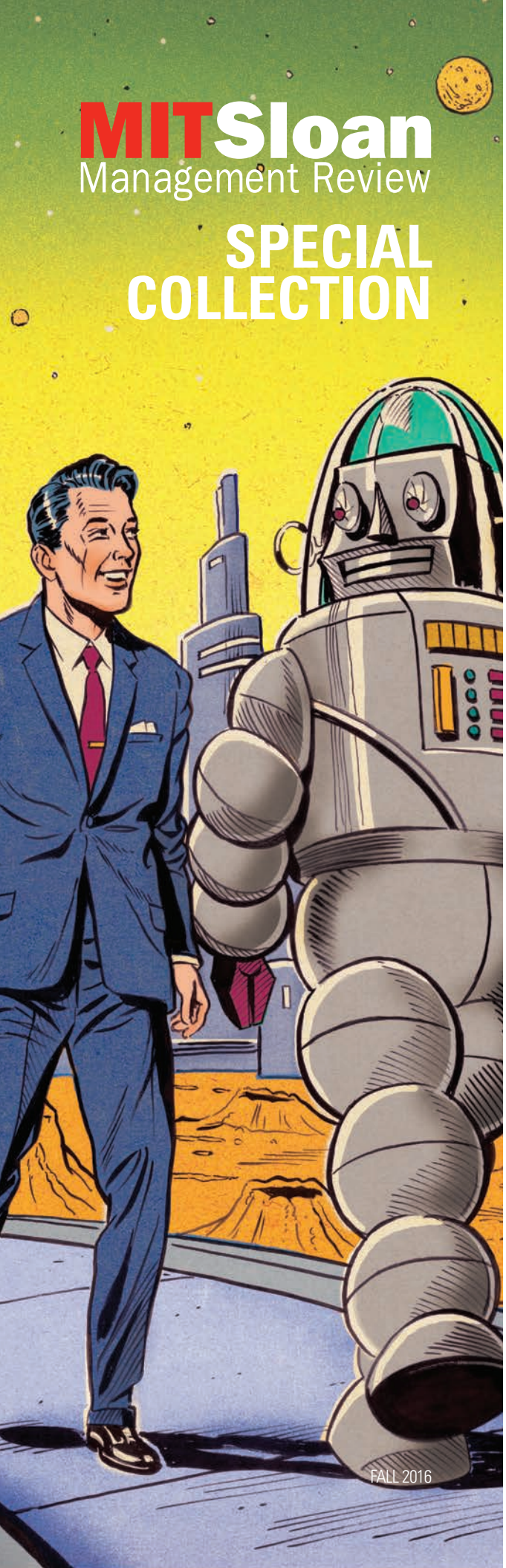
MITSloan Management Review

SPECIAL COLLECTION



FALL 2016

TECHNOLOGY & MANAGEMENT

Frontiers: Exploring the Digital Future of Management

Fifteen experts from academia and industry envision how technology will change the practice of management.

Brought to you by:

ptc

CONTENTS

Frontiers: Exploring the Digital Future of Management

SLOANSELECT COLLECTION

1 Introduction
By Paul Michelman

2 Rethinking the Manager's Role
By Lynda Gratton

3 Managing the Bots That Are Managing the Business
By Tim O'Reilly

5 A New Era of Corporate Conversation
By Catherine J. Turco

7 Executive Assistants for Everyone
By Hal R. Varian

8 Is Your Company Ready to Operate as a Market?
By Rita Gunther McGrath

10 Ethics and the Algorithm
By Bidhan L. Parmar and R. Edward Freeman

12 Predicting a Future Where the Future Is Routinely Predicted
By Andrew W. Moore

13 Why Digital Transformation Needs a Heart
By George Westerman

14 Using Artificial Intelligence to Set Information Free
By Reid Hoffman

16 Unleashing Creativity With Digital Technology
By Robert D. Austin

18 The Three New Skills Managers Need
By Monideepa Tarafdar

19 Tackling the World's Challenges With Technology
By Andrew S. Winston

21 Digital Today, Cognitive Tomorrow
By Ginni Rometty

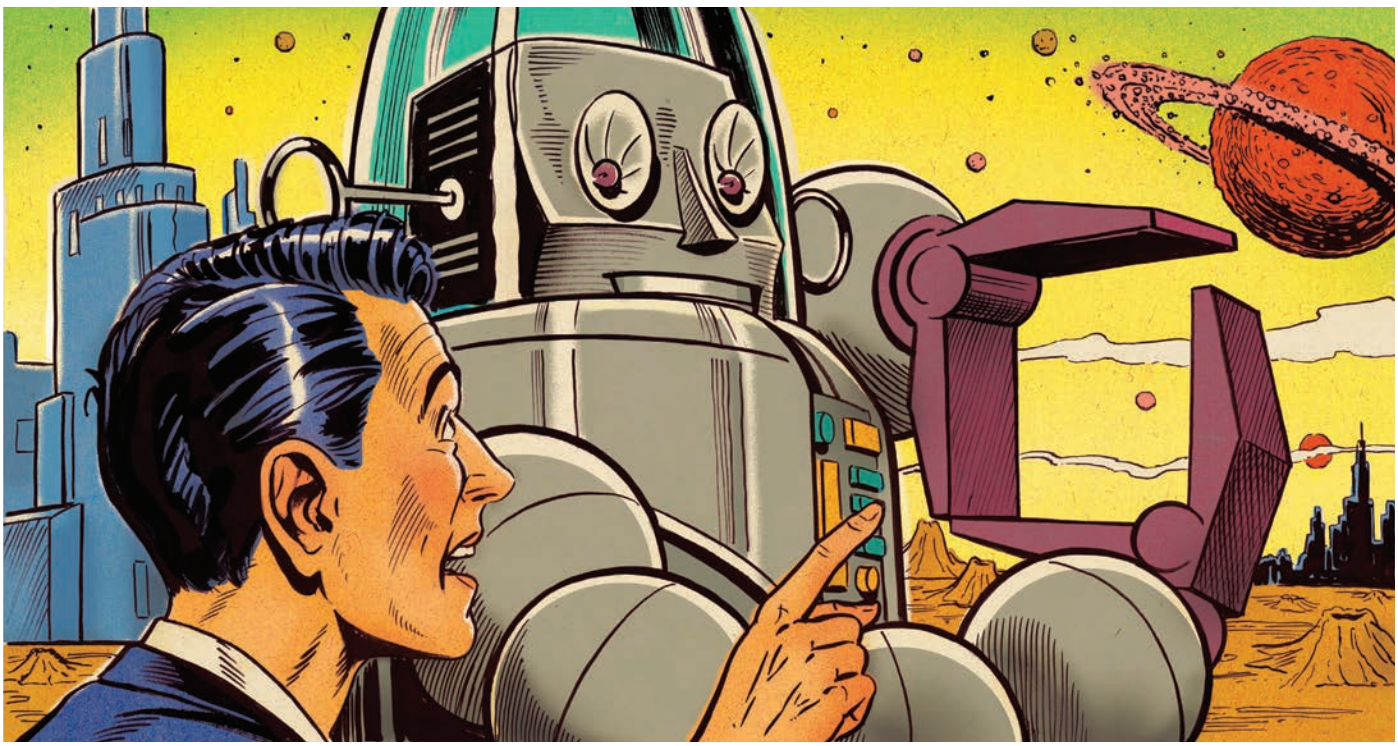
22 Rise of the Strategy Machines
By Thomas H. Davenport

Please note that gray areas reflect artwork that has been intentionally removed. The substantive content of the article appears as originally published.

Reprint #: FR0916

FRONTIERS

EXPLORING THE DIGITAL FUTURE OF MANAGEMENT



WELCOME TO FRONTIERS. Our goal with this new initiative, which spans both the print magazine and the *MIT Sloan Management Review* website, is to help our readers envision and prepare themselves for the future craft of management, particularly as it is being shaped by digital innovation. We aim, too, to help executives better seize on new opportunities presented by technology.

To celebrate the launch of Frontiers — and to help set the agenda for the research and insights we will feature in these pages going forward — we asked 15 leading lights in academia and industry to give us a glimpse into the future of management by contributing essays in response to this question:

"Within the next five years, how will technology change the practice of management in a way we have not yet witnessed?"

You will find their intriguing responses on the pages that follow. To learn more about Frontiers, please visit sloanreview.mit.edu/frontiers.

— ***Paul Michelman****, editor in chief*

ILLUSTRATION BY JONATHAN CARLSON

***Lynda Gratton** is a professor of management practice at London Business School.*

[MANAGEMENT]

Rethinking the Manager's Role

Technology will not render managers obsolete — but they will need to be more skilled than ever before.

BY LYNDA GRATTON

I've been thinking about technology and management for over a decade. In the process, I have written two books describing some of the ways that the practice of management will respond to rapid technological innovations. Looking back, I made four predictions about management and technology.

First, it was clear to me that the manager's role as a coordinator of work would come under increasing pressure. Constant improvements in robotics and machine learning, in conjunction with the automation of routine tasks, make management a more unclear practice. What is a manager, and what is it that managers do? Are we witnessing the end of management?

Next, I could see an inevitable shift in which a parent-to-child way of looking at the relationship between the manager and his or her team would be questioned and ultimately superseded by an adult-to-adult form. The nexus of this more adult relationship concerns how commitments are made and how information is shared. When technology enables many people to have more information about themselves and others, it's easier to take a clear and more mature view of the workplace. Self-assessment tools, particularly those that enable people to diagnose what they do and how they do it, can help employees pinpoint their own productivity issues. They have less need for the watchful eyes of a manager.

Third, it seemed to me obvious that technology would tip the axis of power from the vertical to the horizontal. Why learn from a manager when peer-to-peer feedback and learning can create stronger lateral forms of coaching? Moreover, technology-enabled social networking is capable of creating robust and realistic maps of influence and power — so no more hiding behind fancy job titles.

