race with the machines. In this excerpt, they argue that technological advancements present exciting new opportunities for innovation and entrepreneurship. All in the name of humankind.

new jobs. Some of them also create platforms for thousands of businesses themselves, but collectively they can do more to create jobs and wealth than even the most successful single venture.

Of the most valuable knowledge in an economy is dispersed among individuals.

opportunities for individuals to use their unique and dispersed knowledge for the benefit of the whole economy. As a result, technology enables more and more opportunities for what Google chief economist Hal Varian, MIT SB ’69, calls “micromultinationals”—businesses with fewer than a dozen employees that sell to customers worldwide and often draw on worldwide supplier and partner networks. While the archetypal 20th-century multinational was one of a small number of megaﬁrms with huge ﬁxed costs and thousands of employees, the coming century will give birth to thousands of small multinationals with low ﬁxed costs and a small number of employees each. Both models can conceivably employ similar numbers of people overall, but the latter one is likely to be more ﬂexible.

But are there enough opportunities for all these entrepreneurs? Are we running out of innovations?

When businesses are based on bits instead of atoms, then each new product adds to the set of building blocks available to the next entrepreneur instead of depleteing the stock of ideas the way minerals or farmlands are depleted in the physical world. New digital businesses are often recombinations, or mash-ups, of previous ones. For example, a student in one of our classes at MIT created a simple Facebook application for sharing photos. Although he had little formal training in programming, he created a robust and professional-looking app in a few days using standard tools. Within a year he had over one million users. This was possible because his innovation leveraged the Facebook user base, which in turn leveraged the broader World Wide Web, which in turn leveraged the Internet protocols, which in turn leveraged the cheap computers of Moore’s Law and many other innovations. He could not have created value for his million users without the existence of these prior innovations. Because the process of innovation often relies heavily on the combining and recombinng of previous innovations, the broader and deeper the pool of accessible ideas and individuals, the more opportunities there are for innovation.

We are in no danger of running out of new combinations to try. Even if technology froze today, we have more possible ways of conﬁguring the different applications, machines, tasks, and distribution channels to create new processes and products than we could ever exhaust.

Here’s a simple proof: Suppose the people in a small company write down their work tasks—one task per card. If there were only 52 tasks in the company, as many as in a standard deck of cards, then there would be 52! different ways to arrange these tasks. Combinatorial explosion is one of the few mathematical functions that outgrows an exponential trend. And that means that combinatorial innovation is the best way for human ingenuity to stay in the race with Moore’s Law.

Most of the combinations may be no better than what we already have, but some surely will be, and a few will be “home runs” that are vast improvements. The trick is finding the ones that make a positive difference. Parallel experimentation by millions of entrepreneurs is the best and fastest way to do that. As Thomas Edison once said when trying to find the right combination of materials for a working lightbulb: “I have not failed. I’ve just found 10,000 ways that won’t work.” Multiply that by 10 million entrepreneurs and you can begin to see the scale of the economy’s innovation potential. Most of this potential remains untapped.

As technology makes it possible for more people to start enterprises on a national or even global scale, more people will be in the position to earn superstar compensation. While winner-take-all economics can lead to vastly disproportionate rewards to the top performer in each market, the key is that there is no automatic ceiling to the number of different markets that can be created. In principle, tens of millions of people could each be a leading performer—even a top expert—in tens of millions of distinct, value-creating ﬁelds. Think of them as micro-experts for macro-markets. Technology scholar Thomas Malone, Patrick J. McGovern (1959) Professor of Management at MIT Sloan, calls this the age of hyperspecialization. Digital technologies make it possible to scale that expertise so that we all beneﬁt from those talents and creativity.

There has never been a worse time to be competing with machines, but there has never been a better time to be a talented entrepreneur.