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The Disruptive Era of Smart Machines Is Upon Us

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The smart machine era will be the most disruptive in the history of IT. New systems that begin to fulfill some of the earliest visions for what information technologies might accomplish — doing what we thought only people could do and machines could not —are now finally emerging.

Key Findings

- Smart machines include autonomous vehicles, intelligent personal assistants, smart advisors (such as IBM's Watson) and advanced global industrial control systems.
- Gartner is launching an integrative body of research on the evolution of the technologies and the individual (personal), enterprise, industry, economic and social opportunities, risks and implications that smart machines represent.
- This document scopes the range of topics, provides examples and exposes some of the hypotheses we are testing now in our research process (for future publication).

Recommendations

IT leaders should:

- Explore smart machines to understand the new technologies and systems involved and open a specific dialogue with other, non-IT executives in their organization to understand the business implications, opportunities and risks.
- Invest sooner rather than later because these tools — including those that enhance personal productivity — can offer competitive advantages if adopted early. They are not the typical utility tools implemented today.
- Engage suppliers of smart machines to explore the opportunity to co-develop with them new smart machines that marry your organization's specific body of expertise with their smart machine technologies to create new businesses for both entities.
- Treat risk management as a major concern and engage advisors who can help navigate and avoid the risks that often emerge coincident with the introduction of new, disruptive forces.

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Analysis

Introduction to Smart Machines

Smart[1] machines[2] promise to be more disruptive[3] than any of the prior technology generations.[4] Starting in the second half of this decade, we expect to see dramatic growth in the availability, sale and use of smart machines — technologies that:

- Do what we thought only people could do[5]
- Do what we thought machines couldn't do

Smart machines can make people more effective, empowering them to do "the impossible." For example, physicians can stay up to date on tens of thousands of new scientific research papers published in their discipline every year while engaged, full time, in an advanced medical practice. Smart machines can also encroach on what people do, displacing them. Think of the long-term impact on truck driver employment of automated trucks that are already in commercial use on private property in limited numbers today.[6]

Some smart machines are little more than clever, brute force automation, as in semiautonomous vehicles such as self-driving cars demonstrated by Google[7] or automated crash-avoidance braking systems (such as optional equipment available now on new Mercedes Benz cars[8]) that will autonomously apply the brakes when the car's systems detect an imminent threat to which the driver has not properly responded.

Other smart machines are genuinely smarter. They are built to exploit self-learning, machine learning and deep learning[9] algorithms. They behave autonomously (see Note 1) and adapt to their environment. 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. The criteria defining smart machines will continuously advance as well (see Note 2).

IBM's Watson of today[10] and Apple's 1987 "Knowledge Navigator" vision[11] represent two (of many) different instances of smarter machines.

We expect individuals will invest in, control and use their own smart machines to become more successful. Enterprises will similarly invest in smart machines. Consumerization versus central control tensions will not abate in the era of smart-machine-driven disruption. If anything, smart machines will strengthen the forces of consumerization after the first surge of enterprise buying commences.

Different Types of Smart Machines

We see at least three broad classes of smart machines:

1. Movers — autonomous vehicles
2. Sages — information-based helpers
3. Doers — machine-focused helpers

Examples of Smart Machines

Examples can illuminate the category. Following author William Gibson's famous observation that "The future is already here — it's just not very evenly distributed," we provide illustrations that can also offer a glimpse into a much more disruptive future.

Movers: Autonomous Vehicles

Current examples include:

Kivasystems' Kiva robots autonomously navigate "human exclusion zones" in warehouses to find merchandize and bring it to humans to pack and ship. Wired Magazine's videos expose the anthropomorphic names given to Kivasystems products, for example, the BettyBot.[12] They also speak to the business advantages these autonomous transporters provide. Tugs, used in hospitals, are a more human-friendly delivery system that can coexist with pedestrian traffic with no rules or training.[13]

One big step up the evolutionary ladder, Boston Dynamics' Big Dog project has evolved into DARPA's Legged Squad Support System, a military prototype.[14] This autonomous vehicle is designed to support dismounted troops. With four legs and a body, it resembles a pack mule. With visual tracking, it is designed to follow troops and can carry up to 400 pounds of material up to 20

miles before needing to refuel. It handles rough terrain adeptly and is now acquiring the ability respond to spoken language. It's under field test today with the U.S. Marine Corps. Boston Dynamics has also added a fifth limb, an arm, to the automated pack animal. That arm could be used to throw objects or manipulate objects on its back.