Finally, the rise of platform-based businesses such as Uber Technologies Inc. has everyone excited about platforms and how they can create a fertile arena for new businesses to be built while also acting as a conduit for flexible ways of working.

What is the role of management in all of this?

From those four predictions, one could easily imagine that the "the end of management" is in sight — crushed by peer feedback, pushed out by specialist roles, disintermediated by powerful platforms, and exposed by social network analysis.

And yet it seems that the current reality is a great deal more complex. Rather than seeing the end of management, we seem to be witnessing the rise of a more skilled form of it. Over the last seven years, I have directed the "Future of Work Consortium," a group that has involved executives from 60 multinational companies from all over the world and from different sectors. Through workshops, focus groups, and an annual survey, we have followed the impact that technology is having on work and management.

For most of our participants, the surprise is that so little has changed over the last five years in the way they work. In fact, they report that their use of technology in their personal and home life has far exceeded their experience of technology at work. Many indicate that the real positive impact of technology has been on the way they run their everyday life rather than on their productivity at work. Inevitably, this will change in the next five years — but how will management use new technology tools?

We asked these executives to consider how they see the future and to assess the current capability of their corporations. From this, we were able to identify the "future risk factors" — those aspects of the corporation that will be important in the future but are currently poorly executed. The same top risks came out every year: how to manage virtual teams; how to manage multigenerational groups (particularly with regard to differences in technology use);

and how to support rapid knowledge flows across business units.

Notice what all three areas of risk have in common: They are all fundamentally about management. But this is a very complex form of management — managing virtually rather than face to face; managing when the group is diverse rather than homogenous; and managing when the crucial knowledge flows are across groups rather than within. These are highly skilled roles in terms of both managerial capabilities (for example, how to build rapid trust, coach, empathize, and inspire) and management practices (for example, team formation, objective setting, and conflict resolution). It is these managerial skills and practices that will be augmented by technology over the coming years in ways we may not yet have grasped — but that will emerge over time.

Comment on this article at http://sloanreview.mit.edu/x/58105, or contact the author at smrfeedback@mit.edu.

Reprint 58105.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[THE DIGITAL ECONOMY]

Managing the Bots That Are Managing the Business

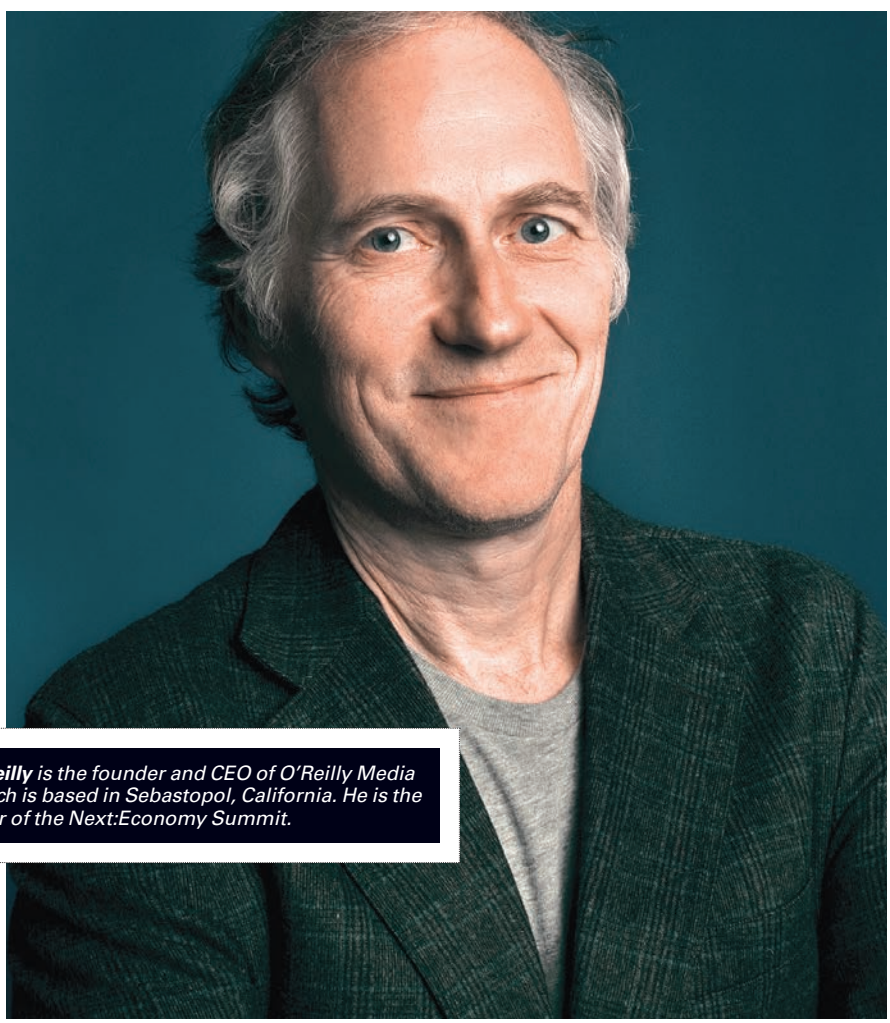
We are just at the beginning of the transformation from an economy dominated by human workers to one dominated by electronic workers.

BY TIM O'REILLY

Science fiction writer William Gibson once said, "The future is already here. It's just not very evenly distributed." You don't need to wait five years to see how technology will change the practice of management. You just need to study companies that are already living in the future that remains around the corner for everyone else.

You must also reframe what you see so that you aren't blinded by what you already know. Consider Google, Facebook, Amazon.com, or a host of more recent Silicon Valley startups. They employ tens of thousands of workers. If you think with a 20th century factory mindset, those workers spend their days grinding out products, just like their industrial forebears; only today, they are producing software rather than physical goods. If, instead, you step back and view these organizations with a 21st century mindset, you realize that a large part of the work of these companies — delivering search results, news and information, social network status updates, and relevant products for purchase — is performed by software programs and

(Continued on page 4)



***Tim O'Reilly** is the founder and CEO of O'Reilly Media Inc., which is based in Sebastopol, California. He is the organizer of the Next:Economy Summit.*

algorithms. These programs are the workers, and the human software developers who create them are their managers.

Each day, these "managers" take in feedback about their electronic workers' performance — as measured in real-time data from the marketplace — and they provide feedback to the workers in the form of minor tweaks and updates to their programs or algorithms. The human managers also have their own managers, but hierarchies are often flat, and multiple levels of management are aligned around a set of data-driven "objectives and key results" (OKRs) that are measurable in a way that allows even the electronic "workers" to be guided by these objectives.

And if your notion of management isn't stretched enough, consider that the algorithms themselves are sometimes the managers — of human workers. Look at Uber Technologies Inc. and Lyft Inc. as compared to an old-school taxi service. Cars are dispatched not by a person but by a "management" program that collects passenger requests in real time and serves them to the closest available drivers. Humans are still in the loop both as workers delivering the actual service and as managers who set the rules of the algorithms, test whether they are working correctly, and adjust them when they are not. Human managers are called in to deal directly with the human workers, the drivers, only under rare circumstances.

While it is early in this process, you can make the case that the core function of management has gone from managing the business to managing the bots that are managing the business.

Some further implications of this insight include:

- A typical programmer in a 20th century IT shop was a worker building to a specification, not that different from a shop floor worker assembling a predefined product. A 21st century software developer is deeply engaged in product design and iterative, customer-focused development. For larger programs, this is a team exercise, and leadership means organizing a shared creative vision. Technology is not a back-office function. It is central to the management capability of the entire organization. And companies whose CEOs are also the chief product designers (think Larry Page of Alphabet Inc., Jeff Bezos of Amazon, or Apple under Steve Jobs) can outperform those whose leaders lack the capability to lead not just their human workers but their electronic workers as well.
- In 20th century organizations, you gained influence by gaining budget to hire more workers. In 21st century organizations, you gain effectiveness through your ability to *create* more workers — of the 21st century variety. Even in jobs that are not considered "programming jobs," the ability to create and marshal electronic resources is key to advancement. A salesperson who can write a bot to "scrape" LinkedIn for leads has an edge over someone who has to do it manually. A marketer who can build an online survey or data-gathering app has an advantage over one who has to hire an outside company. A designer/developer who can build a working application prototype is more valuable than a designer who is only able to draw a picture.
- Managers must become product and experience designers, deeply engaged with customers and their needs, creating services that start out as a compelling promise and get better over time the more people use them, via a "build-measure-learn" process. A service like Uber is based on a deep rethinking of the fundamental work flows of on-demand transportation (what used to be called "taxis") in light of what technology now makes possible. Before Uber, who would have thought that a passenger could summon a car to a specific spot and know just when they were going to be picked up? Yet that capability was already lying latent in smartphones.
- There is an arc to knowledge in which expertise becomes embodied in products. Workers can be "upskilled" not just by training but by software assistants that allow them to do jobs for which they were previously under-qualified. "The Knowledge," the legendary test that London taxicab drivers must pass, requires years of study, yet with the aid of Waze, Google Maps, and the Uber or Lyft app, virtually anyone can become a driver for hire, even in a strange city. There is a lot of fear about technology replacing workers, but in what I call "Next Economy companies," technology is used to create new opportunities by augmenting workers.

> "The great management challenge of the next few decades will be understanding how to get the best out of both humans and machines, and understanding the ins and outs of who manages whom."

We are just at the beginning of the transformation from an economy dominated by human workers to one dominated by electronic workers. The great management challenge of the next few decades will be understanding how to get the best out of both humans and machines, and understanding the ins and outs of who manages whom.

Comment on this article at http://sloanreview.mit.edu/x/58102, or contact the author at smrfeedback@mit.edu.

Reprint 58102.

Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

Catherine J. Turco *is the Theodore T. Miller Career Development Professor and associate professor of organization studies at the MIT Sloan School of Management, in Cambridge, Massachusetts. She is the author of* The Conversational Firm: Rethinking Bureaucracy in the Age of Social Media *(New York: Columbia University Press, 2016).*

[ORGANIZATIONAL BEHAVIOR]

A New Era of Corporate Conversation

With workers who expect to have their voices heard, and social media tools to enable that, it is now possible — perhaps even paramount — to build a far more open communication environment within organizations.

BY CATHERINE J. TURCO

If you want to see how management is changing, take a look inside today's high-tech offices. In the past, corporate leaders sat behind closed doors in large private suites. Today, many sit side by side with employees in open workspaces. In the past, workers toiled alone in cubicles, waiting for formal meetings to speak with their managers and colleagues. Today, they turn and chat with the managers and colleagues sitting right next to them, while conversing with others on digital chat systems that connect the entire organization, and with yet others in lounge areas and cafés built to promote informal connection and dialogue.

These changes are surface manifestations of a deeper transformation under way: Long-held assumptions about corporate communication and hierarchy are breaking down. Social media tools allow more open communication up, down, and across the corporate hierarchy. In the coming years, the savviest leaders will tap into the spirit and tools of openness from social media to build what I call *conversational firms*.

Over the past decade, social media has transformed how (Continued on page 6)

people communicate in their personal lives. It is beginning to do the same in our work lives. Millennials who grew up on Twitter, Facebook, Instagram, Snapchat, and the like are now the fastest-growing portion of the labor force. They are accustomed to constant connection and information access and engage in more open sharing than generations past. And they are carrying these expectations and habits into the workplace.

Meanwhile, the last several years have seen an explosion of social media tools designed for use inside companies — everything from wikis and microblogs, to multichannel platforms such as Yammer, Slack, and HipChat, to employee feedback tools such as TinyPulse. With workers who increasingly expect to have their voices heard, and with tools to enable that, it is now possible — perhaps even paramount — to build more conversational firms.

Conversational firms differ from conventional bureaucratic ones by having a far more open communication environment. Executives use multiple platforms to share information with the entire workforce. They encourage employees to speak up, ask questions, and share ideas and opinions. They saturate the workplace with digital tools and physical spaces designed to encourage dialogue. The result is an ongoing conversation that transcends the formal hierarchical structure.

Forward-thinking leaders are already managing their organizations this way. I profile one such company in my new book, *The Conversational Firm: Rethinking Bureaucracy in the Age of Social Media*. When this company's SaaS (software as a service) business model was jeopardized by a spike in customer churn, executives used an internal wiki to share 138 pages of detailed analysis with the full 600+ person workforce. The analysis included the sort of information other executives might pore over in closed meetings but hesitate to share with more than a few select employees — such as trends in bookings, customer acquisition costs, competitors' churn rates, fine-grained profit and loss and cash flow statements, and the complete results of a recent customer survey.

Armed with this information, employees throughout the business responded on the wiki with questions, thoughts, and analyses. The company then extended the conversation offline, hosting an open "Hack Night" for interested individuals to present their ideas in person. Executives sat in the audience listening to employee suggestions and joined small breakout groups to discuss various proposals. In the following weeks, these breakout groups continued to hack away at the churn problem, coordinating their work over the company's internal chat system and posting updates on the wiki for everyone to see. Within a few months, the churn problem was resolved and the organization had new and improved internal processes to avoid future spikes.

This was not an isolated event. During the 10 months I was embedded inside the company, executives shared information broadly and encouraged employees to offer their input on a range of topics. This fostered a well-informed and engaged staff, willing and able to share their knowledge and insights. In turn, the organization was able to respond rapidly and thoughtfully as problems and opportunities arose.

What organization wouldn't want this? In today's markets, customer preferences evolve quickly, and new technologies and competitors continually emerge to unsettle the status quo. Open dialogue is one of the few ways to surface a multidimensional understanding of complex new realities and possible responses. Conversation brings the entire organization's collective wisdom to bear on issues, and in doing so it helps the organization adapt and learn.

Some managers will worry that giving employees broad freedom of speech will weaken their decision-making authority. But blasting open the communication hierarchy doesn't have to mean destabilizing all of the corporate hierarchy. Leaders can give employees voice and engage them in dialogue while retaining the right to make the final call. For example, the company I studied maintained a conventional reporting and decision-making hierarchy while supporting the sort of radically open communication I described above. In fact, the decisions executives made had more legitimacy with the workforce because employees had been invited into the conversation and knew their voices had helped shape the decision-making context. In the customer churn case, executives retained final authority over which ideas the company pursued. However, the ideas themselves were better because they had been shaped by the group's insights and opinions. When done right, open communication can complement formal control.

Doing it right is hard, though. There are challenges to creating conversational companies. For one thing, executives need to see that the point of conversation is to surface a range of opinions. This awareness must guide their approach to everything from the people they hire to how they lead. After all, for valuable dialogue to occur, an organization can't hire a workforce of clones who think and act exactly alike; a diversity of perspectives is required. What's more, employees need to know that their leaders won't punish them for expressing dissenting opinions; absent that trust, people will say only what they think management wants to hear.

Through it all, executives and managers will need patience and a thick skin. Some comments will sting, not every thought shared will be an insightful one, and some conversations will get derailed; these are unavoidable costs. However, leaders willing to invest in truly open dialogue with their workforce will be well positioned to face — and shape — the ever-evolving future.

Comment on this article at http://sloanreview.mit.edu/x/58124, or contact the author at smrfeedback@mit.edu.

Reprint 58124.

Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[PRODUCTIVITY]

Executive Assistants For Everyone

The mobile cloud is about to democratize one of the most prized perks in management.

BY HAL R. VARIAN

***Hal R. Varian** is the chief economist at Google Inc. and is also an emeritus professor at the University of California, Berkeley, in three departments: business, economics, and information management.*

Currently, only top managers have *human* executive assistants, but in the near future, everyone who has a smartphone can have a *digital* executive assistant. This will be made possible by the "mobile cloud" — technology that integrates the convenience of the mobile phone with the power of cloud computing. The mobile phone interface will shift toward interactive voice communication — just like communicating with a human assistant — but your digital agent will be able to access and search vast amounts of information in the cloud almost instantaneously, enabling quicker and better decisions.

Setting up meetings, making appointments, organizing trips, coauthoring documents, and accessing databases and dashboards will all become much simpler, more intuitive, and more convenient.

Today, the low-cost communications and computing power available to even small enterprises is dramatically more powerful than what even the largest multinational corporations could afford 20 years ago. This has led to the growth of "micro-multinationals" — small startup firms that are born global. Real-time machine translation will make global operations even easier. One person can speak English while the other hears a real-time translation into Chinese. This is now possible in the lab but will be available to everyone within the next few years.

Management inherently involves organizing groups of people to get things done, and communication is a key piece of organization. In the future, there will not only be more person-to-person and person-to-agent communication, but more agent-to-agent communication.

How will this work? Suppose that you want to meet with a colleague. You will ask your digital agent to negotiate with his or her digital agent to schedule a meeting. When the meeting happens — either in person or online — both of your agents will listen in on the meeting and transcribe the results into text that can subsequently be searched and accessed as needed. The meeting notes can be algorithmically edited and summarized.

But workday meetings are only part of the story; sometimes you want to get together just for fun. Your digital agent will send a note to your friends — really your friends' agents — suggesting a get-together after work. The agents will pull together a list of suggestions about where to meet, and your friends can indicate their preferences, allowing the agents to find a consensus location. The agents can remind their masters when to leave so as to arrive on time, and if someone is late, his or her agent can notify the others.

Organizing groups of people — even small groups — has always involved work, some of which has been tedious and repetitive. But tedious and repetitive tasks are what computers do best. In the next five years, we will see dramatic progress in computer-supported cooperative work.

Comment on this article at http://sloanreview.mit.edu/x/58114, or contact the author at smrfeedback@mit.edu.

Reprint 58114.

Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[ORGANIZATIONAL STRUCTURE]

Is Your Company Ready to Operate as a Market?

Traditional hierarchies are giving way to market forms of organizing that will recast the role of management.

BY RITA GUNTHER MCGRATH

New technologies are eroding transaction costs — and in the process creating a world that is increasingly connected. The resulting level of interdependence creates a radically new set of challenges for management.

In particular, *complicated* business situations are being replaced with *complex* ones. In a *complicated* system, even though there may be many inputs and outputs, one can predict the outcome by knowing how the system works. For instance, the global air travel system is complicated, and yet its unprecedented safety has been made possible by driving down the margin of error and correcting known defects. In a *complex* system, on the other hand, different parts can interact in ways that make predicting, and therefore controlling, the outcome nearly impossible. For instance, the interconnectedness of the global financial system means that events occurring in one part of the system have unexpected interactions with others, leading to unpredictable outcomes. As Janet L. Yellen, now chair of the U.S. Federal Reserve System, said in 2013, "Complex links among financial market participants and institutions are a hallmark of the modern global financial system. Across geographic and market boundaries, agents within the financial system engage in a diverse array of transactions and relationships that connect them to other participants." Such interconnectedness was blamed for both the severity of the 2008 financial crisis and the difficulties encountered in resolving it.

Rita Gunther McGrath *is a professor at Columbia Business School in New York City.*

Connecting parts of a system that used to be sealed off from one another can create enormous benefits. For instance, companies installing enterprise resource management (ERM) systems benefit from having different operations across silos able to share information. Companies using various electronic payment systems benefit from decreased costs of doing business. In a complex system, however, benefits for one set of players can create losses for others.

