

# Gartner Top Predictions 2014: Plan for a Disruptive, but Constructive Future

**Published:** 7 October 2013

---

**Analyst(s):** Daryl C. Plummer, Joseph Feiman, Pete Basiliere, Marc Halpern, Yvonne Genovese, Adib Carl Ghubril, Gregor Petri, Ken McGee, Stephen Prentice, Michael Shanler, Don Scheibenreif, Tom Austin, Richard Fouts, Julie Hopkins, Mike McGuire

These top predictions focus on disruptions brought about by digital business, the Internet of Things, smart machines and the onset of the Digital Industrial Revolution. IT leaders face a new set of realities in a much larger context.

## Key Findings

- Smart machines will both enhance and threaten the ability of employees to do their jobs.
- 3D printing will create intellectual property rights risks as well as ethical dilemmas about human transplants.
- Digital business will open new opportunities for businesses to engage customers, employees and partners in a digitally enabled ecosystem.
- The Internet of Things will bridge the gap between people and computers in ways both subtle and gross.

## Recommendations

- IT leaders must begin to strategize about how smart machines and machine-assisted tasks should enter their IT planning.
- IT leaders must prepare an evaluation of how 3D printing might affect their business supply chain or product intellectual property.
- IT leaders should architect to support the collection of consumer data and the use of that data to enable sales opportunities.
- IT leaders must identify how many, and where, devices have embedded sensors in order to design a new set of solutions targeted at wearable technologies.

## Table of Contents

---

Strategic Planning Assumptions.....	2
Analysis.....	3
What You Need to Know.....	3
Selecting Predictions.....	5
Strategic Planning Assumptions.....	6
The Digital Industrial Revolution.....	6
Digital Business.....	10
Smart Machines.....	21
Internet of Things.....	28

## List of Figures

---

Figure 1. A Graphic Presentation of Our Prediction.....	24
---	----

## Strategic Planning Assumptions

### The New Industrial Revolution

By 2018, 3D printing will result in the loss of at least \$100 billion per year in intellectual property globally.

By 2016, 3D printing of tissues and organs (bioprinting) will cause a global debate about regulating the technology or banning it for both human and nonhuman use.

### Digital Business

By 2020, the labor reduction effect of digitalization will cause social unrest and a quest for new economic models in several mature economies.

By 2017, over half of consumer goods manufacturers will employ crowdsourcing to achieve fully 75% of their consumer innovation and R&D capabilities.

By 2017, 80% of consumers will collect, track and barter their personal data for cost savings, convenience and customization.

By 2020, enterprises and governments will fail to protect 75% of sensitive data, and will declassify and grant broad/public access to it.

## Smart Machines

By 2024, at least 10% of activities potentially injurious to human life will require mandatory use of a nonoverridable "smart system."

By 2020, the majority of knowledge worker career paths will be disrupted by smart machines in both positive and negative ways.

By 2017, 10% of computers will be learning rather than processing.

## Internet of Things

By 2020, consumer data collected from wearable devices will drive 5% of sales from the Global 1000.

## Analysis

### What You Need to Know

---

Gartner's top predictions for 2014 combine several disruptive topics. Those topics — the Digital Industrial Revolution, digital business, smart machines and the Internet of Things — can disrupt the IT function in ways both subtle and gross. More importantly, these topics have disruptive effects well beyond just the IT function. In 2014, IT leaders will have to plan what they do in a larger context that includes changes that are affecting the lives of people, businesses, entire industries and even global political realities.

Gartner's 2013 CEO survey suggests that CEOs feel that business uncertainties are declining. Yet CIOs awake each day to a world of technology uncertainty and change. Savvy CIOs will get their CEOs to recognize that the changes being brought about by disruptive shifts come at an accelerated pace and at a global level of impact. IT is no longer just about the IT function. Instead, IT has become the catalyst for the next phase of innovation in personal and competitive business ecosystems.

One place where this is evident is at the beginning of the Digital Industrial Revolution, which threatens to reshape how we create physical goods using 3D printing. 3D printing is even a technology worthy of mention by U.S. President Barack Obama in his 2013 State of the Union address: "A once-shuttered warehouse is now a state-of-the-art lab where new workers are mastering the 3D printing that has the potential to revolutionize the way we make almost everything. There's no reason this can't happen in other towns." Innovations in this field cause changes that are worthy of mention by a president because 3D printing, 3D manufacturing and 3D production will change the very nature of business and/or even the structure of industries. 3D printing merges manufacturing with the supply chain by letting any business (or individual for that matter) become its own homegrown factory.

From descriptions of exciting current uses in medical, manufacturing and other industries to futuristic ideas, such as using 3D printers on asteroids and the moon to create parts for spacecraft and lunar bases, the hype leads many people to think the technology is some years away when it is actually available now and is affordable to most. More prosaic examples of current interest include Nokia allowing users to 3D print their own covers for the recently launched Lumia smartphone and consumers printing characters from games, their faces in chocolate and other novelties. And, more startling revelations can be found when considering that the political ramifications of a 3D-printed world can reshape the balance of power on a global scale.

In 2013, China continues to rise in power and position due to a large inexpensive labor force and a willingness to compete aggressively to become the "worlds' supplier" of almost anything. However, when 3D printing hits the masses, how much of China's manufacturing and distribution strength will be affected, reduced or eliminated in favor of locally printed supply? The answer is all of it. China's primary advantages, workforce and economies of scale in aggregated production, are minimized in a 3D-printed world. Those advantages cannot compete with elimination of the distribution costs associated with shipping, customization and speed of manufacturing changes — all of which are significantly more effective with 3D printing.

Our predictions on 3D printing examine the effects on intellectual property (a particularly vulnerable thing in a digital world), and on our health as bioprinting becomes more practical. Two key flags serve as indicators to look at in the next few years to validate that these predictions are on track. The global automotive aftermarket parts, toy, IT and consumer products industries will report intellectual property theft in 2016 due to 3D printing worth at least \$15 billion. And, by 2015, at least one high-profile case of the use of bioprinted organs will become a global headline news story due to its success or failure. That case will most likely be centered on the Asia/Pacific region, with Western countries asking ethical questions related to the case based more on curiosity than fear.

So, that is the context in which IT leaders must plan the future of the IT function and the future of their businesses. It has long been said that IT must partner with the business or that IT is the business. Now, a more appropriate statement would be that "the business is IT." No business can afford to ignore or underplay the impact of technology-driven disruptions that are even transforming what it means to be a business in a digital world.

To that point, the "digital business" refers to business created using digital assets and/or capabilities, involving digital products, services and/or customer experiences, and/or conducted through digital channels and communities. This definition exposes a large number of challenges that await a traditional business, such as how to take advantage of digitalized assets. The term itself often poses a challenge as most people have a vision of what digital (1s and 0s) means, but not a good idea of how a business can become digital. The term *digitalized* might be more appropriate, because it really refers to the notion that we are accessorizing ourselves, our processes and our businesses with digital assets and capabilities. For example, digitalization has changed the book business through Web commerce, digitization of books, and delivery of books through mobile digital devices (Kindles and iPads) and audiobooks played anywhere. In this way, the book business has become a digital business.

With digital business, IT leaders must come to terms with what digital really means in the context of their work. It is bigger in scope than the typical company definition of IT, because it includes

technology outside a company's control: smart mobile devices (in the hands of customers, citizens and employees), social media, technology embedded in products (such as cars), the integration of IT and operational technologies (such as telecom networks, factory networks and energy grids), and the Internet of Things (physical objects becoming electronically tractable). So, the creation of a digital business strategy may include references to how marketing is now done in a digital world.

Our digital business predictions focus on four areas of interest. Particularly, they focus on the effect digital business will have on labor reductions, consumer goods revenue and use of personal data. While these do not cover the sum total of digital business, they do highlight critical areas of medium- to long-term impact.

The emergence of smart machines adds opportunity and fear as "cognizant and cognitive systems" can enhance our processes and decision making, but could also remove the need for humans in "process and decision" efforts. CIOs will see this as a means of delivering greater efficiency, but will have to balance between the active human workforce and the cold efficiency of machines that can learn.

However, as with other areas of disruption, the effect goes beyond just what the CIO might do. What happens when a business finds that smart machines make better decisions about infrastructure operations or begin to use cloud automation to create autonomic (self-healing) infrastructure? What happens when automated assistant technologies improve the safety of automotive fleets? What happens when smart decision systems shift the makeup of global workforces? The answer to all of these questions can be difficult, but a few short-term flags will indicate where we look for answers. Our predictions on smart machines address some of these probable futures.

