HANOVER RESEARCH

Canon
CANON BUSINESS PROCESS SERVICES, INC.

LEADING A FUTURE-READY BUSINESS:
Vision 2025

Disruptive Technologies

On pace to effectively compete?

Canon in association with Hanover Research reviews today's hyper-competitive business environment and its future trajectory. The culmination of digital business, disruptive technologies, cultural and demographic forces, put unprecedented demands on business leaders to navigate the opportunities and threats.

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Accelerating technological innovation is disrupting established business principles within companies and across industries, and moving businesses towards a radically different future environment.

This unprecedented pace of change creates a mandate for businesses to reinvent their operations, restructure their product offering, and rethink the way they create value. To survive long term, they are forced to adapt and find new emerging opportunities.

With this backdrop, Canon Business Process Services (Canon) in association with Hanover Research, a leading market research firm, surveyed the environment to better understand the forces that are driving change in business and how they may shape business towards 2025.

Disruptive Technologies

EXECUTIVE SUMMARY

At its core, a disruptive technology is an emerging system, product or process that displaces established ways of doing business. Disruptive technologies are giving rise to new business models and re-inventing established business models; disruptive technologies are used by entrepreneurs, Fortune 500 companies, and service providers alike.

This report analyzes the technological innovations to which business leaders must adapt. The potential of cloud, mobile internet, analytics, RPA, IoT, 3-D Print and other emerging technologies are reshaping markets and established organizations. Business leaders will have to implement change on a continuous basis to keep up with rapid adoption rate and risk recalculation. Failure to capitalize on the technological innovation will be catastrophic for today's industry incumbents.

Key Findings

- The most susceptible to disruption over the next decade will be technology products and services, media and entertainment, retail, financial services, and telecommunications
- US technology leaders predict Data and Analytics, Cloud and Cyber Security will disrupt company operations the most in the next 3 years
- The cloud will break down the silos between internal company operations, suppliers, and customers. But, cybersecurity professionals are either "moderately" or "very" concerned about cloud security.
- 84 percent of U.S. executives agree mobile is central to the company's ability to become a digital business. And, 90 percent of surveyed businesses are either implementing or planning to implement mobile workstyles over the next five years.
- Robotic process automation (RPA) is emerging as a tool to automate the business processes. However RPA does not have the power to disrupt as Cloud, Mobile and Analytics do.
- The IoT technology will grow rapidly with estimates of the potential economic impact at $4 trillion to $11 trillion annually by 2025

DISRUPTIVE TECHNOLOGIES

Business disruptions due to advances in technology and innovative use of technology will vary across regions and industries. The most susceptible to disruption over the next decade will be technology products and services, media and entertainment, retail, financial services, and telecommunications. Industries that will change at the margins rather than in their core enterprise functions will be education, hospitality/travel, CPG and manufacturing, and healthcare. Least affected will be utilities, oil and gas, and pharmaceuticals.[26]

Over the next decade, technological advancement will continue to drive economic growth while simultaneously disrupting legacy operational models. This disruption will provide opportunities for businesses, but will also carry risks for leaders who fail to adapt. At its core, a disruptive technology is an emerging system, product, or process that displaces established ways of doing business.[27] A variety of vehicles providing greater connectivity, innovative data analytics, and new business platforms have emerged in recent years, with adoption trends expected to strengthen at a rapid pace. For example, the world of supply chain management is changing as startups challenge installed legacy systems with cloud-based solutions offering comparable support at a fraction of the cost.

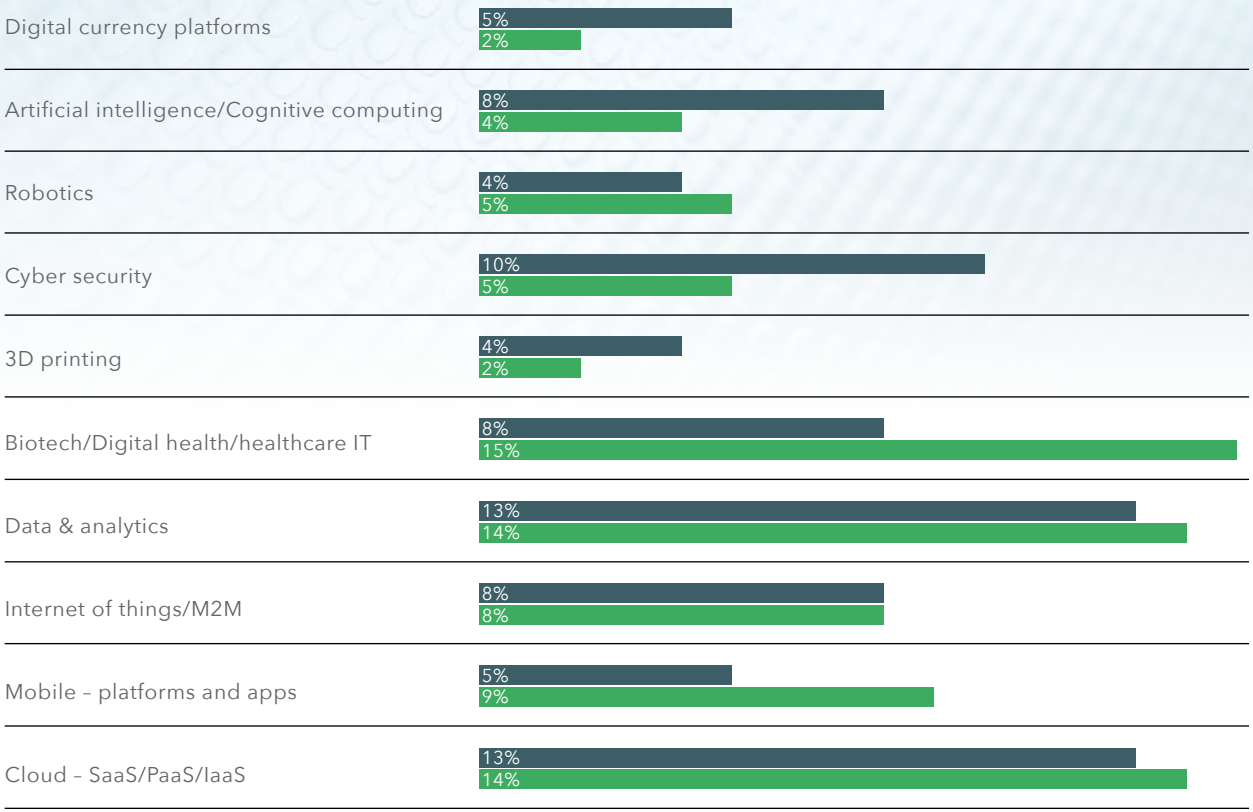
[26] Bradley, J., J. Loucks, J. Macaulay, A. Noronha, and M. Wade. "Digital Vortex: How Digital Disruption is Redefining Industries." Global Center for Digital Business Transformation, IMD and Cisco. June 2015.

[27] "Guide to 12 Disruptive Technologies." Intelligent HQ. March 2, 2014. http://www.intelligenthq.com/technology/12-disruptive-technologies/

DISRUPTIVE TECHNOLOGIES

In its 2015 Global Technology Innovation Survey, KPMG found that 14 percent of US technology leaders predict that data and analytics will have the most profound impact on the global marketplace over the next three years. In particular, 13 percent of U.S. tech leaders predict that cloud computing and data and analytics will be the most disruptive technologies driving business transformation.[28]

Figure 2.1: **The Most Disruptive Technologies over the Next Three Years**



Source: KPMG Technology Innovation Survey, 2015 [28]

[28] http://www.forbes.com/sites/louiscolumbus/2015/11/08/5-insights-predictions-on-disruptive-tech-from-kpmgs-2015-global-innovation-survey/#73c3954560eb

CLOUD COMPUTING

Cloud computing involves computer applications and/or services "delivered over a network or the Internet, with minimal or no local software or processing power required."[29]

The monthly cost of owning a server is three times that of renting in the cloud. Eighty percent of North American institutions host or plan to host critical applications through external providers.[30] Some experts estimate that public cloud services will grow at a compound annual growth rate (CAGR) of 23 percent through at least 2018.