Consider, for instance, what shipping was like before the 1950s-era invention of the shipping container. It required tens of thousands of dockworkers to load and unload ships. Not only was this a time-consuming process, but it also left cargo vulnerable to theft, as it was very difficult to track the contents of an individual load. The introduction of a container that could be sealed at the factory, shipped, and then transported inland by train or truck transformed global trade. *The Economist* in 2013 reported that "new research suggests that the container has been more of a

driver of globalization than all trade agreements in the past 50 years taken together." According to *The Economist*, one study of industrialized countries found that containerization was associated with "a 320% rise in bilateral trade over the first five years after adoption and 790% over 20 years. By comparison, a bilateral free-trade agreement raises trade by 45% over 20 years and GATT [General Agreement on Tariffs and Trade] membership adds 285%."

The dramatic fall in the cost of shipping fundamentally altered the assumptions management had accepted as given until that time. Once it became possible to ship even low-value goods and make a profit, the rules of competition changed. Rather than being a relatively fixed commodity located in one physical place — the docks — labor could now be sourced from anywhere containers could be packed. And rather than employer and worker being tied to each other in one relatively enduring relationship, an army of outsourced and freelance workers came into play and redefined the dynamics between management and labor. The advent of shipping containers created global competition for jobs and transformed entire supply chains. As former Intel chairman and CEO Andy Grove lamented in 2010, the unintended consequences of all this were to undermine job creation in the United States, even as employment growth among U.S. trade partners in Asia skyrocketed.

The markets vs. hierarchies concept, originally pioneered by the economist Oliver E. Williamson, suggested the conditions under which one could operate purely by contracting on an open market as opposed to requiring some kind of organization (a hierarchy) to accomplish one's goals. Hierarchies are favored, in his formulation, when uncertainty is high, various parties face a risk of opportunism in market exchanges, and information about what is being exchanged is asymmetrically distributed.

As with containerization 60 years ago, new ways of sharing information today and, most likely, robotics and data analytics in the near future have the effect of continuing to push transactions that were once executed within an organization's boundaries out into open markets. Consider how clearly the Ubers and Airbnbs of the world today demonstrate that one does not need to own assets in order to use them. And this phenomenon goes well beyond those popular examples, as the rise of Amazon Web Services and the proliferation of software-as-a-service offers demonstrates. The advent of blockchain technology further promises to distribute tasks that used to be centralized within organizations into markets — by offering an alternative to the centralized validation banks provide, for example.

How does management attention need to shift as the world moves more toward market forms of organizing? Clearly, we are moving from a business world dominated by hierarchies, in which assets are controlled by a company, to a world of markets, in which assets can be accessed when needed. The conventional relationship between buyers and suppliers then shifts to more complex configurations in multisided markets and ecosystems. Networks become a primary vehicle for exchanging information of all kinds. Increasingly porous organizational boundaries mean that information is less likely to be hoarded. And increasingly, customers are looking to organizations for complete experiences rather than product and service features.

> "We are moving from a world dominated by hierarchies, in which assets are controlled by a company, to a world of markets, in which assets can be accessed when needed."

Managing in such a complex environment requires not only traditional management skills such as planning and controlling, but also new ones, such as negotiating complex agreements, quickly detecting the unexpected, accelerating organizational learning, and fostering the creation of trusting relationships among groups and teams who may be only temporarily associated with one another. And this all takes place at an accelerated pace of change for which many will be unprepared. The lines between a defined managerial role in a traditional company and an entrepreneurial role in these newly emerging market contexts are definitely blurring.

Practically, what does this mean for managers looking for a new way of operating? First, the assumption that change is the unusual thing and stability is the normal thing is worth challenging. Today, leaders need to identify, as early as possible, the patterns that deserve their attention and make constant course-correcting adjustments. Instead of being precise but slow and reinforcing existing perspectives, leaders need to be comfortable with making roughly right and fast decisions and with challenging the status quo. Instead of just using traditional management tools such as net present value, managers need to be more discovery-driven and options-oriented. And they need to remember that one of the most valuable gifts colleagues can give one another in a complex environment is candor about what is really going on out there.

Comment on this article at http://sloanreview.mit.edu/x/58107, or contact the author at smrfeedback@mit.edu.

Reprint 58107.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[BUSINESS ETHICS]

Ethics and the Algorithm

Behind every piece of code that drives our decisions is a human making judgments — about what matters and what does not.

BY BIDHAN L. PARMAR AND R. EDWARD FREEMAN

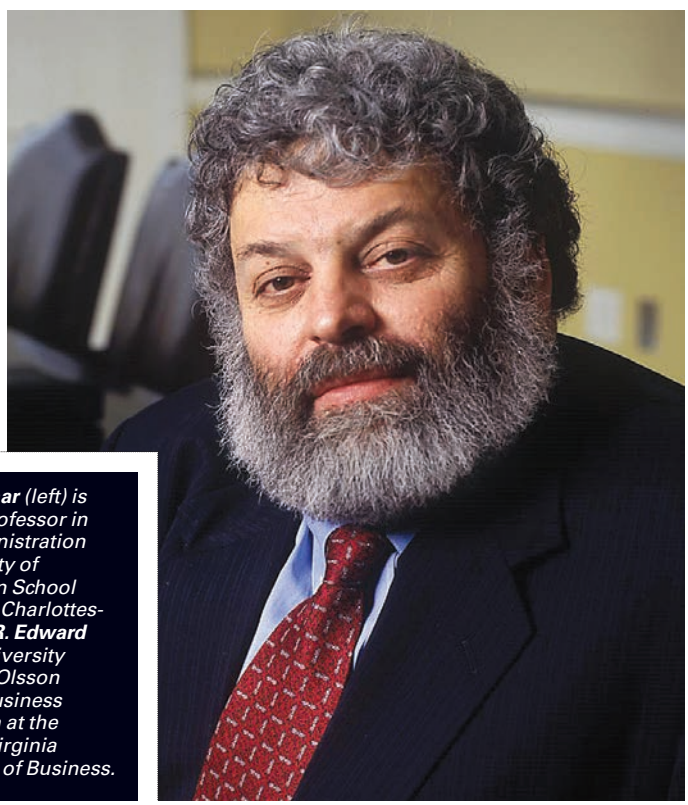
Are we designing algorithms, or are algorithms designing us? How sure are you that you are directing your own behavior? Or are your actions a product of a context that has been carefully shaped by data, analysis, and code?

Advances in information technology certainly create benefits for how we live. We can access more customized services and recommendations; we can outsource mundane tasks like driving, vacuuming floors, buying groceries, and picking up food. But there are potential costs as well. Concerns over the future of jobs have led to discussions about a universal basic income — in other words, a salary just for being human. Concerns over the changing nature of social interaction have covered topics ranging from how to put your phone down and have a face-to-face conversation with someone to the power dynamics of a society where many people are plugged into virtual reality headsets. Underlying these issues is a concern for our own agency: How will we shape our futures? What kind of world will information technology help us create?

Advances in information technology have made the use of data — principally data about our own behaviors — ubiquitous in the online experience. Companies tailor their offerings based on the technology we employ — for example, the travel website Orbitz a few years ago was discovered to be steering Mac users to higher-priced travel services than it was PC users. Dating sites like eHarmony and Tinder suggest partners based on both our stated and implied preferences. News stories are suggested based on our previous reading habits and our social network activities. Yahoo, Facebook, and Google tailor the order, display, and ease of choices to influence us to spend more time on their platforms, so they can collect even more data and further intermediate our daily transactions.

Increasingly, our physical world is also being influenced by data. Consider self-driving cars or virtual assistants like Siri and Amazon's Echo. There are even children's toys like Hello Barbie that listen, record, and analyze your child's speech and then customize interactions to fit your child.

As our lives become deeply influenced



Bidhan L. Parmar *(left) is an assistant professor in business administration at the University of Virginia Darden School of Business, in Charlottesville, Virginia.* ***R. Edward Freeman*** *is University Professor and Olsson Professor of Business Administration at the University of Virginia Darden School of Business.*

by algorithms, we should ask: What kind of effect will this have?

First, it's important to note that the software code used to make judgments about us based on our preferences for shoes or how we get to work is written by human beings, who are making choices about what that data means and how it should shape our behavior. That code is not value neutral — it contains many judgments about who we are, who we should become, and how we should live. Should we have access to many choices, or should we be subtly influenced to buy from a particular online vendor?

Think of the ethical challenges of coding the algorithm for a self-driving car. Under certain unfortunate circumstances, where an accident cannot be avoided, the algorithm that runs the car will presumably have to make a choice about whether to sacrifice its occupants or risk harming — maybe even fatally — passengers in other cars or pedestrians. How should developers write this code? Despite our advances in information technology, data collection, and analysis, our judgments about morality and ethics are just as important as ever — maybe even more important.

We need to figure out how to have better conversations about the role of purpose, ethics, and values in this technological world, rather than simply assuming that these issues have been solved or that they don't exist because "it's just an algorithm." Questions about the judgments implicit in machine-driven decisions are more important than ever if we are to choose how to live a good life. Understanding how ethics affect the algorithms and how these algorithms affect our ethics is one of the biggest challenges of our times.

Comment on this article at http://sloanreview.mit.edu/x/58106, or contact the authors at smrfeedback@mit.edu.

Reprint 58106.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[ARTIFICIAL INTELLIGENCE]

Predicting a Future Where the Future Is Routinely Predicted

Artificial intelligence systems will be able to give managers real-time insights about their business operations — as well as detect early warnings of problems before they occur.

BY ANDREW W. MOORE

***Andrew W. Moore** is dean of the School of Computer Science at Carnegie Mellon University in Pittsburgh, Pennsylvania.*

Workers on the factory floor have suddenly gathered at a point along the production line. Some are scratching their heads. Others are gesticulating wildly. Most stand with their hands in their pockets. Something is wrong, and no one has thought to call management.

In the near future, scenes like this one will be obsolete. Thanks to advances in artificial intelligence (AI), managers will be alerted to workplace anomalies as soon they occur. Unusual behaviors will be identified in real time by cameras and image-processing software that continuously analyze and *comprehend* scenes across the enterprise.