Finally, there is the Internet of Things, which cements the connection between machines, people and business interactions in the modern era. With the advent of massively connected devices, businesses, governments and people now have access to more information about themselves and their surroundings than they can actually act on. So, the opportunity is growing to build applications and services that can use that information to create new engagement models for customers, employees and partners, as well as to foster a new set of business and marketing models that make the word "engagement" a truly valuable asset.

While all these disruptive topics might seem as if they do not have a direct impact on the IT function, we must embrace the notion that IT is now a part of everything. As the structure of businesses and industries changes, the IT systems that support it will change and so will the skills, processes and controls needed to keep them functioning. The day when a 3D-printed computer architecture exists is upon us, and the days when digital business, smart machines and the Internet of Things change what computers are may not be far off.

## Selecting Predictions

The selection process for our top prediction research included evaluating several criteria that define a top prediction. The issues examined included relevance, impact and audience appeal. More than

160 of the strongest predictions across all research areas were submitted for consideration this year.

Our top predictions are intended to compel readers to action and to position them to take advantage of the coming changes, not to be damaged by them. Clarity and conciseness are also essential characteristics of our top predictions; the average reader of The Wall Street Journal should be able to follow each prediction and its effect on areas of interest.

These top predictions are for general technology areas, rather than being specific to industries. A separate report covers Gartner's top industries predictions (see "Top Industries Predicts 2014: The Pressure for Fundamental Transformation Continues to Accelerate"). When reading these predictions, it will become apparent that our top predictions are pulled directly from research that is topical and ongoing. They include implications and recommendations for organizations seeking change opportunities. IT professionals must examine these predictions for opportunities to increase their support for cost control, revenue generation and business transformation initiatives.

## Strategic Planning Assumptions

---

### The Digital Industrial Revolution

**Strategic Planning Assumption:** By 2018, 3D printing will result in the loss of at least \$100 billion per year in intellectual property globally.

**Analysis By:** Marc Halpern, Pete Basiliere

#### Key Findings:

- Intellectual property theft is a multinational issue. The U.S. alone has over \$300 billion in intellectual property stolen annually.<sup>1</sup>
- 3D printers employ one of seven different technologies, giving each printer a unique range of items it can make or copy.
- The plummeting costs of 3D printers, scanners and 3D modeling technology, combined with improving capabilities, makes the technology for intellectual property theft more accessible to would-be criminals.

**Near-Term Flag:** At least one major Western manufacturer will claim to have had intellectual property stolen for a mainstream product by thieves using 3D printers who will likely reside in those same Western markets, rather than in Asia, by 2015.

**Near-Term Flag:** The global automotive aftermarket parts, toy, IT and consumer product industries will report intellectual property theft worth at least \$15 billion in 2016 due to 3D printing.

**Market Implications:**

Intellectual property is the "ideas, inventions and creative expressions" that range "from trade secrets and proprietary products and parts to movies and music and software."<sup>2</sup> The very factors that foster innovation — ease and low cost using techniques like crowdsourcing, R&D pooling and funding of startups — coupled with shorter and shorter product life cycles provide fertile ground for intellectual property theft using 3D printers. Items or components of finished goods that can already be 3D printed include toys, jewelry, curios, machine parts, automotive accessories, engine parts, medical devices and weaponry.

Gartner forecasts consumer and enterprise 3D printer shipments to grow at an average of 95.4% annually through 2017. The 3D printer market will grow to more than \$5.7 billion by 2017. Importantly, 3D printers use one of seven technologies, giving each printer a unique set of capabilities and giving each the ability to reproduce someone else's property with varying degrees of accuracy and quality. Importantly, 3D printers do not have to produce a finished good in order to enable intellectual property theft. The ability to make a wax mold from a scanned object, for example, can enable the thief to produce large quantities of items that exactly replicate the original.

While the availability of 3D printing is burgeoning from a very small base worldwide, the number of 3D printer manufacturers is exploding as entrepreneurs try to emulate the success of MakerBot (sold to Stratasys for \$400 million), and Formlabs and 3Doodler (which raised \$2.95 million and \$2.34 million, respectively, on the crowdfunding site Kickstarter). Not only are entrepreneurs bringing new 3D printers to market, but governments worldwide are also financially backing 3D printing research and product development. China, which is reportedly responsible for as much as 50% to 80% of intellectual property theft depending on the industry,<sup>3</sup> has national, provincial and city-funded research initiatives. In the U.S., the government-identified 3D printing as a strategic technology for advanced manufacturing.<sup>4</sup>

Given these developments, firms will find it increasingly difficult to fully monetize their inventions, and licensees of related intellectual property will be less able to achieve the maximum benefit of their licenses. Intellectual property thieves using 3D printers will have reduced product development and supply chain costs, enabling them to sell counterfeit products at a discount. The unsuspecting customers (consumers, enterprises and government agencies including the military) are at risk of poor performing and possibly outright dangerous products.

**Recommendations:**

- CEOs must invest in new means of identifying products as genuine that cannot be duplicated with 3D printers, such as embedded chips with unique signal characteristics.
- CEOs and CIOs at manufacturers and retailers must team up to identify more effective means for consumers to validate that products are genuine.
- Chief marketing officers (CMOs) should make easily duplicated products accessible for 3D printing so consumers can print personalized copies, but only after understanding the legal ramifications of consumer-printed copies that fail or injure someone.

**Related Research:**

"Cool Vendors in 3D Printing, 2013"

"Use the Gartner Business Model Framework to Determine the Impact of 3D Printing"

"Gartner Invest/Research Community Vision: Assessing the Revolutionary Potential of 3D Printing"

"Seven Strategies to Boost Technology Innovation"

**Strategic Planning Assumption:** By 2016, 3D printing of tissues and organs (bioprinting) will cause a global debate about regulating the technology or banning it for both human and nonhuman use.

**Analysis By:** Daryl Plummer, Pete Basiliere

3D printing represents a different kind of disruption from other IT-related technologies in that it affects things largely centered on the physical world rather than the digital one. In this regard, the use of digital resources to shape our physical reality can also have the effect of shaping our fears of personal impact. The emergence of 3D bioprinting facilities with the ability to print human organs can leave people wondering what will be the effect on society. Many questions will be raised such as "Who will control the ability to receive bioprints?," "Who will ensure the quality of the organs?" and "Will there be regulation of this emerging industry?"

However, beyond the fears, there is the reality of what 3D bioprinting means in terms of helping people who need organs that are otherwise not readily available. Here, we examine a number of issues surrounding the good and bad of 3D bioprinting.

**Key Findings:**

- There will be rapid technological advances in bioprinting without widespread understanding and acceptance of the ramifications of the technology. People will be fully aware by 2016, sparking a spirited debate about the ethical, moral, political and religious aspects of bioprinting.
- Not all advances will be universally received as good or positive uses of bioprinting technology, especially when "enhanced" organs — such as replacements of a patient's organ made from his or her stem cells in combination with animal cells — are printed.
- The general public and many politicians will view the difference between printing enhanced organs and genetically modifying food crops as nonexistent, at least from a governmental policy and moral perspective, igniting the debate on bioprinting.

**Near-Term Flag:** The U.S. Food and Drug Administration (FDA) or a comparable agency in a developed nation that is charged with evaluating all medical proposals will introduce guidelines that prohibit the bioprinting of life-saving 3D printed organs and tissues without its prior approval by the end of 2015.

**Near-Term Flag:** By 2015, at least one high-profile case of use of bioprinted organs will become a global headline news story due to its success or failure. That case will most likely be centered on

the Asia/Pacific region, with Western countries asking ethical questions related to the case more out of curiosity than fear.

### **Market Implications:**

Bioprinting is the medical application of 3D printers to produce living tissue and organs. The actual printer is one component in a system directed by medical imaging data and software that specifies the design of living tissue and organs to create a functioning human or nonhuman organ from an individual's own or other cells.

The day when 3D bioprinted human organs are readily available is drawing closer. Rapid technological advances have been made without the full awareness of the general public and politicians regarding the ramifications of this work. For example, researchers at Hangzhou Dianzi University (in China) announced in August 2013 that it had invented the "biomaterial 3D printer Regenovo," capable of printing a small working kidney that lasted four months. Earlier in 2013, a two-year-old child in the U.S. received a windpipe built with her own stem cells seeded onto a plastic scaffold onto burn wounds.

While each of these initiatives and others are no doubt well-intentioned, there is a potentially negative side to these developments. A study on complex heterogeneous tissue constructs containing multiple cell types prepared by inkjet printing technology (in January 2013) involved "human amniotic-fluid-derived stem cells, canine smooth muscle cells and bovine aortic endothelial cells (that) were separately mixed with ionic cross-linker calcium chloride, loaded into separate ink cartridges and printed using a modified thermal inkjet printer. The bioprinted constructs were able to survive and mature into functional tissues with adequate vascularization *in vivo*." The study, which combined human and animal cells, demonstrated the feasibility of fabricating complex heterogeneous tissue constructs containing multiple cell types using inkjet printing technology. While demonstrating yet another advance in inkjet printing technology, the key point is that the combination of human and animal cells happened without general public awareness.