Cloud computing has allowed for the explosive growth of Internet-based services and background processing capabilities, dramatically improving the economics of IT for enterprises. Not only does cloud computing enable greater flexibility, it can allow for new business models, such as pay-as-you-go service models that open access to new capabilities previously reserved for the largest businesses.[31]

Cloud computing will be a key enabler of future technological disruptions as it facilitates concepts such as inventory optimization tools, analytics, and mobility. It will fundamentally transform the supply chain into a "digital supply network" that brings together physical flows of products and services in addition to talent, information, and finance.[31] Cloud services will effectively bring a convergence of supply chains, breaking down corporate barriers and providing end-to-end visibility in real time. Where once information silos were purely an internal challenge to organizational efficiency, the cloud will drive companies to break down silos between themselves, their suppliers, and their customers.

[29] "Disruptive technologies: Advances that will transform life, business, and the global economy." McKinsey, May 2013. https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwit6O7z_NnKAhWhtIMKHft3CaIQFggiMAA&url=http%3A%2F%2Fwww.mckinsey.com%2F~%2Fmedia%2Fmckinsey%2Fdot com%2Finsights%2520and%2520pubs%2Fmgi%2Fresearch%2Ftechnology%2520and%2520innovation%2Fdisruptive%2520technologies%2Fmgi_disruptive_technologies_full_report_may2013.ashx&usg=AFQjCNEI- nLU7tfuni_drANuZMvoMs0WcQ&sig2=gJMJUFX4jWWJkEJ-m0DzqQ

[30] Ibid.

[31] "Supply chain management in the cloud." Accenture. 2014. https://www.accenture.com/t20150523T022449__w /us-en/_acnmedia/Accenture/Conversion- Assets/DotCom/Documents/Global/PDF/Dualpub_1/Accenture-Supply-Chain-Management-in-the-Cloud.pdf

CLOUD COMPUTING

Cloud computing rates are expected to increase sharply over the 2014 to 2020 period, with the percentage of U.S. small businesses using cloud computing forecast to rise from 37 percent to nearly 80 percent.[32]

Cloud services enable efficiency through rapid service delivery and automatic product upgrades that are transparent to the user. Computing power required to operate such systems is consolidated in central facilities with optimized floorplans, energy supplies, and redundancies. Firms need not hire personnel and develop in-house training plans to maintain these systems, which are tailored to an ever-increasing degree to the unique circumstances of the business owner. These capabilities allow nimble response to changing needs, which empowers smaller, newer businesses and accelerates the pace of change in the competitive landscape.

Estimates of the total economic impact of cloud computing range from $1.7 trillion to $6.2 trillion per year by 2025.[33] Most of this impact is expected to be in the form of additional surplus generated from cloud delivery of services and applications to Internet users, while the remaining benefit will result from the use of cloud technology to improve enterprise IT productivity. Figure 2.4 outlines these expected economic gains.

As noted, cloud services will interact powerfully with other technological advances and will affect employment decisions in tandem with other tools such as robotic process automation. Information technology is often well outside the core capabilities of successful firms, and outsourcing through cloud services will generate efficiencies in hiring and daily operations. As with most digital business solutions, cloud computing will change the optimal mix of on-site and off-site resources, and with this change will come reconsideration of optimal boundaries of the enterprise. Cloud technology will enable businesses as never before to focus attention on core operations.

Figure 2.2: **Impact and Gains from Cloud Computing in 2025**

Possible Applications	Potential Annual Impact in 2025	Potential Productivity Gains in 2025
Surplus from cloud-based internet	$1.2 to $5.5 trillion	$25–$85 surplus per user per month
Infrastructure and operating expenses	$0.3 to $0.4 trillion	20–30% productivity gains: – Reduced infrastructure and facilities footprint – Higher task standardization and automation
Application development and packaged software	$0.2 to $0.3 trillion	10–15% productivity gains: – Standardization of application environment and packages – Faster experimentation and testing

Source: McKinsey[34]

[32] "How the cloud will transform small business by 2020." Inc.com. August 7, 2014. http://www.inc.com/graham- winfrey/why-the-cloud-will-transform-small-business-by-2020.html
[33] "Disruptive Technologies: Advances that will transform life, business, and the global economy," Op. cit
[34] Ibid.

MOBILE INTERNET

Mobile Internet is defined as "a combination of mobile computing devices, high-speed wireless connectivity, and applications," that allow access to the World Wide Web.[35]

Key devices currently include smartphones and tablets; in the future, wearable, sensor-packed devices may become the norm. In addition to advances in device technology, high-speed mobile connectivity has made major inroads, such as in 3G and 4G/LTE networks. McKinsey predicts that 5G cellular networks, satellite services, and long-range Wi-Fi may become available in the next decade. Software applications provide location-based services, personalized feeds, and constant contact with others.

Currently, over 1.1 billion people use these portable devices.[36] Smartphone and tablet sales have grown by six times since launch of the iPhone in 2007. While this would lead many to believe the market has seen its heyday, the fact remains that there are 4.3 billion people remaining to be connected to the Internet.[37] Emerging economies are leapfrogging entire phases of development experienced in developed countries as mobile infrastructure proves better suited to environments marked by unstable property rights and low public investment. While mobile Internet features prominently in advanced economies, its full potential is far from realized.[38] According to McKinsey, "over the coming decade, this technology could fuel significant transformation and disruption, not least from its potential to bring two billion to three billion more people into the connected world, mostly from developing economies."[39]

Accenture's Mobility Research study finds that 84 percent of U.S. executives agreed that "mobile apps as the portal that opens up digital business and 84% believed they are necessary to fully realize the benefits of digital technologies."[40] However, the survey also found that widespread adoption and use of apps within the enterprise has "yet to occur."[41] The business environment is thus poised for disruptive transformation as new operating models emerge and new markets are connected to the Internet.

