Thomas M. Siebel

Digital transformation: the post-industrial utility

Digital transformation is a concept that increasingly figures at the top of chief executives' strategic plans. There is a lack of consensus about its definition and effect, but a look at the historical context helps provide clarity to the meaning and likely impact of the ongoing, dramatic changes.

In 1973, Harvard sociologist Daniel Bell authored *The Coming of Post-Industrial Society*, in which he predicted the Information Age. Before the minicomputer, prior to the personal computer, the internet, the iPhone, Facebook, Uber, and Snapchat – Bell predicted that the advance of information technology would drive a restructuring of the global economy.

Bell theorized the emergence of a new social order – driven by information technology – dramatically altering the way social and economic interactions are conducted, the way in which knowledge is promulgated and retrieved, and the very nature of the livelihood and avocation of mankind. In the subsequent four decades, no aspect of

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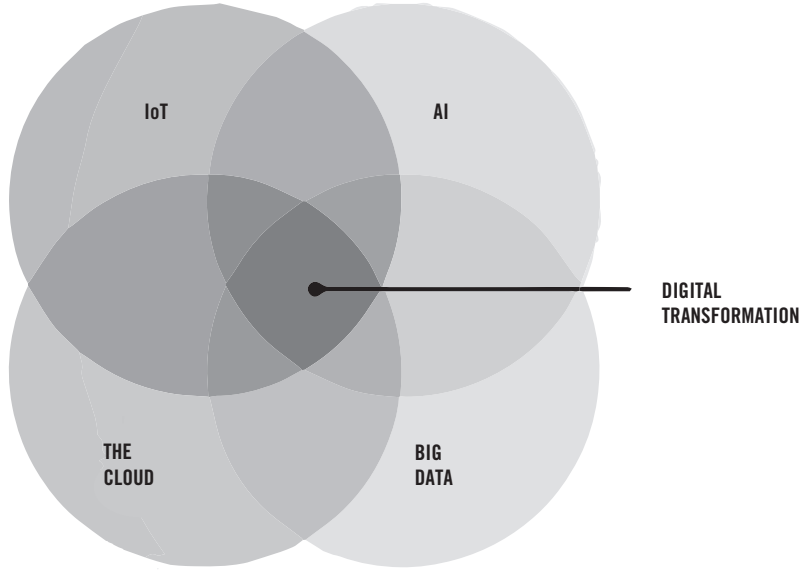
Figure 1 • Convergence of disruptive technologies, driving digital transformation



commerce, industry, government, warfare, international relations, entertainment, communication, and human interaction has remained untouched by this phenomenon.

We are now experiencing an acceleration of Bell's dynamic in the rapid introduction of new disruptive technology vectors, which promise an even greater impact: these include the Internet of Things (IoT), Artificial Intelligence (AI), Elastic Cloud Computing (Cloud), and Big Data.

SMART GRIDS. IoT refers to the ubiquitous sensoring of business and social value chains so that all devices in those value chains become remotely accessible in real or near-real time. The power grid, for example: composed of billions of electric meters, transformers, phasor measurement units and so on, the power grid is the largest and most complex machine ever developed. Indeed, it may be the most important engineering achievement of the twentieth century.

The smart grid is essentially the power grid transformed by IoT. Two trillion dollars is being spent this decade to sensor this value chain by upgrading all the devices in the grid infrastructure so that they all emit remotely machine addressable telemetry.[1] The smart meter is the most familiar example.

With the smart grid, we can aggregate, evaluate, and correlate the interactions and relationships of all the data from all the devices, plus weather, load, and generation capacity. We can do all this in near real-time and apply AI machine learning algorithms to those data as well.

This optimizes the operation of the grid, reduces the cost of operation, increases resiliency, increases reliability, hardens cybersecurity, enables bi-directional power flow, and reduces greenhouse gas emissions. Combining the power of IoT, cloud computing, and AI results in a digital transformation of the utility industry.