We cannot expect that examples such as these, which are what most people would characterize on the surface as good or positive uses of bioprinting technology, will always be the case. What happens when complex "enhanced" organs involving nonhuman cells — not just straight replacements of patients' organ made from their stem cells — are made? What is the difference between printing enhanced organs and genetically modifying food crops, at least from a governmental policy and moral perspective?

People will be fully aware of the plusses and minuses of bioprinting by 2016, sparking a spirited debate about whether to allow complex heterogeneous tissue constructs containing human and animal cells to be produced. If the debate is resolved in the affirmative, the question of who gets access to life-saving, or at least life-altering, 3D-printed organs — the people or the countries with the monetary resources — will have to be addressed.

The examination of bioprinting will extend into intellectual property rights regarding organs and tissue ownership. For example, while U.S. patent law does not allow human organisms to be patented, does that protection extend to individual organs?<sup>5</sup> In this case, not only will personal,

political and moral viewpoints figure into the discussion, but investor interests will also be a powerful force in the discussion.

### Recommendations:

- Research institutions and government agencies that are or may be providing research funds or conducting their own projects must develop guidelines and implement policies that ensure thorough review of all projects involving bioprinting of human, nonhuman, and combined human and nonhuman tissues and organs.
- Enterprises must also develop policies regarding acceptable research parameters for bioprinting, as well as investigating the legal aspects of protecting the resulting intellectual property.
- Bioprinting hardware and software technology providers must investigate the legal ramifications of the use of their technology by customers engaged in human and nonhuman tissue and organ bioprinting research.

### Related Research:

"Cool Vendors in 3D Printing, 2013"

"Use the Gartner Business Model Framework to Determine the Impact of 3D Printing"

"Emerging Technology Analysis: 3D Printing"

### Digital Business

**Strategic Planning Assumption:** By 2017, over half of consumer goods manufacturers will employ crowdsourcing to achieve fully 75% of their consumer innovation and R&D capabilities.

**Analysis By:** Don Scheibenreif, Michael Shanler

### Key Findings:

- Although the word "crowdsourcing" was coined in 2006, consumer goods manufacturers used elements of crowdsourcing techniques years before that. Consumer goods companies must crowdsource more aggressively than most other industries to stay current with the constant shift in attitudes and habits of millions of consumers. Engineers, scientists, IT professionals and marketers are tapping ever larger (and more anonymous) pools of intellect and opinion through aggressive use of digital channels. Most are piloting or actively using new product innovation (NPI) tools to engage the public, by posing questions (directly and indirectly) via user forums, supply chain collaboration sites and virtual focus groups, or through quantitative research surveys. Today's technology makes it easier to digitally crowdsource a much broader range of tasks and goals. This massive shift toward crowdsourcing is enabled by:
  - Advertising (Doritos consumer-created commercials on YouTube)<sup>6</sup>

- Online communities (Clorox's Burt's Bees on Facebook)<sup>7</sup>
  - Scientific problem solving (Johnson and Johnson's Intelli-Ideas)<sup>8</sup>
  - Internal new product ideas (Kimberly Clark using Sopheon's Accolade Idea Lab)<sup>9</sup>
  - Creative problem solving (Heineken's Ideas Brewery)<sup>10</sup>
  - Consumer-created products (L'Oreal's Michelle Phan line<sup>11</sup> and Nike's NikeiD custom shoes<sup>12</sup>).
- Platforms such as Quirky can help consumer goods manufacturers tap into interested consumers — whether it is to generate new ideas or turn ideas into products.
  - In addition to the listing of more than 125 technology vendors (and examples of their applications) on Wikipedia, Gartner sees hundreds of other, not actively publicized offerings that can be applied to tasks such as logo and package design, gamification, and product testing.
  - Consumers themselves — powered by mobile connectivity — are increasingly using crowdsourcing in new and novel ways in their own lives. Some examples include venture capital funding (Kickstarter), new product invention (Quirky), travel (Airbnb) and household chores (LawnMowingOnline.com). As consumers discover the power they possess to access value and influence others, their ability to become skilled contributors of insight for companies will increase over time.
  - Consumer goods manufacturers spend more than \$20 billion annually on innovation and R&D, yet the new product success rate is still only 3%. While crowdsourcing may not change the success rate, the vast array of new tools and technologies will make it easier and less costly to engage crowds and establish on-demand, high-value connections.

**Near-Term Flag:** Deployments of crowdsourcing applications in consumer goods online platforms will increase by 10% in 2014, reflecting growth in the number of examples of crowds supporting consumer goods strategies.

**Near-Term Flag:** Consumer goods companies that crowdsource solutions in marketing campaigns or new product development will enjoy a 1% revenue boost over noncrowdsourced competitors by 2015.

### Market Implications:

Consumer goods companies using crowdsourcing can increase their speed to market, and do so for lower development costs and with increased chances for success by delivering products that are closely aligned with a more realistic view of consumer needs. We see these processes allowing consumer goods companies to fail even faster, so they can, in turn, learn faster and increase their success rates.

Internally applied crowdsourcing techniques will increase employee engagement when injected into closed processes — but only if crowdsourced findings are acted on. A Gallup study shows that

public companies demonstrating top-decile employee engagement deliver 72% higher earnings per share than their peers. Therefore, more opportunities to apply internal social collaboration techniques, such as crowdsourcing, should have a material effect on overall company performance. Good listening and crowdsourcing technologies will not be enough; firms must know how to interpret what the crowds mean and smartly apply filters to match technology capabilities and consumer pull.

Broad application of crowdsourcing also faces challenges. For example:

- Consumer goods companies will protect their well-established innovation and R&D infrastructures in light of the growth of crowdsourcing.
- Protecting intellectual property and trade secrets in an increasingly transparent world will be difficult, because once an idea is in the public domain, it is difficult to capture as a patent asset.
- Competitors using sophisticated social media monitoring technologies can track your programs and develop more insightful competitive intelligence.
- Without the right processes and management, value from crowdsourced work could be low, so managing compensation and payments carefully and within ethical guidelines is essential, especially for cross-border efforts.
- Even if used the right way, crowdsourcing could lead to the repurposing or elimination of existing roles.

Gartner sees crowdsourcing technologies as accelerators of insight, innovation and research processes to keep up with the speed of consumers. Consumer goods companies need all the advantages they can get as they try to grow faster than the population or GDP growth.

### **Recommendations:**

Gartner recommends that consumer goods manufacturers, as well as other industries, consider these factors of successful crowdsourcing:

- Re-examine all internal processes that involve the development of innovative ideas, not just marketing or R&D. Pay equal attention to internal versus external processes.
- Focus on building the right culture to support bottom-up contributions. Without the right established culture — employees who care — these initiatives are likely to fail.
- Change your metrics to focus on crowdsourcing ideas, rather than developing them exclusively as a way to drive a shift in mindset among R&D associates.
- Identify situations in which the problem is well-understood, but solutions are not. Specify the task or challenge (including time frame for responses, guidelines and rules), and be able to notify potential contributors.
- Partner with a technology vendor that can help you manage the logistics and coach you on matters such as process, payment, competitive intelligence, intellectual property implications and quality control.

- View crowdsourcing as a way to vet or challenge ideas, but don't expect the crowds to consistently deliver the original idea that drives your next phase of growth — that comes from the right internal people who know how to listen to the crowds.

**Related Research:**

"Hype Cycle for Consumer Goods, 2013"

"Predicts 2013: CRM for Customer Service and Support in the Age of the Everywhere Customer"

"Who's Who in Innovation Management Technology"

"Cool Vendors in Consumer Goods, 2013"

"Seven Strategies to Boost Technology Innovation"

"Social Media Mass Participation, a Suitability Framework"

**Strategic Planning Assumption:** By 2020, the labor reduction effect of digitalization will cause social unrest and a quest for new economic models in several mature economies.

**Analysis By:** Gregor Petri

As the world returns — at least in most regions — to economic growth and stability, concerns about this growth not creating the expected number of jobs is increasing. Unlike previous productivity innovations — such as the steam machine, assembly line, telecommunications and electronic data processing — increased digitalization does not seem to support the perpetuum mobile (of increased worker productivity resulting in economic growth that led to demand for more jobs instead of fewer) that the Western world enjoyed for centuries.