Bigger still, Rio Tinto and Caterpillar have been working together to implement a fleet of 45 autonomous trucks for use at Rio Tinto mines in Pilbara (Australia). In this constrained environment (private roads), these model 793F mining trucks generate 2,650 horsepower and carry up to 480,000 pounds each while running 24 hours a day. Rio Tinto maintains a monitoring facility, a control room miles away from the action, but the trucks themselves are reported to be smart enough to decide whether to drive around or over obstacles and make other decisions necessary to move from their current location to a supervisor-specified destination. The big focus here is cost reduction, removing the expense of human personnel — hiring, transport, food, housing and entertainment as well as the cost of human foibles. Rio Tinto is not alone in this quest. A key mining competitor, BHP-Billiton, is making similar investments.[15]

Stories about autonomous vehicles are seemingly ubiquitous. Popularized by Google,[16] autonomous (and semiautonomous) automobiles are under development by several manufacturers including Audi, BMW, Tesla and Nissan, the last of which has publicly committed to bringing affordable self-driving cars to the market by 2020.[17] These cars are not "timid" conveyances for those who cannot see (although they hold out the promise of transport for the blind). As a reporter for Wired Magazine[18] wrote last year:

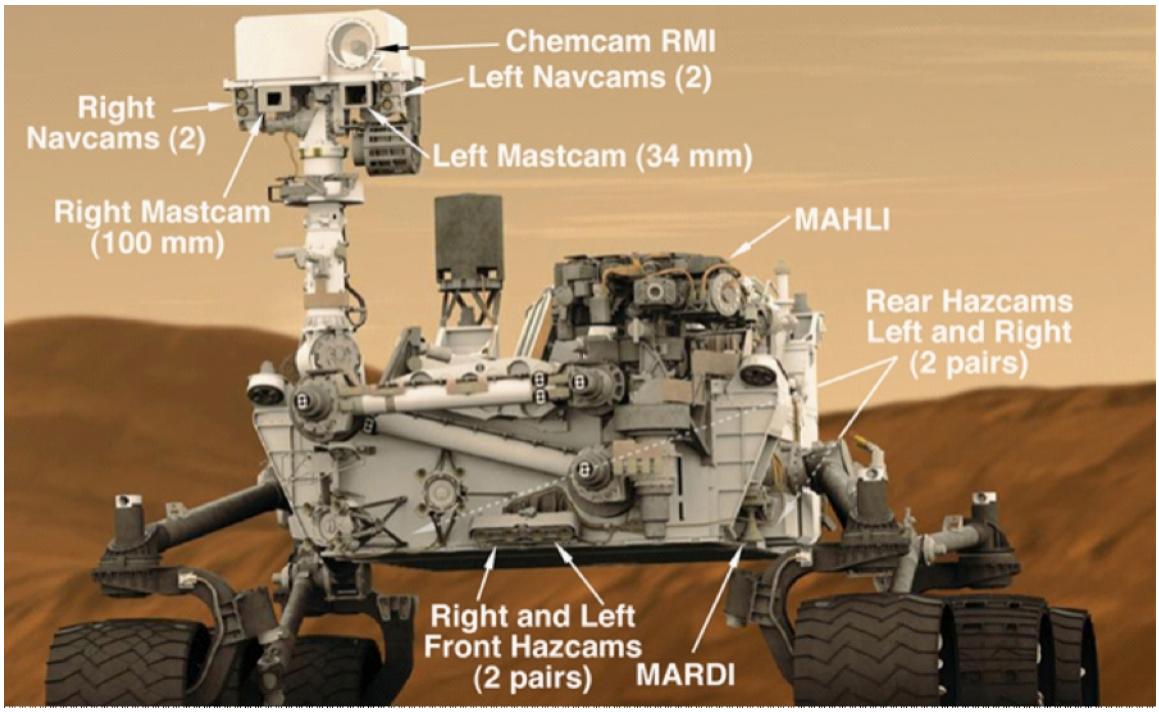
> "We are driving close to 70 mph with no human involvement on a busy public highway — a stunning demonstration of just how quickly, and dramatically, the horizon of possibility is expanding. "This car can do 75 mph," Urmson says. "It can track pedestrians and cyclists. It understands traffic lights. It can merge at highway speeds." In short, after almost a hundred years in which driving has remained essentially unchanged, it has been completely transformed in just the past half decade."[19]

Smart machine technology is already available to a limited degree in selected automobiles as in the automated "pedestrian detection and automatic braking" feature available from Volvo.[20] If the future isn't here now in consumer and commercial offerings, it will be shortly.