IoT proliferation causes an exponential increase in the volume and velocity of data. For example, reading an electromechanical meter monthly gener-

Figure 2 • Digital transformation of the smart grid

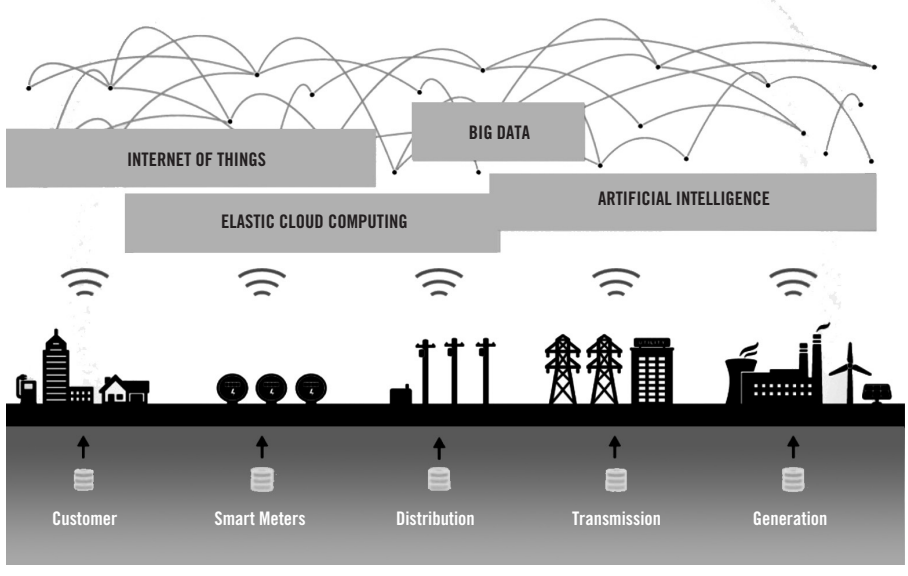
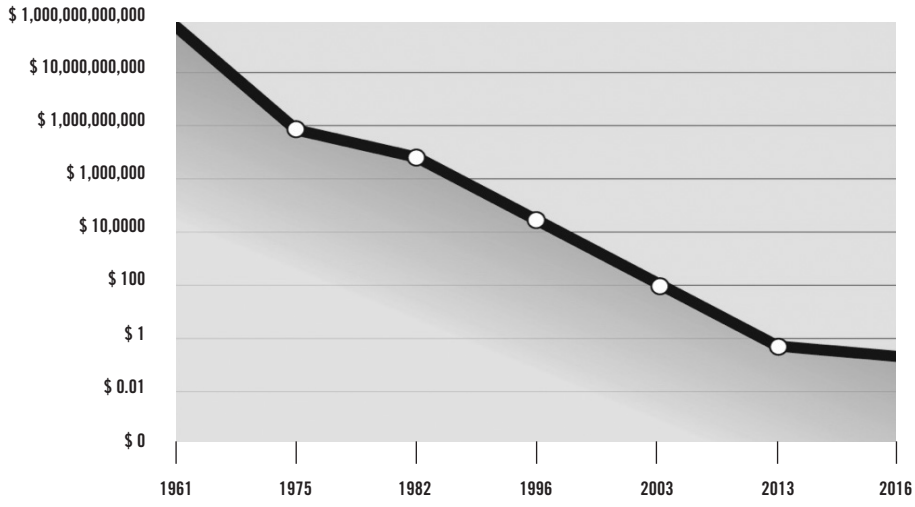


Figure 3 • Moore's Law: the cost of computing and storage continues to plummet

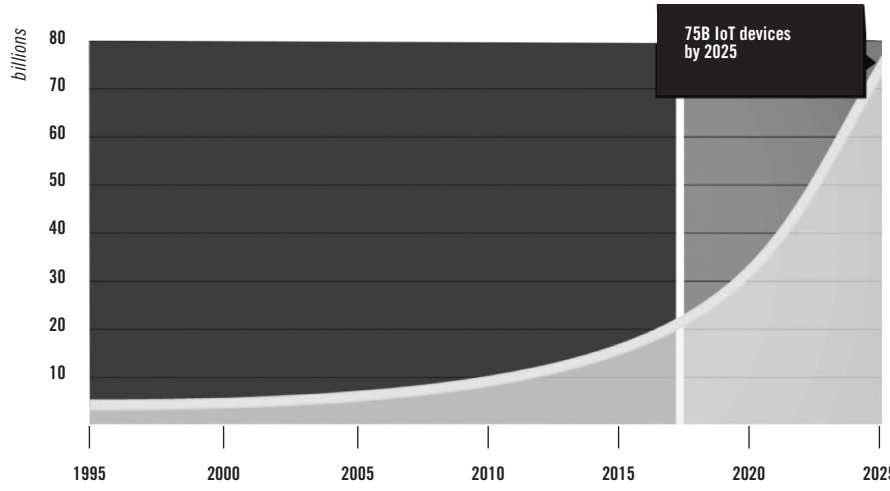


Source: Goldman Sachs,"Profiles in innovation: artificial intelligence," November 2016.

ates 12 measurements per year. A smart meter emitting readings every 15 minutes results in 35,040 measurements per year, an increase of four orders of magnitude. For instance, the large Italian utility, Enel, manages 60 million meters. Enel smart meters will generate more than 5 billion readings per day. Even more extreme, IoT phasor measurement units (PMUs) on transmission lines emit power quality signals at 60hz cycles, each generating some 2 billion signals per year.