As jobs move from agricultural to manufacturing to services, it seems there is no place to go as services increasingly become digitized. And to make things worse, these reductions seem to especially impact the middle class — the engine of the traditional economic growth model.

The fact that Kodak used to employ 130,000 people to basically deliver the same service as Instagram does with 13 people is perhaps one of the most illustrative examples of this trend (see Jaron Lanier's "Who Owns the Future?"). But it happens across many industries; just compare head counts at Skype versus AT&T, Gmail versus the U.S. Postal Service or Netflix versus Blockbuster. In the automotive sector, skilled car mechanics are replaced with diagnostic equipment and minimum staff are trained to swap modules. Consumer travel agents are rapidly becoming an endangered species. Financial institutions are making operational and customer-facing jobs redundant on a large scale, closing back offices that used to employ hundreds of people, and reducing branch offices — in the best cases — to customer meeting places where the last human employee serves coffee while digital (nonhuman) advisors recommend new financial online offerings, or to downloadable apps and interactive websites.

Another (somewhat more futuristic) example: Today, the supply chain of pharmaceutical companies typically entails designing a drug, getting FDA approval, forecasting demand, producing in bulk and shipping to pharmacies, which deliver from stock to patients based on doctors' prescriptions (a process that entails many complex and bureaucratic steps that employ thousands of trained professionals). Now, imagine a (at this moment, fictional) supply chain in which the patient submits his or her DNA (digitally, based on a blood sample analyzed by a local USB device on a laptop or tablet), and, based on that DNA sample, the pharmaceutical company calculates the appropriate drug — likely leveraging third-party cloud compute capacity and not the local IT department, as this requires massive capacity. Next, the drug is printed (using an organic or biological 3D printer) — initially at a third party print-shop for biomaterials, but later maybe at the pharmacist or even directly at the patient's home. Most of today's unique and critical pharmaceutical processes (requiring massive process rigor and labor), such as batch control, secure label printing and multiyear drug approval processes, become largely irrelevant when pharmaceuticals become one-off digitally designed, produced and administered substances. Similar scenarios can be drawn for media (for example, with virtual or even deceased actors playing CGI roles in virtual plots).

The result of all this is not just a reduction in jobs and a redistribution of wealth from labor to capital or intellectual property, but also a massive reduction in cost and price, leading to many of the "free" offers we now see on the Internet.

While the cost reduction of globalization-led offshoring was often temporary and limited (with wages in offshore destinations rapidly increasing as those economies grew), the cost reduction effect of digitalization can be endless, with costs theoretically approaching (although not reaching) zero. So bringing back jobs, as we now see in U.S. manufacturing — be it at much lower hourly rates and with a lot less labor content per product than when they were originally exported — will be an unlikely scenario for any digitized jobs.

### Key Findings:

- Digitalization is reducing labor content of services and products in an unprecedented way, thus fundamentally changing the way remuneration is allocated across labor and capital. Long term, this makes it impossible for increasingly large groups to participate in the traditional economic system — even at lower prices — leading them to look for alternatives, such as a bartering-based (sub)society, urging a return to protectionism or resurrecting initiatives like Occupy Wall Street, but on a much larger scale. Mature economies will suffer most because they don't have the population growth to increase autonomous demand or powerful-enough labor unions or political parties to (re)allocate gains in what continues to be a global economy.
- Seeing this trend, some European countries may retarget their education offerings from preparing youth for traditional white collar administrative and middle management jobs to more high-touch service jobs, like trend watcher (a newly launched curriculum in the Netherlands) or fitness instructor (trying to capitalize on the growing obesity trend), only to see these jobs replaced by big data analytics engines or to find that the next generation of "self-service" gyms uses customer programmable equipment, automatic access gates, personal apps and digital (video) group instructions to reduce employee head count to one person legally required to be capable of first aid, but not a trained instructor.

**Near-Term Flag:** A larger-scale version of an Occupy Wall Street-type movement will begin by the end of 2014, indicating that social unrest will start to foster political debate.

**Near-Term Flag:** By 2015, traditional paid jobs will begin to be replaced by bartering-based systems and voluntary roles in areas such as patient care.

### **Market Implications:**

Unlike consumers in rural areas, who can decide to shop at a local retailer instead of at a nearby megastore to (at least temporarily) preserve the status quo, individual companies will be largely unable to change the course of events. Not digitizing, and thus not being able to reduce product prices or launch free(mium) offers, will simply put them out of business when competing with organizations that do. Also, given today's degree of globalization, local and regional governments and politicians will, to a large extent, not be able to reverse this trend.

While Brynjolfsson and McAfee, in "Race Against The Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy" still see some opportunities to tweak the system, others, such as Lanier, urge for more fundamentally different approaches. Interesting in this context are the "Small is beautiful" ideas of 20th century economic thinker E.F. Schumacher.

Digitalization — where software drives the value-added process (or even largely is the process) — has very low (close to zero) marginal costs for increasing reach or production. This tends to drive digitalized markets toward a winner-takes-all endgame, but a winner that may feel like King Midas: Everything it touches turns to gold, but gold is of relative value if what you really need is food (or, in this case, customers able to buy your products). In a sense, a sustainable model will no longer be about winning; it will be about participating, and enjoying the journey, instead of the destination.

### **Recommendations:**

Companies, especially technology companies, need to be cautious not to be seen as the culprit causing or driving these labor effects. If public opinion turns against them, the backlash in the form of buyer strikes, labor unrest and increased scrutiny of owner and executive compensation will be detrimental.

Executives and nonexecutive board members need to start thinking in terms of participating instead of winning, giving the idea of sustainability a whole new meaning. This will require identifying new types of incentives to function as the carrot on a stick that drives appropriate performance and efficiency, as the old type of economic metrics (ever better/bigger, ever faster, ever cheaper) starts to become counterproductive (remember, if the horse eats, the carrot — the incentive effect — is gone).

Digitalization as such — with its potential to increase productivity, efficiency and even quality (or at least length) of life — is not the culprit here. The issue is that the old economic mechanics and models are leading to undesired effects and consequences (in participation, allocation and enumeration) when applied unchanged to the new digitized reality.

One thing is certain: The new model cannot be like the 1960s Hanna-Barbera cartoon "The Jetsons," in which George Jetson was paid a full wage — enough to support a household of five, including Rosey the robot nannie — for simply pushing one button a day.

#### **Related Research:**

"Understanding the World in 2023"

"Digitalizing the Business"

"Business Model Innovation: Unleashing Digital Value Everywhere"

"The Three Types of Digital Business Leader"

"The Future of the Internet: Fundamental Trends, Scenarios and Implications to Heed"

"Three Factors Will Significantly Impact Enterprise Cloud Use in the Near to Midterm Future"

"Digital Government Must Be Both Inward- and Outward-Looking"

"Gartner's Digital Banking Taxonomy"

"How the Nexus of Forces Deeply Transforms Communications Service Providers' Strategy"

#### **Other Related Resources:**

E. Brynjolfsson and A. McAfee, "Race Against the Machine: How the Digital Revolution is Accelerating Innovation, Driving Productivity, and Irreversibly Transforming Employment and the Economy," Digital Frontier Press, 23 January 2012.

J. Lanier, "Who Owns the Future?," Simon & Schuster, 7 May 2013.

"Small Is Beautiful: A Study of Economics As If People Mattered," by E. F. Schumacher (first published in 1973).

**Strategic Planning Assumption:** By 2017, 80% of consumers will collect, track and barter their personal data for cost savings, convenience and customization.

**Analysis By:** Andrew Frank, Mike McGuire

The much-hyped big data movement is set to disrupt the multibillion-dollar consumer data marketplace with transformational results.

The escalation in consumer awareness of data collection practices has set the stage for offering consumers more control over the disposition of personal data — collected both online and offline. This affects three sectors in particular:

- Online portals and retailers, especially Amazon, Google and Facebook, which collect vast troves of data on users

- Communications service providers, which have visibility into highly revealing data, especially that which is associated with mobile device usage
- Financial services (especially retail banking and credit card services), which keep detailed records of consumer transactions

Each of these sectors is subject to regulatory restrictions on the use of personal data, although the portals are largely governed by self-regulatory standards. Furthermore, what regulation may lack in thoroughness and responsiveness is protected by an effective alliance between an aggressive press and a well-informed community of privacy activists eager to expose transgressions. Yet, acquiring explicit advance informed consent from customers to share personal data still provides an effective shield against most opposition. Thus, as increasing demand and scarcity drives up the value of such data, incentives grow to entice consumers to share it voluntarily.

Meanwhile, consumer interest in self-tracking also suggests that consumers, for their part, are investing more time and energy in collecting data about themselves. They increasingly view such data as a key asset for life improvement, which is potentially consistent with the idea of trading it for value under the right circumstances.