Many other autonomous vehicles are already in use or under development. NASA's Curiosity Rover (see Figure 1) began to autonomously navigate the surface of Mars on 27 August 2013.[21] The rover is now crossing terrain on its own, terrain unexamined by human eyes. In another test, an

autonomous X-47B Unmanned Combat Air System (a drone) successfully landed itself on the deck of a U.S. Navy aircraft carrier, the USS George H. W. Bush (CVN 77) on 10 July 2013.[22]

Figure 1. NASA's Curiosity Rover on Mars



Source: NASA

The biggest constraints to an explosion in semiautonomous and autonomous movers appear to be associated with legal risk which suggests the biggest opportunities may come in less litigious geopolitical systems for manufacturers based in less litigious locales. In turn, that may force governments in more litigious systems to place limits on liability (as they have for airplane travel and nuclear power plants) to allow their economies to enjoy the commercial and individual benefits of a world of smart movers.

While prediction is very difficult, especially about the future,[23] it seems highly unlikely that the sale, rental and use of smart movers will not take off dramatically.[24] Prepare to exploit the opportunities while considering the risks and watching the evolution of competition between various geopolitical opportunity pursuers.

Sages: Information-Based Helpers

"Sages" are technologies that appear to understand the meaning of rich content (including context).

We can identify at least three different categories of sages:

1. Virtual personal assistants
2. Smart advisors
3. Other linguistically smart systems

All of these are linguistically smart, a term that goes beyond natural-language processing to include the understanding of meaning and inference.

Virtual Personal Assistants

We describe virtual assistants in the 2013 Hype Cycle for Human-Computer Interaction[25] and rate them as achieving the Plateau of Productivity within two to five years and delivering a high business impact. That rating is based on virtual assistants in customer service applications, but there is another type of virtual assistant focused on persistently servicing the needs of a specific individual, the virtual personal assistant.

Apple

The virtual personal assistant category harkens back at least to the Knowledge Navigator concept described by former Apple CEO John Sculley in his 1987 book, Odyssey. The Knowledge Navigator concept was the basis for a video of the same name[26] that Apple used at various industry events starting in 1987 to describe its vision for how its computers would add value for people.[27] The Knowledge Navigator begat the Apple Newton MessagePad (1993-1998) which was a distant ancestor of Apple's current virtual personal assistant, Siri (which is delivered as part of the iOS operating system).

As seen in the 1987 vision video, virtual personal assistants retain a deep memory of historical interactions with and observations of the people they work with. They operate using strong contextual awareness, that is, they know what the user is doing and should be doing at a particular point in time and in a particular location. Knowing the user and the user's context are critical.

Siri can be described as a relatively primitive question-answering agent.[28] Beyond voice recognition and speech output, Siri retains context from question to question so it can respond as though it understands context from a prior question. If the user's question or action request contains too little information, Siri will ask the user for more information (for example, if you tell it "Remind me to call Tom," it might come back with the question "What time would you like me to remind you?"). Siri's context sensitivity includes location so the user can refer, for example, to "here," "home" and "work" and Siri will resolve that to a specific location based on user history. Siri suffers from promising more than it can deliver (not uncommon historically among virtual personal assistants). The range of concepts and phrases Siri appears to understand well is far smaller than is needed to be highly useful for a broad set of use cases. Oftentimes, it uses cuteness or cleverness to mask an inability to really understand what the user wants (a characteristic shared by many people) and, sometimes, Apple has programmed it to border on talking trash when asked about various competitor's products such as Google Glass[29] where its responses are funny but not necessarily instructive.

Microsoft

Eric Horvitz, distinguished scientist and co-director at Microsoft Research, gave a TEDx talk on 19 February 2013 on "Making Friends With Artificial Intelligence"[30] in which he talked about virtual personal assistants that Microsoft Research has built. He uses one to help manage matters in his office and support people who want to work with him. He demonstrates the agent and examines how it works (starting at 18:40 on the video). The video demonstration and discussion provide viewers with a valuable perspective on how far along these capabilities already are.