The hunch-based bets of the past already are giving way to far more reliable data-informed decisions. But AI will take this further. By analyzing new types of data, including real-time video and a range of other inputs, AI systems will be able to provide managers with insights about what is happening in their businesses at any moment in time and, even more significantly, detect early warnings of bigger problems that have yet to materialize.

As a researcher, I learned to appreciate the value of early warnings some years ago, while developing algorithms for analyzing data from hospital emergency rooms and drugstores. We discovered that we could alert public health officials to potential epidemics and even the possibility of biological warfare attacks, giving them time to take countermeasures to slow the spread of disease.

Similar analytic techniques are being deployed to detect early signs of problems in aircraft. The detailed maintenance and flight logs for the U.S. Air Force's aging fleet of F-16 fighter jets are analyzed automatically to identify patterns of equipment failures that may affect only a handful of aircraft at present, but have the potential to become widespread. This has enabled officials to confirm and diagnose problems and take corrective action before the problems spread.

With AI, we can have machines look for millions of worrying patterns in the time it would take a human to consider just one. But that capability includes a terrible dilemma: the multiple hypotheses problem. If you sound an alarm whenever something is anomalous at a 99% confidence level, and you check millions of things an hour, then you will receive hundreds of alarms every minute.

Statisticians and AI researchers are working together to identify situations and conditions that tend to sound false alarms, like a truckload of potassium-rich bananas that can set off a radiation detector meant to identify nuclear materials. By reducing the risk of false alarms, it will be possible to set sensor thresholds even lower, enhancing sensitivity.

The predictive benefits of AI will stretch well beyond equipment and process analysis. For instance, researchers are having great success with algorithms that closely monitor subtle facial movements to assess the emotional and psychological states of individuals. Some of the most interesting applications now are in the mental health sphere, but imagine if the same tools could be deployed on checkout lines in stores, lines at theme parks, or security queues at airports. Are your customers happy or agitated? Executives wouldn't need to wait weeks or even days for a survey to be completed; these systems could tell you the emotional state of your customers right now.

Other researchers are deploying AI in the classroom. When I taught, I couldn't tell whether the lecture I was giving was any good — at least not when it

would still benefit me or my students. But simple sensors like microphones and cameras can be used by AI programs to detect when active learning is taking place. Just the sounds alone — Who's talking? Who isn't? Is anyone laughing? — can provide a lot of clues about teaching effectiveness and when adjustments should be made.

Such a tool could also be used to gauge whether your employees are buying in to what you're sharing with them in a meeting, or if potential customers are engaged during focus groups. A "managerial Siri" might take this even further. If you asked your digital assistant, "Do the folks in my staff meeting seem to be more engaged since we had the retreat?," you might receive an answer such as, "Yes, there is an increase in eye contact between team members and a slight but significant increase in laughter."

As a manager, I absolutely detest being surprised. And like everyone else, despite the petabytes of data at my fingertips, I too often am. But AI doesn't get overwhelmed by the size and complexity of information the way we humans do. Thus, its promise to keep managers more in the know about what's really happening across their enterprise is truly profound.

Comment on this article at http://sloanreview.mit.edu/x/58108, or contact the author at smrfeedback@mit.edu.

Reprint 58108.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

***George Westerman** is a principal research scientist with the MIT Sloan Initiative on the Digital Economy in Cambridge, Massachusetts.*

[LEADERSHIP]

Why Digital Transformation Needs a Heart

If used unwisely, digital forces could transform businesses in ways that will have negative long-term implications for both companies and workers.

BY GEORGE WESTERMAN

Three technology-driven forces are transforming the nature of management. Automation is making it more and more possible for companies to do work without humans involved. Data-driven management supplements intuition and experience with data and experimentation. Resource fluidity matches tasks to the people who can best perform them, whether inside or outside the organization.

Taken together, these three forces are helping leaders rethink the way work is organized and managed. Tasks that were previously considered the sole domain of humans — like handling customer requests, driving vehicles, or writing newspaper articles — can now be done by machines. Employees at all levels have the information they need to make decisions and adjust their practices. Computers can diagnose situations and identify challenges that humans don't see. Real-time information makes it possible to run experiments rather than guessing what might work. Employees can self-organize, obtain help from experts inside and outside the organization to get a job done. And companies can manage fluctuations in their resource needs through outsourcing, whether through long-term relationships, hourly hiring, or gigs and piecework.

On the whole, these forces are a good thing. They will help managers to increase productivity, innovation, and customer satisfaction in the coming years. (Continued on page 14)

Why Digital Transformation Needs a Heart

However, if you lead a traditional company, be careful not to let these forces push your management approach to extremes. Taken to their logical conclusion, the three digital forces could transform management for the worse. Accelerating resource fluidity could make all workers contractors, paid only when the company needs them and earning a living only by cobbling together many different gigs. Data-driven management could become Big Brother, evaluating employees' every action, and hiring or firing people rapidly based only on the numbers. Automation could replace workers and constantly ratchet up the pressure on those that remain. If left unchecked, the three digital forces could transform the employment relationship into an emotionless market transaction — a logically interesting approach that could have negative long-term implications for both workers and companies.

This new employment vision is already starting to play out at some companies. Amazon.com Inc. has an intense, data-driven approach to managing people. As *The New York Times* reported in 2015, it hires only the best, pays them well, works them very hard, and regularly culls its workforce to remove those perceived as lower performing. Uber Technologies Inc. has a relatively small number of very talented, full-time employees, and it engages most of its drivers through contracts that adjust to meet minute-by-minute changes in market demand. Uber is now piloting a fleet of self-driving vehicles.

When making sense of fast-moving digital innovation, it can be tempting to see great born-digital companies like these as aspirational archetypes for management. Certainly we can — and should — learn a lot from these companies. But think twice before adopting every Silicon Valley management technique as your own. Most companies don't have the resources to attract and pay the world's most talented workers. And many high-performing workers would not be happy in transaction-based work schemes, preferring more security or better work-life balance instead. Traditional companies, even those in non-technology industries or less-than-sexy locations, can attract great people with the right combination of income, mission, and working conditions.

Beyond the simple question of finding employees, a question remains whether market-based employment contracts are the right kind of *social contract* for the typical business. These

(Continued on page 15)

***Reid Hoffman** is executive chairman and cofounder of LinkedIn Corp.*

[INFORMATION MANAGEMENT]

Using Artificial Intelligence to Set Information Free

We are on the cusp of a major breakthrough in how organizations collect, analyze, and act on knowledge.

BY REID HOFFMAN

Artificial intelligence is about to transform management from an art into a combination of art and science. Not because we'll be taking commands from science fiction's robot overlords, but because specialized AI will allow us to apply data science to our human interactions at work in a way that earlier management theorists like Peter Drucker could only imagine.

We've already seen the power of specialized AI in the form of IBM's Watson, which trounced the best human players at "Jeopardy," and Google DeepMind's AlphaGo, which recently defeated one of the world's top Go players, Lee Sedol, four games to one. These specialized forms of AI can process and manipulate enormous quantities of data at a rate our biological brains can't match. Therein lies the applicability to management: Within the next five years, I

(Continued on page 15)

practices, which work well in some fast-growing digital companies, may not be as effective when growth slows or a disruption strikes. Paying people only for time spent on task reduces opportunities to foster innovation and employee cohesiveness. What's more, such practices do very little to promote loyalty. Many Uber drivers work for its competitors too; they are Uber drivers only until a better offer comes along. Amazon is one of the industry's most innovative companies, but it also has a reputation for high employee turnover. Loyalty helps companies to thrive when they cannot pay world-leading wages; employees work hard and create innovations because they believe in the company and its leaders. And when times get tough, loyalty is what helps companies keep their best people.

As a strong proponent of digital transformation, I do not want to discourage traditional companies from adopting digitally powered management practices. However, when building a vision for the future of your company, think of the digital forces as you would vitamins or prescription drugs: The right amounts, applied under the right conditions, can yield fabulous results. But using too much, or in the wrong conditions, can be poisonous.

To summarize, digital transformation needs a heart. In an age of digital innovation, leaders in every industry should strive to transform every part of the company, from customer experience to business models to operational management. But we cannot forget that *it is people who make companies work*. The vision of management in five or ten years should not be one where all employees are seen as contracted resources laboring under tight, machinelike supervision. It shouldn't be a world in which automation squeezes workers — and managers — out of the system. It should be one where computers help employees to collaborate fluidly, make decisions scientifically, and manage better with automation than they ever could without it. In the long run, digitally savvy companies that engage the hearts and minds of employees will outperform those that treat people like machines.

Comment on this article at http://sloanreview.mit.edu/x/58130, or contact the author at smrfeedback@mit.edu.

Reprint 58130.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

expect that forward-thinking organizations will be using specialized forms of AI to build a complex and comprehensive corporate "knowledge graph."

Just as a social graph represents the interconnection of relationships in an online social network, the knowledge graph will represent the interconnection of all the data and communications within your company. Specialized AI will be ubiquitous throughout the organization, indexing every document, folder, and file. But AI won't stop there. AI will also be sitting in the middle of the communication stream, collecting all of the work products, from emails to files shared to chat messages. AI will be able to draw the connection between when you save a proposal, share it with a colleague, and discuss it through corporate messaging. This may sound a bit Big Brother-ish, but the result will be to give knowledge workers new and powerful tools for collecting, understanding, and acting on information.

Specialized AI will even help us improve that scourge of productivity, the meeting. Meetings will be recorded, transcribed, and archived in a knowledge repository. Whenever someone in a meeting volunteers to tackle an action item, AI software will record and track those commitments, and automatically connect the ultimate completion of that item back to the original meeting from whence it sprang. Sound far-fetched? The AI techniques for classification, pattern matching, and suggesting potentially related information are already part of our everyday lives. You encounter them every time you start typing a query into Google's search box, and the autocomplete function offers a set of choices, or every time you look at a product on Amazon, and the site recommends other products you might like.