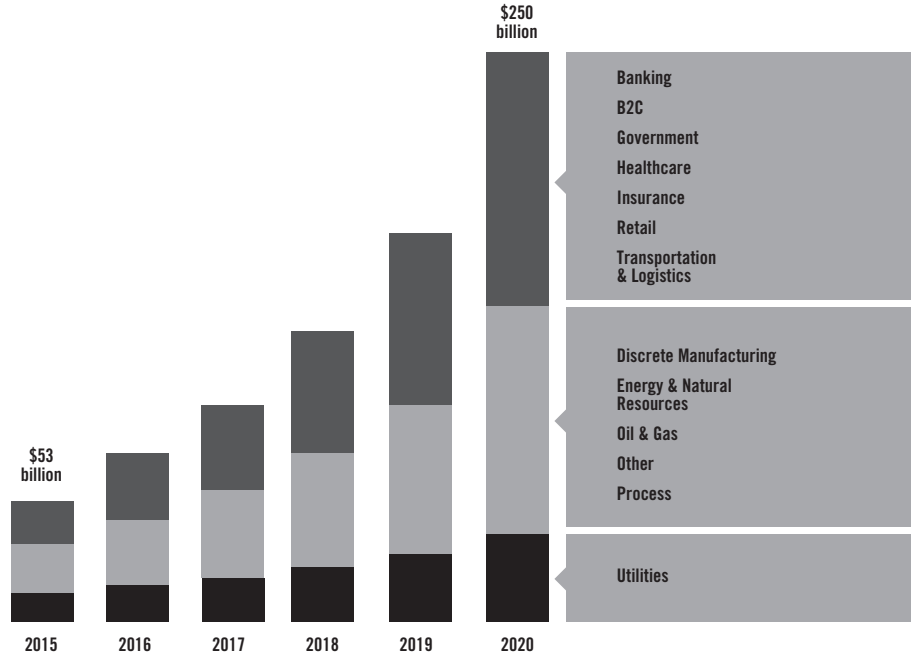
The increased number of data sources and high data velocity resulting from the sensoring of utility value chains generate unprecedented data volumes that were previously unmanageably large and effectively un-processable due to the cost of data storage and the limitations of computer processing power. With the advent of elastic cloud computing, offering virtually unlimited data storage and processing capacity at increasingly low cost, processing these data becomes both instantaneous and cost effective.

Figure 4 • IoT device proliferation across business value chains



Source: IHS Technology, "Tech companies creating strategic platforms to support the Internet of Things," April 2016.

Figure 5 • IoT: $250 billion software market by 2020



Source: BCG, "Winning in IoT: it's all about the business processes," January 2017; Gartner, "Forecast: Internet of Things, endpoints and associated services, worldwide," 2014.

The rate of IoT proliferation is staggering. In the past twenty years, nearly 20 billion sensors have been installed. In the next ten years more than 50 billion more will be installed. All value chains will be disrupted: electricity, oil & gas, manufacturing, financial services, healthcare, government services, defense, telecommunications, retail, travel and transportation, aerospace, education, consumer products, and more.

The growth rates of IoT, the cloud, Big Data, and AI are unprecedented. Within five years, more than 90% of corporate data will be processed in the cloud; accumulated data will increase by a factor of 10 to more than 163 zetabytes by 2025; and AI will grow exponentially. IoT software is expected to become a $250 billion industry by 2020.[2]

ANALYZING ALL THE DATA. "Big Data" is a commonly misunderstood concept. Yes, these data sets become increasingly large, but that is not what Big Data is all about. Historically, computation was performed on data samples and statistical methods were employed to draw inferences from those samples; these, in turn, were used to inform business decisions. With Big Data, we perform calculations on all the data; there is no sampling error. This enables AI to develop self-learning algorithms to perform precise predictive analytics. That is the promise of Big Data.

Thanks to this digital transformation, McKinsey Global Institute estimates that industries will create value ranging from $3 trillion to $11 trillion per year in 2025.[3] No industry will remain untouched.