The increasing need for differentiated data answers the objection that marketers may have little need to compensate consumers directly for data as long as consumer data is plentifully available from third-party aggregators, as it is today. The challenge of today's consumer data marketplace is that it's equally open to competitors, reducing it to a baseline rather than a competitive advantage. Although some competitors might claim an advantage in their approach to analyzing such data, over time, analytics are likely to follow a similar course of commoditization, forcing companies to seek unique data for differentiation. Although compensating consumers directly for data does not guarantee its uniqueness, it does create opportunities, similar to loyalty programs, to add switching barriers to customer relationships and cultivate loyalty through personalized service.

In the past, custom data collection mostly involved targeted surveys or focus groups. More recently, studies have shown that behavioral data, especially when collected over significant periods, is usually a better predictor of future actions than self-reported indicators, such as purchase intent or social sentiment analysis. This is leading to a growing demand among consumer marketers for historical behavioral data, especially transactional, and also data associated with life stage transitions that may cause secular changes in behavior patterns. Consumers do not yet have much access to such data about themselves, but as the companies that do begin to grant access in the name of transparency (such as Acxiom recently did, within limits), consumer demand for control is likely to follow.

Beyond discounts and rewards currency, consumer motivations for engaging in data transactions include control (knowledge of how interests/purchases/actions are tracked and categorized by third parties), participation (in developing/refining products/services the consumer finds valuable) and convenience (e.g., credit and preferential treatment from a vendor/service provider).

**Key Findings:**

- Consumer awareness of the extent to which communications channels, websites and apps are being exploited to reveal personal information to both government (e.g., The National Security Agency [NSA]) and commercial (e.g., Acxiom and Google) interests is escalating. In response, companies are developing apps and services designed to let consumers control how and when marketers collect data.
- Meanwhile, consumer interest in extensive technology-enabled self-tracking and measurement products and services is rising, as embodied by products like Nike Fuel and communities like the Quantified Self.
- Marketers are growing more sophisticated in their use of consumer data for competitive advantage, leading to an increasing need for differentiated data, customer opt-in, and behavioral (rather than attitudinal) data points. At least one consumer is already in on this trend: He is auctioning off his personal data on Kickstarter.

**Near-Term Flag:** The number of Kickstarter-based auctions of personal data will increase by triple-digit percentages by the end of 2014.

**Market Implications:**

- The rising stakes for custom voluntary consumer datasets will foster new competition among major Web entities (Google, Amazon and Facebook), new entrants seeking nontraditional revenue from financial services and telecom, and incumbent consumer data aggregators (Acxiom, Experian, Harte-Hanks and Merkle) and data management platform providers aligned with less-pervasive consumer-facing brands that may have uniquely intimate relationships with customers.
- Startups such as Personagraph are taking the earliest step in developing a branded smartphone app (for consumers) and a marketplace (for marketers and advertisers) that links consumer profile information and behavioral data (via the app) to a real-time marketplace where advertisers and marketers can find what amounts to qualified customers (based on Personagraph's cloud services to identify and track consumer interests and preferences).
- To win at this, marketers and intermediaries will need sophisticated big data analytics capabilities to appraise the potential value of specific consumer data in real time, and to predict and automate the generation of offers based on numerous conditions that maximize the perceived value to the individual. This difficult analytics problem will play an increasingly important role in establishing a new hierarchy of marketing power among consumer-facing organizations.

**Recommendations:**

- Marketers and marketing analysts need to evaluate predictive and prescription models based on behavior to determine long-term data collection and reward strategies.

- Consumer marketers need to keep close track of providers in the consumer data collection space and understand how service provider such as Personagraph and Reputation.com can influence preferences.
- Consumer-facing organizations with high visibility into unique and valuable customer data should begin exploring the degree to which customer goodwill can be translated into receptivity to opt-in data brokering services. Investigate the nature and value of offers required to gain acceptance by customer segment, the market value of the data thus collected, and the measures required to minimize risk and fulfill consumer trust and legal requirements that the data be secure and limited in distribution to appropriate partners.

### Recommended Reading:

"Analytics Gets Personal with the Quantified Self"

"Hype Cycle for Advertising, 2013"

"Hype Cycle for the Internet of Things, 2013"

"Overcome the Four Inhibitors of Data-Driven Marketing"

**Strategic Planning Assumption:** By 2020, enterprises and governments will fail to protect 75% of sensitive data, and will declassify and grant broad/public access to it.

**Analysis By:** Joseph Feiman

### Key Findings:

- An ideal way to protect sensitive data is not to have sensitive data.
- The amount of data stored and used by enterprises and governments is growing exponentially (rapid adoption of big data is just another example). An attempt to protect it all is unrealistic. Organizations' resources are never sufficient to catch up with the constant growth in the amounts of data to be protected and with the complexity of protection. Moreover, enterprises and governments often do not own and control external entities, such as social and professional communities, open-source organizations, and international hackers' groups, with their sources of data and their abilities to collect, share and disclose data. By 2015, we will witness several successful, internationally known hacker attacks on sensitive data that governments and prominent enterprises will have failed to protect.
- Protecting all data is not only unrealistic, but is also unnecessary, because much of the data we think is sensitive is not. Most organizations lack understanding of what should and should not be protected, and thus attempt to protect most/all of it. This happens because they lack thorough and comprehensive tracking and security/privacy classification of data, which incapacitates them as far as determining what data they have and what exactly to protect. Data protection efforts are often excessive. Also, organizations often miss the fact that the data they protect can be obtained via Internet from a variety of open sources: directly or through

inferences. Protecting that data is not justified or possible. By 2017, several governments and international organizations will adopt legislation releasing into the public domain massive amounts of data previously considered sensitive.

- Opening more data to a broader audience is often more beneficial than protecting it. There is a strengthening global social trend toward openness, which demands enterprises and governments to share their data with employees, citizens and the world community. There is also a social trend among individuals toward sharing their personal data that, in the past, has been considered strictly private (such as data about personal illnesses, family issues or financial hardships), and more individuals nowadays do not expect/request enterprises and governments to protect that data. Modern social networks encourage and technologically enable such openness and data exchange.
- Overall, there is no need, nor there are abilities, budgets and resources, to protect as much data as is stored (and keeps accumulating) in the data repositories. Protecting all information that seems to be sensitive is unrealistic and unnecessary. Making more data available to a broader audience — even making it public — brings social and business benefits. Resources released from protecting most or all data should be used to protect minimal amounts of the most sensitive data.

**Near-Term Flag:** By 2015, at least one more Snowden moment or WikiLeaks moment will occur, indicating an upward trend in corporations' and governments' acceptance that they cannot protect all sensitive information.

### **Market Implications:**

Instead of facing the unfathomable task of protecting all data, enterprises and governments will focus on protecting only a small part of it, but protecting it well. For that, they will get necessary resources, once they narrow down what really needs protection.

Society will win as well. Getting access to newly available information, society will establish better control over government and business, preventing abuses of power. At the same time, society will gain greater trust in government and business. Newly available — declassified and placed in broader or open access — data will be analyzed and processed by crowdsourcing efforts, and numerous useful applications for science, medicine, business, etc., will be placed in the public domain.

### **Recommendations:**

- Enterprises and governments should accept that sharing most seemingly sensitive, data is neither dangerous nor unprofitable, politically or economically.
- Rigorous sensitive data discovery and classification should be adopted and applied before data protection efforts begin.
- Cases for data protection should undergo public, parliamentary and professional communities' scrutiny before being adopted.

- Minimalism should be a guiding principle: Protect only the data that is absolutely necessary to protect. Give access to the rest of the data to a broader circle of employees and citizens, with an ultimate objective to make most of data publicly available.

### Related Research:

"Hype Cycle for Application Security, 2013"

"Hype Cycle for Data and Collaboration Security, 2013"

"Magic Quadrant for Data Masking Technology"

"Address Nine Security Issues Before Encrypting Data in a Remote Data Center"

"Tackle Six Security Issues Before Encrypting Data in the Cloud"

"2013 Buyer's Guide to Content-Aware DLP"

### Smart Machines

**Strategic Planning Assumption:** By 2024, at least 10% of activities potentially injurious to human life will require mandatory use of a nonoverridable "smart system."

**Analysis By:** Ken McGee, Steve Prentice

The increasing deployment of smart systems capable of automatically responding to external events is increasing all the time, but there remains deep-seated resistance to eliminating the option for human intervention. At least in the more litigious Western markets, this is heavily influenced by questions of liability and the need for someone to ultimately be responsible for every event. At the same time, it reflects a highly subjective (and usually incorrect) assessment of real versus perceived risk that appears to be inherent in the human psyche. Simply put, most people believe they can react faster than they actually do, that they can accurately assess risk and predict outcomes (generally untrue), and that automatic smart systems cannot perform as reliably and effectively as they can. In the past, that may have been partially true, but with the ever-advancing power of microprocessors linked to a growing array of real-time sensors, allied with vastly improved analytics, the superior capabilities of smart systems (compared to humans) is increasingly a reality.

