

A New Era Emerges: The Age of Connected Intelligence

The Disruption of Technological Revolutions

Are investors getting lost in the weeds with 24-hour news shows, tweets, and virtually instantaneous market updates? While the economic and monetary policy cycles that many routinely discuss and analyze are important, they are mean-reverting and typically affect company earnings and stock prices in a temporary way. However, technological revolutions are different. They create more permanent change, resulting in a market structure that is disruptive to the status quo. Those companies responsible for the disrupting gain market share over many years, enabling secular growth and leaving behind wounded companies that were unable to adapt to the new market reality.

The researcher Carlota Perez posits that technological revolutions occur continuously about every half century and consist of five phases. The first two phases comprise the installation period when the revolution is “a small fact and a big promise,” while the last two phases comprise the deployment period when the new paradigm has become “normal best practice” (see Figure 1).

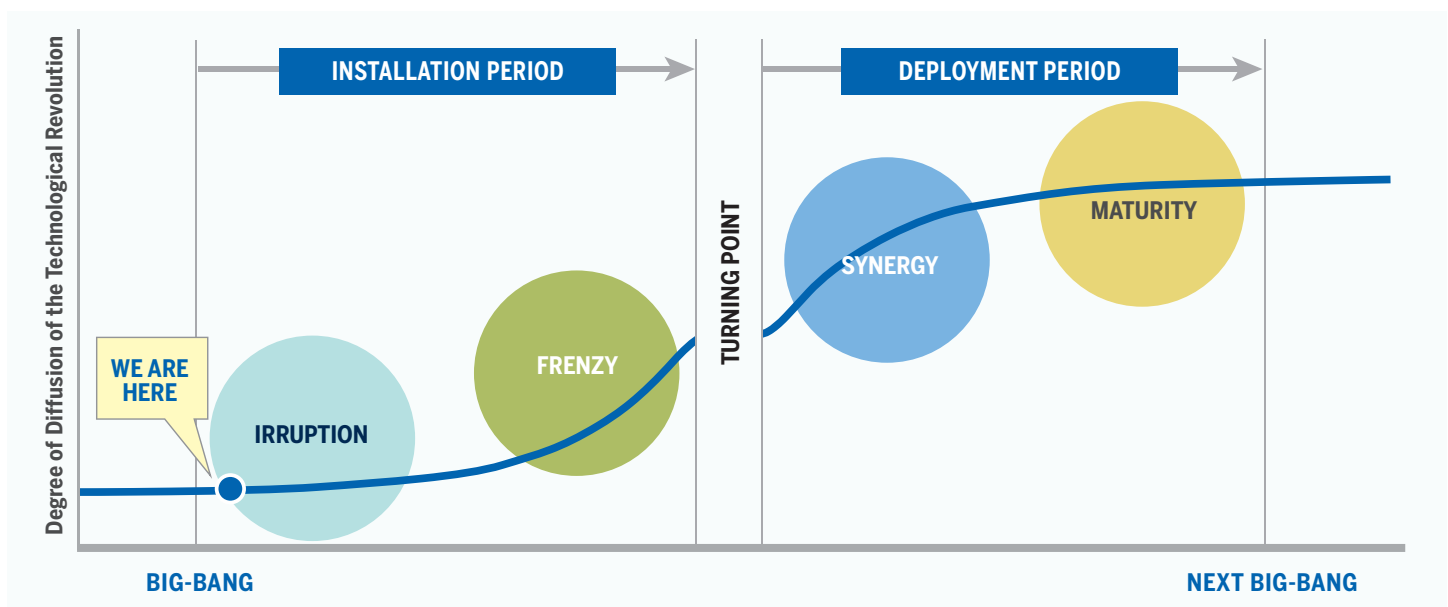
- **Irruption**, starting with a “big-bang” or innovation that leads to the strong growth of new industries while others face disruption and obsolescence

- **Frenzy**, in which financial markets become overly optimistic, diverging from fundamentals and ultimately resulting in a bubble
- **Turning point**, such as a financial market collapse, which helps create the transition to the deployment period
- **Synergy**, when the technology is actually being implemented at scale, often resulting in a “golden age” of output and employment
- **Maturity**, when markets have been saturated and growth slows

The Beginning of a New Technological Revolution

There have been five technological revolutions since the 18th century. The last one, the Age of Information and Telecommunications, began with the microprocessor “big-bang” and continued through the turning point of the collapse of the technology bubble and the subsequent build-out of the internet and introduction of the smart phone. As a result, nearly four billion people today are connected to each other and essentially all of the world’s knowledge via the internet.