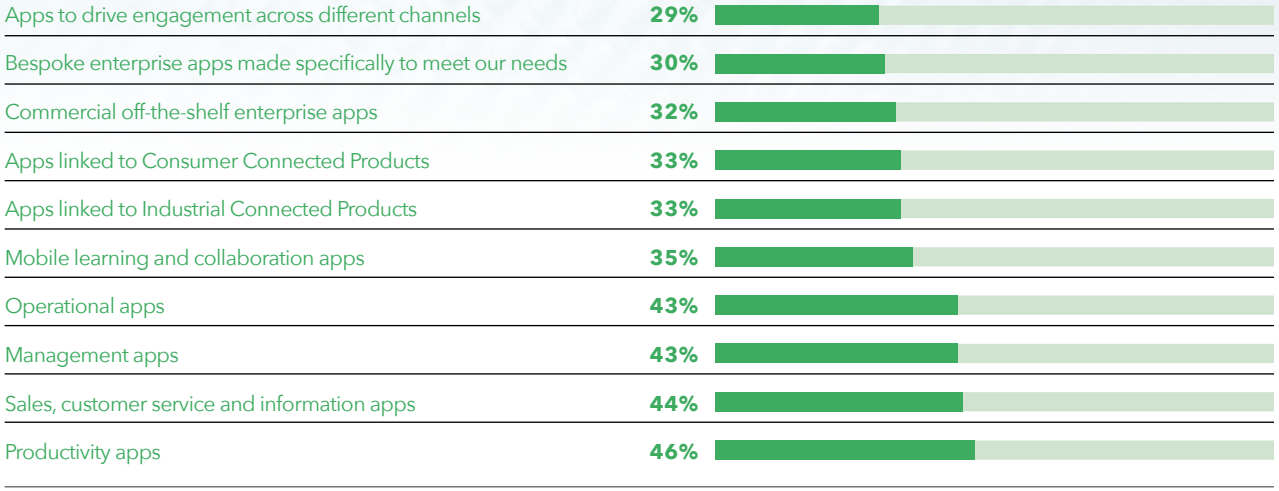
[35] "Disruptive technologies: Advances that will transform life, business, and the global economy," Op. cit.
[36] "Disruptive Technologies: Mobile Internet." FHE. http://futurehumanevolution.com/todays-technology/disruptive-technologies-mobile-internet
[37] "Disruptive Technologies: Advances that will transform life, business, and the global economy." Op cit.
[38] "Disruptive Technologies: Mobile Internet," Op. cit.
[39] Ibid.
[40] "Growing the Digital Business: Spotlight on Mobile Apps." Accenture, 2015. https://www.accenture.com/_acnmedia/Accenture/Conversion-Assets/DotCom/Documents/Global/PDF/Digital_1/Accenture-Mobility-Research-Mobile-App.pdf
[41] Ibid.

MOBILE INTERNET

Mobile technology can greatly improve internal business operations, affecting how frontline workers, sales representatives, and knowledge workers operate on a day-to-day basis. For example, Boeing has developed virtual reality glasses that allow assemblers to see instructions explaining how parts fit together in the assembly process. Transaction workers can also benefit from this technology through information transparency. McKinsey notes that by making pricing, configurations, and options readily available through mobile applications, business-to-business sales have increased by 35 to 65 percent in some cases. Accenture found in a recent survey that 82 percent of executives believe enterprise mobile applications are integral to their organization, and 81 percent consider mobile apps key to "unlocking vital data from across their business."[43]

Accenture surveyed 1,925 senior IT decision makers, and found that while 82 percent of respondents indicated mobile applications were integral to their organization, only 52 percent had testing programs in place to solicit user feedback during the design and build stage. Additionally, only 48 percent were collecting usage reports and analytics to improve live applications.[44]

Figure 2.3: **Types of Mobile Apps Currently Used**



N=1,925 Senior decision makers for digital strategy and technologies
Source: Accenture[42]

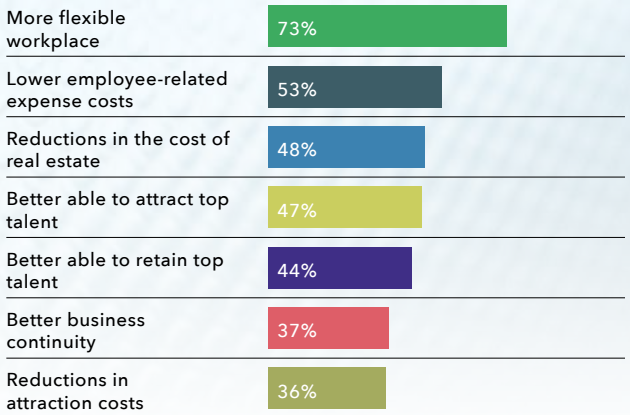
[42] Ibid.
[43] "Growing the Digital Business: Spotlight on Mobile Apps," Op. cit.
[44] Ibid.

MOBILE INTERNET

Mobile Internet thus represents an immense opportunity for improvement in the business environment. As Figure 2.4 suggests, workstyles facilitated by mobile Internet can drive new levels of flexibility and efficiency, affecting everything from real estate costs to employee satisfaction rates and talent retention.

To remain competitive, many organizations must reconfigure, if not entirely reengineer, core business processes in response to mobile technology. Physical constraints and universal business hours are becoming less important as companies rethink their operations.[46] Burrus Research found that at least half of the businesses in survey respondents' industries will use mobile apps within the next two years.[47] Businesses are coming to see mobile as not just a perquisite, but as an enabler of entirely new business models. Examples are rife: Google, Facebook, Uber, AirBnB—these and many more are implementing business models that would not be possible without the element of mobility. Manufacturers are taking mobile tools to the factory floor and uniting them with smart devices and data analytics to produce unprecedented levels of efficiency. Stanley Black & Decker implemented the technology in its Reynosa, Mexico, facility to build a fully connected production line with Real-Time Location Systems, which include small Wi-Fi active RFID tags that attach to virtually any material and provide real-time location and status to workers.[48] Educators are breaking down the walls of their classrooms through massive open online courses. Shippers are democratizing the marketplace and driving margins ever thinner through unprecedented pricing visibility.

Figure 2.4: **Corporate Benefits of Mobile Workstyles**



Source: Mobile Workstyles Survey[45]

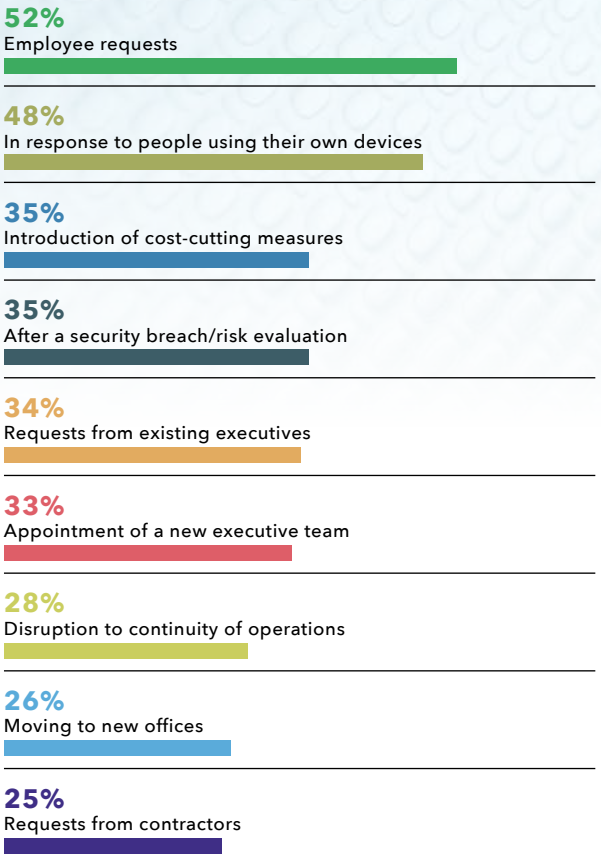
[45] Mobile Workstyles Survey. "Workplace of the Future: a global market research report." Citrix, 2012.
[46] Frank, M., et al. "Code Halos." John Wiley & Sons, Inc., 2014.
[47] "10 Business Process Outsourcing Trends to Watch For in 2014." Datamark Incorporated. http://www.datamark.net/uploads/files/2014_bpo_trends_wp.pdf
[48] "Stanley Black & Decker: Connecting Internet of Everything, One Line at a Time." Cisco.com. July 29, 2014. http://blogs.cisco.com/ioe/stanley-black-decker-connecting-internet-of-everything-one-line-at-a-time

MOBILE INTERNET

What is driving the shift to mobile? Organizational leaders are not generally leading the charge. The top responses by a wide margin to a recent survey asking why companies adopted mobile tools suggest that the change is coming from the bottom up, as illustrated in Figure 2.5. The flexibility provided by mobile Internet is a key demand of newer generations of employees who grew up with the tools.