The rise of the knowledge graph will affect the practice of management in three key ways:

1. Better Organizational Dashboards Right now, organizational dashboards — the sets of information executives monitor and use to guide decision making — are limited to structured data that is easy to extract or export from existing systems, such as revenues, app downloads, and payroll information. These backward-looking metrics do have value: They help managers understand what has happened in their operations and identify hot spots for troubleshooting. But AI-generated knowledge graphs will dramatically expand the scope of these dashboards. For example, managers will be able to access sentiment analysis of internal communications in order to identify what issues are being most discussed, what risks are being considered, and where people are planning to deploy key resources (whether capital or attention). AI-powered dashboards will provide forward-looking, predictive intelligence that will deliver a whole new level of insight to managerial decision making. Computers won't be making decisions for us, but they can sift through vast amounts of data to highlight the most interesting things, at which point managers can drill down, using human intelligence, to reach conclusions and take actions. This is an

(Continued on page 16)

Using Artificial Intelligence to Set Information Free

example of what Joi Ito, director of the MIT Media Lab, refers to as "extended intelligence" — in other words, treating intelligence as a network phenomenon and using AI to enhance, rather than replace, human intelligence.

2. Data-Driven Performance Management Current performance management processes are terribly flawed. A Deloitte study found that just 8% of organizations believe that their annual review process excels at delivering business value. One of the big reasons for this dissatisfaction is the lack of data to drive objective performance management. In order to manage performance, you have to be able to measure it, and in most organizations, this simply isn't possible for the majority of employees. Senior leaders might be evaluated based on the company's overall performance, and certain functions like sales have objective, quantitative performance metrics, but almost everyone else is evaluated by subjective criteria and analysis. In the absence of data, internal politics and unconscious bias can play a major role, resulting in performance management that is biased and inaccurate. The knowledge graph will allow managers to identify the real contributors who are driving business results. You'll be able to tell who made the key decision to enter a new market and which people actually took care of the key action items to make it happen. Yet even as the knowledge graph reduces the role of guesswork and intuition, the human manager will still be in the loop, exercising informed judgment based on much better data. The result will be much more efficient allocation of human capital, as people are better matched with projects that suit their strengths, and the best people are deployed against the highest-leverage projects.

3. Increased Talent Mobility As we get better at allocating human capital, organizations will need to do a better job of supporting increased talent mobility, both inside and outside the organization. In the networked age, talent will tend to flow to its highest-leverage use. Each such "tour of duty" will benefit both the company and the worker. But people are not plug-and-play devices; they need time

(Continued on page 17)

[INNOVATION]

Unleashing Creativity With Digital Technology

Digital technologies are reducing the cost of iteration and experimentation in creative work — and that opens up new possibilities for both people and businesses.

BY ROBERT D. AUSTIN

***Robert D. Austin** is a professor of information systems at Western University's Ivey Business School in London, Ontario.*

If you watch movies or television, you've likely seen Stefan Sonnenfeld's work. It's on display in "Star Wars: Episode VII — The Force Awakens," three "Mission Impossible" movies, four "Transformer" movies, the "Cold Case" TV series, and dozens more. In a 2007 article, *Entertainment Weekly* listed him alongside creative luminaries like Steven Spielberg and Meryl Streep as one of the "50 Smartest People in Hollywood." Unlike some others on the list, however, Sonnenfeld's creativity is *digitally* enabled.

Sonnenfeld is a "digital intermediate colorist." He uses computers to alter the colors in movies and TV shows until they look spectacular. Without the technology, his artistry would not be possible. Nor would the profits that Sonnenfeld and the company he cofounded, Company 3, have generated for its parent companies, Ascent Media (from 2000 to 2010) and Los Angeles-based Deluxe Entertainment Services Group Inc. (to whom it was sold in 2010).

Digital color artistry like Sonnenfeld's is an example of a general principle: Technology can be deployed to augment the creative abilities of people and organizations and make new and valuable forms of innovation possible. Today's digital technologies have reached a level of maturation that enables, across many domains, a practical capability that I have, in my research, called *cheap and rapid iteration*.

To iterate is to try something different from what you tried last time. Sonnenfeld

(Continued on page 17)

to become productive in a new role (in part because it takes time to build the needed connections into a new network). The knowledge graph will make onboarding and orientation far more rapid and effective. On the very first day on the job, a worker will be able to tap the knowledge graph and understand not just his or her job description, but also the key network nodes he or she will need to work with. Rather than a new employee simply being handed a stack of files, onboarding AI software will be able to answer questions like, "Whom do I need to work with on the new office move? What were the meetings where it was discussed? When is our next status meeting?" The new employee will also be able to ask how things were done in the past (for example, "Show me a tag cloud of the topics my predecessor was spending his time on. How has that allocation evolved over the past 12 months?"). AI might even ask outgoing employees to review and annotate the key documents that should be passed on to their successors. The tacit knowledge that typically takes weeks or months to amass in today's workplace will have been captured in advance so that within the first hours of accepting a new job, an employee will be able to start applying that knowledge.

For all AI's potential benefits, some very smart people are worried about its potential dangers, whether they lie in creating economic displacement or in actual conflict (such as if AI were to be applied to weapons systems). This is precisely why I am, along with friends like Sam Altman, Elon Musk, Peter Thiel, and Jessica Livingston, backing the OpenAI project, to maximize the chances of developing "friendly" AI that will help, rather than harm, humanity. AI is already here to stay. Leveraging specialized AI to extend human intelligence in areas like management is one way we can continue to progress toward a world in which artificial intelligence enhances the future of humanity.

Comment on this article at http://sloanreview.mit.edu/x/58101, or contact the author at smrfeedback@mit.edu.

Reprint 58101.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

iterates when he tries out many different color effects on a movie. Sometimes he tries this, then that, then another thing, until he hits on something brilliant. He can do this cheaply and rapidly only because he works at a high-powered computer console with fiber connections, huge amounts of storage, and specialized software for making subtle adjustments to specific areas of a picture and across time in a film. Yes, all that equipment is an investment, but once he's made it, the cost of trying something new — of the next iteration — is nominal.

Iteration is the process that enables most forms of artistry. Painters often create numerous versions of a painting; Pablo Picasso, for example, created dozens of "studies" prior to his famous "Guernica" painting. Theater artists rehearse, trying a scene this way, then that. Designers iterate by building quick-and-dirty prototypes.

Processes often become more creative when rapid iteration is affordable. Unfortunately, this is not the case in a lot of business domains; often, in business, it's costly to try something new, especially if it doesn't work out. That was the case in the film-coloring business before digital technologies, when the process involved painting directly onto film or all-or-nothing photochemical processes. Just as digital changed the game in film coloring, so it can in many areas of business where it's been too expensive to experiment much.

It's most natural to think about such opportunities in product businesses, using technologies like computer-aided design (CAD) and 3-D printing to try out a design and then tweak it. But the phenomenon is also occurring in service businesses. A bank I know is using social media technologies to do quick and rapid trials of new customer offerings. To pull this off, a company must use digital technologies to lower the cost of the processes associated with the iterative cycle: setting up a new try (reconfiguration), trying it (simulation or testing), and examining and interpreting the results (visualization).

In the next five years, managers will awaken to a wide range of new possibilities. They'll act to improve creative capabilities, by figuring out how to deploy technologies to replace expensive physical trying with cheap virtual trying. In effect, they'll be constructing virtual rehearsal spaces, virtual laboratories, and inexpensive prototyping facilities. The aim won't be to design machines to take over people's jobs, but rather to augment human capabilities.

This is not a new idea. In the 1960s, Doug Engelbart proposed using computers to augment human intellect. Also in the 1960s, Internet pioneers J.C.R. Licklider and Robert W. Taylor emphasized the potential of computer networks to enhance creative work. Michael Schrage, in the late 1990s, described how simulation allowed companies to engage in "serious play." My own recent research and that of others point to a coming new age of organizational creativity — an era that may, I believe, finally be here.

National Public Radio once called Sonnenfeld the "da Vinci of the movies." In the coming few years, managers will begin to realize that they can create such da Vincis throughout their companies. And that will be a very profitable thing to do.

Comment on this article at http://sloanreview.mit.edu/x/58131, or contact the author at smrfeedback@mit.edu.

Reprint 58131.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[THE DIGITAL WORKPLACE]

The Three New Skills Managers Need

A changing work environment will require businesspeople to develop new competencies — such as a mindful approach to technology use.

BY MONIDEEPA TARAFDAR

In the coming years, both business leaders and their employees will face a number of challenges as they deal with changing digital technologies. In particular, they will need to learn three important new skills: (1) how to partner with new digital "colleagues"; (2) how to create a mindful relationship with increasingly ubiquitous digital technologies; and (3) how to develop empathy for the varying technology preferences of their human coworkers. Organizations, for their part, will need to design programs and processes to support these efforts.

Monideepa Tarafdar *is a professor of information systems at Lancaster University Management School in Lancaster, United Kingdom, and she is currently a visiting scholar at the MIT Sloan Center for Information Systems Research in Cambridge, Massachusetts.*

1. Partnering With Digital "Colleagues" Employees across a wide spectrum of industries will be working with what are, in effect, "digital coworkers" — algorithms that help them tackle a range of tasks such as answering call-center help desk questions, making financial investment decisions, diagnosing medical conditions, scheduling and running manufacturing assembly lines, and providing dashboard advice regarding important performance indicators. These digital colleagues will embody intelligence that evolves cognitively and learns continuously about the specific task it is applied to, by incorporating new solutions learned from experience and applying them to future problems.

Given the complexity and often real-time application of this sort of intelligence, it may be unnecessary and indeed impossible for human professionals to verify the veracity of an algorithm's solutions. However, as the data become denser and algorithms get faster and more complex, there is a danger of "runaway algorithms" that become disconnected from the reality of the phenomenon they represent, eventually leading to wrong solutions. To prevent this, managers will need to retain their expertise and control over their tasks and processes. They should provide context for the decisions and recommendations of their digital partners by monitoring those decisions from time to time and recalibrating them against their own experience, insight, and intuition — even going against their digital coworkers if necessary.