In the transportation sector, there is a long-established track record of the deployment of smart systems and an increasing tendency to make them nonoverridable and standard equipment, even in midmarket models. Examples include anti-lock braking systems, seat belt tensioners, air bags and the new generation of active crash avoidance systems, which will automatically apply the brakes to prevent a frontal collision if the driver fails to act in time. In aviation, automated landing systems and automatic pilots are in daily use around the globe; although the tradition of a human pilot (or several) in the cockpit remains valid, trials have already demonstrated that this is technically unnecessary. However, the assumed market resistance to fully automated air travel, combined with current regulatory requirements, means that the human pilot will remain — at least for now. At the same time, fully automated (driverless) "people mover" transit systems are commonplace and the

autonomous vehicle is slowly appearing on public highways (albeit with an onboard human ready to take over control, just in case).

### Key Findings:

- The capability, reliability and availability of appropriate technology is not the issue. The willingness of the general population to accept initial widespread deployment and increasing removal of manual override options is the issue.
- Mandated deployment of automated systems requires changes in legislation and regulation, and will also most likely require limitations of liability, such as those that are currently applied in the aviation sector, to encourage manufacturers to implement systems as standard equipment.
- Regions where a high level of "blame culture" encourages a high level of legal activity and punitive damages will have delayed mandated deployments of nonoverridable systems, thereby eliminating the potential savings in human life that such systems have been shown to deliver.

**Near-Term Flag:** Midpriced cars with automated assist technology added as standard equipment will increase through 2014 as an indicator of adoption.

**Near-Term Flag:** The cost of insurance premiums will decline through 2015 as an indicator of acceptance that automated assist systems improve safety.

**Near-Term Flag:** At least one legislative representative will broach the topic publicly in 2014 about starting legislative discussions on automated assist technologies that will include a tentative debate on increased demands for limits of liability.

### Market Implications:

We see no issues with the development and deployment of appropriate technology to meet the requirements of this prediction well within the time scale. The stumbling block will be the legal requirement for mandatory use that will necessarily take time to achieve. In industrial and manufacturing environments, where potentially hazardous situations arise, current safety regulations require organizations to demonstrate a duty of care and deploy appropriate solutions to minimize risk. Many of these will be automatic, nonoverridable systems (for example, safety interlocks). As microprocessor control and sensor deployment advances over the next decade, such systems will be increasingly applied to a wider range of situations. For example, the likely deployment of automated (robotic) systems on the shop floor will spur additional legislation to protect the human workforce. Hence, organizations will increasingly implement and feature these systems for the purpose of competitive advantage.

In consumer-oriented markets, increasing deployment will result in falling prices. As such, systems will become standard equipment in a wider range of situations, and reducing risk without overly increasing costs will drive competitive differentiation and advantage.

Calls for and acceptance of mandated use may be significantly impacted (both positively and negatively) by high-profile instances in which such systems demonstrably saved lives (or failed to do so). Ultimately, mandatory use will be a politically driven decision.

**Recommendations:**

- CIOs and IT leaders should utilize their knowledge of current and forthcoming technological developments to assist the organization in identifying where and how the deployment of automated systems might improve product safety and/or enhance competitive attractiveness across the entire range of organizational products and activities.
- Monitor falling technology prices and advances in data collection and analysis to highlight when new potential opportunities might become financially viable or affordable for more widespread deployment.
- The growing digitalization of our everyday environment and the widespread usage and acceptance of digital devices as interfaces to more complex systems should be monitored to assess the social zeitgeist and potential customer acceptance (even as a premium feature) of automated systems, and this insight should be used to drive product development and release schedules.

**Strategic Planning Assumption:** By 2020, the majority of knowledge worker career paths will be disrupted by smart machines in both positive and negative ways.

**Analysis By:** Tom Austin

A broad and powerful range of new systems — smart machines — is emerging this decade. They do what we thought only people could do and what we didn't think technology could do. Examples include virtual personal assistants (first envisioned in the IT era by Apple with its 1987 Knowledge Navigator video), and smart advisors (exemplified by the Clinical Oncology Advisor, jointly built by WellPoint and IBM, to stay on top of the huge body of medical and scientific literature and provide advice to clinicians when presented with a patient's electronic health record).

Smart machines exploit machine learning and deep learning algorithms. They behave autonomously, adapting to their environments. They learn from results, create their own rules, and seek or request additional data to test hypotheses. They are able to detect novel situations, often far more quickly and accurately than people.

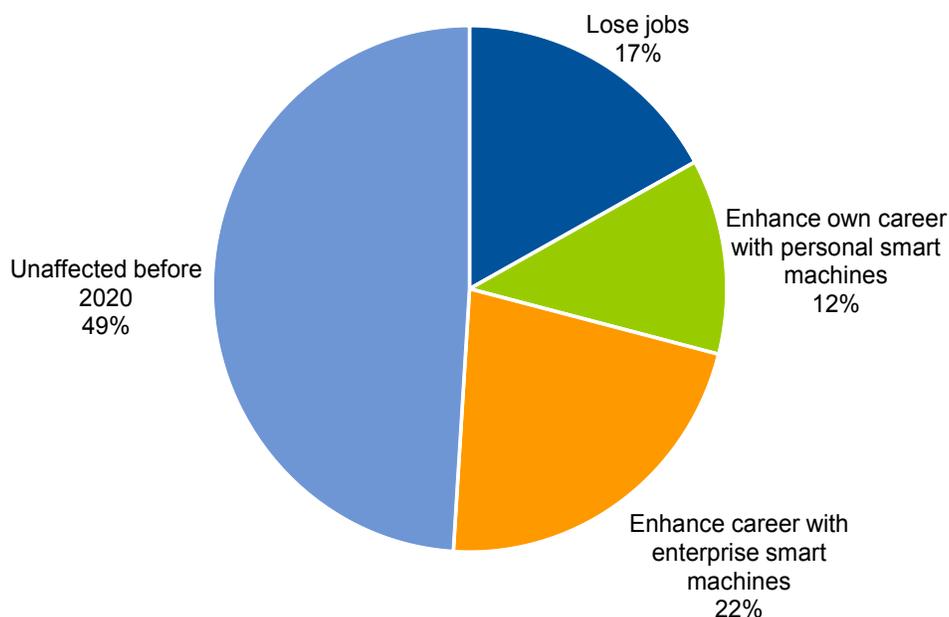
Smart advisors are specifically focused on a particular content domain, a particular class of user or both. They excel at evaluating new evidence and finding where and how it may fit with existing content, offering the user a shortlist of best matches based on all the available information. They make smart people smarter.

Virtual personal assistants are focused on the behavior — habits, activities and needs — of a user or small set of users, independent of the content domain they work in. They are context experts that learn by watching their users and finding opportunities to help them be more effective in dealing with the huge volume of information pouring into their world. They make smart people more effective.

## Key Findings:

- Smart advisors are beginning to enter the market now in relatively small numbers, based in large part on the work of IBM and its many co-development partners.
- By 2015, there should be a large and growing market for Watson-derived smart advisors. Credit Agricole USA is predicting that these systems will account for more than 12% of IBM's total revenue in 2018.
- Google, along with Microsoft, Apple and others, is actively developing virtual personal assistants; Google Now is one example. We expect individual consumers working for enterprises to begin to drag their virtual personal assistants into work, in professional and personal activities, to make themselves smarter, more efficient and, in business, more competitive. This consumerization pattern should emerge clearly by 2017. Enterprise investments in virtual personal assistants will lag individual investments.
- Smart machines will upend a majority of knowledge worker career paths by 2020. Some will gain, some will lose, but those that ignore smart machines do so at tremendous risk long term. We expect there will be more winners than losers, but there will be a lot of losers and the numbers of both winners and losers will climb in the next decade. Figure 1 illustrates our prediction.

Figure 1. A Graphic Presentation of Our Prediction



Source: Gartner (October 2013)

- By 2020, smart advisor and virtual personal assistant technologies will have begun to merge into one another, blurring the lines between them.

- Most smart advisors and virtual personal assistants will be delivered from cloud-based services (to exploit economies of scale and the deep learning benefits of working with huge pools of data). We expect suppliers to provide internal implementation alternatives as well, although those on-premises implementations will likely still require the use of cloud-based services without requiring that enterprise-specific information be exposed to the cloud-based service.