On Monday, 15 July 2013, Microsoft co-founder and chairman Bill Gates gave a keynote speech at the Microsoft Research Faculty Summit in which he spoke about contextual awareness and personal assistant technology. The Wall Street Journal's coverage of the presentation is instructive.[31] In part, Gates speaks of "personal assistants that can help us get things done, help us drive deep insights" from opt-in observations of the user's context and history by the user's personal assistant. Information sources cited included sensors in mobile devices, scheduling software, social connections and activity patterns collectable by the Microsoft Office suite. Gates said he foresees "really unbelievable progress" in the next five to ten years despite misgivings about the impact of privacy concerns on progress. That view is consistent with Gartner's perspective.

We expect Microsoft to be a key player in the development and commercialization of virtual personal assistants. They have the science, the engineers and the market opportunity. The company needs the will to capitalize and Gates' statements about the opportunity suggest it gets it but, to succeed fully, Microsoft needs to broaden the scope of its commercial products to enthusiastically embrace and enhance every user platform with a reasonable market presence regardless of whether it runs Windows or not.

Google

Google Now and The End of Search As We Know It, two initiatives announced in 2012 and 2013 respectively, signal Google's long-term intent.[32] Google is very active in the area of developing virtual personal assistants for everyone. Their thinking has its roots in improving search, to the point where search knows the user and delivers, when appropriate, the right answer the user needs whether the user asks for it or not. If Google delivers the single perfect input to the user's action pattern, the world will lock into Google search and use it as its only tool for accessing and exploiting all of the world's information. Or so, we hypothesize, goes the thinking at Google.

A single answer may be inappropriate. When asking "What's fun in Paris?" for example, you need a way to think about the alternatives in a way that you can relate to, which leads to Google focusing on "just the right information at the right time" — and quite often this will be complex, structured information.

The Google knowledge graph[33] is tooling to help people explore deeper, structured information, as is conversational search, where you can ask follow up questions and have a dialogue with the search engine. The Google knowledge graph covers 570 million entities (things, people and places) and the 18 billion connections between them.[34] The knowledge graph abstracts meaning and helps

Google understand content and draw inferences, not just index it. Google estimates that its knowledge graph is only 3% to 4% complete and is using deep learning and similar technologies operating on data from the billions of daily searches it receives to automatically build and refine it.[35]

All major players in linguistically smart applications (which includes virtual personal assistants and the rest of the sages category) are building or extending these constructs called knowledge graphs. Google currently has some special advantages by virtue of its scale, reach and share of devices and platforms. All competitors are really in a race to demonstrate the best results on the assumption that their engineering moxie will win them the big prize.

The prize for users will be broad spread availability and use of the first major breakthrough this century in user productivity tools beyond simple search and the explosion of new device types.

Smart Advisors

IBM's Watson and Watson-based solutions are the archetype for smart advisors. There are also other firms doing related work, independent of IBM, such as Saffron Technology, and a number of firms are co-developing specific solutions with IBM, such as WellPoint, to be sold by the co-developer, by IBM or both.

Virtual personal assistants attempt to add value for all users across all information while smart advisors are specifically focused on a particular content domain or a particular class of user (or both). Smart advisors do not attempt to add value for all users across all information.

Smart advisors also tend to be more transparent, providing easier access to the underlying evidence behind a recommendation or offered answer. They also offer more than one alternative, with relative ranking, to give users more choice and to better inform them. They leave it up to the user to determine if the advice is valuable, or even makes sense. Many virtual personal assistants tend to lack such transparency and choice.[36]

Much more specialized than virtual personal assistants, IBM's Watson solutions appear to currently lead the way economically in the emergence of smart machines. According to Credit Agricole,[37] Watson is potentially a huge and highly profitable business for IBM[38] representing $2.65 billion of revenue (2.1% of IBM's total) in 2015 and $12.2 billion (12.4% of total) in 2018 (up from 0.5% in 2013). Those numbers don't include revenue for co-development partners or third-party value chain members.

Watson excels at:

- Analyzing — in real time — a specific body of knowledge (the corpus) such as all the available medical and scientific literature that relates to several cancers, or all the product documentation created by a large multinational firm
- Estimating the value and likelihood of various conclusions identified in the corpus which relate to the situation at hand (a patient's history, everything known about a credit applicant or a specific question from a customer seeking advice on what to do next on a complex question such as retirement planning, for example).