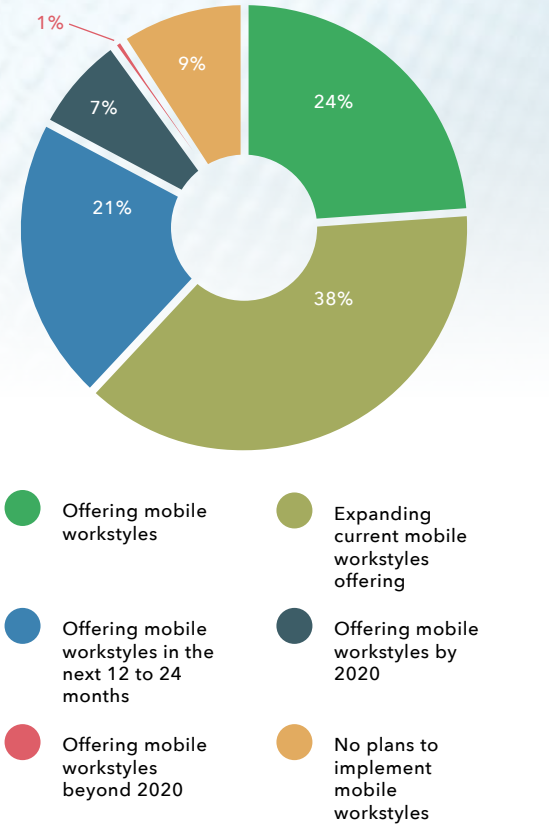
Nevertheless, change is coming. Leaders planning for the future must not consider mobile tools in isolation. Combined with cloud computing, data analytics, and the Internet of Things, mobility will not only enable but will define business in 2025. As Figure 2.6 illustrates, already more than 90 percent of surveyed businesses are either implementing or planning to implement mobile workstyles over the next five years. Those few that are not will likely be pushed there by employees and customers who expect it.

Figure 2.5: **Reasons for Adopting Mobile Workstyles**



Source: Mobile Workstyles Survey[49]

Figure 2.6: **Organizations Offering Mobile Workstyles**



Source: Mobile Workstyles Survey[50]

[49] Ibid.
[50] Ibid.

BIG DATA, PLATFORMS, AND ANALYTICS

Social media, analytics, cloud, mobile Internet, and inexorably rising computing power have produced an exponential increase in the quantity of data available.

Companies are not just collecting data on internal operations. They are unifying information flows across the supply chain and anticipating customer needs before they are stated. The problem now is not that companies are "suffering from a lack of data—they're suffering from a lack of the right data."[51] Entrepreneurs are devising new ways to produce useful insights from the sea of ones and zeroes and building their trove of information.

Integrated platform services and their associated networks gather data from this proliferation of new sources. Accenture defines the term "platform" as "a well-defined technical architecture, firm governance, and set of technology services all focused on enabling the creation of new industry-specific applications."[52] For example, warehouse management connects to transportation management, labor management, and enterprise resource planning. Customers of platform services receive dramatically improved capability across the range of distinct components now united in a single synergistic system with total data visibility.

Benefits are not limited to supply chain management. Accenture highlights John Deere as an example: in 2012, John Deere launched its MyJohnDeere platform, which was a "wholesale push toward precision agriculture that would improve productivity, efficiency, and yield." Through this platform, the company helped agricultural producers "consolidate the management of equipment information, production data, and farm operations—and ultimately improve the bottom line." It also supported an ecosystem strategy that allowed John Deere to create new digital partnerships with "bio-chemistry and agricultural hybridization leaders and to expand its role in the digitally driven precision agriculture market."[53]

The key to success in the world of Big Data is analytics, which turns unmanageable complexity into decision-quality information. Platforms not only gather data across formerly disparate systems, but provide the analytical power to make sense of it. As Accenture notes, "while many businesses are using digital initiatives to harness social, mobile, analytics, and cloud technologies for competitive advantage and disruption, far-sighted leaders are bringing together their digital initiatives under platform umbrellas." These platform umbrellas "enable better ways of operating, as well as create new kinds of revenue streams."[54]

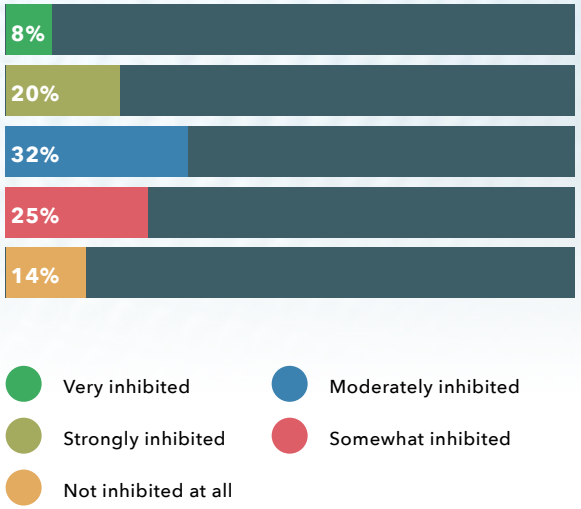
[51] "Digital Business Ear: Stretch Your Boundaries." Accenture. http://techtrends.accenture.com/us-en/business- technology-trends-report.html
[52] Daugherty, P., P. Banerjee, and M.J. Biltz. Op cit.
[53] Ibid.
[54] Ibid.

BIG DATA, PLATFORMS, AND ANALYTICS

In conjunction with the other technologies discussed here, platform services are redefining business models. In one recent survey, 81 percent of respondents felt that industry boundaries will dramatically blur as platforms reshape and redefine entire industries into "interconnected ecosystems."[56] While only 39 percent are using industry platforms today, 72 percent expect that they will see broad adoption of industry platforms that will integrate data with digital business partners within the next two years. Data integration with digital business partners will present opportunities for efficiency that cannot be ignored in the face of increasing competition and falling margins.[57]

In the future more and more companies will leverage internal data analytics, with 45 percent of senior leaders predicting access to self-service tools within three years.[58]

Figure 2.7: **Impact of Technological Complexity on Ability of Businesses to Meet Goals**



Source: Wharton survey of 692 business executives[55]

[55] Ibid.
[56] Ibid.
[57] Ibid.
[58] Ibid.

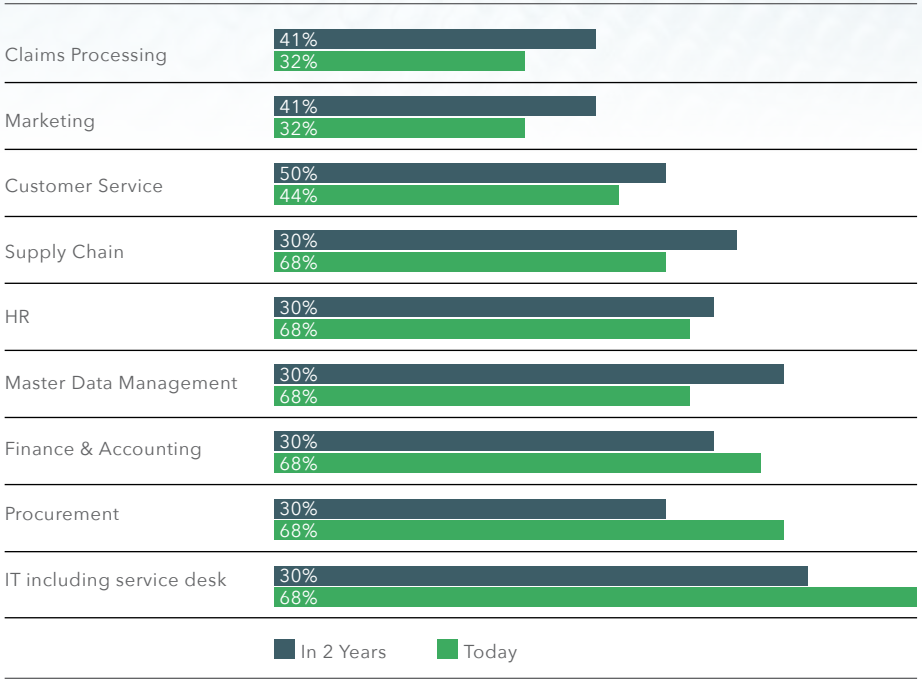
ROBOTIC PROCESS AUTOMATION AND COGNITIVE COMPUTING

Robotic process automation (RPA) uses distinct software tools (or software "robots") to bring together diverse IT systems without the need for constant human interface. Use of RPA in business processes and the back-office environment is another force driving down the barriers between data silos and disconnected systems.