Figure 1: The Lifecycle of Technological Revolutions



Source: Carlota Perez, “Technological Revolutions and Financial Capital,” Edward Elgar Publishing, 2002; Alger.

GLOBAL TECHNOLOGICAL REVOLUTIONS SHAPE OUR LIVES

1771 Industrial Revolution



- **Innovations:** machinery and mechanization helped by water power
- **Impact:** mechanized textile industry; first factories

1829 Age of Steam and Railways



- **Innovations:** iron and coal mining; steam engines
- **Impact:** railway industry; introduction of steam power for many industries

1875 Age of Steel and Electricity



- **Innovations:** cheap steel; electrification
- **Impact:** bridges & tunnels; electrical networks; the telephone

1908 Age of Oil, the Automobile, and Mass Production



- **Innovations:** internal combustion engine; petrochemicals
- **Impact:** automobiles; roads; airplanes

1971 Age of Information and Telecommunications



- **Innovations:** integrated circuit; internet
- **Impact:** worldwide telecommunications network

Today Age of Connected Intelligence



- **Innovations:** artificial intelligence; internet of things
- **Impact:** remains to be seen

Source: Carlota Perez, "Technological Revolutions and Financial Capital," Edward Elgar Publishing, 2002; Alger.

We believe we are in the irruptive phase of a new revolution—one that builds on the computational engineering and information superhighway created over the past several decades. Data is the new oil and advances in cloud computing and artificial intelligence (AI) will turn this now abundant raw material into better decision-making for companies and individuals.

In this current technological revolution, what we call the Age of Connected Intelligence, computing will be ubiquitous and pervasive. As the network of devices becomes smarter with advances in AI, it will aid our decision-making in business and in our personal lives. The "big-bang" of this revolution may be clearer in the rearview mirror of history, but the first computer program to learn on its own, AlphaGo Zero, introduced in 2017, certainly caused a watershed moment. Given only the rules of the game of Go, it was able to beat the best human and computer program in the world in just a few weeks, without using any data from actual human games or being taught any specific strategies. This self-learning means that computers are capable of developing skills without being bound by the limits of human teachers. As this technology is applied to other sectors and problems, it will likely reshape industries and usher in tremendous change. In fact, Google's CEO has said AI is more profound than electricity or fire.

Technological Revolutions Impact Every Facet of Our Lives

The Age of Connected Intelligence is driving a variety of advances such as augmented and virtual reality, blockchain technology, and autonomous vehicles. Each of these will have far-reaching consequences for businesses and society and now they are converging at the same time.

We are about to witness what happens when companies can harness data, use predictive analytics and make decisions instantaneously using inputs from a multitude of endpoints such as tractors and cranes or vehicles. We as consumers leave behind "digital breadcrumbs" everywhere we go. Using AI companies can make predictions about consumers' likes and dislikes based on this data. Similarly, a business can use sensors and cameras in factories to collect data on operational efficiencies. Every piece of equipment, every vending machine can offer us a piece of unique data by which to make the organization more efficient.

The most innovative companies are already using this data to make better decisions. When Marc Benioff, the CEO of Salesforce.com, meets with his board, one of the seats in his boardroom belongs to Einstein. Einstein is not a

person, but an AI engine. Einstein amasses company data, compiles it and draws conclusions based on trends and patterns that it has inferred from historical data. One time, Einstein correctly predicted that one particular region was tracking to lower-than-expected sales prior to the regional manager recognizing the discrepancy. Upon examination, Einstein proved right and the problem was corrected mid-quarter. This kind of agility is only possible with the ability to take large amounts of data and apply computational algorithms to draw conclusions, the essence of AI. This creates a different paradigm dictating how businesses react to developments in real time.

Imagine a smart watch detecting an irregular heart rhythm before a cardiac event and sending an alert to a medical professional to mitigate the problem. Your car may monitor your eyes to see if you are distracted and alert you to a potential hazard or even take over driving for you. Software may review your radiology results and cross-reference the thousands of recently published papers to recommend a new potentially life-saving treatment. In fact, all of these advances already exist in some form of development.