- Offering those conclusions back to the user (results are ordered based on likelihood and backup evidence is available on request).
- Watson can also prompt the user for more information (or the doctor for another set of diagnostic tests), consider the user's response and adjust its response based on results.

We have published more detailed analyses of Watson.[39]

We expect that, at some point in the next decade, virtual personal assistants and smart advisors will merge as both begin to expand their capabilities to encroach on the others' niches, but that's a subject for future research.

Other Linguistically Smart Systems

There are many other smart machines today in the sages category. Most rely on understanding content. Particularly, but not only, unstructured content.[40]

Here are three examples:

E-discovery software: These products analyze, code and group documents to speed and simplify search for any content relevant in any given case. The techniques are not revolutionary. Many have been around in the world of semantic analysis and machine learning for years. What's different is these processes were previously thought to be amenable only to human knowledge and effort.[41] These tools make law offices more efficient, cut legal costs *and* displace junior law associates.

Essay-exam grading systems: EdX, a nonprofit consortium of colleges and universities founded by MIT and Harvard and consisting of 28 institutions worldwide as of August 2013[42] offers massive online open courses.[43] As of now, edX has 1.2 million students. In April 2013, the organization announced that it would release an open-source software system based on artificial intelligence that could automatically grade students' written answers to essay questions.[44] The system requires that a human evaluate 100 written answers to an essay question. Those written commentaries and ratings are then used by the software to train itself to grade future essay answers.[45]

Decision support smart machines: Narrative Science[46] takes business intelligence information (descriptive and predictive analytics, for example) and provides advice in narrative form using its artificial intelligence engine called Quill. These reports provide advice in readable and colloquial text, suggesting what to do based on what the engine sees in the data. In so doing, they can help the business reduce cognitive and emotional biases in their analysis and decision making.[47]

The arrival of these linguistically smart systems will not always be in neat packages with "smart machine" labels and big price tags. Some will be embedded in other goods and services. Some will be offered free, particularly as more applications move to the cloud (which allows applications to learn far more quickly from a broader base of user data and in special server farms that just deliver results to end users).

Doers: Machine-Focused Helpers

The Internet of Things and the convergence between information technology and operational technology intersect and create additional opportunities for smart machines to emerge at various levels of scale, from individual robots though enormous networks of industrial machines.

Robots

Baxter from Rethink Robotics reflects a heavy rethinking of what industrial robots should do, how they should be programmed and how they should operate.[48] Trainable by non-technical personnel, able to work "shoulder to shoulder" with humans and somewhat simplified by using behavior-based artificial intelligence,[49] Baxter does what we thought only people could do, not something machines can do.

At Cornell University, researchers are actively working on robot technologies that can anticipate what humans will do next so as to "intelligently" act in their presence or on their behalf.[50] In one of the researchers' demonstrations, their robot observes a person carrying an object. Its algorithms continuously make predictions on what action the individual will take next, for example, place an object onto a table or put it into a refrigerator. The robot eventually decides the person will put the object in the refrigerator and assists by opening the door.

This example is instructive because it's a physical world (doers) instantiation of the information world examples cited in the sages section. It bears similarities to both virtual personal assistants and smart advisors.

Its behavior is based on intimate knowledge of the behavior of the individual in the physical context (a focus of virtual personal assistants).

It also acts as though built on a smart advisor because it:

- Continuously reevaluates the evidence in real time
- Creates hypotheses
- Calculates their likelihood
- Takes action once the preponderance of evidence suggests (with a high degree of confidence) what is the most likely outcome
- Learns from observing the results

Enormous Networks of Industrial Machines (Including Industrial Control Systems)

Traditional process-control, automation and material handling systems alone are not smart machines. Neither are sensor networks or networks of machines. However, the existence of these networks can create an opportunity to build smart machines by, for example, applying deep-learning technology to a network of hundreds of thousands of sensor-equipped machines to discover previously unknown and unanticipated patterns that could signal failure.