These tools range from robots that automate rules-based tasks to predictive supercomputers and artificial intelligence that analyze data and form hypotheses.[60] Robotic process automation can therefore free human employees from repetitive tasks to work on core business goals and objectives.[61] Heavily regulated industries and those with high-volume, transactional processes will gain the most from the new tools.[62]

Robotic process automation is revolutionizing the way companies think about their business processes, including IT support, workflow, remote infrastructure, and back-office.[63] Automation can significantly increase the efficiency of back-office tasks such as procurement, supply chain management, and accounting.[64] As Figure 2.8 suggests, key applications of RPA include IT processes, procurement, and finance and accounting.

Figure 2.8: **"Where do you believe RPA to be applicable?"**



N=716
Source: HfS Research[59]

[59] McGann, B. "Where is the Action Today in Intelligent Automation?" HfS, September 17, 2015. http://www.irpanetwork.com/wp-content/uploads/2015/10/HfS_Intelligent-Automation-for-OAISS_vFFV.pdf
[60] "From Human to Digital: The Future of Global Business Services," Op. cit.
[61] "Benefits of RPA." IRPA. http://www.irpanetwork.com/benefits-of-rpa/
[62] "Seizing the Robotic Process Automation (RPA) Market Opportunity." Everest Global, October 2015.
[63] "What is Robotic Process Automation?" IRPA. http://www.irpanetwork.com/what-is-robotic-process-automation/
[64] Ibid.

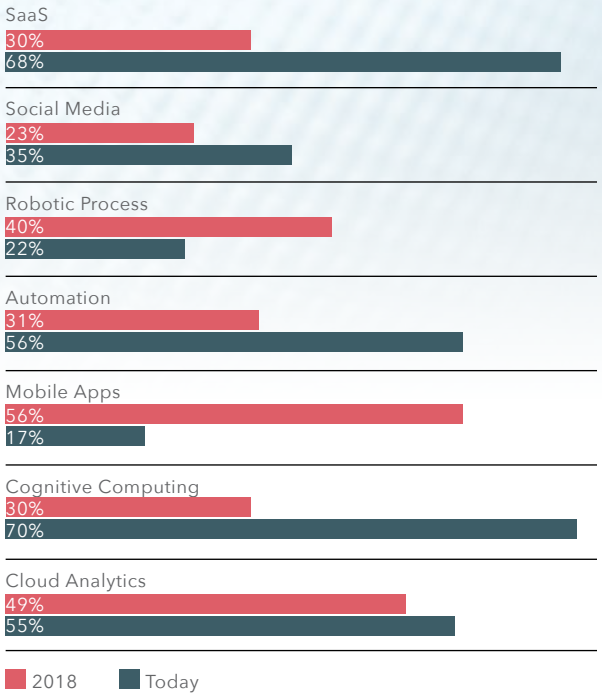
ROBOTIC PROCESS AUTOMATION AND COGNITIVE COMPUTING

By some estimates, business process services providers are increasing their use of RPA at a CAGR of over 100 percent. "Regulated industries with high-volume, transactional business processes" will gain the most from the new tools.[66] As companies seek to reduce reliance on labor by looking into RPA, BPO service providers are responding by developing their own RPA capabilities. Integrating machines with people in this dynamic environment is a significant challenge for business leaders, and outsourcing service providers are offering more sophisticated services that relieve them of the distraction.

Robotic process automation is not a fundamental driver of change in the way that cloud computing or mobile Internet are today. As traditional computing gives way to cognitive computing, however, RPA has potential to reshape the business environment of 2025, as Figure 2.9 suggests. As the builders of the infamous Watson define it, Cognitive computing refers to systems that learn at scale, reason with purpose and interact with humans naturally. Rather than being explicitly programmed, they learn and reason from their interactions with us and from their experiences with their environment.[67]

Where today's computers are deterministic, cognitive systems use probabilities to generate reasoned arguments. This will dramatically increase the power of RPA. The near future will take automation to the next level as inference and context are written into the code. Eventually, cognitive systems will be predictive and self-learning, and will capture an increasing share of knowledge work.[68]

Figure 2.9: **"What are the most significant enabling technologies today ... and which do you think will be most significant in 2018?"**



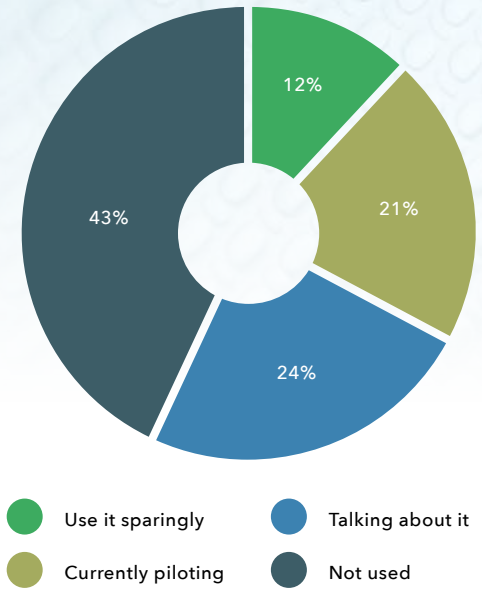
Source: HfS Research and KPMG[65]

[65] Fersht, P., C. Justice, and C. Sutherland. "Where is the Action Today in Intelligent Automation?" HfS Research and KPMG, 2015.
[66] "Seizing the Robotic Process Automation (RPA) Market Opportunity." Everest Global, October 2015.
[67] Kelley, J.E. "Computing, cognition and the future of knowing: How humans and machines are forging a new age of understanding." IBM, October 2015.
[68] "Introduction to Robotic Process Automation: A Primer." Op. cit.