While digital colleagues will, for the most part, independently handle routine aspects of their tasks, exceptions — that is, those cases where their digital intelligence does not have a satisfactory solution — will require human decision making. At the same time, cloud-based intelligent algorithms for relatively narrow and contained tasks — for example, understanding niche buyer behavior — will make it possible for managers to solve everyday problems more effectively. Leveraging such opportunities will require managers to be alert to opportunities and problems, to have deep process knowledge and to explore, innovate, and engage with their digital coworkers. In short, managers will be confronted and challenged by digital colleagues — just as they are by their human coworkers. They will need to learn how and when to question, agree, compromise, and stretch.

2. Becoming Digitally Mindful Because digital technologies enable remote work, the nine-to-five workday is becoming less and less meaningful in many settings. Ironically, current management mindsets still focus on the separation of work and nonwork time. Consequently, because managers find it difficult to establish boundaries between work and nonwork, organizations face the fallouts of "techno-stress," technology addiction, and information overload. However, technologies will only increase in flexibility, richness, and seamlessness, and that will lead to their greater use at home for work and vice versa.

The emphasis on work-home conflict ignores the possibilities of such flexibility. It points employees toward managing a conflict rather than leveraging work-home seamlessness. Technology use that enables a continuous flow of meaningful tasks — irrespective of whether they are work-related or not — may be more beneficial for managers' well-being and productivity. Managers should start thinking about cultivating a mindful relationship (Continued on page 19)

with the technology — one that embodies their individual preferences about what constitutes such flow. Rather than being troubled about work-home boundaries, which perhaps cannot be maintained in the future, organizations will need to support employees in managing the possibilities of flexibility. The paradigm should shift from conflict to flexibility, from technology detox to flow-driven use, and from the digital dark side to digital mindfulness.

3. Developing Empathy for Others' Technology Preferences Even as leaders and managers learn how to work with digital colleagues, they will need to understand and develop empathy for the technology choices and preferences of their human coworkers. A colleague recently objected to me writing work emails to her late at night. On seeing the time stamp the next morning, she felt pressured to answer my messages immediately, to the exclusion of other, more important emails. My first reaction — that she was supposed to prioritize her own email and not be perturbed by what I did with mine — is typical of current organizational mindsets about technology use. Individual managers are so busy managing their own use of technology that they have given little, if any, thought to the preferences and habits of coworkers. However, this goes against an important tenet of management, which is that individuals work best together in teams and departments when there is some level of fit along important aspects.

Everyone has different preferences and habits for using technology. Some may prefer to be contacted by text, others by email, still others by phone or face-to-face. Some may prefer the flexibility afforded by constant email connectivity, while others may favor allotted email time. A clash between preferences can break down communication between teammates and increase misunderstanding, conflict, and stress. Going forward, managers need to not only be proactive about communicating their own technology preferences but also empathetic about their coworkers' choices, particularly when they are working on the same teams and projects.

In terms of future work design, employees with similar preferences should ideally be put on the same projects and teams. For instance, individuals who like multitasking might appreciate frequent synchronous interactions on instant messaging systems when working on a team together. Those who enjoy constant connectivity might work well with supervisors who share such preferences. More generally, the key to handling this and other similar workplace challenges brought about by digital technologies is for managers to be both flexible and thoughtful in the way they respond.

Comment on this article at http://sloanreview.mit.edu/x/58132, or contact the author at smrfeedback@mit.edu.

Reprint 58132.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

***Andrew S. Winston** is a consultant, speaker, and writer who is the author of "The Big Pivot: Radically Practical Strategies for a Hotter, Scarcer, and More Open World" (Boston, Massachusetts: Harvard Business Review Press, 2014).*

[SUSTAINABILITY]

Tackling the World's Challenges With Technology

The power and responsibility that companies have to help build a thriving, resilient world has never been greater.

BY ANDREW S. WINSTON

The next five to 10 years will be a critical time for humanity, in which we can leverage new technologies to address some of our biggest challenges: a dangerously changing climate; pressure on natural resources, especially water and food; and historic levels of inequality.

For decades, business leaders considered these systemic challenges as the domain of government and civil society. Companies, they thought, should focus on creating jobs and making money. But no longer. Expectations are rising fast that business should help tackle our societal challenges — and do it profitably. For example, in one recent study, fully

"The biggest impact technology will have on societal challenges will be through the radical transparency it enables. New data on supply chains — and generations of workers raised to share everything — will open up everything a company does to public scrutiny."

87% of millennials surveyed believe that the success of business should be measured in more than financial performance.

Technology will clearly shake up how organizations operate in every way — no part of management will go untouched in a world of big data, ubiquitous sensors, and powerful analytics providing new levels of insight. But perhaps the most powerful transformation will change how companies manage their relationships with the larger world.

Business, using technology wisely, will help build a thriving, resilient world. Of course, technology comes with its own environmental and social costs. Better AI and robots could mean fewer jobs. And the "cloud" itself is not actually very light on resources; our IT-based world requires very real — and sometimes hard-to-extract — metals, and it's powered by a lot of energy. But the case for techno-optimism is strong. Consider how new hardware and software will both make businesses run better and improve our lives.

The Internet of Things, paired with smarter analytics, will help managers understand a company's impacts on the world in much greater detail. They will know, for example, how much energy and carbon it takes to operate their business at global, brand, geographic, facility, and product levels. Once you measure something, you can manage it. Making better decisions about efficient use of resources is getting easier.

In the largest sectors of the economy, progress is coming quickly. The cost of renewable energy is dropping fast, making clean, distributed energy increasingly competitive with fossil fuels. Physical infrastructure is getting smarter and cleaner as well. New building systems can find heating and cooling systems that someone left on, or shut off lights and computers when nobody is around. These often highly effective operational improvements are becoming trivially easy to achieve.

More powerful computers and cheaper data will also make our transportation systems smarter. Companies with big fleets and good algorithms plot out delivery routes to eliminate unnecessary mileage. Self-driving cars create some operational and moral concerns, but cars in an autonomous system can move much closer together at a steady, energy-saving speed — and they'll save lives. Data and technology are also helping to optimize infrastructure through resource sharing. Car sharing, apartment/room hopping, and worker "hoteling" (which allows an office building to house more people) are saving money and physical resources.

The sector with the largest footprint, food, is undergoing deep change as well. So-called "precision agriculture" — leveraging modern, computerized farm machines — enables farmers to apply fertilizer, pesticide, and water in exact, optimized amounts. And better data on the flow of food through the system should help reduce the monumental food waste that squanders precious embedded energy and water.

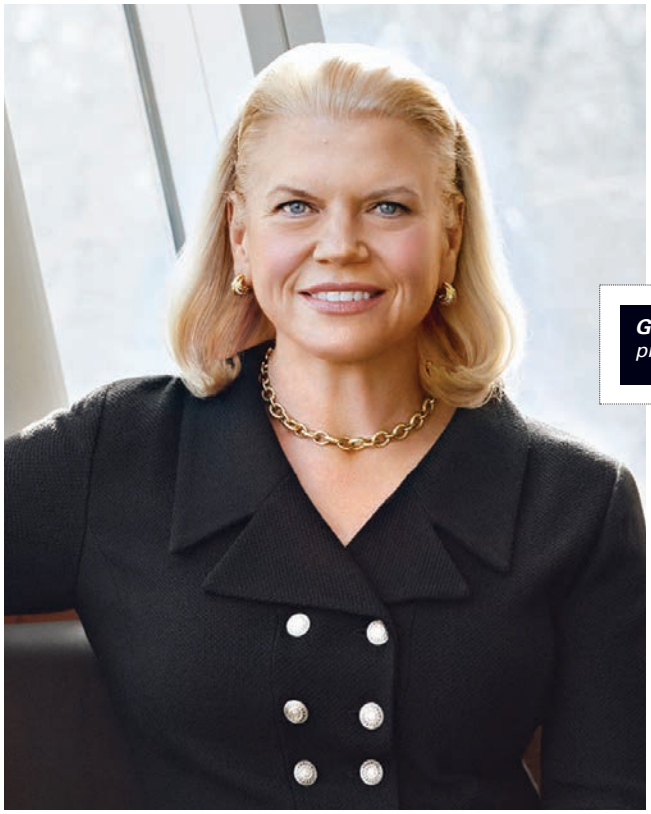
But as powerful as these rosy scenarios may seem, I suspect the biggest impact technology will have on societal challenges will be through the radical transparency it enables. New data on supply chains — and generations of workers raised to share everything — will open up everything a company does to public scrutiny. Someday soon, we will find it quaint that Volkswagen AG could conduct a large-scale fraud about their cars' emissions. In the near future, such subterfuge will be impossible. People inside every company will be talking openly about their work on social media, and each car will have sensors collecting real-time emissions data.

Over the coming decade, I believe business will be at the core of helping humanity tackle climate change and manage our shared resources more equitably. Companies will willingly help build a thriving world both to generate profits and because customers, employees, and society will be watching closely and demanding better of them. The way we manage companies is undergoing a deep change: from focusing solely on shareholders to pleasing a broader array of stakeholders, from short-term focus to longer-term strategy, from pursuing operationally narrow goals to embracing collaborative systems thinking.

Technology is both forcing these changes and also offering solutions. That said, we'll also need to change how we use the ultimate technology: our brains. A mindset shift, to rethink the purpose of business and its role in society, will make all the difference.

Comment on this article at http://sloanreview.mit.edu/x/58104, or contact the author at smrfeedback@mit.edu.

Reprint 58104.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*



[DECISION MAKING]

Digital Today, Cognitive Tomorrow

Digital is not the destination. Rather, it is laying the foundation for a more profound transformation to come.