Imagine where General Electric (GE) could go. GE's data suggests that a global network of industrial machine networks could encompass 46% of global GDP.[51] In just one sector alone — aircraft engines — GE estimates there are 129,000 "big things that spin" (compressors, turbines and turbofans) to tie into a global Internet so that all of the important data from those objects, along with a broad range of context information (such as environmental and operational attributes) could be monitored in real time. GE is developing plans for building the foundation networks.

Meanwhile, there are numerous suppliers today (such as Grok and Mtel) with machine learning technologies that could be used to create an enormous smart machine (consisting of all the interconnected engines as well as other data sources and systems) as well as the little machines (each engine and its compressors, turbine and turbofans) that can learn in real time, adapt and find new unanticipated anomalies for people to deal with.[52]

We expect enterprises to invest in doers (machine-focused helpers) to cut labor costs, increase productivity ("error proofing" certain processes such as high-speed assembly), strengthen process robustness in some manufacturing segments and shorten delivery cycles in some product-centric supply-chain segments and industries.

The Impact of Smart Machines — Why Should You Care?

Smart machines will be the most disruptive change ever brought about by information technology. How people work with information will change and we will rely on, and be aided by, smart machines. How we interact with the physical world will change, via movers and doers. We will be able to spend more time being more productive on the job and have more time to pursue other things in life with some of the gains of productivity (but we're not foolish enough to assume dramatically shortened work days or work weeks).

Other Potential Impacts

(All subject to further research and offered as hypotheses):

- Enterprises will be forced to equip employees with smart machine technology to improve their ability to perform in the service of the enterprise lest their competitors outperform them by virtue of how they equip *their* employees. We will research whether and where smart machines arms races may break out between enterprises and reshape industries.
- Individuals will be forced to equip themselves with their own smart machine technologies to increase their value to their employers and customers (as employees and independent contractors).
- There are numerous uncertain states that can be quite worrisome. How smart machines will influence others, rather than how each smart machine operates as a solo act, needs to be anticipated. For example, what happens when smart machines are in conflict with one another? When will virtual personal assistants be allowed to order your autonomous car to pick up your golf buddy for a match? How is "interspecies" interoperability assured?

- Enterprises will need to re-examine their own information assets to determine if they could benefit by selling smart advisors to others based on usage of the enterprise's own information assets. Enterprises will need to determine, for example, if they can make more money by selling Watson-based advisors than by hoarding that information (and the advisor) for themselves.
- Job categories will disappear. Movers will displace many taxi and limousine service drivers, truck drivers and delivery people. What other categories will be threatened?
- Other job categories will likely be enhanced. For example, nurse practitioners may be more able to fill the role of general practitioners with the assistance of smart machines that make *them* smarter.
- New industries will emerge, built around smart advisors as well as the enhanced creativity unleashed by smart machines and the time freed up by movers and doers. Other industries may be crushed.
- There are major potential economic and social implications with the "creative destruction" wrought by smart machines in some areas, huge opportunities in others and populations, regulations, laws and cultural norms that may not be ready for all the changes.
- Smart machines should be far more adept at making associative leaps if their owners and users ask them to. Will creativity abound? Not everyone will appreciate this property.
- Security, privacy and ethical risks.

All of the surmises above constitute hypotheses to test, research to conduct and advice to formulate.

There are two divergent ways of viewing smart machines. We could look upon them as the beginning of a utopia — or a dystopia — an overly positive or an overly negative worldview.