ROBOTIC PROCESS AUTOMATION AND COGNITIVE COMPUTING

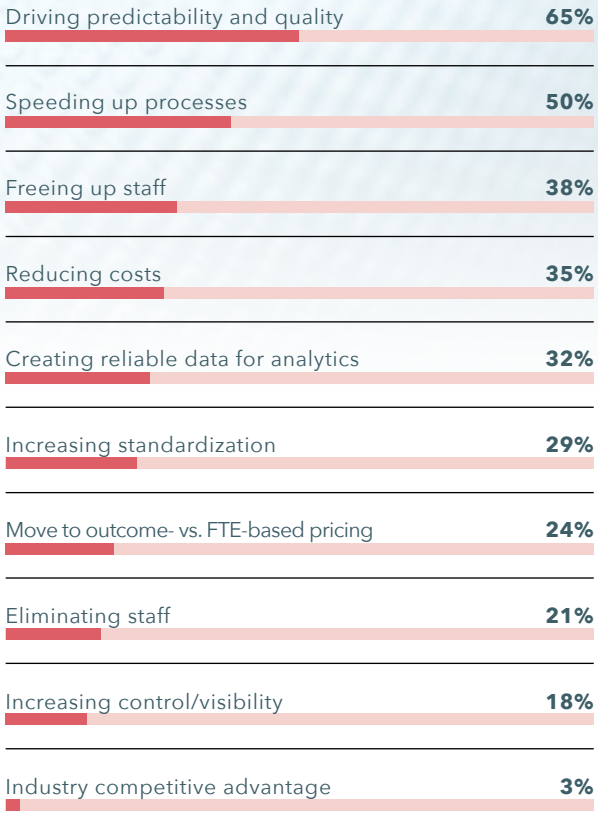
Adoption of RPA is sparing, but growing quickly, with more than half of surveyed businesses either using, piloting, or discussing implementation (see Figure 2.10). The rewards can be significant. Whereas an employee performing such tasks could cost $100,000 per year and offshoring could reduce this cost to $38,000, performing them digitally can cost as little as $13,000.[71] Robotic process automation does not mean eliminating employees entirely from the back office. The automation is assisted rather than independent: a tool rather than a comprehensive solution. More important than freeing up staff, or even eliminating them, are predictability, quality, and speed in process execution, as illustrated in Figure 2.11. As an extension of workflow tools, RPA enhances capabilities around data capture, routing, validation, and execution of business rules. It requires not only new technology, but also significant programming resources and constant quality assurance.

Figure 2.10: **"How pervasive is the adoption of RPA in your enterprise today?**



Source: HfS Research, September 2015[69]

Figure 2.11: **"What are the most important components of the RPA value proposition?"**



Source: HfS Research[70]

[69] Sutherland, C. "The Raw Truth about Intelligent Automation." HfS Research, September 2015.
[70] Ibid.
[71] Ibid.

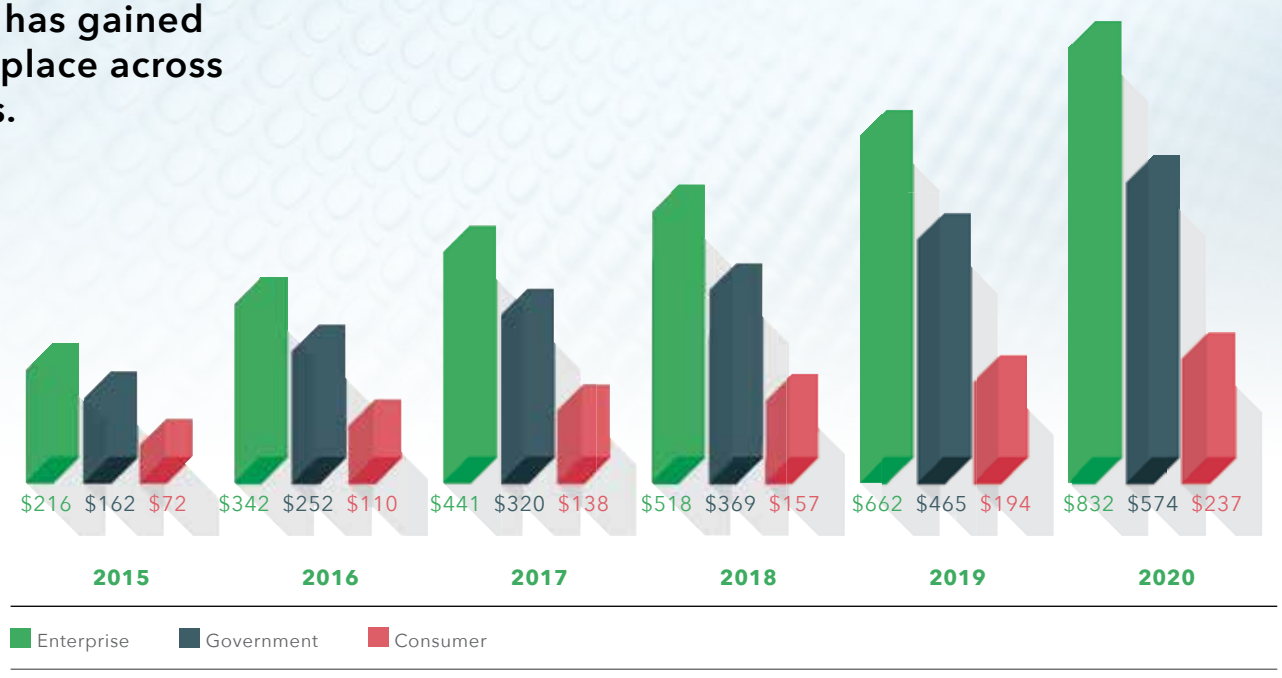
THE INTERNET OF THINGS

Driven by mobile internet technologies, the concept of the Internet of Things (IoT) has gained prominence and will become commonplace across a wide variety of business applications.

It is generally defined as a network of physical objects that contain embedded technology to communicate and sense or interact with their internal or external environment.

Today, less than one percent of things that could be connected to the Internet are connected. DHL and Cisco estimate that roughly 1.5 trillion things on earth could benefit from an IP address, whereas only 15 billion are connected today. Within five years that number will grow to 50 billion, at which time traditional computers, tablets, and smartphones will make up only 17 percent of Internet connections. Business deployments of IoT have grown by more than 300 percent in the last several years as prices of microelectromechanical devices have fallen by 80 to 90 percent.[73,74]

Figure 2.12: **Estimated IoT Investment per Year (Global). (Figures in billions.)**



Source: BI Intelligence[72]

[72] Greenough, J., and J. Camhi. "The Internet of Things 2015: Examining How the IoT Will Affect the World." BI Intelligence, November 2015.
[73] Macaulay, J., L. Buckalew, and G. Chung. "Internet of Things in Logistics." DHL Trend Research and Cisco Consulting Services. 2015.
[74] "Disruptive Technologies: Advances that will transform life, business, and the global economy." Op cit.

THE INTERNET OF THINGS

Potential applications of IoT technology are vast. Such systems can monitor or manage the health and actions of connected objects and machines, as well as people and the natural world. Some of the more notable uses include monitoring the flow of products through a factory, or tracking the flow of water through utility pipes.[76] In addition, the technology has the potential via remote monitoring to improve the health of patients with chronic illnesses and reduce a major cause of rising healthcare costs.[77] The Internet of Things will connect operations to the back office as never before, dramatically increasing visibility and control. Improved asset tracking using sensors and connectivity will result in real-time insights and visibility into businesses' supply chains. Asset locations will be immediately apparent along with the status of preventive maintenance, improving utilization of critical pieces of infrastructure and machinery.[78] Real-time operational insights will also help organizations make more informed, smarter business decisions, such as reducing operating costs, improving process efficiency, and minimizing energy costs.[79]

The technology will complement other emerging systems such as cloud computing and RPA. Not only do networks of interconnected devices allow careful process orchestration, but the quantity of data generated allows for unprecedented analysis of historical trends to optimize future operations. With businesses increasingly leveraging large databases to learn about themselves and their customers, participation of objects in systems previously dominated by people will exponentially increase the amount of information available. Computing power is on pace to meet the challenge and provide business leaders with the insights they need to make decisions at the pace of the evolving landscape. Implementing those decisions will be feasible through integration of IoT technology with process automation capabilities developed in parallel. Increasing spans of control will magnify the potential cost of human error, requiring ever-more precise process execution. Elimination of the human element will serve this end.