**Near-Term Flag:** Watson will account for at least 1.5% of IBM revenue by the end of 2015, and 10% by the end of 2018.

**Near-Term Flag:** Virtual personal assistant usage in business will grow more quickly in 2017 and 2018 than iPad usage did in 2010 and 2011.

### **Market Implications:**

These new technologies promise the first major leap forward in personal effectiveness and productivity this century. They will help people exploit unfathomably large bodies of knowledge (initially in written form), cope with enormous information flows and be smarter than the people they are competing with inside and outside the enterprise. This poses challenges and opportunities.

### **Recommendations:**

- IT professionals need to recognize that smart machines can create substantial competitive advantages, as well as entirely new businesses. It may be fine to lag the leading edge regarding commodity technology but, with smart machines, laggards lose.
- IT executives need to get up to speed on the capabilities of smart advisors immediately, and start a dialogue with other key executive committee members to scope out the places where these technologies might leverage existing or potential bodies of knowledge the enterprise possesses.
- On virtual personal assistants, enterprises that lock into one vendor's end-user device technology and lock down devices to a limited set of approved applications run the risk of having the best, modern, mobile, go-anywhere graphical user interface implementations of the Nth generation of 1980s office automation tools — PROFs or Wang Office with modern communications extensions — and they will be doubly handicapping themselves by denying end users the opportunity to work with the broad range of virtual personal assistant technologies coming from a wide variety of suppliers. Do not bet that any single vendor visible now will have the best tools to maximize your users' effectiveness. We're no longer talking about tiny changes in productivity applications. Virtual personal assistants will have a powerful impact on user productivity and effectiveness.

### **Related Research**

"The Disruptive Era of Smart Machines Is Upon Us"

"Cool Vendors in Analytics, 2013"

"Google, Apple Siri and IBM Watson: The Future of Natural-Language Question Answering in Your Enterprise"

"Exploit the Intersect of IBM's Social Business and Solution Selling Strategies"

"Artificial Intelligence Finally Delivers Real Value for Business Applications"

"Maverick\* Research: Judgment Day, or Why We Should Let Machines Automate Decision Making"

"Maverick\* Research: How Technology Is Ending the Automotive Industry's Century-Old Business Model"

"Smart Machines Mean Big Impacts: Benefits, Risks and Massive Disruption"

**Strategic Planning Assumption:** By 2017, 10% of computers will be learning rather than processing.

**Analysis By:** Adib Carl Ghubril

### Key Findings:

- Deep learning methods, based on deep neural networks, are currently being applied in speech recognition systems as well as some object recognition applications. They have been shown to be more accurate than the current implementations, which are based on Gaussian mixture models, because they adapt to small speech variations, such as accents.
- The Defense Advanced Research Project Agency (DARPA) and Ecole Polytechnique Federal de Lausanne are funding the SyNAPSE and The Human Brain projects, respectively, fostering neuromorphic computing techniques intended for pattern recognition applications, including facial recognition, object recognition, drug discovery and medical diagnostics.
- An important milestone in IBM's endeavor to build a new computing architecture and programming, or training, language was marked in 2012, when 100 trillion synapses, equivalent to the amount estimated for a human brain, were simulated on the Blue Gene/Q Sequoia supercomputer. This proof of concept was achieved using 2 billion of the newly synthesized neurosynaptic cores. Although there are other companies, such as Intel and HP, that are also developing neuromorphic chips, IBM is complementing its TrueNorth architecture with a programming language. Developers will be able to use IBM's library of 150 (or more) corelets — neuromorphic macros, each characterizing a specific task — to produce third-party applications.

**Near-Term Flag:** In 2014, the number of speech recognition applications running on deep neural network algorithms will double.

**Near-Term Flag:** By 2015, a top-tier car manufacturer, law enforcement agency, pharmaceutical company and hospital will have announced the running of deep learning algorithms in their recognition systems.

**Near-Term Flag:** By 2016, the number of developers using IBM's library of neuromorphic macros (corelets) will quadruple.

### **Market Implications:**

Quality of life improves when society is able to derive useful information from the copious amounts of unstructured data collected via the Internet. Medicine, for example, stands to improve significantly if decisions made by healthcare practitioners are derived from clearer diagnoses. But performing data analytics by scanning for artifacts, which computers are preprogrammed to identify, requires sophisticated, complex algorithms, necessitating bulky and power hungry computers. Signal processing based on neural networks is a strong step in the right direction, but it is still limited by the conventional computing architectures on which it runs.

A system with unified hardware and software, built to handle multiple threads of data concurrently while incoming data alters the state of the cross-matrix acquisition network, effectively reprogramming it, is learning to make more accurate assessments at subsequent exposures. The most important implication of a learning computer is that it expends much less energy to recognize more complex patterns. Thus, the neuromorphic computer becomes a vital assistant for the user in several scenarios, including:

- Medical diagnostics — assisting medical practitioners in identifying disease
- Facial and biometric recognition — investigative work and access control
- Machine vision — driver assistance and robotics
- Mood recognition — ascertaining state of mind in social settings, customer service and digital marketing

### **Recommendations:**

- The computing hardware that currently supports the Nexus of Forces consists of CPUs, digital signal processing units (DSPs) and graphics processing units (GPUs). All three architectural types have been tuned for slightly different processing types. Although there are several variants (e.g., CPUs are combined to form powerful multicore processors), their programming may still be accomplished using common development tools. That will not be the case with neuromorphic computers.
- Enterprises must prepare for a new method of programming — training — computers, and should work on developing in-house workshops for "programming by example" approaches.
- Regular interaction must happen between the DARPA SyNAPSE Project and the European Human Brain Project, to better set expectations for a development ecosystem.
- Forming alliances with Google and Microsoft, which have been strong proponents of deep neural network technologies, would be useful to develop an understanding of how such algorithms may be incorporated in end-user applications.

**Related Research:**

"Hype Cycle for Human-Computer Interaction, 2013"

"Exploit the Intersect of IBM's Social Business and Solution Selling Strategies"

**Internet of Things**

**Strategic Planning Assumption:** By 2020, consumer data collected from wearable devices will drive 5% of sales from the Global 1000.

**Analysis By:** Richard Fouts, Julie Hopkins

Wearable computing, or wearables, is quickly moving beyond military applications and the subject of science fiction films into mainstream society, led by the growing, multibillion-dollar health and fitness markets.

Within five years, consumer wearables will become more sophisticated, capturing what the user sees, hears or even feels (through biorhythmic responses). This gives marketers opportunities to connect with buyers with even more intimacy, customization and relevance. (Note: Although this topic has its share of privacy and regulatory issues, they are beyond the scope of this prediction.)

**Key Findings:**

- We all have better things to do with our hands when we're shopping, driving a car, riding a bike or crossing a street than hold a device to our ear or hypnotically gaze into a screen. Hence, consumers are especially attracted to the hands-free, mobile functionality offered by wearables, whether worn on a wrist or embedded in smart fabric, a ring, a pair of eyeglasses or contact lenses.
- The technical hurdles that have stalled the adoption of wearables (battery life, augmented reality, chip evolution and bandwidth) are quickly eroding, opening doors to creative minds determined to exploit this technology for commercial gain (evidenced by sizable investments in wearable technology from Google/Motorola, Apple and Microsoft).
- The less intrusive interaction offered through wearables is inspiring designers to rethink smartphone use cases. It's also offering marketers creative ways to exploit the data flowing to and through wearables. For example, optical ware (augmented reality through enhanced eyeglasses or contact lenses) lets marketers personalize what the user sees about their product, adding dimension, context or data critical to moving the consumer closer to transaction.
- The rapid growth of wearables in the healthcare and fitness space is spilling to other segments: gaming, aging, transportation, fashion, mobile money, disability, music and entertainment. By 2020, this combined market for wearable devices will easily exceed \$12 billion, led by devices worn on the wrist. <sup>13, 16, 17</sup>
- On the commerce front, we believe that, within five years, a world where users never use a card or phone to buy subway tokens, movie tickets or a latte at Starbucks will be commonplace.

Bluetooth 4.0 (which uses less power and instantly pairs with devices) and Near Field Communication (NFC), used in mobile money apps, are two key drivers accelerating this scenario.

**Near-Term Flag:** The number of smartphone apps requesting to share consumer data will increase twofold by 2015, indicating a rise in the number of marketers or proprietors that seek access to customer profile data.

**Near-Term Flag:** By 2015, the use of mobile and wearable devices will carry a requirement to register the device or your profile information prior to extensive use.