Utility operators will produce safer, more reliable, low-cost energy with a dramatically lower environmental impact. Enel is transforming the utility industry in Europe with IoT, predictive maintenance, and fraud detection to drive new levels of reliability, cost efficiency, and clean energy. Consider AI-supported fraud detection. The economic value is immediately obvious:

a reduction in 3-10% non-technical loss at 3-5 times the efficiency of older rule-based processes. What is less obvious and more significant is the impact on generation load – estimated at a 0.2-1% reduction.[4]

DEVELOPMENTS AROUND THE WORLD. Enel will make digital investments of 5.3 billion euro over three years to expand deployment of IoT across its power grids, conventional and renewable power generation, and customer engagement. These investments are expected to contribute €1.9 billion in EBITDA (earnings before interest, taxes, depreciation and amortization) in the short term, by 2020, through improvements in grid and generation reliability, operational efficiencies, and reductions in customer churn.

Duke Energy is investing $24 billion over ten years in seven priority categories – including automated metering infrastructure and automation – to create a "self-optimizing grid" touching over 80% of Duke Energy's 7.4 million customers. These upgrades will harden the grid against storms and outages, help expand renewable energy use, and generate jobs.

Con Edison – primarily serving New York City and surrounding areas – has embarked on a $1 billion investment to sensor their entire distribution infrastructure and support the digital transformation of its internal and customer-facing operations. It will also help the utility support the NY state goal of an 80% reduction in carbon emissions by 2050.

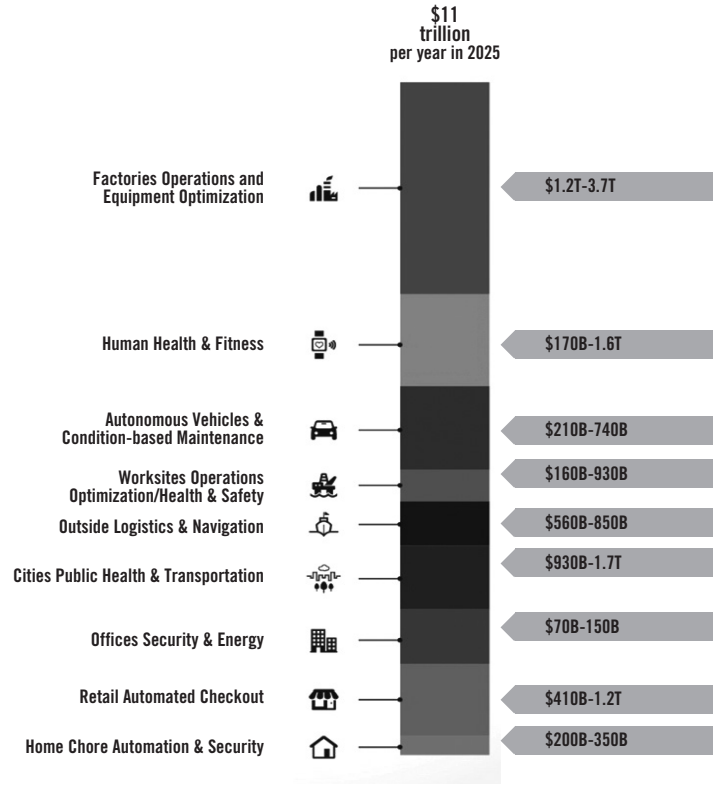
Eversource (formerly Northeastern Utilities) is pursuing a $400 million grid modernization plan with a focus on sensored assets like charging stations, and real-time optimization. Eversource is already the largest investor in energy efficiency programs in the United States, and was rated the leading US utility for energy efficiency in 2017.

New York Power Authority is working to unleash real-time data to offer build-

ing energy load forecasting, fault detection and diagnostics, continuous optimization of energy use, dynamic demand response, and solar and energy storage services. All these efforts aim to lower energy consumption by 185 trillion BTUs (British thermal units) below forecasted energy use in 2025.

Paris-based Engie, the world's largest integrated energy company, is marshalling a massive initiative to digitally transform its global integrated enterprise to assure competitive leadership in the twenty-first century. By delivering a wide range of compelling customer energy solutions based on AI and IoT, Engie projects it will expand its customer base from 23 million to

Figure 6 • $3.9-$11 trillion in business value from IoT



Source: McKinsey Global Institute, "The Internet of Things: mapping the value beyond the hype," June 2015.

30 million, double its services revenues, and further expand its low CO_2 power generation by 18 GW by 2020. EBITDA contributions from low CO_2 power generation and customer solutions is projected to grow rapidly – by 90% and 50% respectively.