Figure 2.13: **Estimated IoT Impact in Various Settings in 2025**

Setting and Possible Applications	Size in 2025	
	LOW EST.	HIGH EST.
Factories (operations, predictive maintenance)	$1.2 billion	$3.7 billion
Cities (public safety, health, traffic control, resource management)	$0.9 billion	$1.7 billion
Human (monitoring and managing illness)	$0.2 billion	$1.6 billion
Retail (self-checkout, customer-relations)	$0.4 billion	$1.2 billion
Outside (logistics routing, autonomous vehicles)	$0.6 billion	$0.9 billion
Work sites (operations management, equipment maintenance)	$0.2 billion	$0.9 billion
Vehicles (condition-based maintenance, reduced need for insurance)	$0.2 billion	$0.7 billion
Homes (energy management, safety and security)	$0.2 billion	$0.3 billion
Offices (organizational redesign, worker monitoring, training)	$0.1 billion	$0.2 billion

Source: McKinsey[75]

[75] "Unlocking the potential of the Internet of Things." McKinsey. June 2015. http://www.mckinsey.com/insights/business_technology/the_internet_of_things_the_value_of_digitizing_the_p hysical_world
[76] "Disruptive Technologies: Advances that will transform life, business, and the global economy." Op cit.
[77] Ibid.
[78] "Reaping the Benefits of the Internet of Things." Cognizant. http://www.cognizant.com/InsightsWhitepapers/Reaping-the-Benefits-of-the-Internet-of-Things.pdf
[79] Ibid.

THE INTERNET OF THINGS

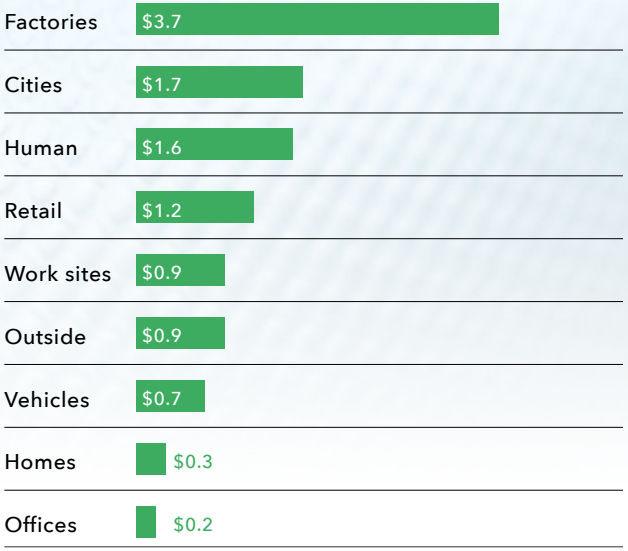
Deployment of IoT technology is not yet widespread. To date, the technology has generally been implemented as a tool to reduce costs and improve efficiency. According to an analysis of 89 IoT implementations by 20 major providers between 2009 and 2013, 65 percent of use cases were focused on cost reduction and efficiency, while 22 percent focused on risk management and 13 percent targeted revenue growth or innovation.[81]

The range of applications for IoT technology will grow rapidly over the next decade, with estimates of the potential economic impact at $4 trillion to $11 trillion annually by 2025.[82] Figure 2.13 and Figure 2.14 provide information on settings and applications, in addition to estimates for the monetary contribution of each to the global economy. Based on high estimates of IoT impact, factories will see an outsized benefit, at $3.7 billion in 2025, while offices will incur the least direct impact at $200 million.[83] Note that factories are here defined as standardized production environments, most notable in manufacturing facilities but also present in agricultural, hospital, and other similar settings. Usage of IoT in factories remains relatively low, with the technology present in an estimated 10 percent of industrial operations.[84]

Future value from the IoT in factories is expected to be derived largely from productivity improvements, such as energy savings and labor efficiency.[85] In addition, improvements in equipment maintenance, inventory optimization, and worker health and safety are also sources of value in factories. Applications will be principally comprised of sensors that remotely control production and monitor equipment health.[86] Already there are examples of IoT in the pharmaceutical industry whereby sensors measure optical characteristics for product inspection, with individual packages measured for the correct level of opacity.[87] This contrasts with the traditional method of inspection through statistical sampling.

Business leaders must be aware that the adoption of IoT technology will entail significant costs as upgrading or replacing equipment requires accommodation of additional sensors and actuators.[88] There will also be technical challenges. The current system of IP address use must change to a system that provides a unique address to every possible object that may need one in the future.[89] The power behind the embedded chips on IoT devices will need to be smaller and more efficient. Another requirement is the development of software applications that can communicate with and manage the stream of data from hundreds of interconnected non-computing devices that comprise a "smart" system which can adapt and respond to changes.[90] Platform lock-in will be a significant concern once such systems are integrated into a production operation. Finally, security vulnerabilities may also slow IoT adoption.

Figure 2.14: **High-end Estimates of IoT Impact in Various Settings in 2025. (Figures in billions USD.)**



Source: McKinsey[80]

[80] Ibid.
[81] "The Internet of Things Ecosystem: Unlocking the Business Value of Connected Devices." Deloitte. 2014. http://www2.deloitte.com/content/dam/Deloitte/global/Documents/Technology-Media- Telecommunications/gx-tmt-lotecosystem.pdf
[82] "Unlocking the potential of the Internet of Things." Op. cit.
[83] Ibid.
[84] "How The Internet Of Things Is Transforming Manufacturing." Forbes. July 1, 2014. http://www.forbes.com/sites/ptc/2014/07/01/how-the-internet-of-things-is-transforming-manufacturing/
[85] [1] Ibid. [2] "The Internet of Things: what it means for US manufacturing." PwC. February 2015. http://www.themanufacturinginstitute.org/Research/Disruptive-Innovations-in- Manufacturing/~/media/659a17245f6f4375bcce889079427cb6.ashx
[86] "Unlocking the potential of the Internet of Things." Op. cit.
[87] "The Internet of Things: what it means for US manufacturing." Op. cit.
[88] "Unlocking the potential of the Internet of Things." Op. cit.
[89] "Definition of the internet of things." Op. cit.
[90] Ibid.

OTHER NOTABLE DISRUPTIVE TECHNOLOGIES

Three-Dimensional Printing

Three-dimensional (3D) printing, currently the domain of advanced manufacturing and the occasional hobbyist, may emerge as a true game-changer that entwines the Internet inextricably with the physical world.

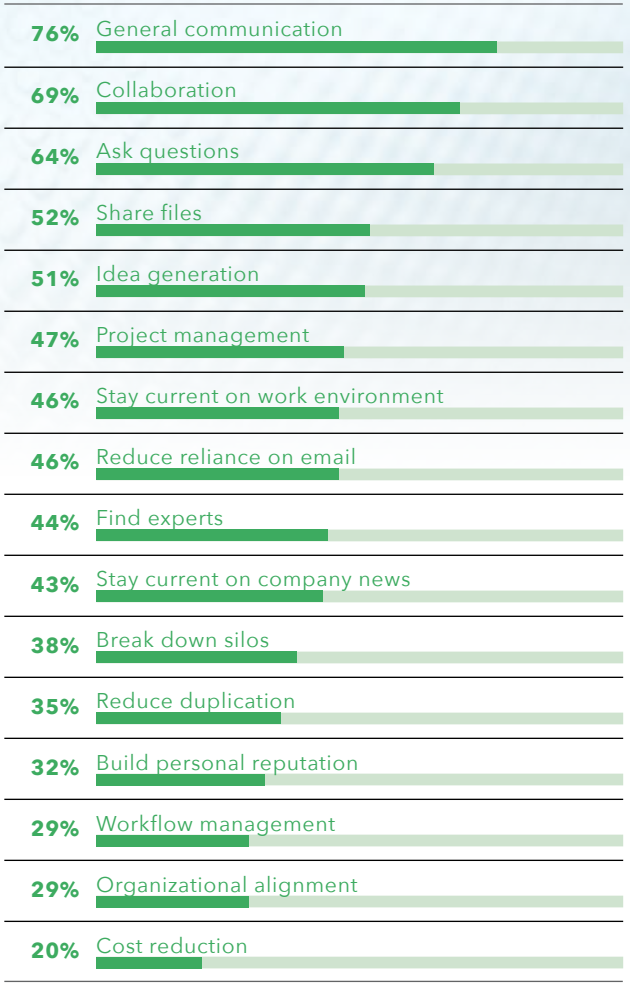
Much like a traditional printer deposits pigment onto a page, 3D printers deposit substances such as plastic or metal. Built up in layer after layer, the base material takes the shape of an object that existed previously only in computer code. Manufacturing is clearly the first industry to be affected by 3D printing, with a fourfold increase in use over the past ten years. Manufacturing makes up 12 percent of the global workforce; more than 320 million jobs could be affected. With prices falling, however, the technology is coming within reach of greater portions of the population. Prices for home 3D printers have fallen more than 90 percent since their introduction.[91]