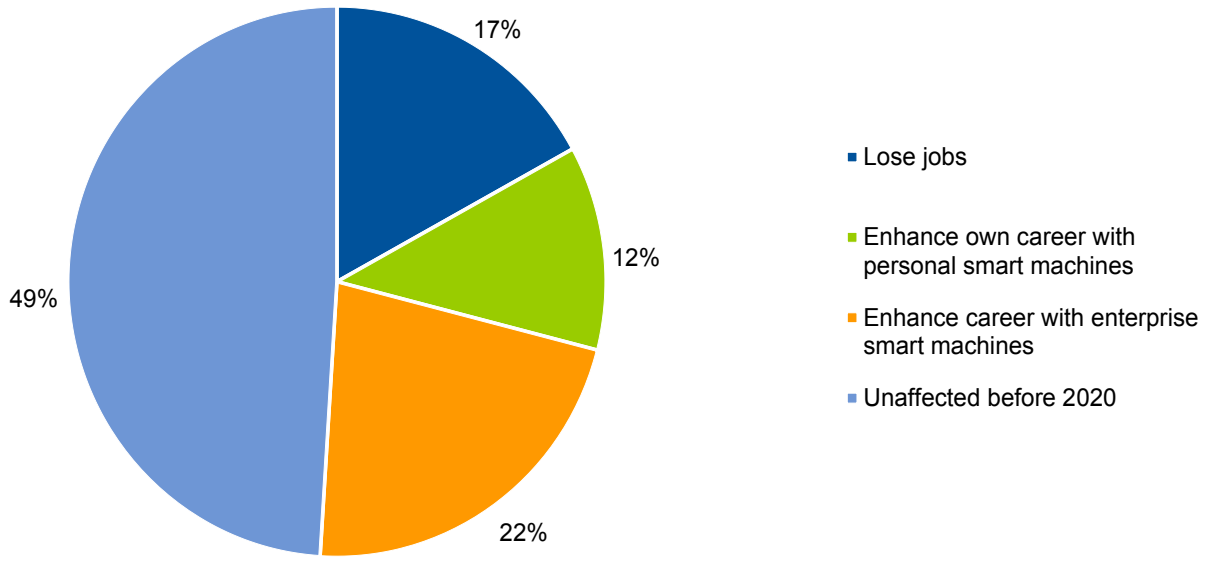
In a utopia, we would see:

- Smarter people and smarter machines working to help each other
- Rising performance and lowering costs
- A broad range of scope, form and implementation models.
  - Scope: from smarter planets to intensely personal advisors
  - Form: ranging from robots, through virtual personal assistants and autonomous systems
  - Implementations: cloud-based services, personal apps, on-premises systems (and all combinations of these alternatives).

From a dystopic point of view[53] there have been warnings ranging from unemployment in specific job categories (such as the loss of 5.7 million professional American truck driver jobs over the next 20 years as autonomous trucks take hold in the market) through widespread unemployment and negative economic and social implications.[54]

One of our working hypotheses (they are still under evaluation — not finalized) assumes a middle ground between utopia and dystopia. Smart machines will upend a majority of knowledge workers' career paths by 2020. Some will gain, and some will lose, but those that ignore smart machines do so at tremendous risk in the 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 next decade. We've constructed Figure 2 as an illustration of this hypothesis.

Figure 2. 2020 Knowledge Worker Career Impact Hypothesis



Source: Gartner (September 2013)

Other Terms, Approaches and Distractions

There are a lot of overlapping terms and approaches that fit within the notion of smart machines. There is not a lot of order across these terms and approaches but they're important to reference.

Examples include:

- Artificial intelligence[55]
- Thinking machines[56]
- Conversational assistants[57]
- Natural-language processing and computational linguistics[58]
- Natural-language question answering[59]

- Intelligent agents, virtual assistants and virtual personal assistants[60]
- Smart machines (as originally used by Soshana Zubhoff)[61]
- Machine learning and deep learning
- Cognitive computing[62]
- Digital workforce engineering[63]
- Cybernetic friends[64]

There are also various terms that do not add a lot of value in terms of looking at smart machines and their impact over the rest of this decade. They're distractions. They include human mimicry, absolute accuracy, technological singularity and generality.

In the next decade, smart machines:

- Do not need to mimic how humans behave any more than airplanes need to flap their wings to fly. Modeling how humans behave and how the brain functions are offer intriguing scenarios, but they're not central to the widespread emergence of smart machine this decade.
- Do not need to be "perfect." They operate within defined tolerances or limits and assess the probability of potential future states. Smart machines cannot freeze up because they can't completely predict the future — they have to calculate the probability of various outcomes, act on the most likely outcome, observe the results and adjust their models accordingly. Particularly (but not only) in the case of smart advisors, users have to evaluate the quality and value of advice smart machines give them and act accordingly.
- Are a far cry from the vision of technical singularity wherein greater-than-human intelligence emerges from human technological development. The singularity quandary is out of scope for the time frame we are working within.
- Are not a technology-based, general-purpose intelligence. In other words, do not expect your self-driving vehicle to be able to pilot an airplane.

Act Now

There are few times when IT executives have an opportunity to play a strategic leadership role in their businesses. This is one of those times as the impact of the era of smart machines is dramatically different from the typical generational change in technology.