BY GINNI ROMETTY

In today's economy, we are seeing companies, business models, products, and processes undergoing major transformation. Enterprises and governments are rapidly "becoming digital" as they seek to capture the cost savings, agility, and collaboration enabled by cloud, analytics, mobile, and social technologies.

However, digital is not the destination. Rather, it is laying the foundation for a much more profound transformation to come. Within five years, I believe all major business decisions will be enhanced by *cognitive* technologies.

I sensed the magnitude of the transition for the first time in 2011, when I watched IBM's Watson system win on "Jeopardy!" At the time, I felt that I was watching history in the making: The technology known as artificial intelligence (AI) was finally moving from the lab into the world.

Why are we seeing this now?

First, the technologies required for cognitive systems — not just AI, but a broad spectrum of capabilities that include natural language processing, human-computer interaction, deep learning, neural nets, and more — have made exponential advances in recent years.

Ginni Rometty *is chairman, president, and CEO of IBM Corp.*

Second, the abundance of data being generated throughout the world today requires cognitive technology. Much of this data is "unstructured": video, audio, sensor outputs, and everything we encode in language, from medical journals to tweets. However, such unstructured data are "dark" to traditional computer systems. Computers can capture, move, and store the data, but they cannot understand what the data mean (which is why cognitive systems are so vital).

Finally, and most important, we will see systems that learn. We *need* systems that learn. Think of the challenges and issues we face today: predicting risk in financial markets, anticipating consumer behavior, ensuring public safety, managing traffic, optimizing global supply chains, personalizing medicine, treating chronic diseases, and preventing pandemics.

The challenges today go beyond information overload. In many ways, we live in an era of *cognitive overload*, characterized by an exponential increase in the complexity of decision making. It's impossible to create protocols, algorithms, or software code to successfully anticipate all the potential permutations, trajectories, and interactions. But cognitive systems are not simply programmed. They actually improve with use, as they receive expert training, interact with clients and customers, and ingest data from their own experiences, successes, and failures.

Some people think of cognitive systems as supercomputers, and there is no question that the computational power behind systems like Watson is considerable. But thanks to the increasing prevalence of application program interfaces (APIs) — which can be encoded into digital services and easily accessed or combined in new ways in the cloud — it's possible to build a kind of thinking into virtually every digital application, product, and system.

And because we can, we will. If it's digital today, it will be cognitive tomorrow — and not a distant tomorrow. IDC Research Inc. has estimated that by 2018, more than half of the teams developing apps will embed some kind of cognitive services in them, up from 1% in 2015.

Cognitive systems are already transforming everything from the world-changing to the everyday. For example, cognitive oncology is a reality thanks to technology developed in partnership with Memorial Sloan Kettering Cancer Center in New York City that helps oncologists identify personalized,

evidence-based treatment options based on massive volumes of data. This breakthrough technology is now helping scale access to knowledge at Bumrungrad International Hospital in Thailand, Manipal Hospitals in India, and more than 20 hospitals in China. Cognitive assistants are at work helping build more intimate, personalized relationships at the Brazilian bank Banco Bradesco, the insurance company GEICO, and the retailer The North Face. Dublin-based Medtronic plc, a global health care solutions company, is creating a cognitive app for people with diabetes to predict a hypoglycemic event hours in advance. These are just a few examples of organizations that are using cognitive systems today.

It's important to note that we are not talking about the AI we see in movies. This isn't about creating a synthetic brain or an artificial human. Rather, this is about augmenting human intelligence. Indeed, there is nothing in either cognitive science or its application that implies either sentience or autonomy.

Of course, anyone familiar with the history of technology knows that technological breakthroughs often have major effects on work and jobs. Some jobs are eliminated, while others are created. With cognitive systems, we are already beginning to see the emergence of new disciplines — from data curation to system training, as well as new fields of scientific knowledge and new kinds of work — quite possibly more than in any prior technology revolution.

Data can be seen as the world's great new resource. What steam power, electricity, and fossil fuels did for earlier eras, data promises to do for the 21st century — if we can mine, refine, and apply it. Thanks to the new generation of cognitive technologies, we can. Intelligence *augmentation* — IA as opposed to AI — will change how humans work together, make decisions, and manage organizations.

Comment on this article at http://sloanreview.mit.edu/x/58133, or contact the author at smrfeedback@mit.edu.

Reprint 58133.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

[STRATEGY]

Rise of the Strategy Machines

While humans may be ahead of computers in the ability to create strategy today, we shouldn't be complacent about our dominance.

BY THOMAS H. DAVENPORT

As a society, we are becoming increasingly comfortable with the idea that machines can make decisions and take actions on their own. We already have semi-autonomous vehicles, high-performing manufacturing robots, and automated decision making in insurance underwriting and bank credit. We have machines that can beat humans at virtually any game that can be programmed. Intelligent systems can recommend cancer cures and diabetes treatments. "Robotic process automation" can perform a wide variety of digital tasks.

What we don't have yet, however, are machines for producing strategy. We still believe that humans are uniquely capable of making "big swing" strategic decisions. For example, we wouldn't ask a computer to (Continued on page 23)

Thomas H. Davenport *is the President's Distinguished Professor of Information Technology and Management at Babson College in Wellesley, Massachusetts, and a fellow at the MIT Sloan Initiative on the Digital Economy.*

"It's certainly a good and necessary thing for strategists to begin embedding their thinking into cognitive technologies, but they also have to keep their eyes on the broader world. There is a level of sense-making that only a human strategist is capable of — at least for now."

put together a new "mobility strategy" for a car company based on such trends as a decreased interest in driving among teens, the rise of ride-on-demand services like Uber and Lyft, and the likelihood of self-driving cars at some point in the future. We assume that the defined capabilities of algorithms are no match for the uncertainties, high-level issues, and problems that strategy often serves up.

We may be ahead of smart machines in our ability to strategize right now, but we shouldn't be complacent about our human dominance. First, it's not as if we humans are really that great at setting strategy. Many M&A deals don't deliver value, new products routinely fail in the marketplace, companies expand unsuccessfully into new regions and countries, and myriad other strategic decisions don't pan out.

Second, although it's unlikely that a single system will be able to handle all strategic decisions, the narrow intelligence that computers display today is already sufficient to handle specific strategic problems. IBM Corp., for example, has begun to use an algorithm rather than just human judgment to evaluate potential acquisition targets. Netflix Inc. uses predictive analytics to help decide what TV programs to produce. Algorithms have long been used to identify specific sites for retail stores, and could probably be used to identify regions for expansion as well. Key strategic tasks are already being performed by smart machines, and they'll take on more over time.

A third piece of evidence that strategy is becoming more autonomous is that major consulting firms are beginning to advocate for the idea. For example, Martin Reeves and Daichi Ueda, both of the Boston Consulting Group, recently published a short article on the *Harvard Business Review* website called "Designing the Machines That Will Design Strategy," in which they discuss the possibility of automating some aspects of strategy. McKinsey & Co. has invested heavily in a series of software capabilities it calls "McKinsey Solutions," many of which depend on analytics and the semi-automated generation of insights. Deloitte has developed a set of internal and client offerings involving semi-automated sensing of an organization's external environment. In short, there is clear movement within the strategy consulting industry toward a greater degree of interest in automated cognitive capabilities.

Assuming that this movement toward autonomous strategy is beginning to take place, what are the implications for human strategists? As Reeves and Ueda point out in their article, cognitive capabilities will need to be combined with human intelligence in what they call an "integrated strategy machine." Just as contemporary autonomous vehicles can take the wheel under certain conditions, we'll see situations in which strategic decision making can be automated. Other situations, however, will require that a human strategist take the wheel and change direction.

Big-picture thinking is one capability at which humans are still better than computers — and will continue to be for some time. Machines are not very good at piecing together a big picture in the first place, or at noticing when the landscape has changed in some fundamental way. Good human strategists do this every day.

In a world of smart, strategic machines, humans need to excel at big-picture thinking in order to decide, for example, when automation is appropriate for a decision; what roles machines and people will play, respectively; and when an automated strategy approach their organization has implemented no longer makes sense.

Executives who see the big picture are able to answer the critical questions that will guide their organizations' future: how their companies make money, what their customers really want, how the economy is changing, and what competitors are up to that is relevant to their company.

These kinds of issues and trends can't be captured in data alone. It's certainly a good and necessary thing for strategists to begin embedding their thinking into cognitive technologies, but they also have to keep their eyes on the broader world. There is a level of sense-making that only a human strategist is capable of — at least for now. It's a skill that will be more prized than ever as we enter an era of truly strategic human-machine partnerships.

Comment on this article at http://sloanreview.mit.edu/x/58103, or contact the author at smrfeedback@mit.edu.

Reprint 58103.
Copyright © *Massachusetts Institute of Technology, 2016. All rights reserved.*

MITSloan Management Review

PDFs ■ Reprints ■ Permission to Copy ■ Back Issues

Articles published in MIT Sloan Management Review are copyrighted by the Massachusetts Institute of Technology unless otherwise specified at the end of an article.

MIT Sloan Management Review articles, permissions, and back issues can be purchased on our Web site: sloanreview.mit.edu or you may order through our Business Service Center (9 a.m.-5 p.m. ET) at the phone numbers listed below. Paper reprints are available in quantities of 250 or more.

To reproduce or transmit one or more MIT Sloan Management Review articles by electronic or mechanical means (including photocopying or archiving in any information storage or retrieval system) **requires written permission.**

To request permission, use our Web site: sloanreview.mit.edu
or
E-mail: smr-help@mit.edu
Call (US and International):617-253-7170 Fax: 617-258-9739

Posting of full-text SMR articles on publicly accessible Internet sites is prohibited. To obtain permission to post articles on secure and/or password-protected intranet sites, e-mail your request to smr-help@mit.edu.