Already we are in the process of merging ourselves with computers. Today, the uplink to look up information is measured in minutes as we take out our smartphones and type into them, using several taps to retrieve the relevant information. But that time delay will be reduced dramatically with innovation. Ray Kurzweil, Director of Engineering at Google, describes the future this way: "We will have augmented reality essentially at all times projected onto our retinas from our glasses and lenses, and in our ears. Most requests for information and tasks will not be explicit but our ever present AI assistant will anticipate our needs by watching and listening in on our activities."*

Disruption Impacts Investing Decisions

If we have entered into the irruption phase of the sixth technological revolution, new companies and industries will be born and old ones will die. Technologies such as AI and the Internet of Things may drive a 30% to 40% reduction in business costs over the next five to seven years. The ramifications of that projection are clear for business owners. If one company adopts a digital transformation strategy and becomes more agile to respond to changes in real time, it will establish a competitive edge relative to its peers. The businesses that fail to keep up with the technology will no longer be able to compete. This is a structural imperative and companies are just beginning to contemplate a technological overhaul to adapt.

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Autonomous driving is an interesting area because it involves rapidly processing dynamic inputs without dependency on human inputs to make decisions, a real test of AI. It is easy to comprehend that a trucking company that misses out on autonomous driving will be disrupted. Not as obvious are the entire business models that may be disrupted. For example, will lower transportation costs enable new real-time inventory that makes mass warehousing or retail obsolete?

As we look across the market, this concept of disruption is pervasive throughout many sectors from technology to energy. The changes are so profound that our analysis shows that 31% of the S&P 500 is potentially being disrupted. That is a big number! These are large publicly traded companies that we believe are facing profound changes that put their business models at risk. This includes most of media and entertainment as the internet enables not only new ways for content to reach customers but new types of content as well. It also includes transportation which we discussed previously as well as the various retail industries that unfortunately still face a lot of disruption given the excess retail space in the U.S. (the U.S. has more than four times the retail square feet per capita than the rest of the world). In the consumer staples sector, radically increased price transparency as well as new methods of accessing the consumer are putting pressure on previously large margins. Additionally, banks are facing disruption not just from the business transitioning to mobile from in-person branch locations but from technology that threatens to disintermediate banks entirely and link borrowers and lenders directly. Within energy, while the sector may not be directly impacted by advances in connected intelligence, it is being disrupted by innovation that is rapidly bringing down the cost of renewable sources. Within industrials there is much change, such as air freight and logistics, which is facing changing supply chains and even new modes of delivery (e.g., drones).

Interestingly our estimate of the percentage of companies that are doing the disrupting is much lower than those being disrupted. By our calculations, 14% of the S&P 500 is disrupting more than twice its size or 31%, which translates into \$7.6 trillion in companies' values potentially being disrupted.

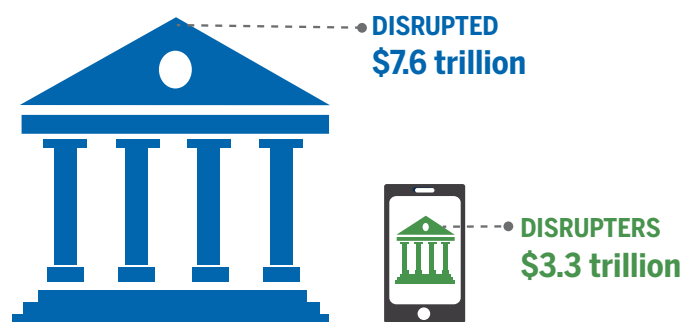
*Ray Kurzweil, The Singularity is Nearer, 2019.

This is significant because it speaks to the incredible investment opportunity that these innovators may have, given that the market capitalization that accrues to the disruptors should be, in our view, at least as large as that which is lost by the disrupted companies (see Figure 2).

We are in a new world. Uber is the world's largest taxi company but owns no vehicles. Facebook, the world's most popular media owner, creates no content. One of the

world's most valuable retailers, Alibaba, has no inventory and Airbnb, the world's largest accommodation finder, owns no real estate. These companies are eliminating the middleman or reducing costs through other business model changes and in the process they are changing or destroying whole industries. They highlight how important it is to be on the right side of change when investing in such dynamic environments.

Figure 2: Are You Disrupting or Being Disrupted?



Source: Alger, market capitalization of companies in the S&P 500, as of 6/30/19.

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