Networking giant Cisco is using smart meter data to manage energy use across its 380 office sites in 165 countries. The 40 billion dollar company uses advanced AI, IoT and Big Data applications for a unified view of its complex global energy consumption and greenhouse gas emissions. In February 2018, Cisco was recognized by Barron's as the world's most sustainable company.

As solar panel manufacturers start using artificial intelligence and IoT-based analytics to monitor and optimize operations, they will enable up to a 10% increase in solar installation energy output, displacing utility energy and resulting in a reduction in greenhouse gas emissions.

FARSIGHTED LEADERS. In the past 50 years, the world has advanced from mainframe computing to minicomputing, to personal computing, and now to the internet. Software has evolved from bespoke custom programming to packaged enterprise application software, and then to software-as-a-service cloud solutions. The results include increased productivity, lower cost of operations, and increased profitability. Perhaps the most unique aspect of this technology trend is that the digital transformation is being driven from the top – by CEOs.

Enel's three-year digitalization plan, driven by Francesco Starace, projects over €1 billion in incremental earnings, mostly from digital operational efficiency across power generation and distribution. Engie's Isabel Kocher is targeting a 50% increase in earnings worth €1 billion annually. New York Power Authority's CEO, Gil Quinones, is leading the organization to become

the nation's first end-to-end digital utility. Visionary chief executives are personally driving massive digital transformations of unprecedented scale. Michael Porter, of the Harvard Business School, speculates that IoT represents a sea change in the fundamental dynamics of competition.[5] Porter posits that IoT is not a matter of competitive advantage; it is existential. 52% of Fortune 500 companies have been acquired, have merged, or have declared bankruptcy since 2000. John Chambers of Cisco predicts that 40% of today's businesses will fail in the next ten years; 70% will attempt to digitally transform, but only 30% will succeed. As he put it: "If I am not making you sweat, I should be."[6]

There is a hurricane of corporate activity in response to this disruptive threat. Industrie 4.0 – a group of leading German industrialist CEOs – is working to make sure that Germany establishes a leadership position to exploit "the ability of machines, devices, sensors and people to connect and communicate with each other via the Internet of Things."[7] The European Commission initiated the Horizon 2020 project to assure that the EU is well positioned in the IoT economy. In China, IoT, "the third industrial revolution", and "the internet of energy" are concepts central to the mandates of the 13th Five-Year Plan.

FLEE OR FIGHT. The digital transformation changes the way products are designed, manufactured, sold, delivered and serviced. It ushers in new economic models like the "sharing economy". It changes business processes, management practices, information systems. It changes the very nature of customer relationships, consumer expectations, the supply chain, pricing models, and customer service. And it changes the nature of work. McKinsey estimates this change is happening 10 times faster than that of the Industrial Revolution at 300 times the scale. That means an impact 3000 times greater.[8]

Like Darwinian speciation, our digital transformation portends highly disruptive punctuated equilibrium.[9] Many new and unanticipated enterprises will emerge; new business models will be created; enterprises will be transformed; and the majority that fail to transform will cease to exist. The opportunity is exceeded only by the existential threat.

[1] Derived from "Estimating the costs and benefits of the smart grid," Electric Power Research Institute, March 2011.
[2] See "Cisco Global Cloud Index: forecast and methodology, 2015-2020," 2016; "Data Age 2025: the evolution of data to life-critical," an IDC White Paper, April 2017; "Why Artificial Intelligence is the future of growth," Accenture, September 2016; "Winning in IoT: it's all about the business processes," BCG, January 2017.
[3] "The Internet of Things: mapping the value beyond the hype," McKinsey Global Institute, June 2015.
[4] Assuming a 50% commercial re-capture rate for non-technical losses, and 50% reduction in demand from these accounts.
[5] Michael Porter and James Heppelmann, "How smart connected products are transforming competition" and "How smart connected products are transforming companies," *Harvard Business Review*, November 2014 and October 2015.
[6] "Retiring Cisco CEO delivers dire prediction," *Business Insider*, June 2015.
[7] www.plattform-i40.de.
[8] Georgios Petropoulos, "Do we understand the impact of artificial intelligence on employment?" Bruegel, April 2017.
[9] Punctuated equilibrium is a theory in evolutionary biology which proposes that once species appear in the fossil record the population will become stable, showing little evolutionary change for most of its geological history. This contrasts with the idea that evolution generally occurs uniformly and is thus a smooth and continuous process.