### Market Implications:

- **Wellness/fitness:** By 2017, over 150 million wearable devices will ship worldwide, led by the sports and fitness sectors.<sup>14</sup> Nike FuelBand technology (targeting general consumers), combined with the adidas launch of miCoach (targeting professional sports), are just two illustrations of how the human body's transmission of information triggers commerce. For example, advertisers access exercise data and eating habits through devices like the Fitbit, unleashing opportunities to sell nutritional products, supplements, clothing and shoes.<sup>15</sup>
- **Healthcare delivery:** Increased consumer attention toward personal health, and a focus by payers and providers on wellness as a route to cost containment, will spawn adjacent applications in healthcare. Monitoring that can position patients for successful in-patient outcomes, reduce hospital readmissions, and support remote care delivery in assisted living, chronic case management or specialty monitoring. This will trigger products and services for pharmaceuticals and medical services.
- **Disability:** Wearable technologies will also emerge in the huge disability market (such as aids for the deaf, blind, paralyzed and elderly). For example, last year, the U.K. Design Council challenged vendors to find ways to embed jewelry with "hear ware" as most hearing impaired people avoid these aids due to their cumbersome, unattractive look. Continuing on with the fashion angle, Lady Gaga's "living dress" has spurred interest from a number of designers, such as Electricfoxy, talk2myShirt and LilyPad Arduino.
- **Manufacturing/distribution:** In the general manufacturing and distribution markets, wearable computers worn on the arm for hands-free operation will continue their popularity in field service and assembly lines and warehouses. Field services will be enabled through improved part identification and ordering, but also on-site repairs made possible by the alignment of the technician's and centralized service perspectives.
- **Retail:** Although Google has said it won't give advertisers access to its Glass, consumers will use it to view ad-rich social sites, Web pages and Facebook news streams. Developers will buy over 100,000 pairs of smart glasses this year, up from 50,000 last year, climbing to over 400,000 in 2014. Copycat technologies will certainly follow, giving marketers opportunities to consider how to incorporate enhanced visual images into their product and marketing plans.

## Recommendations:

For designers and manufacturers of wearables (including apps):

- Learn from the past. Wearables help people pay attention to the world in front of them (to avoid the unfortunate accidents, many of them fatal, that have accompanied texting and talking while operating a vehicle). Designers must be sensitive to enabling ease in helping users juggle rival cognitive tasks, and to help them focus on the task at hand, not the device.
- Keep in mind that wearables contribute to one's identity, social status and power. A wristwatch doesn't just tell time; it's both a status and fashion statement. Watches and bracelets in fitness and body monitoring spaces are also a big influence in how wearables will play out from a design perspective, if they are inconspicuous and don't commit any fashion violations.
- Try not to design wearables as a replacement for something else. For example, Google Glass offers an entirely new approach, not a redesign of the mobile phone. Think of wearables as devices that deliver alerts precisely when consumers need them, in sync with their other devices. For example, a shopping list is automatically sent to your phone as you pass the grocery store (because you're low on vegetables). Similar scenarios exist in healthcare in which a wearable device leverages lifesaving hyperawareness.

For marketers looking to exploit wearables:

- Define whether your target will intersect the wearable buyer market, and in what context wearables will be used. The rise of mobile devices required marketers to adapt their existing customer personas to reflect consumers' approaches to mobile interaction. Existing personas should now be tuned to reflect wearable use cases, and the instances in which your user may be leveraging wearables, or building data from wearable interfaces.
- Assess how context data improves targeting accuracy, or introduce it where none existed previously. If your consumer is likely to leverage wearable technology, you have the opportunity to connect with them using context data that is nearer to them than any previous device. What data about the user and their environment, given improved accuracy and proximity, could you now leverage to change their direct experience with your product or, more accurately, connect with them via ads or recommendations? Where you once might have known via mobile check-in that your buyer was at a driving range, what could you do with the digital data detailing the speed of his or her golf swing? Consider marketing and product design concepts that you previously shelved due to overly large margins for error, or those not previously possible, and explore test-and-learn opportunities for future plans.
- Explore how augmented reality can enhance the shopping experience for your product. Some products can improve use cases based on wearable data surrounding what the user is feeling or doing. Other products can enhance the user's experience based on what the user is seeing, or even hearing. How can you add dimension to product packaging, or help visualize product usage, using augmentation tools? To the extent that "seeing and believing" force some of your product decisions, consider how you can integrate this further back into your consumers' research and decision-making phases of your marketing program.

## Recommended Reading

"Technology Overview: Quantified Self"

"Analytics Gets Personal With the Quantified Self"

"Maverick\* Research: The Future of Humans: Get Ready for Your Digitally, Chemically and Mechanically Enhanced Workforce"

"Market Trends: Enter the Wearable Electronics Market With Products for the Quantified Self"

## Evidence

<sup>1</sup> [IP Commission Report](#), May 2013

<sup>2</sup> [www.fbi.gov/about-us/investigate/white\\_collar/ipr/ipr](http://www.fbi.gov/about-us/investigate/white_collar/ipr/ipr)

<sup>3</sup> [IP Commission Report, May 2013](#)

<sup>4</sup> [www.whitehouse.gov/the-press-office/2012/08/16/we-can-t-wait-obama-administration-announces-new-public-private-partners](http://www.whitehouse.gov/the-press-office/2012/08/16/we-can-t-wait-obama-administration-announces-new-public-private-partners)

<sup>5</sup> ["A Look at the Patentability of Human Organs"](#)

<sup>6</sup> <http://videocontestnews.com/2012/10/08/doritos-2012-2011-2010-2009-and-2007-crash-the-super-bowl-finalists/>

<sup>7</sup> [www.facebook.com/burtsbees](http://www.facebook.com/burtsbees)

<sup>8</sup> [www.jjconsumerideas.com/](http://www.jjconsumerideas.com/)

<sup>9</sup> [www.sopheon.com/Portals/1/pdf/WhitePapers/WhitePaper\\_TopTenWays-TransformFEI-CPG.pdf](http://www.sopheon.com/Portals/1/pdf/WhitePapers/WhitePaper_TopTenWays-TransformFEI-CPG.pdf)

<sup>10</sup> [www.ideasbrewery.com/AgeGate/](http://www.ideasbrewery.com/AgeGate/)

<sup>11</sup> [www.wwd.com/beauty-industry-news/color-cosmetics/loral-teams-with-michelle-phan-for-color-cosmetics-7090057](http://www.wwd.com/beauty-industry-news/color-cosmetics/loral-teams-with-michelle-phan-for-color-cosmetics-7090057)

<sup>12</sup> [www.nike.com/us/en\\_us/c/nikeid](http://www.nike.com/us/en_us/c/nikeid)

<sup>13</sup> BI Intelligence has forecast a [\\$12 billion market for wearables](#) by 2020.

<sup>14</sup> ABI Research estimates the market for wearables in sports and health sectors will grow to nearly [170 million devices by 2017](#).

<sup>15</sup> Earlier this year wearables company Fitbit raised a [\\$43 million round of financing](#). Fitbit devices are now sold in 15,000 retail locations across the U.S., according to the company. Investors are

starting to note that wearables as a fast-emerging category may be slowing growth in the tablet market.

<sup>16</sup> Samsung is hard at work on [the Galaxy Gear 2](#), which could hit the market in early 2014.

<sup>17</sup> Buzz continues around Apple's rumored [iWatch](#).

**GARTNER HEADQUARTERS****Corporate Headquarters**

56 Top Gallant Road  
Stamford, CT 06902-7700  
USA  
+1 203 964 0096

**Regional Headquarters**

AUSTRALIA  
BRAZIL  
JAPAN  
UNITED KINGDOM

For a complete list of worldwide locations,  
visit <http://www.gartner.com/technology/about.jsp>

---

© 2013 Gartner, Inc. and/or its affiliates. All rights reserved. Gartner is a registered trademark of Gartner, Inc. or its affiliates. This publication may not be reproduced or distributed in any form without Gartner's prior written permission. If you are authorized to access this publication, your use of it is subject to the [Usage Guidelines for Gartner Services](#) posted on gartner.com. The information contained in this publication has been obtained from sources believed to be reliable. Gartner disclaims all warranties as to the accuracy, completeness or adequacy of such information and shall have no liability for errors, omissions or inadequacies in such information. This publication consists of the opinions of Gartner's research organization and should not be construed as statements of fact. The opinions expressed herein are subject to change without notice. Although Gartner research may include a discussion of related legal issues, Gartner does not provide legal advice or services and its research should not be construed or used as such. Gartner is a public company, and its shareholders may include firms and funds that have financial interests in entities covered in Gartner research. Gartner's Board of Directors may include senior managers of these firms or funds. Gartner research is produced independently by its research organization without input or influence from these firms, funds or their managers. For further information on the independence and integrity of Gartner research, see "[Guiding Principles on Independence and Objectivity](#)."