Social Media

Social media are a much-discussed phenomenon in the business-to-consumer sector, but in industrial and office environments they are more often seen as a distraction.

They should not be discounted out of hand. Platforms such as LinkedIn and Indeed are rapidly increasing efficiencies in the job market, which will make it both easier for firms to identify talent and harder to keep it on board. They are a significant driver of the move toward Big Data analytics, with legions of entrepreneurs and industry incumbents inventing new ways to learn from the information they generate. Offices are using social media to communicate, collaborate, and avoid duplication of effort. Social platforms will remain important at a global scale, and will continue to encroach on the digital business environment.

Figure 2.15: **Why do you use social and collaborative tools?**



Source: Chess Media Group[92]

[91] "Disruptive Technologies: Advances that will transform life, business, and the global economy." Op. cit.
[92] Chess Media Group. "The Future of Work: Reshaping the Workplace Today. Building for Tomorrow." Atlassian, Central Desktop, Citrix, Moxie Software.

THE BUSINESS LANDSCAPE IN 2025

The next ten years will bring about new products, services, and business models that are unimaginable today, but several trends in today's disruptive technologies give glimpses into what we will see in the world of 2025.

The definition of what constitutes a firm is changing, with far-reaching consequences. At the same time that automation and data analytics are empowering organizations of ever-larger scale, mobile technologies and cloud computing are allowing greater flexibility and dispersion of key employees and decision makers. Even the definition of what constitutes an employee will change, as we are already seeing in marketplace business models where front-line operations are carried out by largely uncoordinated individuals who sell their time when and how they wish.

The future will carry this trend beyond Uber and TaskRabbit to other industries and other areas of business operations. Sophisticated technological requirements will extend beyond the core capabilities of many businesses, which will turn to external service providers to execute processes formerly considered central to commercial success. Cloud service providers will offer platforms that remain at the cutting edge of technology at a lower cost than installed legacy systems that require continual updating, investment, and attention on the part of business leaders. Business process outsourcing will expand beyond basic offshoring to include sophisticated management of process automation. Outcome-based pricing models will overtake simple per-unit measurements of value. As we have seen since the beginning of the industrial revolution, people will continue to specialize to degrees never thought possible, and our tools will bring them together to a common purpose despite the growing lack of clarity in what constitutes the boundaries of a firm.

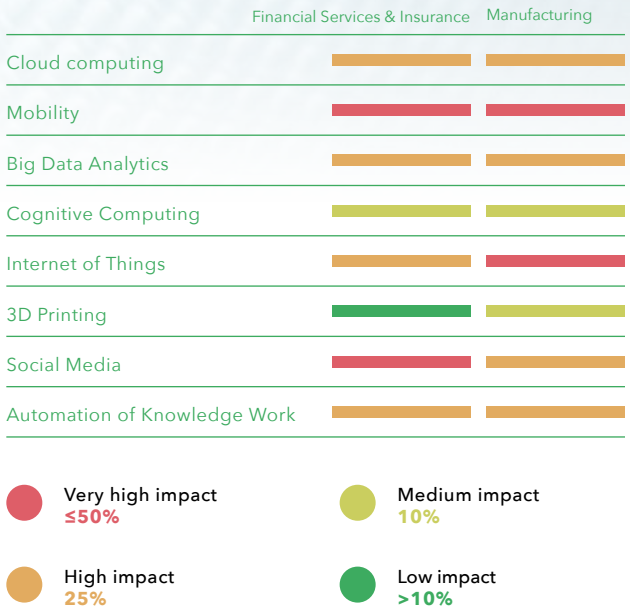
SUMMARY

Disruptive technologies will impact businesses' internal operations, affecting the daily activities of frontline workers and back-office knowledge workers alike.

Repetitive tasks such as handling email or pulling data, for example, will see increasing automation, thereby freeing up employees' time to focus on creating new kinds of revenue streams.

Many of the most notable changes will be driven by advanced concepts surrounding cloud computing, mobile internet, and data analytics. Emerging platform-based services are re- defining the supply chain and introducing unprecedented efficiencies from the back office to Midwest cornfields. Robotic process automation is growing in power as an important set of back-office tools, and is poised for a radical leap forward with the advent of cognitive computing. The Internet of Things and three-dimensional printing are democratizing the physical world even as blockchain technology spreads from the narrow domain of cryptocurrency to potentially democratize swathes of recordkeeping and financial intermediation functions. Beneath these forces, social media are changing how human beings interact at a fundamental level, and generating vast storehouses of data whose full potential is far from realized. By 2025, the adoption of such disruptive technologies will have an estimated annual global economic impact of $14 trillion to $33 trillion.[93] Few will be unaffected.

Figure 2.16: **Impact of Technologies across Industries**



Source: Kairos Future, Tieto[94]

[93] [1] "Ten IT-enabled business trends for the decade ahead." McKinsey. May 2013. http://www.mckinsey.com/~/media/mckinsey/dotcom/insights/high%20tech%20telecoms%20internet/ten%20it- enabled%20business%20trends%20for%20the%20decade%20ahead/mgi_it_enabled_trends_report_may%20201 3_v2.ashx [2] "Manufacturing New Business with the Internet of Everything." Cisco.com. May 16, 2014. http://blogs.cisco.com/ioe/manufacturing-new-business-with-the-internet-of-everything

[94] Eidenvall, L., and M. Lindgren.. Op. cit.

SUMMARY

Disruptive technologies are changing the face of business by reducing cycle times and waste and increasing process precision and overall levels of quality. They are democratizing the workplace in areas ranging from product design to manufacturing to distribution. While many worry about the impact of automation on employment, others are more worried about the shortage of appropriately trained workers to design, implement, and maintain systems of increasing complexity. Even as highly skilled workers become scarcer, they become harder to keep as information availability accelerates turnover in the job market.

Disruptive technologies are giving rise to new business models and re-inventing established business models; disruptive technology is used by entrepreneurs, Fortune 500 companies, and service providers alike. More companies are turning to experts to help them manage the complex dynamics of technological change. The need goes beyond technical assistance, as new technologies interact with human organizations in equally complex and unpredictable ways. In the past, companies regarded the outsourcing of business process as a simple matter of decreasing cost.[95] Today, effectiveness and efficiency is becoming an increasingly important consideration with the growing capability of specialized process providers who understand both the technological and the human elements.

[95] http://www.cognizant.com/InsightsWhitepapers/Business-Process-Services-Redefining-Business-Process-Outsourcing.pdf

ABOUT THE CONTRIBUTORS

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