This is not a new storage medium, a new networking technology, a new way to analyzing data or a better way to model a business. For the first time, we are on the cusp of technologies that can make people significantly more effective in their ability to be more creative, more insightful and far better informed than ever before.

These benefits, however, come with risks and costs, many of which are still unknown.

IT leaders must come up to speed on smart machines now and open a deep dialogue with other business executives to understand where and how they can and should pursue the opportunities together (we intend to help).

Smart advisors are more in-hand already. Laggards will lose. Explore here first. Starting today.

Virtual personal assistants will be many. Locking user devices and blocking access to the diversity of alternatives denies the enterprise — and its employees — the opportunity to make maximum advantage of what we expect will grow in adoption at a rate in the 2017 to 2018 period eclipsing the meteoric growth of tablet usage in business during the first two years of tablet adoption.

Maximum operational business advantage will go to the organizations that encourage user experimentation with the broad and heterogeneous range of virtual personal assistants that will arrive this decade. Few organizations will be fully comfortable with the potential security and privacy implications of this advice, but that's the way it is with major disruptions. Enterprises need to thread their way through the various risks knowing there is no painless path forward.

Monitor the risks carefully while pursuing the opportunities aggressively.

Recommended Reading

Some documents may not be available as part of your current Gartner subscription.

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

"Hype Cycle for Human-Computer Interaction, 2013"

"The State of E-Discovery in 2013 and Beyond"

"Artificial Intelligence Finally Delivers Real Value for Business Applications"

"Maverick* Research: A Workforce Without Humans: Three Ways Technology Will Eliminate Skilled Jobs in the U.S. Through 2020"

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

Note 1 Autonomous Behavior

Smart machines are autonomous (or semiautonomous) in that they appear to control themselves and to make their own decisions under most conditions. They are not under direct, continuous and complete remote control. The Mercedes-Benz automated crash avoidance braking system acts in a semiautonomous fashion: if the driver ignores warnings to apply the brakes, the car does it for the driver. Prototype cars that automatically drive trips of distances of tens or hundreds of miles under typical public road conditions without human intervention are an even better illustration of

autonomous behavior. The operator could take control or the car's automatic driving system could turn over control to the operator. But the car can, under many circumstances, behave in an almost totally autonomous way.

Similarly, virtual personal assistants and smart advisors (and other helpers) function without human intervention.

Note 2 A Rising Bar

The smart machine requirements bar will continuously evolve as smart machines are developed, commercialized and become commonplace. Roombas (self-guided vacuum cleaners built by iRobot) are losing their status as smart machines because it's no longer surprising in many societies to see such devices moving around a room, cleaning the floor as they go. Roombas do not build maps of their environment as they move. Navigation is based on path randomization and detection of discrete events such as collisions and loss of contact with the floor. To the knowledgeable, they're simple stimulus-response machines with no real autonomy.

Evidence

[1] We are using the term "smart" despite our aversion for needlessly anthropomorphizing technology. Smart is arguably the least offensive adjective that still connotes some of the capabilities we expect to emerge.

[2] In this usage, the word "machine" includes physical devices, such as a self-driving car, as well as logical entities, such as software. Software without hardware does not perform useful work so a software-based machine logically incorporates some physical representations.

3 The rate of change and level of disruption will vary in many dimensions including sector, industry and job role.

[4] Smart machines leverage a combination of various technologies and it is the integration and aggregation that makes them disruptive.

[5] Many of these smart machines will do things no human could ever do either. For example, detecting new signal patterns in global industrial networks.

6 "Daddy, Could You Tell Me What a Truck Driver Was?" The Wall Street Journal, 23 July 2013

7 "Self-Driving Car Test," Google Jobs

8 "Distronic Plus with Pre-Safe Brake," Mercedes-Benz

[9] "Deep Learning," MIT Technology Review, 23 April 2013

[10] "Transforming the Lifetime of Relationships Between People and Companies," IBM

[11] "Apple Knowledge Navigator Video," YouTube, 1987

[12] "The Window: Robots at Work," Wired, 1 July 2013 and "The Window: Robot Economy," Wired, 12 July 2013

[13] "TUG: Automating Delivery to Improve the Delivery of Care," Aethon

[14] "Darpa's Legged Squad Support System (LS3) To Lighten Troops' Load," Darpa, 7 February 2012

[15] "BHP Billiton Could Slash Workforce with Automated Mining," Design Build Source, 15 March 2013

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